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SEEKING A CLEARER CHANNEL:  
CANADIAN VENTURES IN SATELLITE TECHNOLOGY AND  
NATION BUILDING, 1958-1972

by

Pam Roper

Thesis submitted to  
the Faculty of Graduate and Postdoctoral Studies  
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## ABSTRACT

SEEKING A CLEARER CHANNEL:

CANADIAN VENTURES IN SATELLITE TECHNOLOGY AND

NATION BUILDING, 1958-1972

Pam Roper  
University of Ottawa 2003

Supervisor:  
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This account of Canada's early research and telecommunications satellite programs provides insight into the evolution of Canada's advanced technology capacity, viewed by most as essential to a country's well-being. It synthesizes developments in several fields including federal government science and industrial policies, and Canada-U.S. relations. It also reveals the unintended impacts of nationalism.

Through source materials including Royal Commission reports, position papers, and internal memoranda, this study attempts to recreate the policy consciousness that pervaded the federal government from the late 1950's into the early 1970's to expose and understand the motivations that led Canada to enter the space age and to become the first country in the world to have its own domestic telecommunications satellite. Like consciousness itself, the development of Canada's early satellite program was based on the blending of experience and perception. The success of the first *Alouette* led to the extended International Satellites for Ionospheric Studies (ISIS) research satellite program, while prevailing perceptions about the need to bolster Canada's science and technology base as well as concerns about American cultural and economic dominance guided policy makers to invest in a domestic telecommunications satellite in the late 1960's.

The consciousness that affected Canadian policy and opinion makers oscillated between a defensive and an expansionary nationalism. Despite nearly a century of nationhood, the Canadian mentality of the 1960's unfairly compared itself with the leading Anglo metropolises of Great Britain and the United States, which resulted in a self-defeating inferiority complex and anti-colonial outlook. At the same time, Canada, in keeping with the rest of Western culture, was affected by an imperial drive that impelled politicians and government officials to seek ways to ensure that the country expanded and developed.

In the early part of the decade, this drive began to focus on science and technology as the keys to prosperity. Canadian policy makers quickly adopted this stance, but their prescriptions were based on misleading analyses that the country's research and development (R&D) greatly lagged behind other industrial nations. Social critics and government insiders leapt to the mistaken conclusion that the blame for this perceived underdevelopment lay with the pattern of American foreign ownership in the Canadian economy.

Policy and opinion leaders' ready acceptance of the "branch plant" explanation regarding what they believed were weaknesses in Canada's R&D base, despite credible evidence to the contrary, indicated their tendency to place perception ahead of analysis to the detriment of sound decision making and planning. Thus, the paradox of economic nationalism was that it weakened Canadian initiative rather than strengthened it, as was the purported intent.

## ACKNOWLEDGMENTS

The inspiration for this thesis derived from many influences and experiences. My ambition for a career in the Canadian Public Service brought me from Atlantic Canada to Ottawa in September 1987. I studied public administration at Carleton University, and at the end of that program began a position with the Women's Bureau in the federal department of Labour. Shortly after that, I decided to return to the study of history by beginning a Masters degree at the University of Ottawa. There I had the good fortune to pursue my curiosity about industrial policy and political economy when I completed a thesis under the supervision of Professor Donald Davis. My research about Canada's automation controversy stirred my fascination with underlying beliefs and policy motivations, and I began to discern "progress" as the dominant cultural consensus. When I entered the Ph.D. program, I sought a topic that would allow me to combine my interests in the history of technology and public policy. A chance visit to the "Canada in Space" exhibit at the Canada Science and Technology Museum led me to this focus on the country's early research and communications satellite programs.

Many of my feminist friends and colleagues were puzzled by that choice. Surely my professional life, with its concentration on the structural barriers to gender equality, would induce me to study women's history. While I had the privilege of completing a Ph.D. field in that topic, I knew that I wanted to better comprehend why business interests and economic concerns occupy so central a place on government policy agendas, often to the detriment of equality seeking programs. I am convinced that in order to initiate a transformative social agenda, we must have an intimate understanding of prevailing power structures and how they are maintained. That is why I selected this topic.

I have come full circle since undertaking the Masters in Public Administration program over fifteen years ago. In January of 2001, I resigned my position with the federal government in order to devote myself full-time to scholarly research. That decision has brought me great satisfaction, and a heightened excitement as I contemplate the "life of the mind" that I now plan to pursue.

While my quest for a "clearer channel" of self-insight and professional fulfillment often landed me in strange and turbulent waters, I was buoyed by the support of many friends, colleagues, and family members. I decline to name them individually as I might inadvertently leave someone off such a list, or denote an order of precedence that is unintended. I am fully grateful to you all, however, for the many blessings that you bring to my life.

There are some people whom I do wish to acknowledge specifically. I thank the supervisor of this thesis, Professor Jeffrey Keshen, for the kind interest in his students' welfare that he consistently demonstrates, and for his willingness to go that extra mile to review work in such a timely manner.

I also thank Dr. Randall Brooks, who is the Curator of Physical Sciences and Space at the Canada Science and Technology Museum. Dr. Brooks generously opened the museum's archives relating to the "Canada and Space" exhibit for me, which proved of enormous value to my research.

There is a person who had an indelible impact on my life, and his devotion to public service continues to guide and inspire me. I dedicate this project to the memory of my father, Ben Roper, whose school of lively kitchen debates kindled my interest in all things political.

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## *Introduction*

*It is generally agreed that satellite communications is one of the most important items with which this government will have to deal. The manner, speed, and extent of development which it permits or encourages will have a determinant effect upon virtually all aspects of Canadian life for many years to come. The economic, cultural, social, scientific and historical impact, of what the Canadian government decides to do, or authorizes to be done by others, will be as important in this century as the development of railways, broadcasting and telephone companies has been in the last.*

R.G. Roberston  
Clerk of the Privy Council  
Memorandum to Cabinet Ministers, February 21, 1967<sup>1</sup>

Robertson's brief to the Cabinet reverberated with what telecommunications historian, Robert Babe, deemed the tendency of "our policy makers [...] to substitute myth in the place of history."<sup>2</sup> Babe concluded that these purported instruments of nation building (the railway, successive telecommunications systems) in fact led to greater commercial integration with the United States. He blamed what he viewed as policy makers' tendency to confound fact with wishful thinking as the reason why these expensive state subventions drew Canada closer to the U.S. Babe contended that federal policy makers preferred to cling to the myth that these technologies fostered

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<sup>1</sup>National Archives of Canada (hereafter NA), RG 97 (Department of Communications), volume 310, file 5045-0, part 1. February 21, 1967 Memorandum to Cabinet, "Space Satellite Communications Systems for Domestic Use in Canada," Cabinet Document No. 107/67, p. 1.

<sup>2</sup> Robert Babe, *Telecommunications in Canada: Technology, Industry, and Government* (Toronto: University of Toronto Press, 1990), p. xiii.

primarily east-west, nation building ties rather than acknowledge that these telecommunications systems actually created incentives for capital to flow along north-south lines.

While Babe successfully demonstrated the negative effects of myth-making on policy development, he was too quick to dismiss the foundations of Canadian mythology and the reason for its presence in political decisions. After all, mythology is a crucial component of national identity because it imbues the cultural consensus in which policy makers operate. We are all affected by culture, that is the norms, values, and ideological bases from which we make choices, render decisions, and act. It is therefore unreasonable to expect that policy makers could rid themselves of these cultural influences. What we should demand of our politicians and senior officials, however, is that they question their assumptions and seek clarity about their policy motivations. It was precisely a series of unchecked perceptions that led federal bureaucrats and politicians in the 1960's to over-emphasize the threat of U.S. foreign ownership, and to place an undue sense of urgency on the need for Canadian industry to develop its research and development (R&D) base. These policy misperceptions led to a great waste of resources and missed opportunities, and may have ultimately undermined the government's faith in the efficacy of active industrial programs.

However, even faulty policy visions can create positive results, especially when they are applied to solid plans and ideas. This was the case with Canada's early research and communications satellite programs, which included *Alouette I*, launched in 1962, the International Satellites for Ionospheric Studies (ISIS) series, and the world's first domestic telecommunications satellite, *Anik 1*, launched in 1972.

Canada initiated the *Alouette* research project in 1958 to deploy the new satellite technology in its quest for knowledge about the auroral zone over the country's northern regions. Researchers hoped to improve radio communications and radar readings in this area, a crucial consideration for North American defence in this period of heightened Cold War tensions. The success of the first *Alouette* led to an expanded cooperative program between Canada and the United States that resulted in the launch of three more research satellites, *Alouette II*, *ISIS A*, and *ISIS B* between 1965 and 1971. These efforts put Canada in the forefront of space technology, especially in key components like antennas, structural design, radio receivers and tracking beacons.

Canada's Defence Research Board (DRB) was the federal government agency responsible for developing these research satellites.<sup>3</sup> In addition to contributing to Canada's defence preparedness through its world class laboratories, the DRB also nurtured Canadian industrial development by involving private companies in its R&D efforts. Indeed, the decision to enter into the 1963 ISIS agreement between the DRB and the U.S. National Aeronautics and Space Agency (NASA) was predicated more on economic development goals than on defence needs. However, this extension of DRB's mandate to a more civilian focus would bring the satellite research program under the scrutiny of the 1963 Royal Commission on Government Organization (Glassco), and the federal Treasury Board in the mid-1960's.

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<sup>3</sup> In 1947, the DRB was established as a separate branch of the Canadian Armed Forces. As part of a larger reorganization of the Department of National Defence (DND) in 1974, the Board was dismantled and its activities re-distributed throughout

The Glassco Commission also paid considerable attention to Canada's overall investments in science and technology, and recommended that, to better harness these efforts to national development, the government should create a central mechanism to encourage this type of economic growth. Prime Minister Pearson quickly adopted Glassco's recommendations and established the Science Secretariat of the Privy Council Office in 1964, and the Science Council of Canada in 1966. However, the Glassco Commission's analysis was construed from a faulty base that drew its conclusions by comparing Canada only with the United States and the United Kingdom, two countries with much larger and more greatly diversified economies, and which had longer track records in university and industrial research.

Glassco's findings carried great weight in the Liberal government, which was intent on developing Canada's industrial base partly because many within the party's ranks viewed this as a means of achieving greater independence from American foreign investment. Since the mid-1950's, influential Liberals like Walter Gordon had raised concerns about U.S. owned subsidiaries operating in Canada. By the mid-1960's, his arguments attracted many followers as economic nationalism gained popularity with the general public and within government decision making circles. The exaggerated worry that the Glassco Commission generated about Canada's "poor" industrial research track record and its over-reliance on government performed R&D was adopted by economic nationalists. They concluded, without much analysis

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the rest of the department. DND's current defence research activities are administered by Defence Research and Development Canada.

and by ignoring key evidence, that the pattern of U.S foreign ownership was to blame for Canada's scientific "under-development."

Meanwhile, this heightened interest in augmenting the country's technological capacity and the success of Canada's research satellite program led many to conclude that an increased investment in space research would achieve great economic benefits. Lobby efforts by private sector and university researchers coincided with demands by the Treasury Board for the DRB to justify its involvement in an essentially civilian-based program. These policy currents pushed the federal government into undertaking an extensive review of all its upper atmosphere and research programs. The resulting Chapman Report, published in Canada's centennial year, recommended that the country expand its space program by establishing a domestic telecommunications satellite. In 1968, the federal government announced its intention to develop such a system by issuing the *White Paper on a Domestic Satellite Communication System for Canada*. The White Paper expressed the federal government's desires to promote unity by extending television coverage to French-speaking Canadians as well as to Canada's northern regions, and to augment Canada's already extensive telecommunications infrastructure.

The White Paper contained the same nation-building aspirations expressed in Robertson's 1967 brief to the Cabinet, which likened the communications satellite system to canals, roads, and railways. These politicians and senior bureaucrats believed that they had found the solution to Canada's burgeoning unity crisis initiated by growing Quebec nationalism, as well as a means to address the commercial and cultural threat of their southern neighbour. Policy documents and media coverage

were filled with nationalistic references to “Canada’s satellite,” growth opportunities for Canadian industry, and jobs for Canadian engineers and scientists.

However, the decision to award the contract for the first communications satellite, *Anik 1*, to an American firm, Hughes Aerospace, exposed the extent to which Canada’s path had become inter-twined with the United States in the post-1945 era. While closer economic integration and technological cooperation with the U.S. brought many benefits to Canada, such proximity and interdependence increased Canadian anxiety about annexation by the much larger power. Thus, the dominant patterns of Canadian identity, which cause it to oscillate between an expansive and defensive nationalism, propelled Canadian policy makers to pursue contradictory impulses. These actions resulted in successes like the research and communications satellites, but also in failures such as the government’s overall industrial policy that expended tremendous efforts to diversify the economy, but had limited effect in re-orienting Canadian economic development. Had these policy makers more clearly understood their own cultural beliefs and contrary tendencies, there would have been fewer disappointing results.

Admittedly, this level of clarity is difficult to achieve as mythology exerts a powerful influence. In the 2002 Bronfman Lecture in Canadian Studies at the University of Ottawa, artist Tomson Highway described mythology as existing halfway between truth and a lie.<sup>4</sup> He noted that in his native Cree the word myth describes a mediating state in which what we dream or imagine (“the lie,” that which

is not “provable”) affects how we act or interpret reality to be (“the truth” of our everyday and cumulative experience). If our personal mythology is that of a confident, secure adult, we tend to discern most events through this lens and therefore meet challenges with strength and assuredness. Conversely, an insecure ego might consistently view life through a prism of rejection and neglect, and consequently lash out at or hide from difficulties encountered. Experience begets belief, which in turn affects how we interpret what has occurred, and successive actions are coloured by existing perceptions. Consciousness is forged within a perpetual helix in which the material world of lived experience commingles with the imagined reality of that which we conceive.

Myth functions in the psychological realm of motivating belief, as well as on a broader cultural level of shared experience and the interpretation of our collective past. Indeed, the branch of historical inquiry known as historiography is dedicated to uncovering what precepts and events shaped the practitioners of “Clio’s craft,” and how these affected the way in which historians construed their explanatory narratives. This is not to imply that historical research and interpretation can be relegated to a collection of impressions and personal biases, or that it can only be communicated from the philosophical standpoint that essentially nothing is knowable except in very individualistic and ephemeral terms. The discipline of history is empirical in approach, but it also encompasses more intangible forms of inquiry including

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<sup>4</sup> Tomson Highway, “Comparing Mythologies,” Charles R. Bronfman Lecture in Canadian Studies, University of Ottawa, September 23, 2002. See [http://www.canada.uottawa.ca/highway\\_eng.htm](http://www.canada.uottawa.ca/highway_eng.htm).

discourse analysis as well as the insight and intuitiveness that each historian brings to the craft.

This study of Canada's early research and communications satellite programs constructs a narrative of what occurred from the available written record produced by the bureaucratic and political levels of government. The interpretation of these events comprises a chronicle of dates, events, and actions, as well as conclusions drawn about what motivated decisionmakers' choices and their impact. It relies on a blend of the more readily verifiable data contained in source documents like internal government memoranda and media coverage, as well as on a less generalizable approach that deconstructs the messages and symbols contained in the text of these reports and communiqués. This thesis attempts to recreate the policy consciousness that pervaded the federal government from the late 1950's into the early 1970's to expose and understand the motivations that led Canada to enter the space age and to become the first country in the world to have its own domestic telecommunications satellite. Like consciousness itself, the development of Canada's early satellite program was based on the blending of experience and perception. The success of the first *Alouette* led to the extended ISIS research satellite program, while prevailing perceptions about the need to bolster Canada's science and technology base as well as concerns about American cultural and economic dominance led policy makers to invest in a domestic telecommunications satellite in the late 1960's.

All of these decisions were rendered through a cultural filter that considers progress and economic expansion as paramount. Indeed, Canada is a liberal capitalist society in which business enjoys a privileged position relative to other interests. Like

that in other Western nations, Canadian political consciousness is affected by a dominant social consensus that professes economic growth as imperative to survival. One might term this cultural impetus to accumulate wealth as an *imperial drive*, which generally outweighs all other policy considerations. Certainly the evolution of the welfare state throughout the twentieth century has mitigated the imperial drive, yet the expansive outlook maintains its primacy.

Many variants of the imperial drive have existed over time and space. These off-shoots have been germinated by ideas governing the role that the state should play relative to private interests, as well as views on what constitutes the most important elements to serve expansion. By the early 1960's, a new consensus emerged that science and technology were the key determinants to growth. In concert with this fresh awareness, most Western nations adopted a more systematic approach to the development of scientific and technological competence to enhance economic output. Canada's decision to alter and expand its research satellite program to create a domestic telecommunications satellite system exemplified this quest to yoke scientific and technological achievement to national purpose.

Canada shares many characteristics in common with the larger Western culture, but like every country it exhibits a distinct approach to the imperial drive. In Canada's case, the expansionary impulse coexists with a defensive nationalism that causes Canadians to compare themselves (usually unfavourably) with the United States and other societies. More than a century since Confederation, more than eighty years since the Statute of Westminster granted full formal independence, and more than two decades since the repatriation of the constitution, Canadian nationalism is

more often than not coloured by the defensive qualities of an anti-colonialism that fears absorption by a larger power.

English-Canada's cultural touchstones are the former British empire and the American commercial and military colossus. Typical of a younger and smaller power, Canada seeks to distinguish itself from these metropolises, while it simultaneously attempts to emulate their achievements. The quest for cultural equality with these two giants might explain the Canadian propensity for self-effacement and negativity. Indeed, Canadian scholarship tends to focus on perceived national failures like the cancellation of the AVRO-Arrow program in 1959, while virtually ignoring such achievements as the Alouette-ISIS programs. Survival in a harsh land, with such complex political balances to be maintained and nurtured, has too solidly ingrained a sense of pessimism into Canadian consciousness.

The title of this dissertation refers to the various layers of motivation that prompted the federal government to create a satellite program. At its most basic level, "seeking a clearer channel" captures the research goals of the first *Alouette* satellite project. Since the 1920's, Canadian and other scientists had experimented with radio waves and their interaction with Earth's upper atmosphere as a means of understanding and improving long distance radio communications. They found that the auroral zone located over Canada's polar regions was prone to radio blackouts and signal fading, which they deduced was related to the composition of the ionosphere over this area. As the strategic importance of Canada's north increased during World War II and with the advent of the Cold War, Canada's Defence Research Board devoted considerable attention and resources to understanding this area. When the

Soviets launched the world's first artificial satellite in 1957, Canada, in cooperation with the United States, assumed the challenge of designing and constructing its own space vehicle to apply new knowledge about the ionosphere to establish clearer and more stable communications.

At a second layer of meaning, the title's metaphor evokes the quest for stronger east-west ties to strengthen the country, a goal that has long been associated with Canada's central mythology. In their nation building efforts, federal bureaucrats and politicians in the late 1960's invoked the great transportation projects of the previous century such as canals, roads, and the railways to validate their decision to construct a communications satellite system. In fact, they were exhibiting a long standing imperial drive to create "clearer channels" to serve expansion.

The early titans of English-Canadian scholarship, Harold Innis and Donald Creighton, have been credited with respectively developing and popularizing the "Laurentian thesis" that offered a Canadian explanation of continental expansion from initial European colonization in the sixteenth century through to modern Canada. Also referred to as the "staples theory," Harold Innis' early work demonstrated how a succession of natural resources such as furs, fish, and lumber tied Canadian development to the wide nexus of French and British imperial pursuits.<sup>5</sup> The staples theory proffered an explanation of "forward and backward linkages" that accounted for patterns of colonization and the use and development of specific transportation

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<sup>5</sup> See for instance, Harold Innis, *The Cod Fisheries: The History of an International Economy* (New Haven, Yale University Press, 1940), as well as his *The Fur Trade in Canada: An Introduction to Canadian Economic History* (Toronto: University of Toronto Press, 1956).

systems.<sup>6</sup> Innis and Creighton concluded that the St. Lawrence river system played a central role in transmitting goods, culture, and eventually a political vision of a unified confederation of the British North American colonies. Innis was interested in technology, and the confluence of economic and cultural explanations. Conversely, Creighton focused more on political issues, and cast Sir John A. Macdonald as the heroic visionary and architect of a strong northern nation.<sup>7</sup>

Another dominant theme used to explain Canadian identity and mythology is survival. A concept more strongly associated with Canadian arts and letters, like Margaret Atwood's *Thematic Guide to Canadian Literature*, the survival myth has a strong explicative power for understanding Canadian political dynamics and federal

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<sup>6</sup> A number of scholars have attempted to resurrect Innis' influence on social science and historical research. In his *History and Communications: Harold Innis, Marshall McLuhan, and the Interpretation of History* (Toronto: University of Toronto Press, 1990), Graeme Patterson employed a post-modern analysis to link Innis' early staples work with his later treatises on communications and the key question of whether information media act as stabilizing or disruptive forces within cultures. Patterson explored the binary pulse of Innis' work and his tendency to oppose ideas as "foreground" and "background," and conjectured how this fascination might account for Innis' nearly impenetrable prose style. John Bonnett's recent Ph.D. history thesis, "Communication, Complexity and Empire: The Systemic Thought of Harold Adam Innis," (University of Ottawa, 2001), also argued that Innis should be considered among the foremost of Canadian scholars, and applied the science of complexity as a framework to expose the unity of Innis' thought. Bonnett examined how Innis believed that a balance between order and freedom was necessary for civilizations to flourish, or, in ecological terms, to be self-sustaining. Given the Canadian oscillation that fluctuates between expansiveness and defensiveness, as well as the alternating currents of conservative (both the Tory and social democratic variants) and liberal thought that mark Canadian political economy, it is not surprising that a scholar of Innis's stature and creativity would employ the prevailing dynamic of his own culture in such a way.

<sup>7</sup> Donald Creighton, *The Commercial Empire of the St. Lawrence, 1760-1850* (Toronto: Ryerson Press, 1937). See as well his two volume biography of Canada's first Prime Minister, *John A. Macdonald* (Toronto: Macmillan, 1965).

government policy consciousness.<sup>8</sup> Canada's obsession with the question of its own continuance has its origins in a forbidding climate, in which survival is never a certainty. The Canadian landscape is humbling, as is proximity to the world's remaining superpower. Canadian anxiety about America's paramount position in the relationship is understandable as are the continuous attempts to "defend" Canada from American dominance. The Canadian oscillation, fueled by the inter-twining patterns of expansion and defensiveness, affected all of the policy choices that led from the first *Alouette* in 1958 to the first Canadian communications satellite, *Anik 1*, in 1972.

Most expressions of nationalism contain some degree of defensiveness because at their root these emotions reflect a tribal instinct to define and protect community. The Canadian variant demonstrated a distinct anti-colonial bias that generated contradictory impulses. Canadian cultural values caused policy makers to simultaneously seek to emulate more powerful nations, but also to fear imperial pretensions and to doubt whether they could free themselves from this pull. Thus, when the Glassco Commission selected the U.K. and the U.S. as the only benchmarks against which to measure Canadian R&D performance, its members exhibited a colonial urge to measure themselves against the American and British metropolises. In

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<sup>8</sup> Margaret Atwood, *Survival: A Thematic Guide to Canadian Literature* (Toronto: House of Anansi Press Limited, 1972). Atwood developed her thesis through an extensive review of Canadian literature, which included her earliest childhood readings of Seton's wildlife tales. She contrasted these gruesome accounts, which typically ended in a tragic death met with fatalistic acceptance of the challenges to be encountered in such a harsh environment, with the sunnier stories found in American and British children's literature. Atwood also compared the central Canadian

concert with this imperial drive to replicate their success, the Canadian inferiority complex caused an overly negative interpretation. For instance, Glassco's statistical analyses determined that the proportion of R&D performed in Canadian government laboratories was much higher than that conducted by Canadian industrial laboratories relative to the U.S. and U.K. While this may or may not have been a fundamental issue requiring immediate correction, the Glassco commissioners concluded that it indicated a severe weakness that should be addressed posthaste. They did so without reference to any other national experience, or to Canada's own pattern of economic development. Whatever the particular challenges faced by Canadian industry, Glassco's rather slanted interpretation and the Liberal government's uncritical acceptance of it occluded more penetrating analyses.

Some might argue that the Liberal government reaction simply reflected a strong survival instinct in the face of challenges that presented themselves in the turbulent 1960's. While the desire to endure is understandable, when fears are over-exaggerated, as was the case with science policy discussions in that era, they produce distortions and an undue sense of urgency. Decisions made in this alarmist atmosphere do not necessarily serve the best interests of the country, although sometimes positive choices can be made as occurred with the Canadian research and communications satellite programs. In addition to the untoward panic generated by the Glassco Commission findings concerning Canadian R&D production relative to the U.S. and U.K., federal policy consciousness in this period was marked by an

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“survival” myth with that of the United States, which she deemed was the “frontier,” and that of the United Kingdom's, which she argued is “the island.”

antipathy to American foreign ownership. Certainly, it was quite valid to question the impact of increased interdependence with the American economy on Canadian development. However, policy and opinion leaders' ready acceptance of the "branch plant economy" explanation for perceived lags in Canada industrial R&D development, despite credible evidence to the contrary, indicated their tendency to place perception ahead of analysis to the detriment of sound decision making and planning. Thus, the paradox of economic nationalism was that it weakened Canadian initiative rather than strengthened it, as was the purported intent.

Concerns about American preponderance pervade Canadian consciousness. This fascination is reflected in the literature on Canada-U.S. relations, which is quite extensive and includes scholarly as well as more popular accounts that encompass a wide variety of topics and academic disciplines. Despite the economic and political significance of Canada's military-industrial base and its situation within a larger North American military industrial complex, there have been relatively few studies of how technological cooperation served to more closely link Canada with the U.S. Other than a very specialized literature that deals with defence policy and thus speaks to a small community of Canadians, few have considered how the relationship was forged by a complex set of military strategic concerns as well as the inter-play of economic and technological factors.<sup>9</sup>

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<sup>9</sup> These include Joseph Jockel, *No Boundaries Upstairs: Canada, the United States and the Origins of North American Air Defence, 1945-1958* (Vancouver: University of British Columbia Press, 1987); David Haglund, ed., *Canada's Defence Industrial Base: The Political Economy of Preparedness and Procurement* (Kingston: Ronald P. Frye & Company, 1988); D.L. Middlemiss and J. Sokolsky, *Canadian Defence Decisions and Determinants* (Toronto: Harcourt Brace Jovanovich, 1989); and Joel

Canadian defence and foreign policies were transformed when Canada signed the Ogdensburg Agreement and Hyde Park Declaration made with the United States in 1940-41. These events were a watershed in Canadian-American relations as they led to an increased continental integration for Canadian defence and economic policies. Despite the widely held perception that Canada was “forced” into a dependent relationship with the United States after 1939 (whether through lack of alternatives or the short-sightedness of its leaders), the development of a Canadian component within the North American military-industrial complex was not a cut and dried case of Canada’s weakness leading to a “surrender” of national military and economic independence. Nearly all of Canadian defence and foreign policy scholarship addresses the question of Canadian independence by asking in some way: to what degree did Canada act as a sovereign nation with regard to economic, foreign and defence policy decision making? A number of works, including those by very well-respected historians and political scientists, paint a picture of Canada’s total surrender to the United States and the unequivocal loss of national freedom. Their debate varies only as to whom should be assigned the blame for the loss.

J.L. Granatstein contributed another take on this question with his 1988 book, *How Britain’s Weakness Forced Canada Into the Arms of the United States*.<sup>10</sup>

Explaining how the economic and defence necessities generated by World War II and

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Sokolsky and Joseph Jockel, eds., *Fifty Years of Canada-United States Defense Cooperation: The Road From Ogdensburg* (Lewiston: The Edwin Mellen Press, 1992).

<sup>10</sup> J.L. Granatstein, *How Britain’s Weakness Forced Canada Into the Arms of the United States* (Toronto: University of Toronto Press, 1989). Granatstein made a

the Cold War drew Canada increasingly away from Great Britain and towards the United States, Granatstein flouted the prevailing interpretations written by both conservative and left-nationalist writers.<sup>11</sup> These authors placed the blame for this “surrender to the American embrace” on successive Liberal governments that held power from 1939 onwards.<sup>12</sup> Employing three case studies, Granatstein examined the

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similar argument with R.D. Cuff in *Ties That Bind: Canadian-American Relations in Wartime from the Great War to the Cold War* (Toronto: S. Stevens, Hakkert, 1977).

<sup>11</sup> Granatstein cited, *inter alia*, Donald Creighton and George Grant as conservative-minded thinkers, and James Laxer and Mel Hurtig as examples of those on the left. The left-nationalist school developed in the late 1960's and early 1970's. Its most common characteristics were a virulent anti-Americanism, an assumption of Canadian economic underdevelopment, and usually a socialist-democratic outlook (not always, however, as during the 1988 debate on the Free Trade Agreement with the United States, more liberal-leaning thinkers, including the then opposition federal Liberal party, aligned themselves with this view point). A typical left-nationalist perspective can be found in Paul Phillips and Stephen Watson's, "From Mobilization to Continentalism: The Canadian Economy in the Post-Depression Period," in Michael S. Cross and Gregory S. Kealey, eds., *Modern Canada: 1930-1980's: Readings in Canadian Social History, Volume 5* (Toronto: McClelland and Stewart, 1984). Phillips and Watson posited that Canada's dependency on the U.S. stemmed from an over-reliance on the export of natural resources, particularly those controlled by multinational industrial capital (pulp and paper, petroleum, minerals, etc.). They argued that as a result Canada never sufficiently developed its own R&D capabilities. For a similar perspective, see as well Kari Levitt, *Silent Surrender: The Multinational Corporation in Canada* (Toronto: Macmillan of Canada, 1970); Philip Resnick, *The Land of Cain: Class and Nationalism in English Canada, 1945-75* (Vancouver: New Star Books, 1977); Wallace Clement, *Continental Corporate Power: Economic Elite Linkage Between Canada and the United States* (Toronto: McClelland and Stewart, 1977); Jorge Niosi, *The Economy of Canada - A Study of Ownership and Control* (Montreal: Black Rose Books, 1978); and Melissa Clark-Jones, *A Staple State: Canadian Industrial Resources in Cold War* (Toronto: University of Toronto Press, 1987).

<sup>12</sup> Granatstein's analogy of "landlord and pitiful, yet virtuous, maiden" that he used to explain the American-Canadian dynamic was both sexist and disturbing in its use of a sexual assault metaphor. It was also self-contradictory. The image of a weak-willed and essentially powerless Canada flies in the face of Granatstein's own argument that Mackenzie King exercised wise management under exigent circumstances. Pitiful maidens at the mercy of cruel landlords are not thought capable of exercising such agency.

conditions which led Robert Borden to seek economic assistance from the Americans during World War I, the events leading to the signing of the Ogdensburg Agreement in 1940 and the Hyde Park Declaration in 1941, and the factors which bonded the Canadian and American economies more closely in the early Cold War. The common link in all of these events, Granatstein concluded, was the reality of Britain's economic and military vulnerability. Far from surrendering to the Americans, as Canadian scholars have so often depicted him and his successors as doing, Granatstein argued that King *et al* did what they could in difficult circumstances to ensure Canadian freedom of action.

In contrast to the vast literature on Canada-U.S. relations, the history of Canada's science and technology past is very little developed. Even less attention has been paid to the history of Canada's science policy. Beyond Bruce Doern's *Science and Politics in Canada*, there are no secondary treatments of this topic.<sup>13</sup> For insights on science policy development researchers must rely on government reports like the 1951 *Royal Commission on National Development in the Arts, Letters and Sciences* (Massey Commission), the 1963 *Royal Commission on Government Organization*

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<sup>13</sup> Bruce G. Doern, *Science and Politics in Canada* (Montreal: McGill-Queen's University Press, 1972). Doern provided comprehensive coverage of the creation of the Science Council of Canada, as well as the internal politics of the Senate Committee on Science and Technology. See also N. Harvey Lithwick, *Canada's Science Policy and the Economy* (Toronto: Methuen Publications, 1969), and Phillippe Garigue, *Science Policy in Canada* (Montreal: The Private Planning Association of Canada, 1972) for contemporary reviews about science policy. Lithwick approached the issue very critically and questioned the accepted wisdom that any form of state support for research and development would lead to gains for the economy.

(Glassco Commission), and the 1970 *Senate Special Committee on Science Policy*.<sup>14</sup>

Of value as well are key studies prepared by the Science Council of Canada, *Towards a National Science Policy for Canada* and the Economic Council of Canada's, *Science, Technology and Innovation*.<sup>15</sup>

While there have been several treatments of Canada's early research and communications satellite programs, most have been celebratory in nature, that is non-critical chronicles of Canadian achievements in space. Foremost among these is Doris Jelly's, *Canada: 25 Years in Space*, published in 1988.<sup>16</sup> Dr. Jelly worked on the *Alouette* projects when she was employed with the Defence Research Board in the 1960's, and later served as the curator of the "Canada and Space" exhibit at the Canada Science and Technology Museum (CSTM). In addition to Jelly, there have been several promotional books prepared by government agencies like the Department of Communication's *Alouette*, and Telesat Canada's, *Satellite Communications in Canada*.<sup>17</sup>

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<sup>14</sup> Canada, *Report of the Royal Commission on National Development in the Arts, Letters and Sciences* (Ottawa: King's Printer, 1951); Canada, *Report of the Royal Commission on Government Organization* (Ottawa: Queen's Printer, 1963), and Canada, Parliament, Senate Special Committee on Science Policy, *A Science Policy for Canada: Report of the Senate Special Committee on Science Policy* (Ottawa: Queen's Printer, 1970).

<sup>15</sup> Science Council of Canada, *Towards a National Science Policy for Canada* (Ottawa: Queen's Printer, 1968), and Economic Council of Canada, *Science, Technology and Innovation* (Ottawa: Queen's Printer, 1968).

<sup>16</sup> Doris Jelly, *Canada: 25 Years in Space* (Montreal: Polyscience Publications Inc., 1988). Ian Allaby, in his "Canada's Impressive Role in Space," *Canadian Geographic*, vol. 101, no. 5 (1981), provided a similar non-critical overview of Canada's early efforts in this domain.

<sup>17</sup> Department of Communications, *Alouette* (Ottawa: Queen's Printer, 1970), and Barrie C. Kirk, *Satellite Communications in Canada* (Ottawa: Telesat Canada, 1993).

James Brothers and Bruce Doern were among the first to take a more critical look at Canada's satellite program. They were primarily interested in the tri-partite ownership structure of Telesat Canada as a new form of crown corporation, and they drew upon the company's annual reports as well as interviews with senior government officials.<sup>18</sup> Despite his otherwise comprehensive treatment of the early regulatory history of Canadian telecommunications companies, Robert Babe did not access archival sources for his coverage of the *Alouette-Anik 1* story.<sup>19</sup> Instead, *Telecommunications in Canada* relied on the House of Commons *Debates* as well as interviews with key officials like Alan Gotlieb, who was the Deputy Minister of Communications when *Anik* was launched in 1972.

Babe was primarily concerned with exposing what he believed to be the beguiling effects of the east-west mythology, and how the lack of policy clarity frustrated nation building efforts. Similarly, Marc Raboy's well researched communications history, *Missed Opportunities*, focused on questions of how to render state policy more effective.<sup>20</sup> Raboy brought a Quebec focus to communications policy, and adopted a leftist orientation to understanding the role of the state and its relationship to private and public ownership. Laurence Mussio's recent *Telecom Nation: Telecommunications, Computers, and Governments in Canada* also viewed greater state control as imperative to better and more affordable telecommunications

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<sup>18</sup> G. Bruce Doern and James A.R. Brothers, "Telesat Canada," in Allan Tupper and G. Bruce Doern, eds., *Public Corporations and Public Policy in Canada* (Montreal: Institute for Research on Public Policy, 1981).

<sup>19</sup> Robert Babe, *Telecommunications in Canada*.

<sup>20</sup> Marc Raboy, *Missed Opportunities: The Story of Canada's Broadcasting Policy* (Montreal-Kingston: McGill-Queen's University Press, 1990).

systems.<sup>21</sup> He concluded that, notwithstanding the increasing prominence of telecommunications on the federal policy agenda in the post-World War II era, the combined forces of rapid technological changes and the government's uncoordinated and contradictory policies resulted in the state's failure to control this key economic sector. While Mussio provided useful context for this period through his detailed account of the creation of the Department of Communications in the late 1960's, his analysis was marred by an obscured, but ever present, political view that rendered his conclusions overly deterministic. Mussio committed the error of interpreting his evidence through an *a priori* ideological framework that presumed state failure.

Therefore, while Canada's early satellite programs have received some popular and scholarly treatments, few researchers have delved into the archival record and none have utilized the innovative policy consciousness framework that this dissertation employs.<sup>22</sup> This study draws on primary source documents, which are concentrated in the former Department of Communications (DOC) record group at the National Archives of Canada.<sup>23</sup> While the Defence Research Board had initial responsibility for the satellite projects (*Alouette I and II* and *ISIS A and B*), authority and programs were transferred to DOC upon its creation in 1968. Of particular

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<sup>21</sup> Laurence B. Mussio, *Telecom Nation: Telecommunications, Computers, and Governments in Canada* (Montreal-Kingston: McGill-Queen's University Press, 2001).

<sup>22</sup> John Vardalas's "Moving up the Learning Curve: The Digital Electronic Revolution in Canada, 1945-70" (unpublished Ph.D. thesis, University of Ottawa, 1996) provided an impressive reconstruction of the work of the Defence Research Board and its contributions to the electronics and computer industries. However, his thesis did not address the specifics of satellite policy.

importance are the files of Dr. John H. Chapman who oversaw all of the satellite projects for the DRB and served as an Assistant Deputy Minister in DOC until his death in 1979. The Department of Transport records relating to telecommunications regulation were also subsumed under the Department of Communications files in 1968 when program responsibility was transferred from Transport to DOC. Dr. John H. Chapman's personal papers are another rich source of materials relating to the satellite programs. This extensive collection contains copies of key memoranda, speeches and talks that he delivered to university and other research audiences, as well as his personal correspondence that lend insight into the values and cultures of the DRB and DOC environments in which he worked.

In keeping with the effort to recreate the policy consciousness that affected choices and outcomes in this period, we will review the chronology of events that led from *Alouette* to *Anik 1* in the first five chapters of this dissertation, and conduct a more in-depth review of perceptions and motivations in chapter six. Chapter one reviews how Cold War defence concerns ushered Canada into space with the first *Alouette*, as well as the growing linkages between Canada and the U.S. that resulted from this project. The first satellite's success led to an extended cooperative program between the DRB and NASA, the International Satellites for Ionospheric Studies (ISIS) program. Chapter two focuses on the outcomes of ISIS and the changing nature of Canada's defence industrial policy. The third chapter examines Canada's attempts to develop a science policy and how these efforts were hampered by policy

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<sup>23</sup> The Department of Communications was subsumed under the Department of Industry (RG 20) following an extensive re-organization of federal government

misperceptions and the distorting effects of economic nationalism. We review these developments in order to understand the broader context of Canada's quest for a successful science policy and how that, combined with other pressures, accounted for the federal government's decision to re-orient the satellite program from defence research to civilian telecommunications.

This quest for a systematic approach to developing an industrial R&D base and achieving greater economic growth was one of the prime motivating factors affecting the federal government's decision to build a domestic telecommunications satellite system. Chapter four reveals how the confluence of rapidly developing satellite technology, corporate interest in exploiting the commercial aspects of the new communications satellites, concerns about American domination of the international satellite system, nascent Quebec nationalism and a federal vision of a fully bilingual nation prompted the federal government to mandate communications as Canada's destiny and invest some \$100 million dollars in a satellite system. Spurred by a nationalistic impulse to preserve and promote Canada's culture and develop its economy, politicians described the telecommunications satellite as a "100% Made in Canada" project. Chapter five explores how the federal government was forced to confront the realities of North American commercial integration and Canada's interdependence with the U.S. when an American company, Hughes Aerospace, was selected as the main contractor on the first *Anik* communications satellite.

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ministries in 1993.

Chapter six decodes the symbols and messages deployed by policy makers in the post WWII era in order to examine the Canadian consciousness more deeply. This extended analysis is intended to lend insight into the impact of an overly negative mentality, and to suggest how such a pessimistic outlook might be re-balanced by considering successes as well as failures. It is hoped that this quest for knowledge and understanding will result in greater clarity to support the development of more effective policies.

In a system such as Canada's, elected representatives and senior bureaucrats are entrusted with the country's well-being. The democratic state exists as the ultimate expression of a society's wealth and power, and serves as guardian for its citizens and those who reside there. This case study of government decisionmaking will reveal a mixed record that ranges from the excellent execution of the well-developed Alouette-ISIS satellite programs to the more ambivalent outcomes achieved by federal science and industrial policies in the 1960's. Throughout we shall observe how the particular oscillation of Canada's national mythology, an expansive imperial drive combined with a defensive anti-colonialism, pervaded choices and perceptions.

## Chapter One

### *Exploring the Arctic Frontier: The Cold War Ushers Canada into the Space Age*

It was nearly midnight on October 4, 1957 when, as part of its regular newscast, the CBC radio station in Halifax “transmitted a rapid series of dots for about ten to fifteen seconds.”<sup>1</sup> This was not a technical glitch, nor was it a stray burst of Morse Code accidentally broadcast. No, this was an intentional “message” that was being relayed from the just-launched *Sputnik I*, the Earth’s first artificial satellite in orbit nearly 900 kilometers above the planet. This astounding technical achievement riveted global attention and accorded the Soviets the first victory in what was to become a “space race” among the major Cold War antagonists. As a member of the Western alliance (and Cold Warrior nation), the *Sputnik* launch had military and economic repercussions for Canada.

Having been greatly transformed by its participation in the Second World War, Canada was equally, if not more, affected by the four-decade-long standoff between the United States and the Soviet Union. World War II engendered rapid development industrially, scientifically, and politically in Canada, and completed the transition from “colony to nation” in its foreign relations outlook. The post-1945 Liberal governments pursued a path of active nation-building to consolidate the gains

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<sup>1</sup> *The Globe and Mail*, October 5, 1957, p. 1 coverage of the Sputnik launch. The *Globe* reported that CBC Halifax used a recording of the Sputnik signal made by a local radio enthusiast. Soviet news agencies supplied the satellite’s broadcast

made during 1939-45, and to guide Canadian affairs through the often treacherous realities of the Cold War era. One of the most intricate and trying of these was Canada's relationship with its southern neighbour, as the less powerful nation often found itself jostling with the American superpower to protect and promote its own economic and political interests. The exigencies of the Cold War entangled Canada more closely with the United States -- their relationship forged by a complex set of strategic defence concerns and the inter-play of economic and technological factors.

These influences were responsible for Canada's decision to develop its own satellite in 1958. With the launch of *Sputnik*, Canadian defence analysts determined that space would likely be exploited for military purposes and thus necessitated Canadian involvement in this cutting-edge field. A satellite program would also build on Canada's long-standing work in upper-atmosphere physics and radio wave propagation theory. The scientists, technicians and engineers who designed and constructed *Alouette* surpassed all expectations as they ventured into a wholly uncharted technology and succeeded in crafting one of the most sophisticated vehicles of the early space exploration period. The success of the *Alouette* project led to an extended agreement with the United States National Aeronautics and Space Administration (NASA) for the International Satellite for Ionospheric Studies (ISIS) program, which remained in effect until the early 1970's.

The Alouette-ISIS programs, while spearheaded by the Defence Research Board, had long-lasting civilian benefits as they spawned a new advanced-technology

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frequency to encourage such "listening in" as part of its propaganda campaign to celebrate this "socialist triumph" over Western technology.

sector and would later transform telecommunications. This outcome was hardly accidental, however, as Canada's military and political leaders in the 1950's pursued a defence industrial policy designed to create spin-offs in the civilian economy. The architects of Canada's defence and industrial development policies could not be but influenced by the impressive growth experienced during World War II and were eager to harness Canada's military science and technological output to the larger goal of nation building. The post-1945 environment provided greater opportunities than any other previous time in Canada's economic history to develop science and technology infrastructures. Military research and development expenditures played a major role in this growth.

Canada's scientific development during World War II was remarkable, especially so as the country had evolved only rudimentary science and technology resources by the war's beginning. Since Confederation, Canadian scientific research developed at a slow pace, and, indeed, Canada had no formal mechanism for supporting research and development until the founding of the National Research Council (NRC) in 1916. The Borden administration created the Council at the urging of Imperial government. Britain's war-time leadership concluded that Germany's strong investments in scientific and technological development furnished it with a distinct battle-field advantage, and they sought to replicate this winning strategy.

Despite Canada's ability to supply great quantities of munitions during World War I, there was little impetus to maintain a strong defence- industrial base following

its end.<sup>2</sup> Any related research and development efforts withered with the war industries' demise as did many of the government's incentives to support industrial research activities. During the inter-war years, the NRC faced steep challenges with few financial resources.<sup>3</sup> Its mandate to foster Canada's science and technology resources was furthered hampered by the scarcity of private industries conducting research and development and the paucity of trained scientists in the country.<sup>4</sup>

Despite these major impediments, the Council did manage to establish two effective mechanisms for stimulating Canada's research capacity: the scholarly grants program and the Associate Research Committees.<sup>5</sup> National Research Council historian, Mel

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<sup>2</sup> Military analyst, Ronald G. Haycock, argued that, in 1919, the federal government had few incentives to maintain defence industrial preparedness as there seemed to be no immediate threat of further conflict and furthermore public opinion was decidedly against continued support of the "Merchants of Death." See his "Policy, Patronage, and Production: Canada's Public and Private Munitions Industry in Peacetime, 1867-1939," in David G. Haglund, ed., *Canada's Defence Industrial Base* (Kingston: R. P. Frye, 1988), p. 80.

<sup>3</sup> In the years before World War II, the NRC employed a total staff of 300, and had an annual allocation of \$900,000. By the end of war, the Council had acquired twenty-one new laboratories, 2000 personnel, and its annual budget increased to \$7 million. See the Senate Special Committee on Science Policy, *A Science Policy for Canada: Report of the Senate Special Committee on Science Policy* (Ottawa: Queen's Printer, 1970), p. 61.

<sup>4</sup> Mel Thistle remarked that at the time of the Council's founding there were fewer than "fifty full time researchers in the physical sciences" in Canada. See Mel Thistle, ed., *The Mackenzie-McNaughton Wartime Letters* (Toronto: University of Toronto Press, 1975), p. ix.

<sup>5</sup> Historian Wilfrid Eggleston estimated that the scientific war effort was enriched by over 1000 people who were "trained as a result of the grants system." See his *Scientists at War* (London: Oxford University Press, 1950), p. 11. Eggleston further noted that during World War II there were over twenty major associate research committees with nearly 100 sub-committees established, which fused "hundreds of Canada's most eminent professional men and scientists from universities and from industry," p. 14. E.H. Dudgeon concurred with Eggleston's assessment of the efficacy of the Associate Research Committee structure. He concluded that "World War II forced a rapid expansion in technical capability within Canadian industry and

Thistle, related that these Committees functioned like mini-NRCs in that they brought together experts from industry, academia and government to guide research inquiries and prevent costly duplication of effort.<sup>6</sup> Canada could ill afford to squander such rare industrial and scientific resources. An early survey of Canadian business determined that of the 2400 manufacturers who responded to the NRC's national inquiry, only 37 of these "claimed to conduct any research at all, and the expenditure by all government laboratories, Dominion and provincial, amounted to less than \$100,000 per annum."<sup>7</sup>

Throughout the inter-war period, the Council continued to provide research support to Canada's military. There were few demands for its assistance, however, until the mid-1930's, when senior defence officials began to anticipate an impending major conflict and were thus anxious to re-fit Canada for war. Consequently, several defence preparedness efforts were undertaken including the appointment of General A.L. McNaughton as President of the National Research Council in 1935. McNaughton immediately began to intensify the Council's defence research efforts by initiating a number of projects such as those related to radio research. In 1936, defence officials formed a joint armed forces committee that began tabulating a list of potential military suppliers. Within three years, the Committee compiled information

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much of this was directed and stimulated through a mechanism established and funded by NRC -- the NRC Associate Committee structure." See his "The National Research Council's Contributions in World War II," in George R. Lindsey, ed., *No Day Long Enough: Canadian Science in World War II* (Toronto: Canadian Institute of Strategic Studies, 1997), p. 17.

<sup>6</sup> Thistle, *The Mackenzie-McNaughton Wartime Letters*, p. xi.

<sup>7</sup> W.E.K. Middleton, *Mechanical Engineering at the National Research Council, 1929-1951* (Waterloo: Wilfrid Laurier University Press, 1984), p. 3.

about "1597 industrial plants that might contribute to large-scale war production."<sup>8</sup>

Canada would begin the 1939-45 conflict with a modicum of defence industrial preparation.

When the Mackenzie King Cabinet committed Canada to war in September 1939, the National Research Council assumed primary responsibility for defence research. Shortly thereafter, McNaughton accepted a new appointment to become Inspector General of the Units of the First Canadian Division. The government recruited engineer Chalmers Jack (C.J.) Mackenzie to act as the interim president of the National Research Council. Mackenzie provided superb leadership throughout the war, and remained president of the Council until 1952, where he continued to promote Canada's post-war industrial research and development efforts.

Even with the early preparations made by McNaughton and the effective guidance provided by Mackenzie it is doubtful, however, whether Canada's scientific resources would have developed to the degree that they did without the 1940 Tizzard scientific mission to North America that was led by British scientists, A.V. Hill and Henry Tizzard. According to Mackenzie, "the Tizzard mission gave Canada a head start of at least two or three years on real war problems and, of more importance, an even greater head start in developing a sound base for post-war scientific and industrial technology."<sup>9</sup> The escalating military crisis, which ensued after the fall of

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<sup>8</sup> Haycock, "Policy, Patronage, and Production," p. 86.

<sup>9</sup> Thistle, *The Mackenzie-McNaughton Wartime Letters*, p. 9. Mackenzie also argued that America's delayed entry into World War II served to advance Canadian scientific and industrial development. He concluded that U.S. neutrality forced Britain to rely on Canada, and therefore provided its former colony with a protected environment free from American competition in the early months of the war.

France, persuaded British Prime Minister Winston Churchill to authorize an official exchange of information with the Americans and Canadians to enlist their help in the production and refinement of radar and other weapons. Tizzard arrived in Ottawa on August 15, 1940 and met with C.J. Mackenzie, senior war-research scientist Frederick Banting, and members of the Cabinet including Prime Minister King, Minister of Munitions and Supply, C.D. Howe, Minister of National Defence, Colonel J.L. Ralston, and James Duncan, acting Minister of National Defence, Air. Mackenzie recalled that the inclusion of senior military officials and politicians at the initial meeting between Tizzard and the NRC “paved the way for the effective cooperation between the NRC, Canadian industry and the Armed Forces which prevailed over the next three or four years.”<sup>10</sup>

Canada’s rapid scientific growth and the success of its researchers in World War II convinced C.J. Mackenzie of the necessity to continue investing in the country’s science and technology infrastructure after the war. Historian W.E.K. Middleton credited Mackenzie with possessing the foresight to prepare for the post-war realities.<sup>11</sup> Mackenzie’s lobbying efforts began in earnest in 1943 when he recommended to Howe that the NRC, and science and technology generally in Canada, should receive continued support. Once Howe was appointed Minister of Reconstruction in 1944, Mackenzie proposed that the Council’s post-war budget be maintained at wartime levels or higher. The NRC president toiled endlessly to secure

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<sup>10</sup> *Ibid.*

<sup>11</sup> W.E.K. Middleton, *Radar Development in Canada: The Radio Branch of the National Research Council 1939-46* (Waterloo: Wilfrid Laurier University Press, 1981), p. 114.

more stable funding for the Council as he believed that Canada's post-war economic development would be contingent upon the robustness of its science and technology sectors. These arguments proved convincing, and on October 13, 1944 Prime Minister King announced that "research would be extended and more liberally supported in the post-war period."<sup>12</sup>

While NRC president C.J. Mackenzie had secured strong funding for the Council for the post-war era, he wanted to re-orient its focus to a civilian basis. Accordingly, he recommended that a separate body be created to conduct research for the military. This vision coincided with that of General Charles Foulkes, Chief of the General Staff at the end of the war, and it was he who commissioned Colonel W.W.(Wally) Goforth to develop a set of options regarding a defence oriented research agency. Goforth's 1945 report, "The Future of Canadian Army Research and Development," initiated much debate among the heads of the three Services, most of whom argued that each branch of the Services should develop its own separate research arm.<sup>13</sup> However, Foulkes and Goforth championed the option of a single, autonomous agency that would serve all branches and report directly to the Deputy Minister of Defence. They envisioned an agency that would, by its separate status,

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<sup>12</sup> Thistle, *The Mackenzie-McNaughton Wartime Letters*, p. 139. During his radio broadcast, King also announced the appointments of C.D. Howe as Minister of Reconstruction and C.J. Mackenzie as President of the National Research Council.

<sup>13</sup> Captain D.J. Goodspeed provided a highly detailed account of these debates in his *A History of the Defence Research Board of Canada* (Ottawa: Queen's Printer, 1958). Writing more than a quarter of a century later, O.M. Solandt, the Board's first Chair, credited C.J. Mackenzie, General Foulkes, and Colonel Goforth with providing the leadership and vision for the establishment of the Board. See O.M. Solandt, "The Defence Research Board's Untimely End: What It Means for Military Science," *Science Forum*, vol. 8, no. 5 (October 1975).

have sufficient authority to coordinate all research efforts that related to defence needs.

The autonomous model eventually prevailed, and in March 1947 the Defence Research Board (DRB) was formally created by an amendment to the *National Defence Act*. The architects of the new Board assumed that in any future conflict in which Canada participated that the country would function as a member of an Anglo-American led alliance. Accordingly, they decided that the DRB should not try to duplicate U.S. and British research. Instead, Canada would concentrate on areas where it had a unique defence requirement like the arctic, or in fields such as ionospheric studies where its defence scientists already demonstrated considerable expertise.

The experience of WWII also taught the Board's planners that, in order to have any influence with their more powerful allies, Canadian researchers needed to be highly credible and have something of value to exchange. The Board's first Chair, Dr. O.M. Solandt, considered it essential that the DRB's staff include "first-class scientists who could talk as equals to their counterparts in Great Britain and the United States."<sup>14</sup> Solandt also developed four major principles to guide the new Board's research priorities and selection of projects. The first delineated the scope of DRB's research activities as falling somewhere between pure and applied research, in essence the fundamental work that precedes engineering design. Solandt's second principle mandated that the Board concentrate on a relatively few number of projects to maximize the effectiveness of limited human and financial resources, and thirdly

that these projects should utilize Canadian sources as much as possible. Solandt's fourth principle prescribed that the results of the Board's research should benefit the civilian population as well as serving military aims. This was quite consistent with the government's view that military research should be used to contribute to Canadian society as a whole, which it articulated in a 1947 published statement on defence policy. In that document, Brooke Claxton, the Minister of National Defence, linked the military goal of defence preparedness with the nation building aspiration of industrial development. He noted that these objectives included "close integration of the armed forces, the defence purchasing agency, government arsenals and civilian industry."<sup>15</sup>

Similar to the way in which the National Research Council operated, the Defence Research Board included representatives from industry and universities to better inform its research. The Board sponsored symposia and fostered regular interaction between its researchers and their counterparts in the private sector and academia as well with other research bodies (both military and civilian) in the United States and Great Britain. On-going contact with Canada's major allies remained essential for Canadian defence research, and Defence Liaison Offices were established in Washington and London in 1947. Thus, when the opportunity came a decade later to develop a satellite for ionospheric research, these well established

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<sup>14</sup> Solandt, "The Defence Research Board's Untimely End," p. 20.

<sup>15</sup> Government of Canada, Department of National Defence, *Canada's Defence: Information on Canada's Defence Achievements and Organization* (Ottawa: King's Printers, 1947), p. 12.

research networks facilitated cooperation between the Canadian and American programs.

Canadian expertise in ionospheric studies had developed in large part from radar research conducted during World War II, which was, in turn, based on radio physics work performed by the NRC and several Canadian universities during the inter-war period. Researchers were attracted to studies of the ionosphere, the electrically charged -- i.e. ionized -- layer of the earth's atmosphere that serves as a gigantic reflective surface, to better understand and thus improve radio communications. In the pre-satellite era, long-distance communications depended on signals being refracted by the ionosphere from one point to another, or transmitted by expensive to construct underwater- or land-based cables or by microwave systems. By the mid-1920's, physicists began measuring the height of the ionosphere by calculating the time elapsed from the transmission of a radio pulse to the receipt of its echo to chart the structure of this ionized layer. A decade later, both the Naval Research Laboratory in the United States and researchers in the United Kingdom had adapted these "sounding" principles to a working radar system, which was to become an essential offensive and defensive weapon against German sea and air power.

Canadian interest in studies of the upper atmosphere began in the early nineteenth-century when both the first magnetic observatory and the Meteorological Service of Canada were established in Toronto in 1839.<sup>16</sup> Canada contributed to several early international efforts in atmospheric research including the first

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<sup>16</sup> Doris H. Jelly, *Canada: 25 Years in Space* (Montreal: Polyscience Publications in co-operation with the National Museum of Science and Technology, 1988), p. 14.

International Polar Year (IPY) in 1882-1883 and the second IPY in 1932, for which several new field observation stations in the North were constructed. In the same year, additional observation stations were built in Ontario and Newfoundland to conduct research on the ionosphere and the effect of radio fading during a total solar eclipse.<sup>17</sup> In his study of *Physics at the National Research Council of Canada, 1929-1952*, W.E.K. Middleton described the University of Toronto and McGill as the leaders of physics research in Canada during the inter-war period, while research was also conducted at Queen's, Dalhousie, and the Universities of Manitoba and Alberta. Most of this research activity focused on the study of the atmosphere, specifically the light-wave bands produced by the *aurora borealis*, using a technique called spectroscopy.<sup>18</sup>

In his detailed review of Canada's WWII scientific efforts, Wilfrid Eggleston observed that the country possessed expertise in radio research prior to 1939, especially on "the propagation and reception of radio waves."<sup>19</sup> In 1930, the NRC established a Radio Associate Committee to advise on the direction of radio research at the Council and in the universities. That same year, the Associate Committee agreed to cooperate with Radio Research Board in the UK "on the study of the

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<sup>17</sup> W.E.K. Middleton, *Physics at the National Research Council of Canada, 1929-1952* (Waterloo: Wilfrid Laurier University Press, 1979), pp. 52-53. Middleton noted that the NRC established a similar field station at the Rockcliffe airport in Ottawa in 1933 and another in Forrest, Manitoba (in cooperation the Department of National Defence) in 1936. Scientists believed that these stations would yield insights into meteorology as well as information about the ionosphere.

<sup>18</sup> *Ibid.*, pp. 3-5. See also Yves Gingras, *Physics and the Rise of Scientific Research in Canada* (Montreal-Kingston: McGill-Queens University Press, 1991) for a detailed look at physics research in Canada during the inter-war period.

<sup>19</sup> Eggleston, *Scientists at War*, p. 28.

atmospheric disturbances known as static.” Within three years, the Committee identified three research priorities for work in Canada: atmospheric, measurements and standards, and wave propagation.<sup>20</sup> In keeping with these identified priorities, the Council hired radio physicist, Dr. John Henderson, who joined the Radio Division of the NRC in 1933. Henderson’s early work concentrated on determining the bearings of thunder storms, which were thought to be related to the problem of radio static, as well as initiating some preliminary studies related to wave propagation theory. Like a number of other Canadian physicists, Dr. Henderson formed strong links in the UK when he studied with Professor Edward Appleton of Kings College, London while completing his doctorate.<sup>21</sup>

As Appleton’s former student, Henderson had the requisite expertise to conduct sounding experiments, but the growing urgency of military-related work pushed these ionospheric studies to the side. Instead, Henderson shifted his focus to applications relating to the cathode ray direction finder, a rudimentary radar that was patented by Canadian engineers Colonel W.A. Steel and Major-General A.G.L. McNaughton in 1926.<sup>22</sup> In the late 1930’s, the NRC hired another radio specialist, C.W. MacLeish, to whom the Council provided funding to conduct ionospheric

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<sup>20</sup> Middleton, *Physics at the National Research Council of Canada*, pp. 52-53.

<sup>21</sup> Middleton, *Radar Development in Canada*, p. 2. Appleton was one of the first physicists to conduct sounding experiments on the ionosphere.

<sup>22</sup> McNaughton and Steel’s invention employed a cathode-ray oscilloscope mounted on a bi-directional antenna (one pointing north-south, the other east-west). See Eggleston, *Scientists at War*, p. 28. Henderson’s work in the mid-1930’s consisted of trying to adapt the device to air and marine use. See Middleton, *Radar Development in Canada*, p. 2

soundings.<sup>23</sup> Given the NRC's limited budget, the fact that so many resources were being devoted to radio work underlined its importance to defence preparations.

During WWII, the Royal Canadian Navy (RCN) requested that the NRC intensify its study of the effects of ionospheric conditions on radio wave transmission to aid in anti-submarine warfare. The Council established a station in Chelsea, Quebec that was based on MacLeish's design.<sup>24</sup> By mid-war, both the British and the Americans proposed that similar kinds of stations be established throughout the United States and the Commonwealth, with research to be coordinated in London and Washington. In accordance with this plan, automatic equipment was installed at Churchill and on Baffin Island by the Carnegie Institute in 1943, while the Royal Canadian Corps of Signals opened a station in Prince Rupert, British Columbia. Two years later, the Royal Canadian Air Force (RCAF) established another station in St. John's, Newfoundland, and the NRC placed an automatic ionospheric recorder at Victoria Beach, Manitoba. In 1944, the Department of National Defence (DND) formed the Canadian Radio Wave Propagation committee to coordinate radio research being conducted for the three branches of the armed forces, and to supervise these six ionospheric stations.

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<sup>23</sup> Middleton, *Physics at the National Research Council of Canada*, p. 54. MacLeish published a paper in 1940 from his own sounding station design work and research entitled "Note on a Method of Plotting Electron Distribution Curves for the *F* layer" in the *Canadian Journal of Research*.

<sup>24</sup> Jim Norman and Rita Crow, eds., *A History of the Defence Research Establishment Ottawa, 1941-1991* (Ottawa: Protective Sciences Division, Defence Research Establishment Ottawa, 1992), p. 9. See as well Goodspeed, *A History of the Defence Research Board*, pp. 191-92.

When DRB was founded in 1947, a small research unit, the Radio Propagation Laboratory, was moved to the Board under the supervision of Frank T. Davies. In 1951, the radio group and another laboratory supervised by Davies, the Defence Research Electronics Laboratory, merged into one unit to form the Defence Research Telecommunications Establishment (DRTE). Throughout its existence, DRTE operated as a centre of excellence as its successive management teams continually reinforced high standards and a reputation for world-class science. LeRoy Nelms, a former DRTE employee who worked at the Shirley's Bay laboratories as a junior scientist when the *Alouette* program was being established, recalled that at DRTE:

the supervisors, from Section head to Chief Superintendent exuded a confidence that DRTE could do anything (scientific) it set out to do, do it better and more successfully than any other organization, and that if you wanted to be part of this team you had better be certain that your science was impeccable, that your approach left no avenue unexplored, and that you knew your specialty 'inside-out.' If you did not measure up, you were torn to ribbons when you presented your science to your peers and supervisors. In other words, it was taken for granted that competence and excellence were mandatory and nothing less would be tolerated.<sup>25</sup>

DRTE researchers and technicians were also encouraged to exchange information with Canadian university and industrial-based researchers as well as with their counterparts in the U.S. and the UK, and to participate in various international fora such as the scientific committees sponsored by the U.N. based International Council of Scientific Unions.

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<sup>25</sup> Leroy Nelms, "DRTE and Canada's Leap into Space: The Early Canadian-Satellite Program," in Norman and Crow, *A History of the Defence Research Establishment*, p. 77.

When DRTE was created in 1951, the Electronics lab employed three scientists and four technicians who conducted much of their research collaboratively with non-DRB personnel through a system of university grants. Their early work continued to focus on radio-propagation problems as evidenced by the posting of several members of the DRTE staff to the University of Saskatchewan to conduct work on ionospheric and geomagnetic problems related to auroral disturbances. Other staff were assigned to the joint Canada- U.S. laboratory at Fort Churchill, Manitoba, where between 1954 and 1957, they made photographic and spectrographic observations of the aurora. At the request of the Royal Canadian Navy, DRTE staff devised a series of prediction tables to indicate the best times to use communication equipment in the polar regions. They theorized that increased auroral disturbances were linked to communications black-outs, and sought a better understanding of this relationship through continual observation and data collection at Churchill and other ionospheric sounding stations in Ottawa, Saskatoon, and Resolute Bay.<sup>26</sup> DRTE's research program had strong civilian and military rationales. Any knowledge leading to improved long distance radio communications would benefit both commercial and military users, and, as such, justified on-going research efforts.

From the late 1940's into the mid-1950's, North American strategic defence was predicated on early warning detection and air-bomber interception, which is why Canada and the United States collaborated to build the Distance Early Warning

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<sup>26</sup> Goodspeed, *A History of the Defence Research Board*, p. 194 and 198.

(DEW), Pinetree and Mid-Canada radar “fences.”<sup>27</sup> Canadian and American armed forces concentrated primarily on this air defence strategy until 1951, when research shifted to anti-missile defence. The Canadian Armament Research Defence Establishment (CARDE) led the defence preparedness efforts in this area with a project called “Velvet Glove” that involved researchers from the DRTE as well as from private industry.<sup>28</sup> By the late 1950’s, these ionospheric studies attracted a higher priority as Soviet inter-continental ballistic missile (ICBMs) capabilities became apparent. As part of its anti-missile research efforts, DRTE, in cooperation with the U.S military, constructed the Prince Albert Research Laboratory (PARL) in northern Saskatchewan. Opened in 1959, PARL was used to test the radar systems that were developed to detect missiles, and, in particular, to determine how natural

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<sup>27</sup>Defence analyst George Lindsey observed that up until 1949 defence decisions were taken separately in Canada and the U.S., but at that point the Military Cooperation Committee “began to fashion detailed joint plans [that included] 34 radar stations in Canadian territory.” Completed by 1954, the “Pinetree line” stretched roughly along the Canada-US border. See his “Canada-US Defence Relations in the Cold War,” in Joel Sokolsky and Joseph T. Jockel, eds., *Fifty years of Canada-United States Defence Cooperation: The Road From Ogdensburg* (Lewiston, New York, 1992), p. 64. In 1953, a joint Canada-U.S. Military Study Group was formed and it recommended the construction of the Distance Early Warning (DEW) line from Alaska to Baffin Island, at roughly 70N latitude. The DEW line was paid for and maintained solely by the United States and was in operation by 1954. Canada, in turn, constructed its own system of radar defence that followed the 54th parallel from Saskatchewan to Labrador, and was known as the Mid-Canada line.

<sup>28</sup> Alain Gelly, and H.P. Tardif, *Defence Research Establishment Valcartier, 1945-1995: 50 Years of History and Scientific Progress* (Ottawa: Department of National Defence, 1995). The first Soviet ICBM test occurred on August 26, 1957.

phenomenon like the *aurora borealis* could affect readings by scattering radio signals.<sup>29</sup>

Tracking ICBMs with radar was possible because these missiles, traveling at nearly fifteen times the speed of sound, left an ionized wake that created a reflective surface from which to refract radio signals. Research experiments determined that different types of missiles created unique plasma signatures that could be distinguished and thus tracked. Despite extensive work on this problem, DRB scientists concluded that without better knowledge of the upper atmosphere defensive systems would remain underprepared.<sup>30</sup> Canada's auroral zone, in particular, presented many challenges as it was prone to radio blackouts and signal fading. Scientists theorized that this was linked to how the ionosphere thinned over Canada's polar regions and to the intensity of solar radiation, or sun-spot, activity. While researchers had a good understanding of the areas of the ionosphere that could be reached by sounding rockers and radar equipment, they had no information about its "top-side." DRTE scientists, like their counterparts in the United States, theorized that an artificial satellite could be used to gather the necessary data in order to better understand the composition and conditions of the upper reaches of Earth's

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<sup>29</sup> PARL employed twelve technical and scientific personnel, while research planning and direction came from DRTE in Ottawa and the MIT Lincoln Lab in Massachusetts, which had been contracted to act on behalf of the U.S. Armed Forces.

<sup>30</sup> National Archives of Canada (hereafter NA), MG 31, J43 (J.H. Chapman papers), volume 1, file 33, "The DRTE Satellite and Rocket Program, December 1959." Notes for a presentation by J.H. Chapman, R.K. Brown and W. Heikkila made on December 9, 1959, p. 3. As they outlined the research challenges regarding atmospheric research to their colleagues, the DRTE scientists stressed that "our knowledge of that region is negligibly small. We do not know, within a large factor, the density of gas, its temperature, its degree of ionization or its chemical composition," p. 4

atmosphere. With *Sputnik's* launch in 1957 there were sufficient political and strategic defence reasons to commit funds for a Canadian satellite. Cold War defence requirements ushered Canada into the space age.

While the popular imagination mythologizes *Sputnik* as a completely revolutionary idea that appeared from nowhere, the origins of satellite technology were based in rocket research conducted by German, Soviet and American scientists in the 1920's and 30's. Germany's successful V-2 rocket program in World War II spurred both the U.S. and USSR to continue supporting space-based research after that conflict. As early as 1945, the American Navy's Bureau of Aeronautics established a committee to assess the feasibility of developing space vehicles, and, by 1946, the Navy had recommended to the U.S. Joint Research and Development Board that the U.S. should place a satellite in orbit. The idea was rejected, however, on the basis that there was "insufficient military requirement" for such a project.<sup>31</sup> This military reasoning may appear quite short-sighted, yet it should be acknowledged that Cold War tensions had yet to deepen by this point, and once they did in 1947 with the Berlin airlift crisis and the Soviet Union's detonation of the A-bomb, U.S. military strategy had come to rely on armed bomber defence and not missile technology.<sup>32</sup>

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<sup>31</sup> Richard Hirsch and Joseph Trento, *The National Aeronautics and Space Administration* (New York: Praeger, 1973), p. 12. Hirsch and Trento provided a highly detailed and readable account of NASA's origins, including the military research that preceded its creation.

<sup>32</sup> Rip Bulkeley, *The Sputnik Crisis and Early U.S. Space Policy: A Critique of the Historiography of Space* (Bloomington: Indiana University Press, 1991). Bulkeley explained that the U.S. Airforce initially believed that its air bombers would be sufficient for attack on the Soviet Union and as such there was no incentive to develop long-range missile capability. It was not until Eisenhower took office that

While the U.S. delayed its rocket program, the Soviet Union surged ahead with its own research program.<sup>33</sup>

Even though the U.S. Armed Forces lagged behind their Soviet counterparts, American civilian scientists like Van Allen were at the forefront of promoting satellite technology, which he did at the 1948 meeting of the International Union of Geodesy and Geophysics. Other bodies such as the International Scientific Radio Union also advocated the idea of an earth satellite to supplement studies of the ionosphere. In 1954, the International Council of Scientific Unions agreed to hold an International Geophysical Year (IGY) from July 1, 1957 through December 31, 1957, “in order to observe a period of maximum sun-spot activity and [...] promote a broad, worldwide investigation of the earth-sun relationship by taking precise measurements around the globe and in the atmosphere at the same instant of time.”<sup>34</sup> The Director of the U.S. National Science Foundation proposed the idea of developing an American satellite for the IGY to President Eisenhower in March 1955. After considering the effects of devoting resources to a solely scientific, as opposed to a military-based project related to the American missile program, the Eisenhower Administration not only agreed to

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serious study was given to missile development in the U.S., and actual development did not begin until 1954, “some four or five years later than the Soviet(s),” p.17.

<sup>33</sup> Hirsch and Trento related that by 1947 there were two possible options: the Navy’s “Vanguard” rocket program, or a joint Army-Navy proposal called the Redstone rocket. Despite evidence that the Vanguard lagged behind the Redstone program, Hirsch and Trento observed that the decision was made to continue backing the Vanguard project so as not to undermine Navy prestige. See their *The National Aeronautics and Space Administration*, p. 14.

<sup>34</sup> *Ibid.*, p. 13.

the idea, but rushed to ensure that the U.S. plans would be made public before those of the Soviet Union.<sup>35</sup>

Ultimately the Americans fell victim to their own hubris when on October 4, 1957, the Soviet Union launched *Sputnik I*, the world's first artificial satellite. This was a large space vehicle that weighed eighty-four kilograms and required a highly powerful and sophisticated rocket to place it in orbit. *Sputnik II* was launched a month later and weighed considerably more than the first satellite. Dubbed *Muttik*, this second vehicle was equipped with life support for the dog *Kudryavka* ("Curly") that it carried.<sup>36</sup>

With such dramatic achievements on the part of the Soviet Union, it appeared to the world that the United States had fallen drastically behind. Its first efforts to catch up to the Soviets ended in a public relations disaster when a rocket exploded on the launch pad in full view of the media in December 1957. Setbacks such as these generated a deepened sense of crisis within the Eisenhower Administration. Not only had the U.S. attempt to demonstrate its parity with the Soviet Union failed, but decisionmaking was greatly impeded by "an atmosphere of disappointment, bafflement, and outrage," and by finger-pointing and airing of dirty laundry in the world's press.<sup>37</sup> However, the American government rallied and, by March 1958, it

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<sup>35</sup> Bulkeley, *The Sputnik Crisis and Early U.S. Space Policy*, p. 17. He observed that that the U.S. made its announcement for use of satellites during the IGY without truly understanding how much further ahead the Soviets were.

<sup>36</sup> "New Russian Satellite Aloft: Half-Ton *Sputnik II* Carries Dog, Circles Earth at 1000 Miles Level," *Globe and Mail*, November 4, 1957, p. 1.

<sup>37</sup> Hirsch and Trento, *The National Aeronautics and Space Administration*, p. 15. They recalled that the Soviet triumph "reverberated through the halls of Washington like bells of doom. The hard, unpalatable fact was that the Soviets were first with the

introduced the legislation that established NASA. American pride was also somewhat salvaged by the successful launching of three satellites between January and March of 1958.<sup>38</sup> After faltering in the blocks, the U.S. regained its footing, if not completely its stride, in the space race against the Soviets.

Meanwhile in Canada, DRTE staff successfully tracked *Sputnik's* orbit within forty-eight hours of its launch, the first specialists outside of the Soviet Union to do so. With their usual high level of dedication, the DRTE team had been “working day and night” to confirm radar observations and verify calculations, which they forwarded to the IGY headquarters in the U.S., well ahead of the Smithsonian

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ICBM. They were first in space with heavy payloads, and the United States was short of its often proclaimed goal to leap ahead of, or at least abreast of, Soviet weaponry.” The *Globe and Mail* also reported on this internal division in the U.S. in its October 10, 1957 edition that relayed news about American efforts to reclaim its pride. The Toronto paper quoted senior U.S. military and political officials views that they doubted Soviet claims concerning the technical sophistication of *Sputnik*. One U.S. admiral referred to it as a “hunk of iron almost anyone could have launched.” Eisenhower claimed that he was not worried about the Soviet breakthrough and tried to cast doubts as to its accuracy and whether the ICBM program was that greatly advanced in the USSR. The *Globe and Mail* noted that during a press conference the President laid the blame for the U.S. delay on the lack of coordination among the Armed Services and on U.S. scientists for not requesting sufficient research funds. Not surprisingly, this angered the scientific and military communities who, “no sooner [than the] press conference was over [that] sources in the Defense Department and governmental scientific laboratories willingly contradicted to reporters practically everything that the President had said. The scientists claimed that Eisenhower could not bring himself to admit that U.S. fell behind on his watch.” *Globe and Mail*, October 10, 1957, p. 1.

<sup>38</sup> Hirsch and Trento listed these as *Explorer I*, launched on January 31, 1958, which contained a 14 kilogram payload; the “elegantly engineered but light weight *Vanguard*” that was launched on March 17, 1958 with a 1.4 kilogram payload; and *Explorer II*, which contained a 8.4 kilogram payload and was launched on March 26, 1957. See their *The National Aeronautics and Space Administration*, p. 23. Bulkeley observed that the smaller U.S. payloads were partly due to the Americans’ greater use of miniaturization made possible through newly developed transistor technology. See his *The Sputnik Crisis and Early U.S. Space Policy*, p. 18.

astronomers in Cambridge, Massachusetts.<sup>39</sup> Like most members of the Western alliance, *Sputnik's* launch caused great consternation for the Diefenbaker government. DRTE's quick action abated concerns that the West had fallen greatly behind the Soviets and had no means to catch up.<sup>40</sup> Still fears were sufficiently strong to have prompted the Prime Minister to state on October 9, 1957 that Canada "should adopt a policy of devoting more of [its] defence budget dollars to research and development."<sup>41</sup>

There was certainly strong Canadian military interest in the Soviet and American satellites. DRB teams across Canada studied their orbits to produce data that would be used to prepare anti-missile defence.<sup>42</sup> While the tracking program

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<sup>39</sup> *Globe and Mail*, October 9, 1957, p. 1. The DRB media relations policy appeared to favour openness and a commitment to educating the public on scientific matters. For instance, the October 10, 1957 edition of the *Globe and Mail* carried a picture of *Sputnik* that had been taken in Newbrook, Alberta. The accompanying news article quoted a DRB representative who provided the press with a candid explanation that the photo would be used to help pinpoint the accuracy of their calculations about the satellite's orbit.

<sup>40</sup> NA, MG 31 J43, volume 4, file 7. December 9, 1957 letter from Chapman to Leroy Nelms. Chapman disclosed to his DRTE colleague, who was stationed in England at the time of *Sputnik's* launch, that "*Sputnik* diplomacy has had its effect here. DRTE has received publicity (i.e. newspaper reports like the one above) and a certain amount of additional support, since we have been aware of the problem for some time, and have done something about them," p. 2.

<sup>41</sup> Clark Davey, *The Globe and Mail*, October 9, 1957, p. 1. Davey reported that "speaking to reporters as he left another long cabinet session, the Prime Minister said that the Free World has been aroused as never before to the need for making its scientific and research institutions reasonably competitive with those of the Soviets."

<sup>42</sup> NA, MG 31 J43, volume 8, file 14. February 11, 1958 memorandum classified as SECRET, Canadian Eyes Only." In this memorandum John Chapman outlined DRB tracking activities for military purposes, and observed that "CARDE [has] an active program for measurement of passage of satellites particularly during the re-entry phase. Six equipments are being placed across Canada from Halifax to Esquimalt," p. 6. He elaborated that the satellite tracking program made "valuable radar targets for experiments to determine the structure in the ionosphere and the electron density

provided valuable information, senior staff within DRTE continued with their plans for a Canadian satellite program.<sup>43</sup> It was understood, however, that even if Canada could develop a satellite of its own, it would require the help of another country to launch it into space. In all likelihood this would require a cooperative program with the United States.

The first opportunity to present the satellite proposal to their American colleagues came in October 1958, when representatives from DRTE were invited by leading U.S. space expert Lloyd Berkner to attend a meeting sponsored by the Space Science Board of the U.S. National Academy of Sciences.<sup>44</sup> The Canadian design was quite sophisticated as it proposed that the main experiment aboard the satellite should be a swept-frequency sounder, meaning that instead of gathering information about the ionosphere at one fixed-radio frequency, the satellite's radar would take successive readings at a number of frequencies, much like moving up and down a

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integrated over the path from the radar to the satellite. Of direct military interest is the use of the satellite as a radar target for calibration of A/ICBM radars, for measurement of systematic errors due to propagation effects, and for studies into propagation factors affecting radar performance," p. 8.

<sup>43</sup> Leroy Nelms on p. 75 of his "DRTE and Canada's Leap into Space," recalled that Dr. Eldon Warren, who headed the section responsible for bottom-side ionospheric soundings, first proposed the idea and that it was also discussed by Dr. C. Hines, Dr. John Chapman as well as Dr. P.A. Forsyth at the University of Saskatchewan. Nelms credited Warren with pushing forward with a proposal for a swept-frequency topside sounder.

<sup>44</sup> NA, MG 31 J43, volume 1, file 44. During a January 18, 1964 presentation to the Royal Canadian Institute on "The Alouette Satellite," Dr. Chapman told his audience that DRTE received a call from Dr. Lloyd Berkner, who chaired the U.S. Space Science Board, as "they were seeking to establish a suitable space program." Chapman recalled that at that point in time NASA was just being established and "scientists all over the United States were being asked to suggest programs, and several Canadian groups were invited to make proposals," p. 1.

musical scale.<sup>45</sup> The DRTE scientists developed the idea for a swept-frequency topside sounder, “since [they] expected that the polar ionosphere above the F-peak [a mapping designation for the ionosphere] would be complex and therefore too difficult to interpret, if, for example, only a few fixed frequencies were employed.”<sup>46</sup> While the DRTE proposal was well received, the creation of NASA halted all other civilian-based space projects, including the ones being developed by the National Academy of Sciences.

The Canadian proposal did not flounder for long, however. In November 1958, at the founding meeting of the Committee on Space Research (COSPAR) in London, England, Dr. Rose from the NRC and Dr. Chapman of the DRTE were approached by American colleagues who were eager for Canada’s participation in space exploration.<sup>47</sup> At that meeting, both the Americans and Soviets signaled their readiness to “provide room in their satellites and space probes for experiments and equipments of other countries.”<sup>48</sup> In keeping with the Cold War atmosphere, the space race was heating up not only as a competition for technological supremacy, but also one of ideological dominance. As such, the U.S. constantly promoted the openness of

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<sup>45</sup> NA, MG 31 J43, volume 11, file 7. February 12, 1962 (F-12-62) *NASA Facts* “Alouette- Canada’s First Satellite,” p. 2.

<sup>46</sup> NA, RG 97 (Department of Communications), volume 70, file 23. Draft speaking notes for the address by Chapman to the XV General Assembly of URSI, Munich, September 1966, p. 2.

<sup>47</sup> NA, MG 31 J43, Volume 9, file 15. November 19, 1958 confidential memorandum on the “Canadian Space Research Program” by DRTE Chief Superintendent, James (Jim) C.W. Scott. Scott indicated that Canada was invited to the inaugural meeting of COSPAR at the “instigation of the Space Board of the USA Academy of Sciences.”

<sup>48</sup> NA, MG 31 J43, volume 9, file 7. “Confidential Report to Vice Chairman on Visit to U.K. November 12-15, 1958, n.d.” Chapman related that “at the COSPAR

the American space program as being in sharp contrast to the secrecy of the Soviet Union's. The United States -- at least publicly -- also made the free exchange of information and international cooperation a high priority for its space program. NASA quickly established an international program and the *National Aeronautics and Space Agency Act* made "space an instrument of foreign policy."<sup>49</sup>

While DRTE officials furthered their networks at the COSPAR meeting in London, one of the DRB's officers in Washington learned of NASA's impending international program. B.A. Walker submitted the DRTE proposal to NASA in December 1958 following a meeting between NASA and DRTE officials earlier that fall. Walker assumed that the chances of the Canadian proposal being accepted were good, but not automatic, since, in accordance with its scientific review policy, NASA placed DRTE's design with the Central Radio Propagation Laboratory (CPRL) in Boulder Colorado for assessment.<sup>50</sup> While CPRL ultimately approved the DRTE design, scientists there thought that the swept-frequency design was too ambitious and recommended that, while the program could proceed, a U.S. fixed-frequency sounder satellite should be placed in orbit first.<sup>51</sup> Thus, NASA accepted DRTE's proposal in

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meeting, it was clear that the cooperation of Canada in space research is keenly desired by the USA," p.1.

<sup>49</sup> Hirsch and Trento, *The National Aeronautics and Space Administration*, p. 140, 149.

<sup>50</sup> NA, MG 31 J43, volume 9, file 15, "Topside Sounder Satellite 1958-1959." December 31, 1958 memorandum from B.A. Walker, for the Defence Research Member, Canadian Joint Staff, Washington to J.C.W. Scott, Chief Superintendent of DRTE.

<sup>51</sup> NA, MG 31 J43, volume 1, file 16. Draft paper prepared by Chapman, n.d. "Topside Sounding of the Ionosphere." Ultimately *Alouette* was launched into orbit several months before the American made satellite.

January 1959, and a Memorandum of Agreement between NASA and the DRB was signed in March that year.

The design phase of the Canadian satellite project, designated S-27, began in early 1959. DRTE employees faced a very steep challenge as little was known about satellite technology. The extreme sophistication of its on-board experiments added to the complexity of their task as did the need to miniaturize many of the satellite's components. Very few of the pieces of equipment used in ground based transmitters could be employed as they would be too large to meet the size and weight requirements dictated by existing rocket power.<sup>52</sup> A promotional booklet published in 1970 by the federal Department of Communications described the task in these terms:

in effect, what Canadian engineers were told is this: build a miniature electronic laboratory you can blast into the earth's upper atmosphere on top of a rocket and which will then do four different kinds of sophisticated measurements in an environment full of unknown hazards; build it to work at least a year and you won't get much time to think about it either.<sup>53</sup>

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<sup>52</sup> Canadian Museum of Science and Technology (CMST) Archives, file "Space Science -- Alouette-ISIS-- Awards IEEE-- Engineering Canada." June 16, 1986 nomination of Alouette project to the Canadian Engineering Centenary Awards by former DRTE employee, C.A. Franklin. Franklin explained to the awards committee that at the time that the DRTE engineers and scientists were starting the project "text books on space technology and the in-orbit radiation environment were non-existent and the open literature and internal NASA reports were sparse. Indeed NASA had only been in existence for four months when work started on Alouette at DRTE, Ottawa in 1959. The Canadian engineering team had no prior experience in the design of space systems and hardware. Most of its members, were, however part of a world-class centre (DRTE) in both the then emerging field of solid state electronics and the established field of upper atmospheric physics -- the latter being a discipline in which Canada has had a long tradition of excellence. This combination with valuable support from the emerging Canadian space industry was probably the key to the extraordinary success of the program," p. 3.

<sup>53</sup> Department of Communications, *Alouette* (Ottawa: Queen's Printer, 1970), p. 10.

While DRB and NASA initially planned that the DRTE swept-frequency sounder would be included in a U.S.- built satellite, it was soon agreed, however, that DRTE would construct its own satellite as well as the experiments. This decision provided the design team with greater freedom to develop a customized pay-load and “eased the problems of incompatibility of the topside sounder with other experiments.”<sup>54</sup> The design team recognized immediately that they would have to rely on transistor technology to compress the heavy, high energy consuming ionosonde into a space of about a third of a cubic metre and within a weight limit of twenty-three kilograms.<sup>55</sup> DRTE eventually constructed four payload models of the satellite: two for testing, one for the actual launch, as well as a backup model. NASA’s then spotty launch record necessitated the contingency of a duplicate satellite as at this time, only one in every two attempts met with success.

The 1959 agreement with NASA committed the DRB to construct the satellite per the American agency’s performance standards. Therefore, the design and testing phases involved a number of launch simulations that entailed the recruitment of a great many personnel.<sup>56</sup> Over 100 DRB employees were involved in the project,

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<sup>54</sup> NA, MG 31, J43, volume 4, file 10. December 18, 1959 memorandum from Frank T. Davies, Chief Superintendent, DRTE, to Chair, DRB, p. 2.

<sup>55</sup> NA, MG 31 J43, volume 1, file 16. December 1962 draft paper by Chapman, “Topside Sounding of the Ionosphere.” Chapman explained that “present ionospheric sounders, using vacuum tubes, are heavy, and most consume kilowatts of power. However, an order of magnitude improvement in efficiency and weight can be achieved using solid state devices, thus making the experiment feasible for satellite application,” p.1.

<sup>56</sup> MG 31, J 43, volume 10, file 9, August 14, 1962 (revised August 22, 1962) “S-27 Satellite Program: History, Future and Costs,” p. 2.

including professional, technical, and support staff.<sup>57</sup> By the summer of 1962, the joint DRTE-NASA teams were ready to begin the final performance tests of the completed satellite, which was a compact, roughly hexagonal, sphere constructed from aluminum and covered with 6500 solar cells.<sup>58</sup> When in orbit and facing the sun the satellite drew its power from these solar panels. The sun's power also regenerated the on-board nickel-cadmium batteries that maintained the satellite when it was within earth's night side.<sup>59</sup> *Alouette* weighed 145 kilograms and contained 6000 electronic components connected through "sophisticated circuitry."<sup>60</sup>

Its main experiment, the top-side sounder, operated like a miniature radar set, switching on and off repeatedly between transmitter and receiver mode to send a signal and then record its echo. It operated "62 times a second," designed to be a sufficient interval in which to relay the data to the receiving ground station located 1000 kilometers below.<sup>61</sup> The sounder swept through nearly 700 different radio

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<sup>57</sup> *Ibid.* Appendix I of this memorandum listed the personnel commitments for the two phases of the satellite's design and construction. Phase I entailed a total of "26.6 man years on preliminary studies and tests," and Phase II required 115.7 people (44 professional, 41.5 technical and 30.2 support staff).

<sup>58</sup> NA, RG 97, volume 71, file 47, October 16, 1962 press release, p. 2.

<sup>59</sup> Department of Communications, *Alouette*, noted that there were six rechargeable nickel cadmium batteries on board: four to run the satellite, and two spares, p. 18.

<sup>60</sup> NA, MG 31 J43, volume 1, file 16. December 1962 draft paper by Chapman, "Topside Sounding of the Ionosphere," p. 15. For a description of the satellite components, see NA MG 31, J43, volume 1, file 41. January 25, 1963 presentation to Kiwanis luncheon by Chapman, "Canada in the Space Age," p. 4. The circuitry was described in NA, MG 31 J43, volume 10, file 20, March 31, 1961 press release by DRB, "Joint DRB-NASA Satellite Project: Progress and General Information," p. 4.

<sup>61</sup> The Department of Communications promotional publication, *Alouette*, provided the satellite's precise operating details: "each transmission is sustained for only 0.0001 second. Another 0.0001 second after the transmitter shuts off, the receiver switches on and waits for the pulse to travel into the ionosphere, be reflected and return. The receiver operates slightly less than 0.016 each time. After it has shut off

frequencies (between 1.6 and 11.5 megahertz) in each operation. *Alouette*'s second main experiment consisted of six particle counters built by the Cosmic Ray Section of the NRC. These instruments operated much like Geiger counters and were used to detect radiation signatures that provided data about the type and amount of energy-particles interacting within one another over Canada's auroral zone.<sup>62</sup>

The third on-board experiment relied on a small looped antenna mounted on the top of the satellite that monitored cosmic noise (naturally occurring radio frequencies found throughout the universe) "across the 0.4 to 11.5 mc/s band [by] telemetering the receiver automatic gain control (AGC) voltage to the ground."<sup>63</sup> This information gave the experimenters some sense of the electron density surrounding the satellite in order to verify the operation of the sounding receiver. The data also provided insights into the cosmic noise itself, which was impossible to obtain from any other source than a space-based vehicle because reception of the galactic radio waves was normally blocked by the earth's atmosphere. The fourth experiment used a "simple audio-frequency amplifier operating in the 0.4 to 10 kc/s band, [that was] coupled to the sounding antenna." This equipment recorded "audio-frequency atmospherics, whistlers (like lightening strikes), and VLF (very low

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the transmitter switches on again [...] While the reflecting surface is always within this limit, signals may, in fact, not take the direct-line route and travel considerably further. At the other extreme, the sounder can't detect any reflecting layers closer than 35 kilometers," p. 16.

<sup>62</sup> NA, MG 31 J43, volume 1, file 16. December 1962 draft paper by Chapman, "Topside Sounding of the Ionosphere," p. 7. See also NA, MG 31 J43, volume 1, file 36. October 12, 1961 talk by Chapman to a presumed military audience given the sensitive material covered, p.3.

<sup>63</sup> NA, MG 31 J43, volume 1, file 20, "The Topside Sounder Satellite *Alouette*, 1963." Re-print of a paper published by Chapman and Warren, p. 314.

frequency)” as the experimenters believed that the “VLF emissions also appear to be related to ionospheric storm effects,” and they hoped that any information about their frequency and cause would lead to improved communications in Canada’s northern regions.<sup>64</sup>

In addition to the cosmic-noise-wire loop, the satellite also had four short antennas that transmitted results to the ground stations, as well as housekeeping information on battery voltage, solar charging currents and temperatures, while a sixth small antenna provided a tracking beacon. The satellite’s command receiver was tuned to recognize forty commands sent by different combinations of tonal frequencies.<sup>65</sup> *Alouette* was also equipped with two 25 metre long antennas that were essential to the sounder tests as the radio waves involved in the main experiment measured over 100 metres, and therefore the combined reach of the antennas had to measure half that length.<sup>66</sup> These long antennas presented a specific design challenge, as the “shroud” or nose cone on the rocket provided less than a metre of space. A solution had to be found to store the antennas and then extend them once the satellite achieved orbit. The resulting innovation became one of the emerging Canadian’s space industry’s most successful products and helped it to cement an international reputation for excellence in key components. The design team adapted an idea developed by NRC engineer G.J. Klein for a spool-like mechanism that could

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<sup>64</sup> NA, MG 31 J43, volume 1, file 16. December 1962 draft paper by Chapman, “Topside Sounding of the Ionosphere.” Chapman noted that this “experiment was made possible by utilizing the broad band telemetry capacity provided for the topside sounder receiver,” p. 7.

<sup>65</sup> *Ibid.*, p. 17-18.

unwind thin strips of metal into long antenna-like structures.<sup>67</sup> The STEM (storable, tubular extendible member) antenna design was eventually sold by de Havilland (later Spar Aerospace) to a number of countries, and was used extensively in the U.S. Apollo space program.<sup>68</sup>

Once the flight models of the satellite were completed in July 1962, final preparations for its launch began.<sup>69</sup> The operation's team chose a time frame that would ensure there would be sufficient sunlight when the satellite was ejected from the nose-cone of the rocket to power the satellite, but not expose it to too much solar

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<sup>66</sup> NA, MG 31 J43, volume 1, file 39. November 19, 1962 talk by Chapman at the University of Toronto, p. 3.

<sup>67</sup> According to the Department of Communications promotional brochure, *Alouette*, Klein developed the mechanism to be used on tanks, p. 10-11. Doris Jelly, *Canada: 25 Years in Space*, also credited Klein, but noted that the mechanism was originally designed in order for a "beacon to be dropped by military aircraft," p. 107.

<sup>68</sup> Doris Jelly, *Canada: 25 Years in Space*, p. 110. According to Dr. Jelly, these included "Allan Shepherd's first U.S. manned sub-orbital flight." For further details concerning the STEM antenna's success, see the company histories by Fred Hotson, *The de Havilland Canada Story* (Toronto: CANAV Books, 1983), and Lydia Dotto, *A Heritage of Excellence: 25 Years at Spar Aerospace Limited* (Toronto: University of Toronto Press, 1992).

<sup>69</sup> NA, MG 31 J43, volume 10, file 9. August 14, 1962 memorandum about the "S-27 Satellite Program: History, Future and Costs," p. 1. DRTE and NASA officials considered postponing the launch entirely as they were uncertain what effect the radiation from recent nuclear test by the U.S. in July 1962 would have on the satellites solar panels, as they had few empirical data. See also NA, MG 31 J43, volume 4, file 16. September 4, 1968 memorandum from Frank T. Davies (Chief Superintendent of DRTE) to Chair, DRB, re: Artificial Radiation Belt: Effect on Topside Sounder Satellite." Davies reported that while the DRTE team predicted some degradation of the solar cells due to the increased radiation, they thought that they should proceed with the launch as the loss was "manageable". Also, and perhaps more importantly, he believed that the data from the on-board experiments, particularly on the cosmic ray experiment would provide crucial information about radiation from the nuclear test. Davies indicated that the "data is of obvious military as well as scientific value," p.1.

radiation that could potentially damage the on-board electronics.<sup>70</sup> The S-27 satellite, newly re-christened *Alouette* by DRB's new chair Dr. Zimmerman, was launched at 11:06 Pacific Daylight Savings Time on September 28, 1962 at the Vandenberg Air Force Base in California. The first telemetry from the satellite was captured by a Canadian engineer stationed in Fairbanks, Alaska. His report that the satellite had successfully received its first set of commands and was operating per design parameters was greeted with excitement by the DRTE staff at mission control in California. Speaking at a Kiwanis Club luncheon nearly four months after the launch, Dr. Chapman recalled the mood of great celebration at mission control: "We could feel the jubilation in the Mission Direction Centre at this time, there was a smell of success, as though things were working out in our favour. [When the Canadian engineer called from the station in Alaska] "He almost jumped down the telephone line when he said 'it's here.'"<sup>71</sup> Three years of hard work and risk taking had paid off beautifully.

Following the tremendous success of *Alouette's* launch, the DRTE team was immediately faced with the challenge of managing the satellite's operation. In addition to building and equipping the satellite, the agreement with NASA committed DRB to instrumenting and operating three ground control stations in Canada. Between October 1960 and August 1962, Canada built stations in Prince Albert, Saskatchewan, Resolute Bay, North West Territories, and Shirley's Bay, Ontario, where the satellite's main operations were directed. Three additional ground-based

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<sup>70</sup> Department of Communications, *Alouette*, pp. 12-15.

sounding stations were erected in northern Canada at Goose Bay, Iqaluit, and Baker Lake. This expanded the existing network of five stations that had been created during or immediately following World War II.<sup>72</sup> Each station followed a similar layout to NASA's minitrack design that included "6 racks of receiving equipment and tape recorders, a tracking antenna, [and] 10-20 kw of power and operating quarters" for the six member crew.<sup>73</sup> The spacecraft followed a circular path from 80 degrees of latitude north to 80 degrees south, which meant that a northern station like Resolute Bay station received eight daily passes of the satellite.<sup>74</sup>

The joint Canada-U.S. program exhibited further international dimension as there were thirteen ground stations around the globe that received data from the satellite.<sup>75</sup> The information collected by the ground stations was first relayed to NASA's Goddard space centre and then to Ottawa where the magnetic tapes containing the ionosonde radio recordings were played back and "photographic

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<sup>71</sup> NA, MG 31 J43, volume 1, file 41. January 25, 1963 presentation to Kiwanis luncheon by Chapman, "Canada in the Space Age," p. 4.

<sup>72</sup> NA, MG 31 J43, volume 10, file 9. August 14, 1962 memorandum about the "S-27 Satellite Program: History, Future and Costs," p. 2. The stations were operated by the Department of Transport for DRB.

<sup>73</sup> NA, MG 31 J43, volume 4, file 11. April 1, 1960 report of March 24, 1960 visit to NASA by Chapman and Brown, p. 3.

<sup>74</sup> NA, MG 31 J43, volume 1, file 36. October 12, 1961 talk by Chapman, p. 4. The DRB produced a promotional video about the personnel working in these northern research stations that was aired by the CBC. The piece noted that the station's directional antenna was built to "withstand arctic gales of 90 miles per hour and more." CBC Newsfilm pack, cat #8208-1919 ISN: 178851 V19612-0116.

<sup>75</sup> These included eight NASA Minitrack stations located in St. John's, Newfoundland; College, Alaska; East Grand Forks, Minnesota; Fort Myers, Florida; Quito, Ecuador; Antofagasta, Chile; Winkfield, England; and Woomera, Australia, in addition to the three operated by DRTE at Resolute Bay, NWT; Prince Albert, Sask; and Ottawa, and the two operated by the British Department of Scientific and Industrial Research in Singapore and the Falklands. *NASA Facts*, p. 5.

records made of each sounding made from the satellite."<sup>76</sup> These "ionograms" were made available to the international scientific community, and by 1966 over a million of these "pictures" had been produced.<sup>77</sup>

The DRTE team in Ottawa had primary responsibility for the satellite's daily operations. They developed a time-table that indicated which ground station would activate the satellite, and for how long, based on a calculation of *Alouette I's* power reserves, the status of the on-board electronics and its orbit, which they could predict with a high degree of certitude. Linda Petiot's article "Dirty Gertie" described how the DRTE team "built a computer program that would calculate the percentage of sunlight on the spacecraft for about three months [at a time]."<sup>78</sup>

Each tracking station followed a similar procedure. Once the satellite was within 2200 kilometres, the ground station's operators sent a "specially coded command message over its very-high frequency (VHF) command transmitter, consisting of combinations of seven audio tones. Such commands [would] tell the satellite to turn its sounder on, or report on the state of its batteries, or perform one of

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<sup>76</sup> NA, MG 31 J43, volume 4, file 16. October 2, 1961 draft press release, "Canadian Ionosphere Topside Sounder Satellite (S-27)," p. 5. See as well *NASA Facts*, p. 5.

<sup>77</sup> NA, RG 97 volume 70, file 23. Draft speaking notes for the address by Chapman to the XV General Assembly of URSI, Munich, September 1966 on the awarding of the first Dellinger Gold Medal to Canada for *Alouette*, p. 4. The ionograms were deposited in the World Data Centre A in Boulder Colorado. See also NA, MG 31 J43, volume 10, file 20. March 31, 1961 press release by DRB, "Joint DRB-NASA Satellite Project: Progress and General Information," p. 4 in which it was announced that a data reduction centre was established at DRTE for the project.

<sup>78</sup> Linda Petiot, "Dirty Gertie: The DRTE Computer," *IEEE Annals of the History of Computing*, vol. 16, no. 2 (1994), p. 49. In his 1997 Ph.D. thesis about the history of computing in Canada, John Vardalas refuted Petiot's claim the DRTE computer was used in secret operations research. See his "Moving up the Learning Curve: The Digital Electronic Revolution in Canada, 1945-70," (University of Ottawa, 1996),

its other experiments.”<sup>79</sup> The satellite would be “switched on” for about ten minutes, during which it would take about 30 ionograms and sweep through its “high frequency band every 15 seconds,” and during this interval it would travel nearly 3000 kilometers.<sup>80</sup> A built-in safety feature to conserve energy would automatically shut the satellite off after ten minutes and return it to its normal “quiet” mode with only the tracking beacon in operation. Each ground station received experimental data (soundings, cosmic noise, etc.), as well as status information about the satellite’s batteries, power reserves and the on-board electronics.

Originally designed to function for only one year, *Alouette I* continued to transmit data for a full decade. It received numerous international awards and laid the basis for the Canadian space industry.<sup>81</sup> The reasons for its success were numerous, including DRTE’s very competent staff and managers, the high level of cooperation enjoyed between DRB and NASA personnel, and the engineering principle of “robust design,” i.e. continually testing and re-testing each component and adding redundancies and back-up systems to the satellite’s design. It was a conservative

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p. 136.

<sup>79</sup> Department of Communications, *Alouette*, p. 9.

<sup>80</sup> NA, MG 31 J43, volume 1, file 18. Re-print of an article written by J.H. Chapman, “A Survey of Topside Sounding of the Ionosphere,” in Geoffrey M. Brown, ed., *The Ionosphere, Volume III* (Amsterdam: Elsevier Publishing Company, 1965), p. 6.

<sup>81</sup> These included the Gold Medal of Public Service of Canada in 1964; the first Dellinger Gold Medal of International Union of Radio Scientists (URSI) in 1966; Charles Cree Medal and Prize of the Physical Society and the Institute of Physics in 1967; McCurdy Award of the Canadian Aeronautics and Space Institute in 1967; NASA Group Achievement Award in 1971; the Canadian Engineering Centenary Award in 1987; and The IEEE Milestone Award in 1993. CMST archives, file “Space Science-- Alouette-ISIS-- Awards IEEE-- Engineering Canada.” June 16, 1986 submission by C.A. Franklin, to the Canadian Engineering Centenary Awards committee.

approach, yet it incorporated innovative ideas like the STEM antenna design and used, then state-of-the-art, transistor technology. Speaking at the 1993 ceremony at which Alouette was awarded the IEEE International Milestone in Engineering Award, Colin Franklin, a member of the satellite's development team described this design principle as "novel and controversial. Little reliance was placed on statistical reliability calculations. Instead we insisted on a thorough understanding of semiconductor devices and circuit operation and worked closely with manufacturers to ensure that only semiconductors with median parameter values were procured."<sup>82</sup>

Canada's entry into the space age exhibited high levels of achievement.

*Alouette I* performed well beyond expectations, and the reputation that DRB scientists and engineers garnered with the satellite project solidified NASA's interest in working with Canada over the long term. *Alouette I* also provided the impetus for a Canadian space-products industry, particularly the STEM antenna developed by de Havilland. Based on this strong beginning, the Canadian government embarked on the more ambitious International Satellites for Ionospheric Studies (ISIS) program with the United States in 1963.

However, one of the paradoxes of these successful technical and industrial programs was that they pushed Canadian researchers and companies toward greater interdependence with their American counterparts. As the 1960's progressed, policy makers would increasingly face the dilemma of promoting national development

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<sup>82</sup> CMST archives, file "Space Science -- Alouette-ISIS-- Awards IEEE-- Engineering Canada." May 13, 1993 speaking remarks by C.A. Franklin, "Alouette/ISIS: How it all Began," IEEE International Milestone in Engineering Ceremony, Shirley's Bay, Ottawa, p. 7-8.

within a continental context, while simultaneously resisting the attraction of the American giant.

## Chapter Two

### *Pursuing a Leading Edge: Defence Research and Canada's Industrial Hopes*

The success of the *Alouette* project encouraged the Canadian government to commit itself to a multi-million dollar venture with the United States.<sup>1</sup> The International Satellites for Ionospheric Studies (ISIS) program would produce three more satellites and consolidate Canada's reputation for excellence in space research, and the design and manufacture of satellite technology. The Canadian government seized this opportunity to strengthen the country's high technology base.

The *Alouette*-ISIS programs highlighted Canada's shifting military priorities in the early 1960's.<sup>2</sup> Following the expensive failure of the AVRO-Arrow interceptor jet program and its cancellation in 1959, Canada's defence industrial policy appeared to be in tatters. That same year, the government signed the first Defence Production Sharing Agreement (DPSA) with the United States, which consolidated a trend towards an integrated North American defence industrial complex that had been

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<sup>1</sup> *Alouette I* cost \$3 million; *Alouette II* \$4.5 million; *ISIS A* \$10.4 million, and *ISIS B* \$7 million for a total of nearly \$25 million. See National Archives of Canada (hereafter NA), RG 97 (Department of Communications), volume 71, file 48, October 25, 1967 memorandum by J.H. Chapman, "International Satellites for Ionospheric Studies," p. 2.

<sup>2</sup> Defence analysts Douglas Bland, Dan Middlemiss, and Joel Sokolsky have traced the decline in Canada's military spending in the post-WWII era from its peak during the Korean War to the reconsideration of Canada's defence strategy in the *Defence White Paper of 1964*. See Bland, *The Administration of Defence Policy in Canada, 1947-1985* (Kingston: Ronald P. Frye & Company, 1987), and Middlemiss and Sokolsky, *Canadian Defence: Decisions and Determinants* (Toronto: Harcourt Brace Jovanovich, Canada, 1989).

evolving since World War II. The Canadian research and development infrastructure owed much to investments in defence spending. Indeed, in-depth reviews of Canada's scientific potential conducted in the 1960's would reveal this reliance on government sponsored research and development as one of the main distinguishing characteristics of the country's science-and-technology base. By the mid-1960's, government policy analysts would commence their search for an alternative path to support Canada's continued science-and-technology growth. At the same time, social critics from both the left and right of the political spectrum would begin to advocate a more independent course from the United States. However, in the early 1960's, this strand of economic nationalism was not yet that influential, and Canada-U.S. cooperation was still looked upon quite favourably by most Canadian officials and the electorate.

This was certainly the case in terms of the origins of the ISIS program. In October 1962, only a month after the launch of *Alouette I*, planners at the Defence Research Board (DRB) were considering how to participate in an extended research satellite program and, in particular, how to ensure that the skills and knowledge that had been developed during the design and construction of *Alouette* could be transferred to Canadian industry. The DRB broached the subject with the U.S. National Aeronautics and Space Administration (NASA) earlier in the year by proposing that Canada participate in their Nimbus satellite program. The Americans countered this suggestion with a plan for an ambitious multi-phase satellite program

to examine the ionosphere during the remainder of the twelve-year, sun-spot cycle.<sup>3</sup>

The combined DRTE-NASA research team agreed that there was significant knowledge to be gained by continued study of the ionosphere throughout this period of increased solar activity. Thus, the DRB had strong scientific and industrial program rationales for continuing its partnership with NASA, but not necessarily those directly relevant to Canada's defence needs.

Before DRB planners were prepared to proceed with the ISIS program, they appraised Canada's existing industrial potential to develop space vehicles and instruments. Their analysis projected that Canadian industry would eventually be able to produce up to eighty percent of design and manufacturing requirements for research satellites of similar complexity to *Alouette I*.<sup>4</sup> DRB staff were also encouraged by the volume of sales of electronic components developed for the first *Alouette* in markets as varied as the UK, the U.S., the USSR, and Nigeria.<sup>5</sup> Defence staff considered these exports compelling evidence of the probable success of the

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<sup>3</sup> NA, MG 31, J43 (J.H. Chapman papers), volume 12, file 16, "ISIS Program - Development of Publicity 1962-1965." October 11, 1962 draft paper "Ionosphere Monitor Satellite Program," p.1. See also MG 31, J43, volume 13, file 6, "DRTE. Electronics Laboratory." March 1967 paper by David Florida, "The ISIS Satellites," p. 15. Florida explained that *Alouette I* was launched at the minimum point of the sun-spot cycle, while the ISIS team planned to have the fourth satellite in orbit by the early 1970's when this activity would reach its peak.

<sup>4</sup> NA, MG 31, J43, volume 12, file 16, "ISIS Program -Development of Publicity 1962-1965." November 22, 1962 memorandum from F.W. Simpson to DIR, "Comments on the IMS (Ionosphere Monitor Satellite)."

<sup>5</sup> NA, MG 31 J43, volume 4, file 16, "Chapman, J.H. DRTE Correspondence June-December 1962." August 9, 1962 memorandum from Chapman (Deputy Chief Superintendent) to the superintendents of the Electronics, Communications, and Radio Propagation laboratories, re: DRTE Projects Resulting in Sales Outside Canada, p. 1.

nascent Canadian space industry, and used it to justify on-going support for this sector.

On the basis of the industry's assessed capacity to both eventually produce a research satellite independently and the potential export markets being created, the DRB recommended to Douglas Harkness, the Minister of National Defence, that he present the proposal to his Cabinet colleagues. In January 1963, the Cabinet approved the new program, and outlined its two primary goals as maintaining Canada's lead in ionospheric research, and develop industrial competence in satellite technology.<sup>6</sup>

It is significant that the Cabinet agreed to fund the program despite its lack of direct defence relevance. Ministers were briefed to the effect that "this program cannot be regarded as having a primary defence objective and indeed it most appropriately to be regarded as a space research effort of the broadest national and technological significance."<sup>7</sup> This indicated that the government viewed the program fundamentally as a tool for industrial development and not as essential to the defence needs of the country. That the Defence Research Telecommunications Establishment (DRTE) was the pre-eminent research facility in satellite design and manufacture reflected Canada's then dependence on military research and development to generate leading edge research and to support the transfer of these kinds of innovations to the civilian economy. While the lack of any strong military rationale did not prevent the Canadian government from undertaking the program, it would raise serious concerns

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<sup>6</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3." January 7, 1963 Memorandum to Cabinet, Ionosphere Monitor Satellite Program, p. 1. The U.S.-Canada ISIS agreement was signed in May 1964.

<sup>7</sup> *Ibid.* paragraph 6.

several years later when cost over-runs forced the DRB to request additional funds from the Treasury Board for the project. Treasury Board analysts questioned the program's defence objectives and suggested that the project might be better placed with another government agency.<sup>8</sup>

The Minister of Defence provided Cabinet with another compelling rationale to participate in the ISIS program. Due to the intricate nature of Canadian and American defence planning and the vastness of the American defence industrial market, he persuaded Cabinet that it would be expedient to pursue this industrial opportunity for Canada because if it did not the advantages accrued during the development of the *Alouette* satellite would migrate to the United States. The DRB predicted that NASA would simply contract the ISIS satellites to a U.S. firm if Canada did not continue to participate in the ionosphere research program. Based on its commitments as America's military ally, DRB officials argued that the Board "would be under some moral obligations to assist the designated contractor in becoming fully familiar with the technique developed in the *Alouette* program. There is thus a considerable industrial and economic argument for taking up this proposal in Canada."<sup>9</sup> This dilemma demonstrated the perennial paradox of the American reality for Canada. While the United States' economy, military and scientific establishments have proffered many opportunities, partnership with the colossus is never a completely secure venture for the smaller power. There is the need for constant vigilance and

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<sup>8</sup> NA, RG 97, volume 219, file 99, part 3, September 3, 1965 letter from the Assistant Secretary of the Treasury Board to the Chair of the Defence Research Board.

<sup>9</sup> *Ibid.*, p. 2, paragraph 8.

flexibility to remain ahead of the giant, and the onus remains on policy makers to negotiate agreements that outweigh any potential losses to Canadian sovereignty.

Once ISIS was approved by Cabinet, the government made its plans public in March 1963. The DRB was soon inundated by a number of inquiries from industry about the program and what opportunities would exist for participation.<sup>10</sup> As there were four planned satellites under the program, DRB officials outlined a strategy in which industry would master a set of skills on one satellite and then become fully responsible for those components on the next satellite in the series. However, the DRTE would retain final control to ensure that its commitments to NASA were met. DRB planners specified that ideally the prime contractor would be a company that had “electronics competence, thermal and mechanical competence,” and the “eagerness and the ability to sell into the USA.”<sup>11</sup> They assumed that industry would take responsibility for the majority of design and construction work after the second planned satellite, *ISIS A*, was launched.<sup>12</sup> DRB planners also forecast that the research demands and subsequent satellite designs would become increasingly complex as more was learned about this region of space.

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<sup>10</sup> NA, MG 31, J 43, volume 5, file 1, “Chapman J.H. DRTE Correspondence January to June 1963.” November 1, 1963 “Statement by the Honourable Douglas S. Harkness, Minister of National Defence.” The Minister’s press release indicated that the DRB and NASA were in discussions about a number of possible experiments to be conducted.

<sup>11</sup> MG 31, J43, volume 12, file 8, “The ISIS Satellite Program: Proposed Plan for Industrial Cooperation, p.1.

<sup>12</sup> NA, RG 97, volume 219, file 99, “Alouette-ISIS Space Program, pt. 3.” January 13, 1964 statement by the Honourable Lucien Cardin, Associate Minister of National Defence, p.4.

The expanded satellite program was similar in many ways to a number of defence industrial programs conducted by the Defence Research Board throughout the 1950's. For instance, the "Velvet Glove" anti-missile research program included six staff members of Computing Devices Limited, who worked with the primary research team at the DRB's Canadian Armament Defence Research Establishment (CARDE). As Computing Devices' expertise grew, the company was eventually entrusted with CARDE's light-gas gun program. The company built a plant near Ottawa to manufacture these weapons, which employed 200 technical personnel by the mid-1960's.<sup>13</sup>

There were similar successes with Bristol Aerospace and Canadair Limited, both of whom participated in the DRB's Black Brant rocket research program. These two companies gained experience and skill from the contact with DRB scientists and engineers, and from the development and procurement contracts in which these companies participated. Eventually their growing competence was recognized by the American Armed Forces when Canadair won contracts with the U.S. Air Force to produce rockets. Bristol Aerospace specialized in producing motors to power the rockets, and by the mid-1960's procured agreements with several NATO members to manufacture these components. The Canadian government also offered direct industrial incentives to Bristol Aerospace in order to promote regional economic development. In exchange for the prime contractor position on the three planned generations of Black Brant rockets, Bristol Aerospace constructed a plant in

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<sup>13</sup> Science Secretariat, Privy Council Office, Special Study No. 1, *Upper Atmosphere and Space Programs in Canada* (Ottawa: Queen's Printer, 1967), hereafter referred to

Winnipeg.<sup>14</sup> The ISIS program would build on the proven efficacy of gradually transferring skill and knowledge to the private sector, and the associated economic and industrial benefits.

By the spring of 1963, the Department of Defence Production (DDP) began its review of proposals from four Canadian companies for the ISIS prime contract position. These included Canadair Limited of Montreal; Computing Devices of Canada (CDC) of Ottawa; RCA Victor of Montreal with de Havilland as associate contractor; and Canadian Westinghouse Limited with Bristol Aerojet Limited of Winnipeg as subcontractor for mechanical and thermal design. In terms of related satellite expertise, Computing Devices of Canada operated the *Alouette* tracking station in Ottawa, and provided technical support to the Resolute Bay Station in the North West Territories as well as to the team controlling *Alouette I* in Ottawa.<sup>15</sup> RCA of Montreal had a strong track record in satellite design and construction for the U.S. and Canadian space programs. In 1959 it was selected to conduct engineering studies on antennas for deep probes, which resulted in a contract for "feed systems" for the Mariner IV Venus probe. In 1961, RCA of Montreal developed and manufactured "repeaters, beacons and simulators" for *Relay*, *Alouette I* and *Explorer XX*. It also started to develop an expertise in satellite ground station receiving equipment, and by 1962 had engineered and supplied the "26 bay tracking control console" for the Prince Albert Radar Laboratory (PARL), and completed a program definition phase study for

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as the Chapman Report, p. 49.

<sup>14</sup> *Ibid.*, p. 45. The Bristol Aerospace plant was completed in 1963.

<sup>15</sup> NA, MG 31, J43, volume 11, file 31. "Alouette II Launch Press Kit November 1965," p. 15.

the U.S. military's MARK 1B "military transportable communication satellite earth station."<sup>16</sup> RCA was able to develop a transmitter for *Alouette I* after the U.S. supplier originally selected to provide the component failed to produce one of sufficient quality.<sup>17</sup> de Havilland also contributed significantly to *Alouette I* by designing and manufacturing its frame and producing the highly successful STEM antenna, which the company marketed widely.

DDP officials assessed the companies' potential to acquire the requisite expertise in satellite design and construction as well as their current level of competence. Of the four contenders, DDP recommended that either RCA or Canadian Westinghouse were in the best position to assume responsibility for the prime contract. DDP examiners rated RCA slightly higher as they concluded that it had a stronger technical ability. They noted, however, that if the desired goal was more strongly weighted in favour of several Canadian companies gaining technical expertise, then the "Westinghouse bid should [be] selected."<sup>18</sup> Eventually RCA won the prime contract, while de Havilland was selected as the main sub-contractor for the first two satellites in the ISIS series.

However, not all DRB team members were convinced that RCA should have been selected as the prime contractor. In November 1962, DRB analyst F.W.

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<sup>16</sup> Chapman Report, pp. 40-42.

<sup>17</sup> Department of Communications, *Alouette* (Ottawa: Queen's Printer, 1970), p.17.

<sup>18</sup> NA, MG 31, J43, volume 12, file 10, "ISIS Program – IMS Policy 1963." July 11, 1963 letter from J. Johnson, for the Chief Superintendent to Mr. F.H. Turner, Chief, No. 3 Division Aerospace Electronics, Electronics Branch, Department of Defence Production, "Recommendation for Main Contractor – ISIS Program."

Simpson communicated his concerns about RCA by stating that he believed that the company would be unable to

undertake to reserve the fruits of such work for production in Canada. I believe that the Canadian company is not being allowed to advertise the telemetry transmitter they developed for S-27 [*Alouette's* pre-launch designation] in the U.S. because of company policy. [ISIS] is not going to meet its economic objective for Canada's future if there are any restrictions on selling into the U.S. or if the company will not agree to letting the Canadian subsidiary be the North American source for developments supported by Canadian Government funds."<sup>19</sup>

The perception that the RCA American parent company was reluctant to allow the Canadian subsidiary to take the lead in satellite technology for the North American market persisted for many years, especially after the controversial decision to award the first *Anik* satellite contract to Hughes Aircraft of California rather than to the RCA plant in Montreal. It is unclear why Simpson's warnings were disregarded by DRB's senior management; a search of the archival record revealed no direct reply to his memorandum. Apparently one voice of dissent was not sufficient to detract from RCA's successful track record. As well, Simpson's allegations were contradicted by the Montreal firm's continuing contribution to the U.S. space program and its later bid to become the main contractor on the *Anik* project in 1970. These business decisions belied any supposed reluctance on the part of the American parent to "allow" its subsidiary to participate in the U.S. market. Simpson's alarmist views

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<sup>19</sup> NA, MG 31, J43, volume 12, file 16, "ISIS Program -Development of Publicity 1962-1965." November 22, 1962 memorandum from F.W. Simpson to DIR, "Comments on the IMS (Ionosphere Monitor Satellite)."

may have simply reflected the early tremors of economic nationalism that would come to such prominence later in the decade.<sup>20</sup>

While Simpson's concerns about the decision to award the prime contract to RCA may have been unfounded, there was one strange omission in the ISIS program. Neither DRB officials nor any Cabinet minister insisted on university participation as one its goals. The ISIS program was an explicit industrial development program, and the DRB had a strong track record in working with university-based researchers. Therefore, the absence of academic and other research institutions from the initial plans for ISIS was an odd oversight. Had it not been corrected by the pressure exerted from the universities, there would have been fewer opportunities to train and employ Canada's science graduates.

DRTE managers soon corrected this omission, however, by inviting university-based researchers to join ISIS.<sup>21</sup> DRTE was adamant, however, that any university researchers should be included solely on merit, so as not to compromise the scientific integrity of the program.<sup>22</sup> Similar to the planned industrial program, Canadian universities would be encouraged to develop an expertise that would be of

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<sup>20</sup> Economic nationalism did not have the same prominence in 1962 as it would later in the decade. However, influential studies like the 1957 *Report of Royal Commission on Canada's Economic Prospects* (Gordon Commission) had already sounded the alarm against U.S. owned subsidiaries and American parent company interference, and might have influenced government officials like Simpson. The economic nationalist perspective and its effects on policy making is addressed in chapters three and six of this dissertation.

<sup>21</sup> NA, MG 31, J43, volume 12, file 9, "ISIS Program – IMS Planning, Pt. II, 1962-63." March 1, 1963 memorandum, re: "The Future DRB Satellite Programme."

<sup>22</sup> NA, MG 31, J 43, volume 5, file 1, "Chapman J.H. DRTE Correspondence January to June 1963." April 11, 1963 memorandum from Chapman (for the Chief

value to the joint Canada-U.S. program, and therefore secure their on-going participation. This would prove to be an ultimately successful strategy as the quality of participation, rather than the quantity of Canadian scientists, was emphasized. This commitment to research excellence ensured that there were continued NASA, U.S. armed forces, and American private sector interest in Canadian research and industrial products. The ISIS project managers placed a higher priority on proven competence and ability to contribute than nationality in order to ensure positive outcomes for the entire program.

ISIS afforded an impressive scope for researchers as so little was known about the outer regions of the Earth's atmosphere. The expanded satellite program also provided ample challenges for engineers and technicians. To save time and money and to ensure that they could place a satellite in orbit by the next phase in the sun-spot cycle, the ISIS team chose to modify one of the first *Alouette*'s back-up models rather than create an entirely new satellite. Design work on the second satellite in the series, *Alouette II*, began with a consideration of necessary modifications. Since the second *Alouette* would be placed in a higher and more elliptical orbit, its transmitter's power had to be increased, which necessitated more powerful batteries and improved solar panels that were better insulated from solar radiation. The satellite's designers also installed a magnetometer and a solar aspect sensor to provide constant information on the satellite's orientation. Satellite technology, due in large part to the billions being spent every year by the U.S. space program, was developing rapidly and DRTE

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Superintendent) to Chair of DRB, re: Participation by Universities in the Satellite Program.

staff members took advantage of the improved products available on the market. They also continued to depend on their own and Canadian industry's ability to develop innovative design solutions such as the "spin sustaining petals" that were added to the sounder antennas. Readings from *Alouette I* indicated that it stopped rotating due to the radiation effects on the twenty-five meter long antennas. The *Alouette II* team addressed this problem by affixing crisscrossed metal slats to the tips of the STEM antennas, which provided sufficient torque to sustain the satellite's spin.<sup>23</sup> These continual design improvements, a hallmark of the entire Alouette-ISIS program, also contributed to Canada's reputation for excellence in specialized space products and generated an increasing international demand for them.

*Alouette II* carried five experiments. These included improved versions of the same four that *Alouette I* carried plus a fifth, the "Langmuir probe," which was designed to measure the "experiment effect" of the long bi-pole antennas. Data provided by the first *Alouette* indicated that the antennas generated a plasma sheath around themselves and researchers wanted to ascertain whether this was contaminating the electron temperature and ion density results received from the satellite. The Langmuir probe was installed on *Alouette II* as well as on the U.S. *Explorer XXXI* satellite, which was launched into a companion orbit with the second *Alouette* in November 1965.<sup>24</sup> The American satellite suffered a battery failure about

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<sup>23</sup> NA, RG 97 volume 70, file 23. "Draft speaking notes for the address by Chapman to the XV General Assembly of URSI, Munich, September 1966 on the awarding of the first Dellinger Gold Medal to Canada for Alouette," p.5.

<sup>24</sup> NA, RG 97, volume 70, file 23. "Space Science Reviews: Topside Sounding of the Earth's Ionosphere," by J.H. Chapman and E.S. Warren, n.d., p.6. The U.S. and

six months into its operation, and by May 1966 was only able to transmit data for a few minutes per day. By contrast, *Alouette II* continued to produce several hours of data daily for a further ten years.<sup>25</sup>

In September 1963, personnel from RCA and de Havilland began working at the DRTE laboratories with the engineers and technicians who had been responsible for *Alouette I*, and who were now re-designing *Alouette II*. However, the practice of transferring DRB's in-house expertise did not always operate as smoothly or certainly as quickly as government planners originally anticipated. Indeed, tension sometimes prevailed between the private sector employees and DRTE staff. According to one report, the de Havilland engineers deployed to the Shirley's Bay laboratory dismissed the DRTE people as abstract theoreticians who did not possess the practical engineering approach on which the de Havilland group prided themselves.<sup>26</sup> DRTE Superintendent, Frank Davies, refuted this criticism from the private sector team by noting that "we are fortunate in DRTE in having the necessary balance between theory and practical experience in both electronics and mechanics."<sup>27</sup> In a 1965 memorandum to the Treasury Board, the Canadian project leader, John Chapman, noted that "the practical problems of changing from an in-house laboratory operation under which *Alouette I* was built, to an operation by industrial contract has proven to

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Canadian satellites were launched from the same rocket, which placed them into orbits that would bring them within 1600 kilometres of each other at all times.

<sup>25</sup> Canadian Museum of Science and Technology (CMST) Archives, file "Space Science – Alouette/ ISIS Review." June 23, 1966 paper prepared by John Chapman, "The Alouette-ISIS Program," p.2.

<sup>26</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS space program, pt. 3." November 4, 1964 memorandum by Frank T. Davies, "Satellite Program."

<sup>27</sup> *Ibid.*, p. 2.

be more time-consuming and therefore [more] expensive than was originally foreseen.”<sup>28</sup>

One of the difficulties that industry faced, and that was also a challenge for the government officials who were responsible for supervising the contracts with these private companies, was meeting NASA’s stringent “ZERO DEFECTS” requirements. The DDP’s time-consuming contract procedures were another cause of delay in the projects and often served as a source of aggravation for the project managers. DDP’s procurement contracts rarely suited the complexities of the experimental research and development realities of the satellite projects. As Chapman explained to the Treasury Board, private industry was contracted to provide “a specified number of precisely defined objects, at a fixed cost,” which entailed the development of detailed contracts that were often re-written to conform to the new specifications that evolved during the research and development process.<sup>29</sup> He urged Treasury Board officials to consider adopting a new contracting system that would allow a more flexible way of managing the complexities of constantly changing requirements, but that still allowed for quality control.

Certainly the frustrations experienced by the Alouette-ISIS team were far from unique. When the extensive review of government management practices, the Glassco Royal Commission, was published in 1963 it pointed to this lack of coordination between DRB, DDP and Canadian Arsenals Limited (CAL) as an

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<sup>28</sup> NA, RG 97, volume 219, file 99, “Alouette-ISIS Space Program, pt. 3.” April 1, 1965 draft report to the Treasury Board, re: ISIS Satellite Program, p. 1.

<sup>29</sup> *Ibid.*, p. 2

underlying weakness in Canada's defence industrial policy.<sup>30</sup> The Glassco Commission found that it could take up to three weeks to process contracts, even the frequently required minor changes that Chapman described to the Treasury Board.<sup>31</sup> These time delays not only resulted in cost increases, they also proved annoying to both government and private sector team members, and acted as a disincentive to industrial participation in the research and development programs.

The contracting issue was particularly germane to the ISIS program as the intensity of the research and development work increased with the inception of the third satellite in the series, *ISIS-A*. This satellite was conceived to be far more technically demanding than its two predecessors. It weighed approximately 200 kilograms more than *Alouette I* or *II* and was powered by double the number of solar cells. It also had tens of thousands of electronic components as compared with the nearly 7 000 or so that operated each of the two *Alouette* satellites.<sup>32</sup> *ISIS-A* carried twice the number of experiments as the previous two satellites: the same five as *Alouette II*, as well as five new ones that were designed to take more detailed electron temperature and density measurements of the ionized layers of the atmosphere.<sup>33</sup>

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<sup>30</sup> Canada, *Report of the Royal Commission on Government Organization, Volume 4* (Ottawa: Queen's Printer, 1963), p. 262.

<sup>31</sup> *Ibid.*, p. 263.

<sup>32</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3." January 9, 1967 memorandum from Frank T. Davies, Chief Superintendent DRTE, to the Chairman of the Defence Research Board, "Funding of the ISIS Program -Vote 715," p. 4. See as well, Louis-Martin Tard, "ISIS-A, le troisième satellite canadien quittera bientôt Montréal pour être mis en orbite," *Le Devoir*, August 2, 1968, p. 3 for details on the satellite's structure and experiments.

<sup>33</sup> NA, RG 97, volume 70, file 23. "Space Science Reviews: Topside Sounding of the Earth's Ionosphere" by J.H. Chapman and E.S. Warren, n.d., p. 7 and 13.

In addition to the main swept-frequency miniature radar set that was used in *Alouette I* and *II*, *ISIS-A* was equipped with a fixed frequency sounder and an on-board data recorder, the latter was in and of itself a major design innovation.<sup>34</sup> *ISIS-A* was developed and constructed primarily by RCA and de Havilland at RCA's plant in Montreal. However, DRTE "retain[ed] responsibility for the overall system design, command system design, and for a few sub-systems in which DRTE engineers [had] particular expertise."<sup>35</sup> By January 1964, over forty private sector employees were assigned to the DRTE laboratories to "familiarize themselves with the satellite techniques employed previously by the DRB scientists and engineers."<sup>36</sup> Not only did private sector engineers and technicians work in the DRB laboratories, one DRTE engineer spent four days a week at the RCA plant in order to provide necessary information to the prime contractor for *ISIS-A*. However, DRTE managers expressed concerns that RCA was still under-staffing the project as they "had not been able to recruit to the full strength that was estimated as being necessary to do the job."<sup>37</sup>

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<sup>34</sup> *Ibid.* The paper by Chapman and Warren noted that the *ISIS-A* swept frequency sounder operated between "0.1 to 10 MHz in 16.6 seconds, or an extended range to 20 MHz in 26.6 seconds [and that] the fixed frequency sounder [operated] at six fixed frequencies between 0.25 and 9.3030 Mhz.," p. 8. For additional technical details about the satellite's design, see CMST Archives, file "Space Science --- Alouette-ISIS--- Awards IEEE--- Engineering Canada." Remarks by C.A. Franklin, "Alouette/ISIS: How it all Began," which he delivered during the IEEE International Milestone in Engineering Ceremony, Shirley's Bay, Ottawa, May 13, 1993.

<sup>35</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3." February 24, 1967 report to the Treasury Board on the ISIS Programme, p.8.

<sup>36</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3."

January 13, 1964 Press Release by the Honourable Lucien Cardin, Associate Minister of National Defence, p. 4.

<sup>37</sup> NA, MG 31, J43, volume 12, file 18, "ISIS Program - DRTE Meeting Minutes - Notes, 1964-65." November 30, 1964 notes on ISIS Briefing by E.F. Schmidlin, Secretary of the Defence Research Board," p. 1.

Despite these concerns about the prime contractor, a memorandum written in June 1966 indicated that the DRB project team remained convinced that private industry would have made sufficient progress by 1969 to be able to develop the fourth satellite, *ISIS-B*, on a “fixed-price contract basis.” This meant that the companies involved would be able to develop the project on a competitive market rate basis, a strong indication that Canadian industry had indeed acquired “industrial competence in space technology.”<sup>38</sup> The DRB planners assumed that the fourth satellite in the series, *ISIS-B*, would “be designed, constructed and tested entirely by industry with DRTE serving as design authority only.”<sup>39</sup> *ISIS-B* was very similar to *ISIS-A*; it weighed slightly more and carried the same ten experiments that *ISIS-A* had with the addition of two more that were meant to study the “optical lines of the aurora.”<sup>40</sup> While the ISIS program appeared to be meeting its targets, it was proving more costly than originally anticipated. In 1967, the DRB requested additional funding from the Treasury Board, and there were questions as to whether the program would continue.<sup>41</sup>

Despite these pressures to justify its continued funding, the Alouette-ISIS programs were meeting their objectives and generating success. It is a tribute to the

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<sup>38</sup> CMST Archives, file “Space Science – Alouette/ ISIS Review.” June 23, 1966 paper prepared by John Chapman, “The Alouette-ISIS Program,” p. 2.

<sup>39</sup> NA, RG 97 Volume 219, file 99, “Alouette-ISIS Space Program, pt. 3.” February 24, 1967 report to the Treasury Board on the ISIS Programme, p.8.

<sup>40</sup> See Peter Calamal, *Ottawa Citizen*, April 1, 1971, p. 23 for details about *ISIS B*’s experiments.

<sup>41</sup> NA, RG 97, volume 71, file 48. October 25, 1967 report to the Treasury Board about the ISIS program. Initially Treasury Board officials refused DRTE’s request for an additional \$2.2 million for the ISIS program, but the DRB prevailed and *ISIS B* was launched in 1971.

competence of the DRTE teams that the satellite programs were so effective given the uncertain and volatile defence planning environment that prevailed in the late 1950's when these projects were conceived. A 1959 memorandum written by senior DRB officer, G.D. Watson, emphasized the confusion created by this lack of clarity. He stated that "since the national policy relating to the relationship of Canadian production to foreign production is not yet clearly established, it is difficult to establish the proportion of research effort which should be applied to these fields of activity."<sup>42</sup> For Canada, this was an especially challenging situation because of its interdependence with U.S. defence strategy, and the clear American preponderance in this arrangement. Watson also pointed to internal difficulties at the DRB and DDP, and raised particular concerns about the over-lapping mandates of these two agencies. He observed that "the development picture is more confused than any of the other phases of activity. The responsibility for planning a sensible over-all programme has never been assigned and many agencies have partial but ineffective responsibility."<sup>43</sup>

In order to better understand the framework that guided defence industrial policies in the late 1950's, we need to revisit the immediate post- World War II period. At that time, senior defence officials and politicians decided that an ambitious defence procurement policy would be an effective means of consolidating and extending industrial gains made during the war. They believed that such a strategy would foster industrial diversification, which in turn would encourage employment

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<sup>42</sup> NA, MG 31, J43, volume 3, file 23, "DRB, Senior Officers' Conference, 1959." October 26, 1959 briefing paper, "Defence Research Board: The Balance of Effort in Defence Science by G.D. Watson," p. 8.

<sup>43</sup> *Ibid.*, p.9.

and wealth. One of the best known projects to evolve from this attempt at defence autarky was the 1946 decision to construct a new, entirely “made in Canada” aircraft, or, as it was to become popularly known, the AVRO-Arrow. Historian James Eayrs observed that the government reluctantly approved plans for an interceptor jet in 1946 despite the skepticism voiced by senior military personnel like General Foulkes.<sup>44</sup> However, the Air Force prevailed with its proposal for an indigenous Canadian air fighter by arguing that supply from the U.K. and the U.S. was sometimes slow and that a jet designed specifically for Canadian conditions (a dual engine design that would require less re-fueling and that would withstand cold weather conditions) would provide the best defence preparedness.<sup>45</sup>

Canada was not alone among the non-superpowers to attempt a form of defence autarky: Britain and France, as well as officially neutral countries like Sweden, pursued similar paths. On Canada’s part, however, there were several insurmountable structural factors that would eventually thwart such plans. These impediments included a tiny domestic defence market existing within a export-oriented economy that preempted the necessary large economies of scale necessary for defence production; the fact that its potential export customers (the U.S., Britain) were pursuing their own defence equipment programs and would be unlikely to buy from another country; and geographic proximity to the United States forced certain

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<sup>44</sup> James Eayrs, *In Defence of Canada: Volume III, Peacemaking and Deterrence* (Toronto: University of Toronto Press, 1972), p. 101-105.

<sup>45</sup> *Ibid.* Eayrs observed that at the same time that A.V. Roe received the contract for the CF-105 plane, the Canadian defence department also secured a license from the North American Aviation Company in Los Angeles to produce the F-86 Sabre.

inescapable considerations onto Canada's defence planning such as the need to coordinate defence strategies and equipment. The expensive business of high-technology weapons systems and the nearly constant strategic and technological changes that they entailed would eventually prove too costly for Canada.

Yet, these limitations were not immediately apparent to planners in the early 1950's as the outbreak of the Korean War triggered a significant rearmament program. By 1951, defence spending increased to nearly \$1.2 billion dollars, or 5.5 percent of gross national product (GNP). That same year, the federal government created the Department of Defence Production under C.D. Howe to "foster a self-sustaining domestic defence industry."<sup>46</sup> By 1953 defence spending reached its peak when the government allocated \$1.9 billion, or 7.6% of the GNP to military requirements.<sup>47</sup> Despite these large investments in defence spending, by the mid-1950's it was becoming evident that Canada would not be able to pursue a "go it alone" defence industrial policy. In 1955 C.D. Howe alerted the House of Commons to the

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Eventually over 2000 of these planes were built by Canadair and were used by the RCAF and exported to nine other countries.

<sup>46</sup> For an overview of the Department of Defence Production, see Alastair D. Edgar and David G. Haglund, *The Canadian Defence Industry in the New Global Environment* (Montreal-Kingston: McGill-Queen's University Press, 1995), and Robert Van Steenburg, "An Analysis of Canadian-American Defence Economic Cooperation: The History and Current Issues," in David G. Haglund, ed., *Canada's Defence Industrial Base: The Political Economy of Preparedness and Procurement* (Kingston: R. P. Frye, 1988), p. 194.

<sup>47</sup> Denis Stairs, "The Military as an Instrument of Canadian Foreign Policy," in Hector J. Massey, ed., *The Canadian Military: A Profile* (Toronto: Copp Clark, 1972), p. 99. See as well Peter C. Newman, *True North: Not Strong and Free: Defending the Peaceable Kingdom in the Nuclear Age* (Toronto: McClelland and Stewart, 1983). He confirmed 1953 as the height of military spending in the post-WWII era when defence expenditures represented forty three percent of the entire federal budget, p. 35.

Arrow's massive budget over-runs, and the program was eventually canceled in 1959. The ensuing controversy continues to foster debates as to whether the project's end consigned Canada to the perpetual status of technological backwater.<sup>48</sup> However, the very public failure of the AVRO-Arrow also underlined the weaknesses in the government's plans, including the absence of a coherent vision and lack of coordination among the various agencies responsible for defence industrial policy.

Two important trends converged with the necessary cancellation of the AVRO-Arrow program: greater Canada-U.S. military coordination and cooperation, and a recognition (if then seldom publicly stated) that Canada could not afford weapons technology autarky and was therefore required to seek alternatives. In a brief two years, Canada consolidated this growing continentalism in military and defence industry terms through the signing of the North American Air Defence

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<sup>48</sup> The literature on the Arrow cancellation is voluminous; however, most of the monographs produced about the aircraft's demise were scantily researched and highly polemicized. See for example Palmiro Campagna, *Storms of Controversy: The Secret Avro Arrow Files Revealed* (Toronto: Stoddart, 1992); Grieg Stewart, *Shutting Down the National Dream: A.V. Roe and the Tragedy of the Avro Arrow* (Toronto: McGraw-Hill Ryerson, 1988); E.K. Shaw, *There Never Was an Arrow* (Ottawa: Steel Rail Educational Press, 1981); and Murray Peden, *Fall of an Arrow* (Toronto: Stoddart, 1978). For a more balanced study of the Arrow cancellation, see James Dow, *The Arrow* (Toronto: J. Lorimer, 1979). In his biography of Diefenbaker, political scientist Denis Smith devoted considerable attention to the Arrow controversy. See his *Rogue Tory* (Toronto: Macfarlane Walter & Ross, 1995). He concluded that the Americans exerted influence on Diefenbaker, and that the Prime Minister agonized for several months before accepting the recommendation to cancel the program. For a first person account of these events, see Diefenbaker's memoirs, *One Canada: The Years of Achievement 1957-1962* (Toronto: Macmillan, 1976), as well as those of his Finance minister, Donald Fleming, *So Very Near: The Political Memoirs of the Honourable Donald M. Fleming* (Toronto: McClelland and Stewart, 1985).

Agreement (NORAD)<sup>49</sup> in 1957, and the first Defence Production Sharing Arrangement (DPSA) in 1959. The DPSA removed procurement policy obstacles that formerly prevented Canadian firms from bidding on an equal basis with their U.S. competitors.

While not all analysts traced the signing of the DPSA directly to the Arrow decision, there is consensus regarding the DPSA's important role in conserving the Canadian defence industry.<sup>50</sup> In his 1972 analysis of the first DPSA, international affairs specialist John Kirton argued that by gaining "access for Canadian products to the lucrative U.S. market, the government was able to provide for the economic survival of the Canadian defence industry."<sup>51</sup> When the DPSA was renewed in 1963,

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<sup>49</sup> In deference to altered strategic and technological realities, in 1981 NORAD became the North American Aerospace Defence Command.

<sup>50</sup> Neither John Kirton, *The Consequences of Integration: The Case of the Defence Production Sharing Agreements* (Ottawa: School of International Affairs, Carleton University, 1972), or Alastair Edgar and David Haglund, *The Canadian Defence Industry* concluded that the DPSA resulted directly from the Arrow's cancellation. Rather, they argued, the agreements could not be viewed separately from the steadily increasing cooperative relationship that evolved between the Canadian and U.S. military establishments from the signing of the Ogdensburg Agreement in 1940, and though joint Cold War defensive efforts like the DEW, Pinetree and Mid-Canada radar fences that were erected in the 1950's. In their view, the DPSA was but one aspect in a long-established continuum of bilateral cooperation.

<sup>51</sup> Kirton, *The Consequences of Integration*, p. 6. See as well Edgar and Haglund, *The Canadian Defence Industry*, in which they concluded that despite the obvious importance of the DPSA's to Canada's defence industry, there were some negative consequences. For instance, they asserted that the Canadian defence industrial base became increasingly a sub-system/component supplier to U.S. firms and to the American Department of Defense (DoD). They also found that regardless of one's position on the effect of the DPSA on Canadian sovereignty (or whether there was any other realistic alternative), "the new relationship clearly did make the domestic industry vulnerable to shifts in the trade and economic policy climate of the United States," p. 64. Their conclusions seem especially valid when we consider that the agreements were not protected by treaty status and were vulnerable to the whims of any particular Congress or presidential administration to change the DPSA's. Such an

Canada and the United States signed a memorandum of understanding regarding research and development projects under which Canadian firms secured the right to bid on American defence research and development contracts funded solely by the American government. This opened the vast American military R&D resources to Canadian industry.

By late 1964, DRB analysts began advocating the adoption of a niche strategy through which Canadian industries and R&D capabilities would be encouraged to develop reputations for outstanding work as a means of attracting U.S. military business. This position was consistent with the policy vision in effect since 1947 that defence preparedness was an important goal that could have spin-offs in the civilian economy. What had changed, however, was that henceforth the strategy would rely on greater integration with the American defence establishment. The limits of Canada's small defence market funneled the imperial drive for economic expansion toward an integrated North American strategy.

Within this revised framework, DRTE analysts continued to promote the connections between military research and broader economic development goals. They recommended a targeted strategy of placing defence contracts with selected Canadian industries and "assisting Canadian companies to compete with U.S. companies for U.S. contracts."<sup>52</sup> However, they believed that to ensure continued

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attempt occurred in the 1970's, during the Nixon presidency, when the U.S. tried unsuccessfully to end the economic terms that favoured Canada.

<sup>52</sup> NA, MG 31, J43, volume 8, file 18, "DRTE Canadian Space Program- Proposals – Memos and Notes, 1963-64." November 5, 1964 memorandum from E.S. Warren, "Items to be Considered in Evaluating a Military Research and Development Program for DND," p.1.

access to the American market, Canadian work had to be clearly superior to anything that Americans could produce.<sup>53</sup> These defence research planners also strategized that promoting Canadian technical superiority in certain key areas would reduce the country's dependence on the American military market as the niche products would find markets in other NATO countries. The leading edge into these markets would be created and sustained by a reputation for excellence in research and development, as had been demonstrated by the Alouette-ISIS programs.

In order to secure this competitive advantage, the government offered direct industrial assistance to the private sector through programs such as the Defence Development Assistance Program (DDAP), which was created in 1959 to complement the first DPSA. Under the DDAP, the DDP bore fifty percent of the cost of R&D, while each participating company was expected to fund the remaining expenses. Defence officials soon realized, however, that the program did not address the real development needs of industry, and therefore the government created the Defence Industrial Research Program (DIR) in 1961. Administered and financed by DRB, the program focused on improving companies' ability to compete for defence contracts in the U.S. and other NATO markets "by helping the companies to maintain or increase their R&D facilities and personnel."<sup>54</sup> Under the terms of the program, proposals had to originate from the companies themselves and were assessed on "technical merit, defence interest and potential [and] the competence of the company's

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<sup>53</sup> *Ibid.*

<sup>54</sup> Andrew H. Wilson, *Science, Technology and Innovation* (Ottawa: Economic Council of Canada, 1968), p. 132.

research personnel."<sup>55</sup> By 1966, the DRB was spending \$44.7 million per year on the DIR program, and sixty percent of its total budget( \$27.4 million) was directed to electronics and physics research. In that year, there were 118 projects in progress, and an additional twenty projects had been completed or canceled since the program's inception five years earlier. Nearly all of the private sector companies who participated in the program testified that it had been of "great assistance," and that a number of participating firms produced spin-offs for the civilian market based on the DIR contracts. The *Financial Post* deemed the program a "resounding success."<sup>56</sup>

Federal officials concurred with that assessment. In late 1965, DRB's senior management concluded that both the DIR program and the Alouette- ISIS projects had "expanded and strengthened" contacts with Canadian industry.<sup>57</sup> They estimated that the two programs were responsible for over "400 professional and technical staff in industry" being involved in active programs, and that the companies' research capacities expanded as a result. A number of these firms had never conducted in-house research prior to the existence of the two government programs. Success was also indicated by the many companies involved who "reported substantially increased business that is directly attributable to the programme."<sup>58</sup> Government officials observed that as a result of these initiatives, DRB research establishments were more

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<sup>55</sup> *Ibid.*

<sup>56</sup> "How Defence Helps Research Through Assistance Programs," *Financial Post*, September 24, 1966, p. E9.

<sup>57</sup> NA, MG 31, J43, volume 3, file 25, "DRB Senior Officers Conference 1965." October 7, 1965 paper prepared by the Secretary of the Defence Research Board, "The Defence Research Board, Trends and Changes," p.4. In this discussion paper, the Secretary of the DRB also projected recent agreements signed with the U.S. Airforce would only augment the success of the program.

likely to turn to the private sector for assistance with specific projects, whereas previously they would have performed this research in their own laboratories.

The research satellite program carried an added advantage as the U.S. agreed that its whole ionospheric research program would be met through ISIS, which in turn meant that Canada would be “the only nation in the world with this capability.”<sup>59</sup> However, DRTE planners recognized that there were disadvantages to being so closely linked to NASA’s goals. For instance, this growing continentalism led to an increased dependence on the American market as was highlighted in a March 1965 DRTE memorandum, which cautioned that Canada’s space research activities functioned as a sub-set of the American program. The situation was further complicated by security concerns. As John Chapman, the ISIS project leader noted, the Canadian research and development plan for space activities was contingent on the “willingness on the part of the U.S. to disclose detailed information on its military space programs, a willingness which has been displayed in some areas of military interest, for example, communications, but not in others, for example, reconnaissance and intelligence, in which it is felt that particularly tight control must be maintained on classified information.”<sup>60</sup> Chapman also observed that Canada’s space activities, particularly their close integration with the American military programs, might directly contradict Canadian foreign policy goals, especially if military action were to be employed in space. Despite these drawbacks, there were few alternatives for

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<sup>58</sup> *Ibid.*

<sup>59</sup> NA, RG 97, volume 219, file 99, “Alouette-ISIS Space Program, pt. 3.” February 24, 1967 Report to the Treasury Board on the ISIS Programme, p.11.

<sup>60</sup> *Ibid.*, p. 7.

Canada to pursue in order to foster its space industries. DRTE analysts admitted that it would be highly improbable for Canada to undertake either military or civilian space programs anywhere near the scale of the United States'. They acknowledged that in order to grow, the Canadian space industry would be dependent in large measure on the American market.

Despite these constraints, overall the Alouette-ISIS projects reaped a number of benefits for Canadian industry. For instance, the space program that was rapidly developing in the United States offered "Canadian industry as complete an education in space technology as would be possible under any program."<sup>61</sup> Yet, DRTE managers acknowledged that these opportunities were not being fully exploited as the tight time-frames on the Alouette-ISIS projects, its small budget relative to the rest of the U.S. program, as well as Canadian industrial lags "have so far prevented more of these challenging technical tasks from being sub-contracted to Canadian industry, and the devices themselves are being procured in the USA for us by NASA."<sup>62</sup> While a definite boon to Canadian researchers and selected industries, closer integration with the United States also reaped a heightened sense of vulnerability and reinforced the perception of Canada as the "junior partner."

Hence, one of the major outcomes of this period of shifting defence priorities was a closer integration with the American defence industrial structure. Indeed, in

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<sup>61</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3." April 1, 1965 draft Report to the Treasury Board on the ISIS Satellite Program, p.1. Chapman reported that these types of equipment included "complex command systems, tape recorders for recording data over remote locations, and clocks on-board the spacecraft."

<sup>62</sup> *Ibid.*

their analysis of the Canadian industrial base, economists Lynne M. Pepall and D.M. Shapiro concluded that it would be more accurate to define Canada as being part of a North American military industrial complex. Pepall and Shapiro described the Canadian defence-industrial sector as “characterized by a number of smaller firms holding the largest contracts, with a large proportion of their production geared to an export market, primarily in telecommunications, electronics and aerospace.”<sup>63</sup>

Canada’s high-technology platform was constructed hastily and without much planning during the 1950’s, a decade in which Canada found itself at red-alert defence readiness. The shortcomings of that approach were exposed by the cancellation of the AVRO-Arrow program. Yet, amid this challenging environment some success stories did emerge, of which *Alouette* and ISIS were prime examples. These satellite programs worked precisely because they relied on careful planning, good coordination, and they were based on a central vision of, and commitment to, scientific and technical excellence.

Canadian participation in the ISIS program was predicated on two goals: to enhance scientific research capacity with the launch of four satellites and to support the development of Canadian industry in this field. While it met with qualified success -- only three of the four satellites were launched, and repeated cost over-runs and delays were experienced -- there were sufficient gains to entice the federal government to consider a more ambitious satellite program that focused on

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<sup>63</sup> Lynne M. Pepall and D.M. Shapiro, “The Military-Industrial Complex in Canada,” *Canadian Public Policy*, volume 15 no. 3 (1989), p. 277 and 268. John Treddenick calculated that eighty percent of Canadian defence exports were earmarked for the

communications applications rather than research. Before we turn to the particulars of that policy development, let us review the broader context of Canada's quest for a successful science policy to understand the pressures and motivations that confronted politicians and bureaucrats and why they opted to re-orient the satellite program from defence research to civilian telecommunications in 1968.

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United States. See his "The Economic Significance of the Canadian Industrial Base," in Haglund, *Canada's Defence Industrial Base*, p. 32.

### *Chapter Three*

#### *Misreading the Landscape: Policy Misperceptions and the Consequences of Fear*

The oft quoted adage that the 1960's were a "turbulent decade" is an apt characterization of Canadian political realities in this era. As historian Ramsay Cook reflected, the sixties were a chaotic time for Canada, marked as they were by rising Quebec nationalism. English-Canada also sought to define itself in new terms, and many chose to pursue a more distinct identity for the country by concentrating on "liberating" Canada from the "shackles" of American cultural and economic domination. Indeed, the 1960's were rife with anti-colonial movements throughout the globe. In the Western world, challenges to the prevailing order co-existed with increasingly sophisticated and ambitious state programs to enhance social welfare. In keeping with these broad trends, the federal Liberal party returned to power in 1963 intent on implementing an activist policy agenda.

Meanwhile, the Cold War continued to affect policy directions, particularly with regard to the pressure to remain ahead of the Soviets in technological terms. The 1957 *Sputnik* launch instilled fears that the United States and its allies had fallen terribly behind the U.S.S.R. Throughout the West, advisory bodies and other policy mechanisms were hastily installed to provide a greater focus on enhancing scientific knowledge. As the decade progressed, however, many in Western Europe and Canada concentrated more intently on their own internal social issues, and began to leave the Cold War increasingly to the Americans. Moreover, as the United States'

technical and economic might became more evident, science policy discussions in Europe and Canada began to focus on concerns about a technology gap with the U.S.

The fact that national and international advisory bodies such as the Organization for Economic Development and Cooperation (OECD) began to discuss “science policy” was an indication of the new intellectual consensus that science and technology were the keys to prosperity and growth. The heightened political attention to these sectors also revealed a trend toward increased reliance on the state to effect change in the economy and society.

While there were previous attempts to find better means to manage the federal government’s investments in scientific research, Canada did not implement a science policy until 1963, when the Royal Commission on Government Organization (the Glassco Commission) advocated the adoption of a systematic approach that linked scientific research to industrial growth. The Glassco Report proved to be highly influential in guiding Canada’s R&D policy. Unfortunately, its recommendations were based on a distorted picture of Canada’s technological development relative to the United States and the United Kingdom, and over-emphasized problems affecting Canadian industrial research. As we shall see in the next chapter, 1963 also marked the origins of an emerging consensus among government, industry, and university researchers about the need to increase Canadian investments in space research. While the resulting communications satellite program proved to be successful, Canada’s overall approach to science policy was marred by the misperceptions enshrined by the Glassco Commission and Liberal government, and the exaggerated concerns generated by economic nationalism.

The earliest attempt to better direct federal investments in scientific research occurred in 1949, when the government established an Advisory Panel on science issues. This internal body comprised thirteen senior public servants including the Chair of the Defence Research Board (DRB), the Deputy Minister or senior scientist from each ministry that had a research arm, a representative from the Department of Finance, and the president of the National Research Council (NRC) who chaired the Panel. This body was created to “offer advice on general policy” to the Privy Council Committee on Scientific and Industrial Research, which was formed in 1916 under the same Act that founded the NRC. The Borden government envisioned that the ten-member Cabinet Committee would review all of the government’s “scientific research efforts,” and in 1947 the Committee’s mandate was expanded so that it would consider all “new proposals of a scientific nature before final authorization by the appropriate authorities.”<sup>1</sup>

However, the Cabinet Committee met rarely (only once between 1950 and 1958), and it held no consultations with industry or the universities. As the Glassco Commission would find some fifteen years later, this supervisory role would ultimately prove to be too cumbersome, and by the early 1960’s the Committee restricted itself to the consideration of major projects or policy changes.<sup>2</sup> The NRC, which was originally conceived to perform an advisory role, did not oversee other federal government research and instead concentrated on the work of its own laboratories and support to the universities. Therefore, despite the federal

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<sup>1</sup> Canada, *Report of the Royal Commission on Government Organization, Volume 4* (Ottawa: Queen’s Printer, 1963), p. 219.

government's increased investments in science following WWII and its attempts to manage its research more effectively, there were no mechanisms to monitor programs or develop means to maximize and transfer the benefits of scientific research to industrial development. We cannot fault policy makers too harshly, however, as Canada's situation was hardly unique. Few industrialized countries, including the United States and Great Britain, implemented science policies prior to 1957.

Yet there were early calls for better coordination of federal spending on science. For instance, the Royal Commission on National Development in the Arts, Letters and Sciences (the Massey Commission) recommended in 1951 that there be a thorough examination of all such expenditures. The Massey Commission was established to review, among other things, financial support to Canadian universities, as well as Canada's scientific research capacity.<sup>3</sup> The Commissioners concluded that "Canadian scientific work has developed remarkably within the last generation," and pointed in particular to Canada's successful track record in physics and medical research. Despite these positive developments, the Commissioners expressed some reservations about Canada's ability to maintain its place internationally in terms of chemistry and mathematics, which they deemed underdeveloped. They also raised fears about the possibility of losing Canada's best and brightest through a "brain

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<sup>2</sup> *Ibid.*

<sup>3</sup> Canada, *Report of the Royal Commission on National Development in the Arts, Letters and Sciences* (Ottawa: King's Printer, 1951), p. 177. For an overview of the background to the Massey Commission, see Paul Litt, *The Muses, the Masses and the Massey Commission* (Toronto: University of Toronto Press, 1992), and David A.A. Stager, "Federal Government Grants to Canadian Universities, 1951-66," *Canadian Historical Review* vol. 54, no. 3 (1973). Stager argued that the federal government

drain” to the United States, and about relying too much on foreign expertise to train Canada’s scientists.<sup>4</sup>

To capitalize on what they characterized as Canada’s impressive gains in science, the Commissioners counseled better coordination of government’s scientific activities and a closer review of spending. They also recommended that a body be established that could be “an impartial arbiter to coordinate competing interests.”<sup>5</sup> The Commissioners also raised doubts about the capacity of the Advisory Panel on science issues to manage and promote Canada’s research efforts, and they questioned whether the Panel had sufficient authority to be effective. The Massey Commission’s review of Canada’s scientific capacity foreshadowed the policy debates of the 1960’s that advocated greater national self-sufficiency in research and development.

While the government did not adopt the Massey Commission’s recommendations for greater centralized decision making, it did continue to expand its science-related activities. By 1961, annual federal government research expenditures exceeded \$220 million, which represented a nearly “sevenfold increase over the 1945 level.”<sup>6</sup> In that year, Ottawa employed nearly 18,000 research personnel including scientists and support staff, and scientific activity spread to departments like Forestry, Fisheries, Northern Affairs and National Resources, National Health and Welfare, Transport, and Veterans Affairs.

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used the Massey Commission as a means of increasing its involvement in the financing of post-secondary education, an area of provincial jurisdiction.

<sup>4</sup> Massey Commission, pp. 180-81.

<sup>5</sup> *Ibid.*, p. 180.

<sup>6</sup> Bruce G. Doern, *Science and Politics in Canada* (Montreal-Kingston: McGill-Queen’s University Press, 1972), pp. 4-5.

These significant investments were scrutinized by the Glassco Commission, which was appointed by the Diefenbaker government in 1960 to “promote efficiency, economy and improved service” in the federal government. G.G. E. Steele, who served as President of the Treasury Board during the Commission’s tenure, recalled that the Commission had been established in part because the expanded federal public service was chafing under the Treasury Board’s central control. Steele also observed that “Parliament itself, particularly after the Conservatives came into office in 1957, was increasingly critical of the Estimates process. Members felt [...] that parliamentary control was diminishing and that the quality of internal management in the public service was not to be trusted.”<sup>7</sup>

In his extensive review of the development of science policy in the federal government in the 1960’s, political scientist Bruce Doern noted that J. Glassco and his fellow Commission members approached their review of government activities and expenditures from a private sector perspective. Doern reported that Glassco demonstrated a marked curiosity about Canada’s R&D activities, and that he “took a keener personal interest in the science sector of his report than perhaps any other single part. Indeed, Glassco drafted it.”<sup>8</sup> Dr. J. R. Weir and Dr. J. R. Whitehead were members of the Glassco Commission science policy study group, and both later joined the federal government’s Science Secretariat as senior personnel. Weir served as its second director, and Whitehead was appointed its deputy director and principal science adviser, where he became involved in the review process that led to the

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<sup>7</sup> G.G. E. Steele, “Needed - A Sense of Proportion!”: Notes on the History of Expenditure Control,” *Canadian Public Administration*, vol. 20, no. 3 (1977), p. 438.

decision to build Canada's domestic satellite telecommunications system.<sup>9</sup> Other members of the Glassco science study group included representatives from several Canadian universities, as well as leading electronics firms like Canadian Westinghouse and Ferranti-Packard Electrical Limited. The group also comprised members from the NRC and the department of Labour, which oversaw national training and labour market policy. The study group was assisted by an Advisory Committee, whose membership was drawn from industry and university researchers.<sup>10</sup>

While tasked to assess the federal government's track record in managing its science-related expenditures, the study group exceeded its mandate and provided a wider ranging critique of Canada's overall scientific research record. The Glassco study group on science issues noted that total federal government expenditures on scientific activity more than doubled between 1951 and 1959, from \$94.2 to \$195.7 million.<sup>11</sup> While they acknowledged that this was a significant achievement, the study group members were concerned, however, about the small amount of research being done in Canada's private sector relative to the United Kingdom and the United States. The Glassco Commission reported that in 1959, Canadian industry performed

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<sup>8</sup> Doern, *Science and Politics in Canada*, p.7.

<sup>9</sup> Dr. Whitehead studied physics and physical chemistry in England, and emigrated to Canada in 1951 to accept a position at McGill. He left the university four years later to become the director of research with RCA of Montreal.

<sup>10</sup> These included the Universities of British Columbia, Manitoba, Western Ontario, Toronto, McGill, and Laval. The Advisory Committee comprised representatives from Polymer, Ayerst, McKenna and Harrison Limited, the Ontario Agricultural College, Hunting Associates Limited, Canadian Pittsburg Industries Limited, and the Universities of Toronto, McMaster and Saskatchewan. Glassco Commission, p. 189.

<sup>11</sup> *Ibid.*, p. 196.

about forty percent of all scientific research, for a total value of \$97 million.<sup>12</sup> In that same year, private industry in Great Britain undertook nearly sixty percent, while in the United States' private sector generated three-quarters of all American research and development related work. In 1959, Canada spent the equivalent of 0.72 percent of its gross national product (GNP) on research and development as compared with 2.11 percent in Great Britain and 2.58 percent in the United States.

In monetary terms, Canadian industry spent less than its counterparts in the U.K. and U.S. However, Canada's total R&D output was smaller than either of these two countries. On a proportional basis, therefore, the amount invested by Canadian companies in research and development fared well in comparison with the United States and Great Britain. In 1959, Canadian industry spent about thirty-one percent of the total amount invested in research and development; the United Kingdom's private sector paid for about thirty percent of its total; and in the United States, industry expended approximately thirty-three percent of the total allocated to U.S. research and development. The Glassco study group also failed to highlight that government funded R&D in the United States and Great Britain exceeded Canada's.<sup>13</sup>

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<sup>12</sup> All figures are derived from table 2, p. 198, *Final Report of the Royal Commission on Government Organization*. In 1959, all science related expenditures (in other words everything funded and/or performed by government, private industry, and the universities) in Canada totaled \$251 million; in Great Britain £478 million; and in the U.S., \$12.43 billion. In that year, private industry in the United Kingdom performed £144 million worth of research, while their counterparts in the United States performed \$9.48 billion.

<sup>13</sup> *Ibid.* On a proportional basis, government funded R&D equaled sixty percent of the total in Canada; sixty-seven percent in Great Britain; and sixty-five percent in the United States.

There were, however, considerable differences between Canada and the other two countries in terms of the amount of research conducted in government laboratories. In Canada, these facilities performed about sixty percent of the total research effort, while in the United Kingdom they conducted about thirty-three percent and in the United States, fourteen percent. This perceived over-reliance on government-based research and the interpretation that Canada had a weak industrial R&D base would become the focus of Canada's science policy debates in the latter part of 1960's. These criticisms of Canada's research performance would also fuel economic nationalist perceptions that these "problems" were caused by American foreign ownership.

Yet, comparisons between Canada and the United States were misleading as the Americans enjoyed a significant head start in industrial research relative to both Canada and Great Britain. In the U.S., between 1900 and 1940 "nearly 350 independent laboratories were established [and] employment of scientists and engineers in independent research laboratories [reached] 3300 in 1940 and more than 5000 by 1946."<sup>14</sup> The U.S. government portion of research represented about a fifth of the total during this period. During the Second World War, the American government greatly increased its expenditures on research and development; however it delegated the actual performance of this research to non-governmental

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<sup>14</sup> David C. Mowery, and Nathan Rosenberg, *Technology and the Pursuit of Economic Growth* (Cambridge: Cambridge University Press, 1989), p. 79.

institutions.<sup>15</sup> Thus, U.S. policy during war, and in the post-1945 era, encouraged the growth of research laboratories in the private sector.<sup>16</sup>

According to Canadian economist, Andrew Wilson, the British were not as successful as the Americans in fostering industrial research and development prior to and following WWII. Even before the First World War, numerous critics voiced concerns that Great Britain lagged behind both the United States and Germany in the development of a science and technology infrastructure. As such, the British government created the Department of Scientific and Industrial Research in 1916 and began financing industrial research associations (RAs). While the RAs initially appeared to be a success, few continued beyond their original five year mandates.<sup>17</sup>

Wilson concluded that British firms never developed the same in-house capacity for

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<sup>15</sup> *Ibid.*, p. 124. Mowery and Rosenberg noted that “total federal R&D expenditures (in 1930 dollars) rose from \$83.2 million in 1940 to a peak of \$1.313.6 million in 1945.” Over the same period, the research expenditures of the Department of Defense rose from \$29.6 million to \$423.6 million (in 1930 dollars). By the mid-1980’s, over seventy-five percent of U.S. government research work was conducted in private laboratories.

<sup>16</sup> For a detailed review of the development of U.S. science policy in this era, see David M. Hart, *Forged Consensus: Science, Technology, and Economic Policy in the United States, 1921-1953* (Princeton, N.J.: Princeton University Press, 1998). The role of Vannevar Bush, President Roosevelt’s chief scientific advisor during WWII, was examined in a special issue of *Historical Studies in the Physical and Biological Sciences*, vol. 25, no. 2 (1995) with articles by Carol Gruber, “The Overhead System in Government-sponsored Academic Science: Origins and Early Development,” and by Nathan Reingold, “Choosing the Future: The U.S. Research Community, 1944-1946.” American scholarship has also focused on the significant impact of the Cold War on American scientific and technological development including Walter A. McDougall’s, *The Heavens and the Earth: A Political History of the Space Age* (New York : Basic Books, 1985), and Jessica Wang’s, *American Science in an Age of Anxiety: Scientists, Anticommunism, and the Cold War* (Chapel Hill: U. of North Carolina Pr., 1999). A recent special issue of *Diplomatic History* vol. 24, no. 1 (2000) also focused on the impact of national security concerns on U.S. investments in R&D.

research and development that their American counterparts achieved in the inter-war period. During World War II, the British government appointed a Scientific Advisory Committee to the War Cabinet, which was replaced after the war with a Defence Research Policy Committee and an Advisory Committee on Science Policy.<sup>18</sup>

World War II also had a major impact on Canada's scientific and technological base. In the post-war era, defence spending continued to exert a significant influence as it represented a third of the federal government's total budget for scientific research. Indeed, DRB's fiscal resources more than doubled during the 1950's. While the research budgets for the departments of Agriculture, Energy, Mines and Resources and the NRC also greatly expanded in this period, defence related research drew the largest science expenditures, even after the cancellation of the AVRO-Arrow program in 1959. Despite these commitments to military preparedness, the Glassco study group expressed serious concerns about the "intensity" of Canadian defence research relative to the United States and the United Kingdom, and about the proportion of the Canadian defence budget dedicated to development of scientific and technological discoveries as opposed to basic research. Canada allocated twenty percent of its total defence research budget to development activities. By comparison, the United Kingdom devoted eighty percent to applied research, and it contracted more than ninety percent of total development work to the

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<sup>17</sup> Mowery and *Technology and the Pursuit of Economic Growth*, pp. 114-115.

<sup>18</sup> Andrew H. Wilson, *Science, Technology and Innovation* (Ottawa: Economic Council of Canada, 1968), p. 54.

private sector. In contrast, Canada placed less than forty percent of this kind of activity with Canadian industry.<sup>19</sup>

The Glassco study group members believed that Canada was squandering a vital opportunity to extend its investment in defence-related research to potential spin-offs in the civilian economy. They found that overall “the impact of defence activities upon defence industries has been very much less significant in Canada than in other countries.” The Glassco commissioners concluded that this was due to a number of factors including Canadian senior military officers’ lack of faith in Canadian industry; the failure to capitalize on the “excellent work” of the DRB; excessive caution on the part of inter-Service research and development committees; and the lack of a central vision and policy making capacity. The study group concluded that this “failure to pursue promising defence developments has had serious effects for Canada in the loss of valuable exports, of facilities for advanced technologies, and --more important -- of some first-class scientists and engineers to other countries.”<sup>20</sup> However, many of the criticisms raised by the Glassco Commission were being addressed through the Defence Industrial Research Program (DIR), which was established in 1961 to channel more development work to Canadian industry.

In addition to their concerns about maximizing Canada’s potential returns from its investments in defence research, the Glassco study group also worried about the management of scientific activities in other government departments, noting that it was often a “fringe” activity that senior managers considered peripheral to their

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<sup>19</sup> Glassco Commission, p. 205.

<sup>20</sup> *Ibid.*, p. 208.

departments' mandates. The study group observed that scientific activities were often required to fit existing departmental structures, which did not necessarily provide the optimal support for research activities such as operational flexibility.

Convinced of the economic potential to be found in a systematic approach to R&D and industrial planning, the Glassco Commission recommended the creation of a "central scientific bureau" to oversee and develop a more effective science policy that would support industrial requirements. The federal government treated the Glassco Report very seriously and immediately created a Bureau of Government Organization in 1963 to "to examine the Commission's proposals."<sup>21</sup> The newly elected Liberal government quickly implemented Glassco's recommendations concerning the management of science activities by creating the Science Secretariat of the Privy Council Office in 1964, and the Science Council of Canada in 1966. The Science Secretariat functioned as an internal advisory body, whereas the Council comprised representatives from twenty-one members drawn from academia and industry. On May 27, 1966, Prime Minister Lester B. Pearson appointed Dr. O.M. Solandt, then chancellor of the University of Toronto (and former chair of the DRB) as the Science Council's first chair, and Dr. Roger Gaudry, rector of the University of Montreal, as its vice-chair. The other members were named in June 1966, and the first meeting of the council was held on July 5, 1966.<sup>22</sup>

The Pearson government's avid adoption of the Glassco Commission recommendations paralleled developments in science policy in the rest of the Western

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<sup>21</sup> J.C. Strick, "Recent Developments in Canadian Financial Administration," *Public Administration*, vol. 48 (Spring 1970), p. 69.

world. Cold War driven concerns about Soviet ascendancy focused intense attention on the issue of research and development. Indeed, the shock of *Sputnik* caused the United States to create a formal scientific advisory body in the Executive branch of the American government, and a Presidential Science Advisor and Advisory Committee were appointed in 1957. Two years later, the U.S. government created a Federal Council for Science and Technology, which comprised representatives from federal agencies dealing with science and technology, and in 1962 it created the Office of Science and Technology.<sup>23</sup> Several U.K. governments implemented similar strategies. In 1959, the Macmillan government designated a Minister of Science, which marked the inception of Britain's science policy infrastructure. During the 1962-1964 review of the British public service, the Trend Committee -- very similar in scope and mandate to Canada's Glassco Commission-- recommended the creation an Advisory Council on Science, and one on Technology. Both were established in 1964, and in October 1966, the Harold Wilson administration added a central advisory committee on science and technology to its internal management structure.<sup>24</sup>

While Western nations like the United States, Great Britain and Canada accepted the precept that science and technology were essential to continued national prosperity, there were ideological divisions as to the extent to which the state should intervene. Canadian partisan politics reflected these differing approaches as the New

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<sup>22</sup> Doern, *Science and Politics in Canada*, pp. 11-12.

<sup>23</sup> Wilson, *Science, Technology and Innovation*, p. 55. Prior to the creation of the President's Advisory Council, there was a research advisory committee situated in the Office of Defense Mobilization, which advised on the science and technology aspects of national security. Wilson noted that this committee helped to form the nucleus of the President's new Science Advisory Committee.

Democratic Party (NDP) advocated high levels of government action, the Liberals implemented a more moderate program, and the Progressive Conservatives adopted a somewhat laissez-faire perspective.

The Liberal Party was the first to adopt a science policy when it accepted the Glassco Commission recommendations in 1963. This represented a rapid evolution in Liberal policy consciousness as a mere three years earlier at their Kingston 'thinkers' conference there had been no discussion of science policy. By 1965, the Liberals made increased investments in research and technology a central plank in its election platform, a commitment that they reissued and reinforced for their 1968 campaign. In that year, their *Party Platform* declared that "innovation and research are major keys to Canada's economic growth. In this era of rapid technological change, our industrial development and evolution of our society will depend increasingly on our scientific effort. The Government has developed important programs to assist industrial research and development, but much remains to be done." Reflecting the fear that Canada lagged behind other countries, the Liberal platform also noted that "Canada spends less on research and development than many other nations, especially in the private sector. Our productivity performance needs to be strongly improved. To achieve these goals, your new Liberal Government will give vigorous support to science in both pure and applied forms as a basis of modern economic development."<sup>25</sup> Thus, the Liberal government enshrined the exaggerated

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<sup>24</sup> *Ibid.*, pp. 54-55.

<sup>25</sup> D. Own Carrigan, *Canadian Party Platforms 1867-1968* (Toronto: Copp Clark, 1968).

perception that Canada was losing the race with other Western nations, particularly with regard to the levels of private sector research.

In contrast to the Liberal Party's ready acceptance of Glassco's recommendations, the Progressive Conservative Party paid relatively little attention to science policy during its tenure in power, and continued to ignore it for the most part until the late 1960's. For instance, they paid almost no attention to science and technology at their Montmorency policy conference held in 1967. It was not until Robert Stanfield was elected leader of the party in 1968 that the Progressive Conservatives began to consider science policy as an important issue when they created an advisory group led by Dr. T.H. B. Symons, then President of Trent University.

Not surprisingly, given their more interventionist stance on most economic and social issues as well as their wide embrace of economic nationalist concerns, the New Democratic Party (NDP) advocated a number of science policy initiatives including the creation of a Ministry of Science and a substantial increase in government spending on research and development. Despite their calls for a more active state role in developing science and technology, the NDP came later to the issue than the Liberals had. The first explicit NDP statement on science policy did not occur until their 4th Federal Convention in July of 1967, when a proposal was developed by one of the Party's policy sub-committees.<sup>26</sup> The resulting document argued that a "complex industrial society such as that of Canada had been made possible only by the rapid development of scientific knowledge and technology in

recent decades. Further advances, not merely in the productions of goods and services, but in the quality of life in our society, depend on further scientific and technological advance.” The NDP went further than the Liberals by assigning a central role to science and technology in all aspects of society. By contrast, the Liberals tended to focus more on the linkages between technological progress and economic growth, and less on overall societal impact.

The NDP connected the perceived lag in Canada’s R&D capacity with the phenomenon of foreign ownership. It declared that “the most disastrous result of the foreign ownership of a large part of our industry has been its effect on scientific research in Canada. The branch plant economy which has developed has resulted in the farming out of research to the parent foreign company.” The NDP platform used the example of oil and gas ownership to illustrate its concerns. It reasoned that because Canada was one of the primary producers in this sector that it should lead the world in geological research. NDP insiders lamented that instead, “students requiring first class graduate study must go to the United States.”<sup>27</sup> Rather than questioning how Canada’s university system rated relative to the U.S., or take into account the necessary time and resources required to develop world class research institutes, the NDP chose to focus on an external explanation for any perceived weaknesses in the country’s R&D infrastructure. Although the economic nationalists might claim that they sought an autonomous path, their analyses rarely considered the particulars of

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<sup>26</sup> Doern, *Science and Politics in Canada*, p. 160.

<sup>27</sup> *Federal Program of the New Democratic Party* (New Democratic Party of Canada, 1967), pp. 31-32.

Canadian development. Their anti-colonial outlook caused them to fixate on the country's performance relative to the U.S. and British metropolises.

While the NDP was more openly critical of foreign ownership than the government, there were influential Liberal Party members who were sympathetic to these lines of reasoning. In fact, general support for Canadian economic nationalism was in full flower by the late 1960's. Canada's obsession with its neighbour to the South has been a near constant facet of its culture since the late eighteenth century -- from Loyalist antipathy to the Revolution to Macdonald's National Policy of 1878 through to Laurier's electoral defeat on the Reciprocity issue in 1911. Canadian nationalist expression focused more strongly on separation from the British Empire during the inter-war period, but following World War II there was again growing uneasiness with encroaching "continentalism." In 1900, U.S. foreign investment in Canada represented fourteen percent of the total, by 1922 it was fifty percent, and by 1939 it had reached sixty percent.<sup>28</sup> During the post-WWII period, American foreign investment in Canada increased from \$2.5 billion to approximately \$10.5 billion by 1960, when it accounted for eighty-seven percent of total foreign investment in Canada.<sup>29</sup>

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<sup>28</sup> For the 1900 figures, see John Herd Thompson and Stephen J. Randall, *Canada and the United States: Ambivalent Allies* (Athens and London: The University of Georgia Press, 1994), p. 58. For the 1922 and 1939 statistics, see J.L. Granatstein, *Yankee Go Home?: Canadians and Anti-Americanism* (Toronto: University of Toronto Press, 1996), pp. 71-72.

<sup>29</sup> Edlegard Mahant and Graeme S. Mount, *Invisible and Inaudible in Washington: American Policies Toward Canada* (Vancouver: University of British Columbia Press, 1999), p. 147

During the 1950's, the St. Laurent government encouraged American foreign investment to help fuel Canada's post-war prosperity.<sup>30</sup> However, by the late 1950's there began to be serious concern expressed about the implications of the high levels of foreign ownership and what this could mean for Canadian sovereignty. This fear of American domination was evident during the Pipeline debate of 1956, the *Report of the Royal Commission on Canada's Economic Prospects* published in January 1957, and in John Diefenbaker's electoral victory in 1958.<sup>31</sup> Walter Gordon, Chair of the Royal Commission Canada's Economic Prospects, had to wait six years before he could attempt to incorporate his nationalist ideas in government policy when he was appointed Minister of Finance after the Liberal's return to power in 1963.

Gordon, the scion of a wealthy Ontario family, began to "worry about the government's economic policies, and particularly the complacency with which Canadians were witnessing the sell-out of our resources and business enterprises to

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<sup>30</sup>For an overview of the St. Laurent government's pro-American investment policies see Robert D. Cuff and J.L. Granatstein, *American Dollars - Canadian Prosperity: Canadian-American Economic Relations, 1945-1950* (Toronto: Samuel-Stevens, 1978); Robert Bothwell and William Kilbourn, *C.D. Howe: A Biography* (Toronto: McClelland & Stewart, 1979); and Lawrence Aronsen, *American National Security and Economic Relations with Canada, 1945-1954* (Westport, Connecticut: Praeger, 1997). There have been a number of critical treatments of the St. Laurent/ Howe policy, most notably in Donald Creighton's, *The Forked Road: Canada, 1939-1957* (Toronto: McClelland and Stewart, 1976), and Melissa Clark-Jones, *A Staple State: Canadian Industrial Resources in Cold War* (Toronto: University of Toronto Press, 1987). Writing from the perspectives of the right and left of the political spectrum respectively, both Creighton and Clark-Jones received criticism for their polemical stances.

<sup>31</sup> For an overview of these events see Granatstein, *Yankee Go Home?*, and in particular chapter six, "Class Traitor, Walter Gordon and American Investment." For a Marxist interpretation of the same events, see Philip Resnick, *The Land of Cain: Class and Nationalism in English Canada 1945-1975* (Vancouver: New Star Books, 1977).

Americans and other enterprising foreigners” as early as 1945.<sup>32</sup> Despite Gordon’s gloomy outlook, however, his prescriptions concerning foreign ownership contained in the *Final Report of the Royal Commission on Canada’s Economic Prospects* were quite moderate.<sup>33</sup> He acknowledged that the Canadian economy had benefited from American investment, but he considered that it was time for Canadians to take greater control of their own economic growth. Gordon concluded that foreign-owned companies should hire more Canadians in senior positions in their firms, and he believed that Canadians should own a greater proportion of stock in these companies.

Gordon’s diagnosis of the problems facing the Canadian economy and his policy ideas regarding controls on investment were poorly received in Washington when the *Report* was made public in January 1957. According to J.L. Granatstein, the American embassy in Ottawa deemed Gordon’s proposals “discriminatory [to the US principally] and they appear unrealistic and impractical.”<sup>34</sup> There was also strong negative reaction from Bay and Wall Streets as, not surprisingly, business interests in both countries opposed any state imposed limits on their ability to invest or to make other business decisions. However, given Gordon’s close ties to the rising elite in the Liberal Party, his views would become more prominent and would find greater acceptance within a few short years, especially as the flavour of Canadian opinion regarding the U.S. began to sour.<sup>35</sup>

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<sup>32</sup> Walter Gordon, *A Political Memoir* (Toronto: McClelland & Stewart, 1977), p. 59.

<sup>33</sup> Canada, *Final Report of the Royal Commission on Canada’s Economic Prospects*, (Ottawa: Queen’s Printer, 1957), p. 393.

<sup>34</sup> *Yankee Go Home?*, p. 150.

<sup>35</sup> Gordon was credited by various Liberal insiders and biographers for the key role that he played in the re-building of the Liberal Party after its disastrous electoral

J.L. Granatstein has argued that Canadians became more critical of their southern neighbour in this period because they began to view U.S. foreign policy as reckless and selfish, and that they perceived that the American giant was too richly endowed for its (and Canada's) own good. Granatstein recalled the derisive laughter that greeted newsreel footage of American rockets self-destructing on their launch pads in the late 1950's as evidence of this negative shift in Canadian attitudes towards the United States.<sup>36</sup> This chillier climate could also be observed in Canadians' reaction to James Minifie's 1960 best-selling book, *Peacemaker or Powder Monkey*. His widely read, and condemnatory, treatment of U.S. international relations, advocated a more independent course --even neutrality-- for Canadian foreign policy.<sup>37</sup>

In 1961, Walter Gordon renewed his campaign to draw attention to what he perceived as the dangers of U.S. foreign ownership through the publication of

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defeat in 1958. Gordon was also an avid supporter of Lester Pearson, and pushed the future Prime Minister's candidacy to become the new Liberal leader after St. Laurent's retirement. In terms of memoirs, see Lester B. Pearson, *The Memoirs of the Right Honourable Lester B. Pearson, Volume 3: 1957-1968* (Toronto: University of Toronto Press, 1975); Mitchell Sharp, *Which Reminds Me ..., A Memoir* (Toronto: University of Toronto Press, 1994); and Gordon's *A Political Memoire*. For a non-first person view of Gordon's influence during the Pearson era, see John English, *The Worldly Years: The Life of Lester Pearson, 1949-1972* (Toronto: Knopf Canada, 1992), and Stephen Azzi, *Walter Gordon and the Rise of Canadian Nationalism* (Montreal-Kingston: McGill-Queen's University Press, 1999), as well as his "It Was Walter's View': Lester Pearson, the Liberal Party and Economic Nationalism," in Norman Hillmer, ed., *Pearson: The Unlikely Gladiator* (Montreal-Kingston: McGill-Queen's University Press, 1999).

<sup>36</sup> Granatstein, *Yankee Go Home?*, p. 119.

<sup>37</sup> James Minifie, *Peacemaker or Powder-Monkey: Canada's Role in a Revolutionary World* (Toronto: McClelland and Stewart, 1960). Minifie, Canadian born, Oxford educated, and an American citizen, worked as a CBC correspondent in Washington.

*Troubled Canada: The Need for New Domestic Policies*.<sup>38</sup> In that book he raised two primary concerns about American owned companies operating in Canada. The first fear was that U.S. parent companies would expect their Canadian subsidiaries to conform to American law, which would in effect restrict Canadian sovereignty. Secondly, he raised the possibility that the head offices of these American firms might decide to restrict the export levels of their Canadian branch plants if the Canadian firms posed a competitive threat to their primary U.S. interests. Gordon portrayed American foreign ownership as a ticking time bomb that would lead to Canada's loss of political independence. While Gordon attracted attention to potential weaknesses in the Canadian economy, his zealous patriotism acted to subvert Canadian development as the fears and faulty perceptions that it created maintained focus on the wrong sets of issues.

Gordon's desire to promote Canadian independence also led him to over-emphasize the American threat. After all, any measurement of U.S. foreign interests in this time period would indicate that the Americans favoured an independent, prosperous northern ally.<sup>39</sup> National security concerns and Cold War ideology

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<sup>38</sup> Walter Gordon, *Troubled Canada: The Need for New Domestic Policies* (Toronto: McClelland & Stewart, 1961).

<sup>39</sup> See for example Thompson and Randall, *Ambivalent Allies*, and Aronsen, *American National Security and Economic Relations with Canada*. These analysts pointed to the U.S.'s tendency to grant generous concessions to Canada like the 1959 Defence Production Sharing Agreement (DPSA) as evidence that the U.S. pursued foreign policy goals that supported key allies. Aronsen derived his theoretical framework from recent American foreign policy scholarship, the post-revisionist school, which posited that the choices involved in developing American economic policy during the Cold War were dictated by national security concerns. According to these findings, U.S. foreign policy nearly always served the larger strategic and political goals of containment. The reality of heightened international tensions,

impelled American governments to fortify open societies like Canada's. Unlike Latin and South America, where American diplomatic and business activities proved to be more nefarious, Canada enjoyed a stable political culture and economy that encouraged more responsible corporate citizenship. While Gordon and his fellow economic nationalists interpreted the high levels of U.S. foreign investment in Canada as a threat, others portrayed this as a positive barometer of Canadian economic health. For instance, economist Harry Johnson, one of the leading opponents of the economic nationalist position, argued that "there [was] no substantive evidence that American enterprises in Canada have acted contrary to the national interest."<sup>40</sup> Rather, he insisted, American investment had brought many benefits to Canada, and that North American economic development remained dependent on continued investment flows from the U.S. to Canada.

Despite Canadian exasperation with what they perceive as an American tendency to ignore its northern neighbour (or to assume that it is a pleasant, less well developed, not quite as successful version of itself), some American political and business interests began to pay quite serious attention to Canadian concerns about American foreign ownership in the late 1950's.<sup>41</sup> As American elite interests --

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Aronsen argued, explained why the United States concluded such favourable agreements with Canada.

<sup>40</sup> Harry G. Johnson, *The Canadian Quandary: Economic Problems and Policies* (Toronto: McGraw-Hill, 1963), p. xix. Johnson received his doctorate from Harvard, and taught in the U.K. and Canada before accepting a position at the University of Chicago in 1960.

<sup>41</sup> The *Report of the Royal Commission on Canada's Economic Prospects* and its concerns about U.S. foreign ownership prompted some Americans to take a closer look at their northern neighbor in order to better comprehend the reasons for this latent hostility. Journalist Joseph Barber wrote one such account in 1958, *Good*

academics, foreign policy experts, and business people -- heard these first stirrings of economic nationalism, they became more sensitized to Canadian fears regarding the U.S.'s dominant position in the relationship. Between 1963 and 1965, three important conferences on U.S.-Canada cooperation were held at major American universities and think tanks.<sup>42</sup> The community of interest between business people in

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*Fences Make Good Neighbors: Why the United States Provokes Canadians* (Toronto: McClelland and Stewart, 1958). Barber traveled extensively throughout Canada, and interviewed a number of influential Americans and Canadians for their views on Canada-U.S. relations. He quoted Canadian columnist, Bruce Hutchinson, who provided a deft encapsulation of Canadian resentment toward U.S. indifference when he opined that "Canada, an inch below its calm exterior, is one of the most complex, brittle, and confusing nations in the world, and for all its stolid outer look, is filled with a hot and passionate pride, is excessively sensitive and easily offended," p. 16. Nearly three decades later, Seymour Lipset observed a similar underlying tension in Canadian perceptions towards Americans. His *Continental Divide: The Values and Institutions of the United States and Canada* (New York: Routledge, 1990) provided an extensive review of the differences and similarities of Canadian and American attitudes on the economy and society, and how their respective national identities were formed. Lipset argued that the U.S. is unique among modern countries in defining its identity in ideological terms, rather than on historical continuity. He contended that "in Europe and Canada, nationality is related to community; one cannot become un-English, or un-Swedish. Being an American, however, is an ideological commitment. It is not a matter of birth. Those who reject American values are un-American," p. 19.

<sup>42</sup> These included the Johns Hopkins Seminar noted above, as well as the 25th meeting of the American Assembly held in 1964. The American Assembly is a think tank founded by President Eisenhower at Columbia University in 1950, "to illuminate issues of public policy." For details of the 1964 conference, see John Sloan Dickey, ed., *The United States and Canada* (Englewood Cliffs, N.J., Prentice-Hall, 1964). The third of these influential events was held on October 6, 1965 during a meeting of the Philadelphia Branch of the English-Speaking Union of the United States, an influential Republican group. This conference attracted eight-hundred people, including both the U.S. and Canadian Ambassadors who addressed participants. Like the earlier conferences sponsored by American Assembly and the John's Hopkins School of Advanced International studies, this gathering in Philadelphia was indicative of American elite and business interests desire for a cooperative working relationship with Canada. Indeed, the conference coincided with a Canadian trade fair designed to promote business between the two countries. See *Highlights From a*

the United States and Canada was also evident in a series of conferences sponsored by the Private Planning Associations of Canada and the U.S.<sup>43</sup> As the two economies grew more tightly entangled, American commercial elites were more strongly motivated to understand the concerns of their northern business partners and customers.

In keeping with this desire to better understand Canadian concerns, the United States Congress sent a Special Study Mission to Canada in 1958, which traveled some 7000 miles and investigated the operation of U.S. foreign owned companies in Canada. The Study Mission found that Canadians were demanding and receiving more management jobs in branch plant companies, and acquiring greater stock ownership in these subsidiaries. Dow Chemicals, for example, employed 1500 persons in Canada and had only one American-born senior manager, while at Chrysler Canada, all its chief executives were Canadians.<sup>44</sup> In a paper prepared for a Canada-US seminar sponsored by the Johns Hopkins School of Advanced International Studies in October 1963, contributor Ivan B. White concurred with the findings of the Congressional group, and reported that he had found that "most executive and professional positions in U.S. subsidiaries in Canada are filled by Canadians."<sup>45</sup>

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*Symposium on United States - Canadian Relations, October 5, 1965* (Philadelphia: Philadelphia Branch of the English-Speaking Union of the United States, 1965).

<sup>43</sup> Conference on Canadian-American Relations, *Canadian-American Planning; the Seventh Annual Conference on Canadian-American Relations, 1965* (Toronto: University of Toronto Press, 1966).

<sup>44</sup> Janet Kerr Morchain, *Sharing a Continent: An Introduction to Canadian-American Relations* (Toronto/ New York : McGraw-Hill Ryerson, 1973), p. 145.

<sup>45</sup> Livingston T. Merchant, ed., *Neighbors Taken for Granted: Canada and the United States* (New York: Published for the School of Advanced International Studies, the Johns Hopkins University, Baltimore by F. A. Praeger, 1966), p.88.

The Gordon Commission recommendations regarding U.S. foreign ownership also prompted the United States- Canada Committee, a joint body formed by the American and Canadian Planning Associations, to sponsor an extensive study of U.S. subsidiaries' business operations including human resource practices, export and import patterns, and industrial research. In 1958, John Lindeman, an international economics consultant for the U.S. government, and Donald Armstrong, Dean of the School of Commerce at McGill University, undertook an extensive survey of U.S. owned companies operating in Canada. They interviewed 150 U.S. and Canadian officials in fifty firms that they considered were representative of U.S. subsidiaries. They believed that these "interviews gave direct policy insight into the operations of over 200 U.S. controlled Canadian firms." Overall they found that "none of the six points of criticism [made by the Gordon Commission] of U.S. subsidiary operations in Canada could stand up as a generalized indictment."<sup>46</sup>

Despite the availability of this type of evidence concerning the positive effects of U.S. foreign investment in Canada, Walter Gordon persisted in his attempts to promote greater Canadian ownership of the economy. When the Liberals returned to power in 1963, Prime Minister Pearson selected Walter Gordon as his Finance Minister. Gordon used the opportunity of his first budget in June 1963 to implement his economic nationalist ideas. The budget contained a series of tax measures designed to make Canadian owned firms more attractive to domestic investors by raising the depreciation allowances for companies with a minimum of one-quarter

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<sup>46</sup> John Lindeman and Donald Armstrong, *Policies and Practices of United States Subsidiaries in Canada* (Montreal: Private Planning Association of Canada and

Canadian ownership. Gordon's budget also sought to discourage foreign ownership with a proposed thirty percent tax on foreign takeovers of Canadian firms.<sup>47</sup>

Reaction to the budget was swift and angry. Eric Kierans, then President of the Montreal Stock Exchange, led an effective protest by the Canadian business community. By early July 1963, Gordon was forced to withdraw the proposed takeover tax; however, he did remain as finance minister until 1965.<sup>48</sup> In the United States, the Kennedy administration was "furious" with the Pearson government, especially because there was no advance warning to the Americans about the budget's content.<sup>49</sup>

The dilemma represented by U.S. foreign investment, and the consequences of the increased integration of the Canadian and U.S. economies, was further revealed in July 1963 when President Kennedy announced plans for an "Interest Equalization Tax" on American indirect investments in other countries as means of repatriating American capital. As this measure could have had serious negative impact on the Canadian economy, the government sought and was granted an exemption from Washington. While this appeared to be a further setback for Gordon, it did not contradict his earlier, retracted, budget measures that were designed to reduce the amount of U.S. foreign ownership in Canada. In contrast to Kennedy's proposal,

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National Planning Association (U.S.A.), 1961), p.9 and 11.

<sup>47</sup> For an overview of these events see Granatstein and Hillmer, *For Better or Worse*, p. 221, and Mahant and Mount, *Invisible and Inaudible in Washington*, p. 148.

<sup>48</sup> Gordon resigned his cabinet position then because he believed that he should take responsibility for advising Pearson to call the general election in 1965, which resulted in another minority government. Pearson re-appointed Gordon to Cabinet in 1967, but Gordon resigned less than a year later and did not seek re-election in 1968.

<sup>49</sup> Granatstein, *Yankee Go Home?*, pp. 157-158.

which sought to restrict indirect investments, Gordon was more concerned with reducing the levels of American direct investment.

Even with this further evidence of the intricacies of the North American marketplace and Canadian reliance on American investment, the tide of economic nationalism continued to rise in Canada. Its momentum was supported by the publication of Walter Gordon's *A Choice for Canada* in 1966, in which he continued his crusade for a "more independent Canada," as well as by philosopher George Grant's *Lament for a Nation*, which argued that Diefenbaker's 1963 defeat to the Liberals marked Canada's surrender of its independence to the allure of American commercialism.<sup>50</sup>

Meanwhile, the effects of Gordon's disastrous 1963 budget and his continued pressure for a stronger economic nationalist stance caused fissures in the Liberal Party. At their October 1966 policy conference, there was debate on several resolutions made by Gordon, which the media portrayed as a split between Gordon and the new finance minister Mitchell Sharp.<sup>51</sup> Calls for reform grew more radical in the late 1960's. Cy Gonick, then editor of the leftist review, *Canadian Dimension*,

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<sup>50</sup> George Grant, *Lament for a Nation: The Defeat of Canadian Nationalism* (Toronto: McClelland and Stewart, 1965).

<sup>51</sup> Gordon continued his battle with Mitchell Sharp in his 1977 *Political Memoir*. He implied that Sharp and his supporters "scrummed" the media to ensure that it would appear that Sharp was victorious, p. 250. Sharp, on the other hand, adopted a more conciliatory tone in his 1994 memoir. While he conceded that he and Gordon held divergent views on the issue of foreign ownership, he refuted claims that his camp stage-managed the defeat of Gordon's policy resolutions. See Sharp, *Which Reminds Me*, pp. 106-109.

gave a rousing speech in March 1967 in which he called for the nationalization of American companies in Canada like Castro had done in Cuba.<sup>52</sup>

While many economist nationalists focused solely on restricting the American threat, Gordon also advocated a number of options to develop the Canadian economy, which included tax incentives to encourage Canadians to invest in their own country, and a Canada Development Corporation to support long term projects.<sup>53</sup> These proposed industrial policies attracted the support of other influential Liberal party members including Maurice Lamontagne, who chaired the Royal Commission on Bilingualism and Bi-culturalism, and Tom Kent, who was Pearson's "closest adviser on social and economic policy."<sup>54</sup> They successfully pushed for the creation of a department of Industry, which was established in 1963. Public administration specialist Richard French characterized the new department as "embodying" a nationalistic and interventionist stance that favoured state initiatives in industrial development.

The late 1960's witnessed considerable interest in science policy, as exhibited by the three-year long Senate Committee on Science and Technology, created in 1967 and chaired by Senator Lamontagne. In March 1968, the Committee commissioned the Science Council, the Medical Research Council, the Science Secretariat of the Privy Council Office, and eminent advisors like former NRC president C.J. Mackenzie to assess Canada's current scientific and technological capacity. The

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<sup>52</sup> Granatstein, *Yankee Go Home?*, p. 160.

<sup>53</sup> Walter Gordon, *A Choice for Canada: Independence or Colonial Status* (Toronto: McClelland & Stewart, 1966), p. 119.

Committee also requested that all federal departments complete a detailed questionnaire about their research activities, and conducted hearings with Canadian universities and colleges, as well as with provincial research bodies, labour and industrial associations, and private companies. The Committee met with the U.S. House Sub-committee on Science, Research and Development, which at this point was overseeing expenditures of over \$25 billion a year, "or approximately half of what is being spent in the whole world on this purpose."<sup>55</sup> The Canadian delegation also visited Harvard University, and met with research specialists in Sweden, Germany, France, Switzerland, the Netherlands, Belgium and the United Kingdom. Members heard from over 300 groups in Canada who appeared at the more than 100 public meetings organized by the Senate Committee. Bruce Doern credited the Committee with initiating the first ever national debate on science policy, as well as inspiring the establishment of the Association of the Scientific and Engineering and Technological Community of Canada (SITEC).

Echoing the recommendations of the Massey and Glassco Commissions, the 1970 *Report of the Senate Special Committee on Science Policy* focused on the role that central machinery and/or policy vision regarding science and technology could have in enhancing Canada's economic base. The Senate Committee attributed what they termed Canada's limited technological development and the "piecemeal" way in which industrial support programs had evolved to the lack of an earlier focus and

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<sup>54</sup> Richard French, *How Ottawa Spends: Planning and Industrial Policy-making 1968-1984* (Toronto: J. Lorimer & Co., 1984), p. 109.

coordination. Senate Committee members argued that as a result of this uncoordinated effort, a plethora of federal and provincial programs existed that created confusion and uncertainty for industry, hardly a suitable climate in which to develop a successful R&D base.<sup>56</sup> A 1971 report by the Science Council of Canada, *Innovation in a Cold Climate*, concurred with the Senate Committee's findings, and noted that these industrial strategies tended to "cancel each other out or are incompatible with one another."<sup>57</sup> The Council recommended greater cooperation between government and business as well as the development of a national strategy on research and development.<sup>58</sup>

However, despite its extensive review and thoughtful insights into Canadian policy efforts, the Senate Committee accepted without question the Glassco Commission perception that Canada languished relative to other countries. Canadian negativity prevailed in the face of more positive reviews, and economic nationalist prejudices contributed to vital evidence being ignored or downplayed. For instance, the 1958 Lindeman and Armstrong study provided credible evidence that "although in some industries there is no adequate basis for comparisons between Canadian and U.S. owned companies, there is little evidence that U.S. subsidiaries in Canada lag

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<sup>55</sup> Canada, Parliament, Senate Special Committee on Science Policy, *A Science Policy for Canada: Report of the Senate Special Committee on Science Policy* (Ottawa: Queen's Printer, 1970), p. 8.

<sup>56</sup> *Ibid.*, p. 109.

<sup>57</sup> Science Council of Canada, *Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing* (Ottawa: Queen's Printer, 1971), p. 38.

<sup>58</sup> *Ibid.*, pp. 38-39.

behind comparable Canadian companies in research expenditures in Canada.”<sup>59</sup> Yet fears of Canadian underdevelopment persisted. With regard to concerns about the impact of foreign ownership on Canadian R&D capacity, A.E. Safarian’s 1966 review of American owned firms operating in Canada concluded that “there is no significant difference in the extent to which [American owned firms] undertake research and development.”<sup>60</sup> Moreover, he observed that nearly all of these Canadian subsidiaries received full access to parent companies’ research facilities. This finding contradicted the economic nationalist assertion that the U.S.-based firms restricted the amount of knowledge shared with their Canadian branch plants in order to limit the risk of competition.<sup>61</sup>

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<sup>59</sup> Lindeman and Armstrong, *Policies and Practices of United States’ Subsidiaries*, p. 64.

<sup>60</sup> A.E. Safarian, *Foreign Ownership of Canadian Industry* (Toronto: McGraw-Hill, 1966), p.177.

<sup>61</sup> Safarian recorded that “fully 187 of the 215 firms which answered the question explicitly indicated that the knowledge of the parent firm was fully available to them,” *Ibid.*, p. 189. He interviewed sixty senior corporate officers in the U.S. and Canada, and based on the results of those interviews developed an in-depth questionnaire which he sent to 1500 firms in September 1960. He received 310 completed questionnaires, of which thirty were excluded because they had been mistakenly sent to Canadian owned firms. He determined that the 280 completed useable questionnaires represented nine to twelve percent of “all firms owned by non-residents in the manufacturing, mining and petroleum industries,” which accounted for approximately forty percent of total value of those sectors, p. 31. He noted that larger firms were more likely to complete and return his questionnaire, and that these responses were more likely to come from companies located in major industrial cities. He received 190 completed questionnaires from Ontario, 100 of which were located in the Toronto area, and fifty from Quebec, forty of which were located in Montreal, p. 33. Safarian found that there was also a relationship between the size of a firm and the likelihood of whether or not it would perform R&D. He noted that “there appears to be a distinct relationship between the size of the company and research and development as a percentage of sales in the sense that larger companies are more likely to do research,” p.178.

The economic nationalists also disregarded a study about Canada's R&D base prepared by the OECD. Its 1969 report concurred with the findings of earlier reviews of Canadian science policy that defence research had a significant impact on Canada, particularly the "swift expansion of military research, atomic research and space research."<sup>62</sup> In overall terms, OECD analysts believed that "the Canadian R&D effort has no organic weakness. In relative terms [especially as a percentage of GNP per capita] and as regards economic and social objectives, it is reasonably close behind the United States and roughly at the same level as other leading industrial countries." They also observed that "since the end of the First World War, Canada has undertaken to develop her scientific and technical potentialities. She has largely succeeded since the national research and development effort now bears comparison with that of most industrialized countries."<sup>63</sup>

However, these positive findings did not seem to be able to penetrate the government consciousness that was so affected by the negative outlook contained in the Glassco Report. Indeed, the OECD's summary of the issues that preoccupied Canadian science policy circles in the late 1960's reflected the degree to which Glassco's findings shaped the debate. According to the OECD experts, three major concerns dominated: 1) the low levels of research done in Canada relative to other countries, with normally only the United Kingdom and the United States used as comparison points; 2) the perceived weakness in Canada's research base was caused by "foreign influence on the Canadian economy"; and 3) that federal laboratories

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<sup>62</sup> Organization for Economic Cooperation and Development, *Reviews of National Science Policy: Canada* (Paris: OECD, 1969), p. 24.

conducted too much R&D, and private labs too little. The OECD cautioned Canadian policy makers against comparisons with the United States and Great Britain given the vast differences in their economic structures and defence industries relative to Canada.<sup>64</sup>

The OECD report also provided several explanations for the low levels of research conducted by Canadian private industry. For one, the country's economy had been dominated by primary industry, and natural resource extraction held few incentives to develop an industrial R&D base as it was not considered necessary to maintain profitability. However, the OECD report noted that the composition of the Canadian economy was changing, and that there were "fast growing industries with highly developed technology."<sup>65</sup> Their findings were corroborated by a 1968 study conducted by the Economic Council of Canada, which observed that "in the past five years, many new industrial laboratories have been opened. Several hundred companies now have their own facilities." The Economic Council attributed this growth to the "favourable business climate and changing attitudes towards R&D activities in industry" as well as the success of the "four special assistance programmes established by the federal government to encourage industrial R&D activities." The Economic Council noted that this new research was concentrated in leading sectors: electronics, aeronautics and space, as well as the chemical and

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<sup>63</sup> *Ibid.*, p. 79.

<sup>64</sup> *Ibid.*, p. 21.

<sup>65</sup> *Ibid.*, p. 223.

pharmaceutical industries.<sup>66</sup> Both the OECD and Economic Council of Canada found evidence of a growing industrial R&D base in Canada.

Given the prominence of the issue of U.S. foreign ownership, the OECD analysts paid particular attention to U.S. owned firms and their effect on Canada's R&D track record. The OECD found no indication of restrictive behaviour on the part of the U.S. parent companies with regard to research performed in their Canadian-based subsidiaries. Nor did the OECD uncover any evidence that U.S. firms kept the "R&D activity of their Canadian branches at a lower level than that in the United States."<sup>67</sup> Contrary to economic nationalist perceptions, the OECD concluded that these American owned subsidiaries were likely to be the very firms using and developing high technology, and were contributors to Canada's R&D base.<sup>68</sup>

The Canadian quest for an effective science policy stemmed from the imperial drive to expand economically. Like other Western nations, Canadian politicians and bureaucrats were convinced that robust R&D infrastructures were the keys to national prosperity. Despite earlier calls for a better management of federal investments in scientific research by the Massey Commission in 1951, the first thorough review of Canada's scientific efforts did not occur until 1963 when the Glassco Commission

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<sup>66</sup> Wilson, *Science, Technology and Innovation*, p. 45.

<sup>67</sup> OECD, *Reviews of National Science Policy: Canada*, p. 248.

<sup>68</sup> These findings were confirmed by John Vardalas in his "Moving up the Learning Curve: The Digital Electronic Revolution in Canada, 1945-70," (unpublished Ph.D. thesis, University of Ottawa, 1996). Vardalas examined the roots of the Canadian computer industry and its reliance on government funded research efforts and the activities of American and British owned subsidiaries.

issued its report. The Liberal Party, newly returned to power, quickly accepted Glassco's recommendations for a central body within government to advise on science policy and created the Science Secretariat in 1964, and the Science Council of Canada two years later.

The Glassco Report observed what it deemed to be several weaknesses in Canada's R&D base, notably the low level of research done by the private sector and the high reliance on government laboratories relative to the United States and the United Kingdom. The Glassco Commission noted that defence-related research had played a significant role in the development of Canada's science and technology infrastructure, but pointed to several organizational weaknesses that delayed industrial R&D, including senior defence official's reluctance to rely on the private sector.

Canadian science policy debates in the 1960's were preoccupied with these perceived low levels of industrial research. Economic nationalists in the Liberal and New Democratic Parties soon linked what they considered as Canadian underdevelopment to U.S. foreign ownership, and claimed that it was the reason that there was so little industrial R&D. This negative characterization of Canada's research capacity gained such wide receptivity that more positive appraisals, such as the Lindeman/Armstrong and Safarian studies as well as the OECD's 1969 review of Canada's science policy, went largely ignored. The fact that an external body like the OECD could find no evidence that U.S. owned subsidiaries in Canada deliberately retarded the growth of Canada's research and development capacity did not deter economic nationalists who continued to maintain the issue of foreign ownership on the federal policy agenda for many years.

This intense focus on the need for greater investments in Canadian science inspired a growing number of university, government, and private sector researchers to advocate increased investment in space research. At the same time, rapid developments in satellite technology spurred interest among telecommunications carriers and broadcasters about the commercial possibilities of the new technology. These combined pressures prompted the federal government to consider communications satellites as a means to further develop Canada's science and technology base. With this context in mind, we return to the chronicle of how Canada became the first country in the world to construct a domestic telecommunications satellite system.

## *Chapter Four*

### *Navigating the National Pathway: The Government Mandates Communications as Canada's Destiny*

With the creation of the Science Secretariat and the Science Council of Canada in the mid- 1960's, the Pearson administration signaled its intention to incorporate science and technology in its arsenal of economic policies. At the same time the federal government adopted this nation-building tactic, the country faced the rising challenge of Quebec nationalism. This evolving threat to unity as well as ever present concerns about American commercial and cultural domination created a sense of urgency for federal politicians and bureaucrats. Like the *coureurs des bois* who were enlisted in Canada's early "commercial empires," these policy makers imagined themselves charged with piloting the country to safety, and ultimately, they hoped, to greater prosperity.

Rapid developments in satellite technology presented a potential bonanza to those willing to exploit its applications to long-distance telecommunications. Canadian policy makers recognized the economic and cultural potential of a technology that greatly reduced the cost of transmitting sounds and images across vast expanses. They regarded communications satellites as a remedy for the country's ills, and also as the means to building a brighter future. Unlike their counterparts in the United States, the Pearson and Trudeau governments were willing to directly involve the power of the state to build such a communications satellite system. Government officials and elected representatives exhibited a policy consciousness that deliberately

linked modern communications technology with earlier nation building efforts like the construction of the railways and the creation of the public broadcasting system. These 1960's policy makers believed that communications were a "natural" expression of Canadian development, and thus, essential to its survival.

While successive U.S. governments from Eisenhower to Nixon refused to directly fund the creation of a communications satellite system, it was in fact the massive investments in research and development generated by the American and Soviet space programs that resulted in such rapid development in communications satellites between the late 1950's and the mid-1960's. While research satellites like the first *Alouette* demonstrated considerable technological sophistication, early communications satellites launched in the late 1950's were usually simple passive "beacons" that could do no more than transmit pre-recorded messages. Within a mere eight years, however, the first generation of communications satellites capable of broadcasting live television were developed.

Early experimental communications satellites included *Score*, a cone-shaped satellite launched in 1958 that "drew international attention"<sup>1</sup> when it "rebroadcast an on-board tape recording of President Eisenhower's Christmas message."<sup>2</sup> The next generation of communications satellites were an improvement on these radio beacons

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<sup>1</sup> National Archives of Canada (hereafter NA), MG 30 E181 (J. Alphonse Ouimet papers), volume 25, file "Space Communications, 1961." December 1961 report "Space Communications Position Report, With An Emphasis on International TV Transmission by way of satellite relays," by Harold Wright, Liaison Officer, p. 1. Hereafter referred to as CBC Report, "Space Communications."

<sup>2</sup> Canada Science and Technology Museum Archives (hereafter CSTM archives), file "Communications History - General." Extract from James Martin, "Communications Satellite Systems," n.d., p. x.

in that they acted as passive relay systems that reflected a signal generated from a ground station to another location. One of the earliest of these type of satellites was *Echo I*, an aluminum coated plastic balloon measuring thirty-metres in diameter, which was launched in 1960. It was the first satellite to relay a two-way telephone message.<sup>3</sup>

These early forays in communications satellite technology drew the interest of both Canada's Defence Research Board (DRB) and the Canadian Broadcasting Corporation (CBC). In a May 1961 position paper, DRB researchers concluded that satellite communications would undoubtedly become very important, but it was too early for them to predict what developments might occur, especially considering how "research in this field is very costly and demanding."<sup>4</sup> The DRB was involved in experiments using *Echo I* through the Prince Albert Radar Laboratory, a joint Canadian -American research laboratory built to track ICBMs.

In contrast to the DRB's keen interest in the new technology, a December 1961 internal report by the CBC demonstrated little enthusiasm for, and a great deal of skepticism about, the potential for communications satellites. Harold Wright, the Liaison Officer who authored the report, noted that while the *Vanguard* series and the RCA-built *Tiros I* and *II* weather satellites were functioning well, overall, he

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<sup>3</sup> For the history of the *Echo* passive relay satellite see Merton E. Davies and William R. Harris, *RAND's Role in the Evolution of Balloon and Satellite Observation Systems and Related U.S. Space Technology* (Santa Monica, Calif.: RAND, 1988), and Donald C. Elder, *Out from Behind the Eight-Ball: A History of Project Echo* (San Diego: American Astronautical Society, 1995).

<sup>4</sup> NA, MG 31, J43 (Dr. J.H. Chapman papers), volume 4, file 13, "J.H. Chapman DRTE Correspondence, January - July 1961." May 25, 1961 draft statement on DRB policy regarding communications satellites, p. 1.

concluded that “space Communication is very new, little developed and with very little experience to indicate what the problems may be.”<sup>5</sup> Nor was the CBC’s technical team very impressed with the quality of transmission. They observed that:

All this work so far, has been confined to relatively narrow-band data transmission or voice transmission and does not really indicate what may happen when attempts are made to relay broad-band television signals. Voice communications to date have not been impressive and both President Eisenhower’s message and voice communication from U.S.A.’s first astronaut, Alan Shepherd, were garbled, suffered from interference and were difficult to follow.<sup>6</sup>

In addition to the poor quality of voice transmission in these early satellites, there were a number of other technical drawbacks inherent in the passive relay systems. For instance, the ground stations used to relay transmissions required large, expensive antennas. Moreover, these balloons tended to deflate, which compromised their ability to reflect radio waves. Despite these technological limitations, however, there was soon avid interest in the commercial potential of communications satellites. In 1960, the American telephone giant, AT&T, proposed a low orbit system of multiple satellites that could be operational by 1964.<sup>7</sup> AT&T’s proposal was met with significant opposition from its commercial rivals, as well as from American public interest groups who believed that the planned satellite system was really a bid to solidify the company’s existing monopoly position. The AT&T plan was soon followed by a number of similar proposals from General Electric, Lockheed, Hughes

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<sup>5</sup> CBC Report, “Space Communications,” p. 1.

<sup>6</sup> *Ibid.*, p. 2.

<sup>7</sup> Gerald W. Brock, *The Telecommunications Industry: The Dynamics of Market Structure* (Cambridge: Harvard University Press, 1981), p. 257. Dick W. Olufs III in *The Making of Telecommunications Policy* (Boulder, Colorado: Lynne Reinner

Aerospace, and RCA. This desire to be first in line to exploit the new technology was also evident in Canada. In 1962, the Telephone Association of Canada “submitted reports to the Department of Transport expressing [its] interest in domestic satellite communications.”<sup>8</sup> It would be several years, however, before the federal government would be required to shape satellite policy for Canada.

Due to the larger magnitude of the U.S. space program and its national security implications, the attention of both the Eisenhower and Kennedy Administrations was brought to bear on the burgeoning field of communications satellite technology sooner than that of the Canadian government. Just prior to leaving office in January 1961, President Eisenhower directed NASA to invest in research and development related to communications satellites and indicated his preference that private sector laboratories perform this work.<sup>9</sup> This position *de facto* favoured AT&T as it had the commercial advantage due to its dominant position as the main provider of telephone service in the U.S. AT&T also owned the Bell research laboratories and most of the voice cable circuits that connected Europe and the United States. Its closest rivals, RCA, IT&T, and Western Union, owned cable lines to Europe, but had no real presence in American domestic telephony. GT&T, the largest independent telephone service provider in the U.S. and thus AT&T’s main

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Publishers Inc., 1999) characterized Brock’s study as “perhaps the most reliable history in the sense that he had greatest access to AT&T files,” p. 57.

<sup>8</sup> NA, RG 97 (Department of Communications), volume 310, file 5045-0, part 1. Background report prepared by the inter-departmental committee on communications, n.d., p. 28.

<sup>9</sup> Thomas P. Murphy, “Technology and Political Change: The Public Interest Impact of COMSAT,” *The Review of Politics*, vol. 33, no. 3 (1971), p. 406. For details about

competitor in that service, had no stake in overseas cable traffic and was small relative to AT&T. At this point it was believed that communications satellites would mainly threaten existing providers of overseas communications. Therefore, both AT&T and RCA had strong motivation for investing in communications satellites to ensure that they maintained a stake in a new technology that could potentially render their existing technical infrastructures obsolete.

Once Kennedy assumed power, however, Eisenhower's laissez-faire approach was superseded by a more interventionist plan. President Kennedy issued an eight point policy statement on communications satellites on July 24, 1961 that mandated the development of international communications, competition among equipment providers, and full access for all of the telecommunications carriers. The following year, the Kennedy Administration submitted the *Communications Satellite Act* to Congress, which provided for the creation of the Communications Satellite Corporation (COMSAT). The Bill proposed that the new corporation be jointly owned by the common carriers (who were limited to a fifty percent ownership of the new corporation) and the public through a common share offering. Kennedy's Bill quickly passed through the House of Representatives, but it was met by a vigorous opposition in the Senate, which delayed passage of the *Act* for over two months.

There were two main camps in the U.S. Senate who opposed the Bill, but for differing reasons. Liberal Democrats favoured more government involvement in the development of communications satellites, whereas an opposing group of Senators

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the development of the early U.S. policy on communications satellites, see pp. 407-410.

adopted the position of the common carriers that these companies should have greater control of the new technology to compensate them for the risks that they would incur by investing in research and development.<sup>10</sup> Ultimately, the original version of the Kennedy Bill prevailed, and the new corporation came into being in January 1963. American communications specialist Gerald Brock described COMSAT's commercial position as holding a monopoly on the provision of communications circuits to other carriers "who could then resell [these] services to the public."<sup>11</sup> Thus, the early U.S. policy position on communications satellites followed the well established pattern of creating a regulated monopoly as a means of balancing competing interests. Similar questions regarding ownership and control, as well as how to reconcile the interests of the carriers and the public, would pre-occupy the Canadian government when it considered establishing a domestic communications satellite system nearly five years later.

The creation of COMSAT attracted the interest of the European Conference on Satellite Communications, whose members invited the United States and Canada to discuss the basis of international cooperation in satellite communications. The U.S. made its position very clear that it was prepared to develop the new system independently as COMSAT was sufficiently well financed (the initial public offering had raised \$200 million), and that it believed that the market for transoceanic traffic was large enough to support satellite communications.<sup>12</sup> However, America's Cold

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<sup>10</sup> Neil P. Hurley, "Satellite Communications: A Case Study of Technology's Impact on Politics," *The Review of Politics*, vol. 30, no. 2 (1968), p. 173.

<sup>11</sup> Brock, *The Telecommunications Industry*, p. 257.

<sup>12</sup> Hurley, "Satellite Communications," p. 176.

War strategy mandated that it promote international cooperation and openness wherever it could. The Kennedy Administration also viewed satellite communications as a potential means for supporting education, and stimulating the economies of less developed nations. At the 1963 Rome Planning Conference of the International Conference of the International Telecommunications Union (ITU), an agreement was made to establish a new body, the International Telecommunications Satellite Consortium (INTELSAT). The new entity would be responsible for building and launching any satellites used in its system, while individual member countries would be required to provide their own earth receiving stations. Membership in INTELSAT was open to all independent countries that had membership in the ITU. Ownership of shares in the new consortium, and thus influence in the organization, was based on individual members' existing portion of global telephone traffic use. By virtue of its existing dominant position in international telephone transmission, the U.S. owned about fifty-six percent of INTELSAT's shares. In contrast, Canada had a 3.75 percent interest in the new organization. Canada and the European members of INTELSAT were concerned about America's majority ownership position, and the fact that the new consortium was managed by the wholly American owned COMSAT.

While the organizational basis of an international satellite communications system had been established, the quest for an optimal commercial system continued. Based on Eisenhower's directive to NASA to sponsor research and development relative to communications satellites, contracts were awarded to both AT&T and RCA to develop relay satellites that would involve more sophisticated circuitry than the passive reflective systems used by the *Echo* and *Tiros* balloon systems. The

AT&T built *Telstar* was launched on July 10, 1962 and was the first satellite to carry a live TV transmission because of its capacity to receive and transmit simultaneously.<sup>13</sup>

Communications specialist, Sig Mickelson, recalled that *Telstar*'s first broadcast endured for almost twenty minutes but it "then died out" as the satellite "passed out of range of the earth stations at Andover, Maine and Pleumeur Bordeaux, France."<sup>14</sup> *Telstar* was used for telephone, television, facsimile and data transmission, and was capable of producing three watts of output power. The second *Telstar* satellite was launched on May 7, 1963. RCA built a similarly designed satellite, *Relay*, that was placed into orbit on December 13, 1962. Like the *Telstars*, it operated in a "low random orbit" and employed two ground stations. *Relay I* was more powerful than *Telstar I*, however, as it generated ten watts of output power.<sup>15</sup> The *Financial Post* eagerly reported Canada's participation in the new satellite when it highlighted the wide-band radio equipment that RCA of Montreal had produced for *Relay*.<sup>16</sup> As these types of satellites remained visible to a ground station for only short periods of time, they required complex ground stations with highly reliable tracking ability. RCA projected that it would require fifty of these relay satellites to render this type of system viable for North America.

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<sup>13</sup> Martin, "Communications Satellite Systems," p. 28. For details of *Telstar*'s development, see Robert Zimmerman, "TELSTAR," *American Heritage of Invention & Technology*, vol. 16, no. 2 (2000).

<sup>14</sup> Sig Mickelson, "Communications By Satellite," *Foreign Affairs*, vol. 48, no. 1 (1969), p. 67.

<sup>15</sup> Martin, "Communications Satellite Systems," p. xi.

<sup>16</sup> "U.S. Communications Satellite to Carry Canadian Radio Relay," *Financial Post*, September 16, 1961, p. 32.

In addition to the considerable expense of building and launching these numerous satellites, another drawback to these “medium altitude active repeater” systems was the high cost of the earth stations required to operate them. Since the system depended on a seamless transition from one satellite to the next, the antennas had to be very large and accurate, which added enormously to operating costs and complexity. As early as 1940, science fiction writer Arthur C. Clarke correctly predicted that a geo-synchronous satellite would be the most efficient and reliable type of communications satellite. In this type of system, a satellite would be placed in orbit 36,800 kilometres above Earth. At that distance, it would require a full twenty-fours to complete one circuit, in effect matching the planet’s own rotational period. In its geo-synchronous orbit, the satellite would appear to remain stationery relative to the transmitting and receiving ground stations, which could then be reduced in size and complexity as they would not have to track multiple satellites. The problem was that no rocket powerful enough to place a satellite in geo-synchronous orbit had yet been developed. However, due to the “bold and ingenious belief of a group of engineers at Hughes Aircraft Company of California,” this technical breakthrough occurred on February 14, 1963, when the first geo-synchronous satellite, *Syncom*, was launched.<sup>17</sup> Hughes gained a tremendous competitive advantage in communication satellite design and construction due to these early advances. A later version of the *Syncom* transmitted television coverage of the Tokyo Olympic Games in 1964.

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<sup>17</sup> Martin, “Communications Satellite Systems,” p. 29. A second *Syncom* was launched on July 26, 1963, and the third on August 19, 1964.

The federal government acted to ensure that Canadian viewers would be able to access such images by constructing an experimental earth receiving station at Mill Village, Nova Scotia. In late November 1963, the Department of Transport signed an agreement with NASA to build the \$5 million facility, and RCA of Montreal received the contract to construct it. The station, equipped with a 25.5 metre long antenna, was designed to handle telephone, television, teletype, facsimile and data processing, and would be able to operate with either "intermediate-altitude-random-orbit satellites like *Relay* and *Telstar* or synchronous satellites like *Syncom*."<sup>18</sup> The station was completed in 1966, and was operated by the Canadian Overseas Telecommunications Corporation.

Communications satellite technology continued to advance, and by 1965 INTELSAT launched *Early Bird*, a new generation of geo-synchronous satellite that employed ground stations costing a tenth of those required for *Telstar*. As communication satellites became commercially viable, television networks in the United States expressed a renewed interest in developing their own satellite systems. The American Broadcasting Corporation (ABC) was the first to approach the U.S. Federal Commission on Communications (FCC) in September 1965, when it applied for permission to launch its own satellite. In October 1966, the Hamilton based Power Corporation submitted a proposal to create a third national television network in Canada, which would be supported by a domestic communications satellite system. Both the American and Canadian governments temporized before rendering any decisions in order to consider the many industrial development and

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<sup>18</sup> The *Financial Post*, June 6, 1964, p. 67.

telecommunication issues involved in such a request. Ultimately, the Canadian government acted first, and Canada became the first country in the world to have its own domestic satellite communications system.

An early and strong consensus formed among private sector, academic, and government representatives about the value of a communications satellite for Canada. This agreement reflected the growing interest in, and support for, science policy in Canada that we reviewed in the previous chapter. The congruence of opinion no doubt facilitated the communications satellite policy process, and was indicative of the close working relationships that existed among these groups of researchers and decision makers. Indeed, the Organization for Economic Cooperation and Development (OECD) in its 1969 *Review of Canada's science policy* deemed these tightly knit networks characteristic of Canada's research and development base.<sup>19</sup>

Beginning in 1963, a succession of briefs and reports prepared by private sector and university researchers conveyed their conviction that an enhanced space program would bring benefits to Canada in terms of economic development, and that it would help stem the flow of highly skilled personnel to the United States. America's vast investments in space research and other scientific programs, as well as its early mastery of satellite communications technology and influence in international fora such as INTELSAT, were an ever present reality for Canadian policy makers and the influential advocates in academia and business who advised them. The Canadian government's decision to establish a domestic telecommunications satellite system

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<sup>19</sup> Organization for Economic Cooperation and Development, *Reviews of National Science Policy: Canada* (Paris: OECD, 1969), p. 79.

evolved from fears concerning American technical and commercial dominance and by the impulse to expand Canada's scientific and technological base. The Canadian oscillation, generated by these defensive and expansive impulses, was in full effect.

As such, in July 1963, a self-described group of "seven scientists and engineers with some experience in the space science holding senior positions in Canadian industries, universities, and government laboratories," recommended to the president of the National Research Council (NRC) that Canada increase its annual spending on space related activities from then current levels of \$ 3-4 million a year to an ambitious \$15-50 million annually.<sup>20</sup> Most of the report's authors also served as members of the NRC's Associate Committee on Space Research that was created in 1959 with representatives from government, industry, and universities. The NRC Associate Committee structure had functioned well since the 1920's as a means of information sharing, and of providing guidance to research activities on specific topics or industries. The 1963 report by the "committee of seven" directed attention towards many of the same issues that later reviews of space activity would address, and which would lay the basis for the 1968 *White Paper on a Domestic Satellite*

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<sup>20</sup> NA, MG 31, J43, volume 9, file 9, "Space Research in Canada, 1963.", p. 1. There were three private sector representatives on the committee, two from government, and two from Canadian universities. More specifically, they included: W.M. Auld, Vice-President of Bristol Aerospace, Winnipeg; P.A. Forsyth, Professor and Head of the Physics Department of the University of Western Ontario; I.I. Glass, a Professor with U of T's Institute of Physics; W.J. Heikkila of the Rocket Section of the Defence Research Telecommunications Establishment; P.A. Lapp, Chief Engineer in the Special Products and Applied Research Division of De Havilland; D.C. Rose, Associate Director, Division of Pure Physics, NRC, who chaired the Associate Committee on Space Research; and R. Whitehead, Director of the RCA Research Laboratories in Montreal, who had served on the Glassco Commission's science study

*Communication System for Canada*, the document that ultimately guided satellite telecommunications policy.<sup>21</sup>

NRC committee members forecasted that if Canada did not invest in a space program of sufficient magnitude and prestige to interest its science graduates, these highly trained professionals would migrate to the United States. They further noted that it was usually the most “outstanding minds” that followed opportunities to the U.S., thus weakening Canadian capacity even further.<sup>22</sup> They also cautioned that Canada would lose access to rapidly developing markets in the United States and Europe if it did not commit sufficient resources to space research, or if it failed to continue to prove its superior technical competence in key products such as the STEM antennas that sold so well internationally. The report’s authors were also convinced of the spin-off potential of the space program, and noted the benefits already evident in fields like communications, meteorology and navigation.<sup>23</sup>

In September 1963, officials in DRTE reached similar conclusions about the economic benefits to be found in continued investment in space research. They assumed that the high level of space research activity generated by the American and Soviet space programs would continue for the foreseeable future, and that there would

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group and who would later hold a senior position with the government’s Science Secretariat.

<sup>21</sup> These key reports included J.H Chapman, P.A. Forsyth, P.A. Lapp, and G.N. Patterson, *Special Study No. 1 of the Science Secretariat of Canada: Upper Atmosphere and Space Programs in Canada* (Ottawa: Queen’s Printer, February 1967), the Science Council of Canada, *Report No. 1: A Space Program for Canada* (Ottawa: Queen’s Printer, July 1967), and Canada, Department of Industry, *White Paper on a Domestic Satellite Communication System for Canada* (Ottawa: Queen’s Printer, March 28, 1968).

<sup>22</sup> NA, MG 31, J43, volume 9, file “NRC Associate Committee, 1962-63.”, p. 5.

be increased demands for communications and defence applications of space research. These DRTE analysts concluded that Canada was developing a scientific and industrial expertise that was sufficiently competent to ensure the country's continued involvement in space programs. The space component market also played to the country's strengths for developing high quality niche products rather than mass production items in which Canada did not compete as well due to the lack of sufficient economies of scale in the domestic market. The space market's extreme reliability requirements also forced companies to adopt better management and manufacturing techniques, which benefited other production processes and increased firm efficiency.<sup>24</sup>

Developments in communications satellites also created potential markets for related technologies like earth-receiving stations. However, DRTE officials cautioned that Canada would have to act quickly as competition from American interests might preempt a national program for Canada. If these were not sufficient reasons to continue Canada's space research efforts, the DRTE analysts, like those who had lobbied the President of the National Research Council, were convinced that continued investment in space was also needed to staunch the loss of trained personnel to the U.S., particularly from Canadian industry, which they noted already suffered from skill shortages. On a more positive note, the DRTE officials estimated a strong ripple effect throughout the Canadian economy should satellite technology be adapted to telecommunications. They reasoned that because the sector was so central

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<sup>23</sup> *Ibid.*, p. 8.

to most business activities that any improvements in communications technology and infrastructure would translate into widespread economic gains.

In 1963, the Glassco Commission also focused its attention on government space research activities and expressed concern about what it saw as the duplication of effort by the NRC and the Defence Research Board (DRB). The Glassco Report recommended that all defence-related work be transferred from the NRC to DRB, and that the DRB's "upper atmosphere research [...] not of direct significance to defence" be transferred to the NRC.<sup>25</sup> The Treasury Board also questioned DRB's involvement in the multi-million dollar Alouette-ISIS program as it perceived that the projects were more greatly civilian than defence oriented, and expressed concerns about the program's escalating costs.<sup>26</sup>

These combined fiscal pressures, as well as the strong interest in the industrial potential of a new space program, prompted the federal government to conduct a thorough review of all of its upper atmosphere and space research activities. In May 1966, the Science Secretariat of the Privy Council Office (PCO) appointed a study group, which was chaired by Dr. John Chapman of the Defence Research Telecommunications Establishment (DRTE). The remainder of the group included Dr. P.A. Forsyth of the University of Western Ontario; Dr. P.A. Lapp of de Havilland; and Dr. G.N Patterson of the University of Toronto. All three scientists

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<sup>24</sup> NA, MG 31, J43, volume 5, file 5, September 30, 1963 memorandum, "The Economic Implications of Space Research in Canada," p. 1.

<sup>25</sup> Canada, *Report of the Royal Commission on Government Organization* (Ottawa: Queen's Printer, 1963), p. 274.

<sup>26</sup> See NA, RG 97, volume 219, file, 99 "Alouette-ISIS Space Program, pt. 3." April 1, 1965 draft report to the Treasury Board on the ISIS Satellite Program.

served on the NRC Associate Committee on Space Research, and were co-authors of the 1963 report to the NRC president that advocated greater spending on space research.

Between June 30 and October 31, 1966, the Chapman study group held hearings in Halifax, Quebec, Montreal, Ottawa, Toronto, London, Winnipeg, Saskatoon, Calgary, Edmonton, and Vancouver, and received a total of 112 briefs and other submissions. They also visited NASA headquarters in Washington to investigate the possibility of using American rockets in any future Canadian program. Reflecting on the strengths of report, Chapman observed that “to the extent that we could achieve it, [the report] is a consolidation of the views of the interested technical community,” and noted that strong agreement existed among these key policy informants.<sup>27</sup> The study group submitted their report in December 1966, and it was made public in March 1967. The Chapman Report was followed shortly by the Science Council of Canada’s *Space Program for Canada*, the recently established Council’s first advisory statement.<sup>28</sup> Council members strongly endorsed the idea of developing a communications satellite system as a means of extending Canadian scientific expertise in space research and of promoting industrial development in this sector.

By the time the Chapman study was commissioned, the federal government was spending \$17 million a year on space research. There was also impressive

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<sup>27</sup> NA, RG 97, volume 70, file 23. Presentation by J.H. Chapman to the Congress of Canadian Engineers held May 29- June 2, 1967, p 2.

<sup>28</sup> Science Council of Canada, *Report No. 1: Space Program for Canada*. (Ottawa: Queen’s Printer, 1967).

growth in the Canadian space industry, which produced \$37 million worth of business between 1961 and 1966. Additionally, there were eighteen Canadian universities involved in upper atmosphere and space research programs, which planned to double “their programs to a level of \$4 million per year by 1970.” The bulk of federal government activity took place in the DRB, which by 1965 employed 185 scientific staff in space related programs and spent \$10.3 million a year. The NRC employed sixty-two staff in space research and allocated \$4.5 million annually to this area. The NRC group provided technical expertise to the university based projects, and also participated in the Churchill rocket range experiments. Despite these significant programs, the Chapman Report noted that most senior researchers expressed concern that Canada’s space program lacked coherence, and that it exhibited “serious gaps,” which if not addressed would become “detrimental to the scientific, technological, social and economic welfare of Canada.”<sup>29</sup>

Much of the economic reasoning and analysis in the Chapman Report appeared to be substantiated by a review conducted by the Electrical and Electronics Branch of the Department of Industry (DOI) in 1966. This directorate was familiar with the electronics industry in Canada, and recommended to the Chapman study group that Canada maximize its opportunities for industrial growth through greater expenditures on space programs such as a communications satellite. DOI’s Electrical and Electronics Branch cautioned, however, that Canada should not try to absorb the cost of a whole system (i.e. not create its own launch facilities), but that the federal

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<sup>29</sup> NA, RG 97, volume 70, file 23. Presentation by J.H. Chapman to the Congress of Canadian Engineers held May 29- June 2, 1967, p 3.

government should increase its current spending in areas already generating successes or that had potential industrial benefit to Canada. Like the earlier briefs by the NRC committee and DRTE, this Department of Industry report also raised fears about producing “brains for export.” DOI analysts concluded that Canadian industry was definitely capable of undertaking an expanded space program, and that “activity to date has been limited by the availability of funds (or contracts) and absence of national direction rather than by a lack of technological capability.”<sup>30</sup> They believed that the communications sector in Canada had developed a sound research and development capacity as “communications have been a forte of the Canadian electronics industry for well over a decade, since the necessity to link widely dispersed communities economically has spurred advanced developments.”<sup>31</sup> The Department of Industry recommended that Canada enhance its commitment to space by \$500 million over the next decade.

Like the 1963 brief made to the President of the NRC, the analysis by the Department of Industry also raised the spectre of technological obsolescence should Canada fail to expand its space program. DOI analysts reasoned that since space research drove so much innovation in electronics generally (and forecasted that it would likely do so for some time considering the magnitude of the U.S. and USSR programs), should Canada not continue to invest in the space industry, the country would not only risk losing potential markets, it would also likely suffer a more

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<sup>30</sup> NA, RG 20 (Department of Industry), volume 1768, file P8001-404/42, part 3. Sept. 15, 1966 report from the Department of Industry to the Science Secretariat Study Group, re: Electronic Industry in Canada, p.7.

<sup>31</sup> *Ibid.*, p. 9.

fundamental set-back to its whole manufacturing sector. That was because electronics had become the basis of so many industries due to innovations in production like automation that relied “almost entirely on electronic methods of sensing, computation and control.”<sup>32</sup> DOI supported a new space research program as two of the government’s main projects, the *ISIS-A* satellite and the Mill Village ground station, were scheduled for completion by 1968 and no other projects were planned.

While the policy consensus concerning the desirability of constructing a domestic telecommunications satellite system grew stronger, the Chapman and Science Council reports added their recommendations to the expanding chorus clamouring for a Canadian satellite. Many believed that such a system would generate many benefits including increased service to northern Canada and more “communications trunks across the country.” The Chapman Report indicated that there was pressure to act quickly because of U.S.’s “near present monopoly on satellite technology and experience.” Chapman also recorded the growing nationalism evident in the positions of “common carriers, the broadcasting agencies and the electronics companies,” who supported the idea of a “Canadian satellite, produced and managed by Canadian companies.”<sup>33</sup>

The common carriers and the broadcasters exerted pressure for a communications satellite project in other ways. In the summer of 1966, Bell Canada applied to the Department of Transport for permission to construct an experimental

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<sup>32</sup> *Ibid.*, p. 3.

<sup>33</sup> Chapman Report, p. 4.

earth receiving station designed to transmit signals in Northern Canada. The Minister of Transportation secured approval from Cabinet in July 1966 for Bell to proceed. In October that same year, Ontario entrepreneur Kenneth Soble, who owned the Niagara Television and Power Corporation of Canada, called for the creation of a third television network to be supported by a domestic satellite system. Soble promised to extend television coverage to reach nearly all English and French-speaking Canadians; a \$5 million "revolving fund" to develop Canadian talent and movie production; and the development of UHF and VHF channels for educational purposes. Soble predicted that his idea would provide "massive stimulation of Canadian space and electronic industries" through the creation of a satellite system to be operated by the proposed Canadian Satellite Corporation (CANSAT).<sup>34</sup> Soble aggressively lobbied Cabinet ministers as well as other government and Opposition members of Parliament.<sup>35</sup>

While the matter of granting a license for a third television network was deferred to the Board of Broadcast Governors (BBG), Department of Transport officials conducted a technical appraisal of the Power Corporation submission and found that it was quite similar to "to the NBC proposal made to the FCC, for which

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<sup>34</sup> CSTM archives, file "Communications. First Canadian Satellite Proposal, 1966, Niagara TV/CNCP." July 28, 1968 submission from Niagara Power Corporation to the CTRC, p.3. Soble proposed that CANSAT be sixty percent owned by the federal government and the common carriers, while his company would hold the remaining shares.

<sup>35</sup> NA, RG 97, volume 310, file 5045-0, part 1. November 8, 1966 memorandum to Minister of Transport regarding the Niagara proposal, p.1.

RCA Astro-Electronics Division (USA) was the technical consultant.”<sup>36</sup> Given the great level of interest by the private sector in communications satellites, the Department of Transport decided that it needed better information about the demand for satellite communications. It commissioned a study by Northern Electric in partnership with Hughes Aircraft of California to assess the market for satellite communications and the possible technical models that could meet that projected demand most effectively. Pressure from Canadian businesses and the ever present possibility that American policy makers might pre-empt Canadian efforts by approving their own satellite system caused some senior Ottawa officials to question whether the government had given sufficient consideration to these trends. A November 1966 Memorandum to Cabinet stated the need for a more comprehensive government policy, particularly as “the common carrier industry in Canada is one of our major industries and it is no longer feasible to make major decisions affecting the domestic common carrier industry without a full consideration of industry interests and problems.”<sup>37</sup>

While the most senior levels of the Canadian government prepared themselves to appraise the issues at stake and develop a more comprehensive policy, the complexity of these issues, linked as they were to cultural and industrial development goals as well as questions concerning the regulation of the telecommunications and broadcasting industries, created an impasse at the Cabinet meeting held in early

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<sup>36</sup> NA, RG 97, volume 310, file 5045-0, part 1. Background report prepared by the inter-departmental committee on communications, n.d., p. 29.

<sup>37</sup> NA, RG 97, volume 310, file 5045-0, part 1. November 15, 1966 appraisal of the Niagara Proposal, p. 5.

February 1967. Since so many areas of policy making were implicated, further decision-making was delayed until the Minister of Transport, Jack Pickersgill, could meet with Prime Minister Pearson and the Secretary of State, Judy LaMarsh, who was responsible for broadcasting issues. Following an extensive discussion with the Prime Minister, the Clerk of the Privy Council, R.G. Robertson, prepared a detailed review of these inter-locking policy goals for the February 21, 1967 meeting of Cabinet. In his brief, Robertson evoked Canada's perennial sense of angst: how could a sparse population, huddled along the southern border of a continental expanse and joined by such fragile linkages, successfully encounter the commercial and technical might of its giant neighbour? Robertson believed in the efficacy of the state to meet the challenges of survival, and found in the communications satellite a panacea for Canada's problems. His convictions were shared by Pearson's Cabinet as well as other senior members of the mandarinat. It was these beliefs, concerning the threats to and the means of survival, that caused the government to mandate communications as Canada's destiny.

Robertson reminded Ministers that communications satellites were particularly important to Canada due to its vast territorial land mass, its small population, and the difficulty and cost of extending the existing microwave network into the northern regions of Canada. He also emphasized the strong economic rationale for satellite communications in that they reduced the transmission costs of telephone, telegraph, radio and television, and data. Robertson urged the Cabinet to consider the social and cultural potential of communications satellites as they "promise easy access from one part of the country to another [and] they bestow a

capacity to use radio and television for mass education and information that otherwise would be utterly impossible.”<sup>38</sup> He further implied that such telecommunications resources could serve as an alternative to the mass-consumerist popular culture broadcasts from the United States.

Robertson’s brief to the Cabinet also expressed concerns about the possibility that the new technology would grant a stronger monopoly position to Bell Canada, which already dominated Canadian telecommunications. Federal policy makers faced the enduring challenge of encouraging industrial and economic growth without favouring one company over another. Robertson’s acute attention to these issues belied the economic nationalists’ concerns that the government was ready to appease a “made in America” or “big corporate” agenda. Canada’s most senior bureaucrat also pressed Cabinet members to consider that “satellite communications are worth billions. Their implications for domestic and foreign policy exceed the imagination. With stakes so high, the government must be wary of all players.” In response to potential criticisms from those who would resist greater state intervention, Robertson indicated that even in the United States “the satellite is largely a product of government financed Research and Development,” and he observed that communications tended to be regulated monopolies, and were therefore state directed to a degree. He reminded Cabinet Ministers that “there is no free market in communications. The prices are set by government regulation and competition is

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<sup>38</sup> NA, RG 97, volume 310, file 5045-0, part 1. February 21, 1967 Memorandum to Cabinet, “Space Satellite Communications Systems for Domestic Use in Canada,” Cabinet Document No. 107/67, p. 1.

minimal, where it exists at all. Thus, how it is to be priced is the responsibility of the governmental as well as the private sector.”<sup>39</sup>

In keeping with its primarily liberal economic mindset, however, Cabinet attempted to preserve the balance between state and private interests. It viewed the challenges of preserving government-business relations while at the same time expanding the telecommunications sector in these terms: 1) to determine how to distribute the innovations garnered from government research; 2) to decide how satellite facilities should be owned and organized; and 3) to distribute the gains and losses created by the implementation of a new technology that could render certain systems obsolescent. While the American experience offered some guidance, there were many differences in the issues that faced the two countries, particularly regarding the magnitude of resources each country possessed. As Canadian policy makers sought to evade the dominant position enjoyed by American commercial broadcasters and other private sector telecommunication companies, they challenged themselves to do so without granting any undue advantage to existing powerful Canadian interests like Bell Canada.

Aside from these considerable policy challenges, there was also the urgent matter of securing a parking spot for Canadian satellites. It was understood that there were twenty-four prime locations for a geo-synchronous orbit, and while Canada could legitimately claim two or three of these, the government needed to secure them to avoid being pre-empted by other national claims. The combined pressures from the Canadian telecommunications carriers and broadcast corporations, policy

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<sup>39</sup> *Ibid.*, p. 2.

developments in the United States, as well as the need to secure an orbital parking space created a sense of urgency.

Accordingly, the Cabinet appointed a special Task Force to develop recommendations concerning a domestic communications satellite system by June 1967. When it created the Task Force, Cabinet was almost completely predisposed to the idea of developing a satellite system. Therefore the Task Force's main function was to consider and recommend technical options (the number of channels, ground stations, etc.), as well as management details such as the critical issue of how the system would be organized and who would own it. Cabinet also directed the Task Force to advise whether the United States or the European space program (ELDO) should be approached for use of its launch facilities.

The Task Force reported to a Special Committee on the Cabinet on Communications issues, which was chaired by the Industry Minister, C.M. Drury. The Task Force consisted of Dr. Chapman, R.G. Nixon from Transport, Pierre Juneau from the Board of Broadcast Governors, and H. Flynn from the Science Secretariat. They began consultations immediately with the Department of Transport, the Canadian Overseas Telecommunications Corporation, and the U.S. Federal Commission on Communications (FCC) concerning issues of regulation and ownership structures. They also met with the Board of Broadcast Governors (BBG), the Department of Transport, the CBC and the common carriers on broadcast issues, and with INTELSAT, the U.S. State Department and Office of the Executive on launch issues and other international considerations. In addition, the Task Force examined studies conducted by the Department of Industry about Canadian industrial

capacity to build the system, and the analysis prepared by Northern Electric and Hughes Aircraft about projected demand for satellite communications as well as options concerning technical specifications.

By July 1967, Chapman drafted an interim report that pinpointed the major policy questions concerning ownership issues, including the question of federal constitutional authority given that many of the common carriers were either provincially regulated or owned by provincial crown corporations. The federal government sought a structure that would grant it exclusive control of the system.<sup>40</sup> One of the strongest economic rationales for a domestic communications satellite was the high growth rate in the telecommunications market, which at that point was growing at some twenty percent per year and had an annual volume of telecommunications traffic valued at \$1 billion.<sup>41</sup> However the key to an economically viable system would be the demand from the common carriers who might not want to switch from the current technology of microwave relays and cable to a new satellite infrastructure. Task Force officials worried that if the carriers had complete ownership of the system, they might not have sufficient incentive to invest in on-going research and development. Chapman's team understood that the proposed satellite system had many policy goals, including the enhancement of the country's science and technology base.

The Task Force also expressed concerns about the commanding position of Bell Canada given its predominance as both a telecommunications carrier and

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<sup>40</sup> NA, RG 97, volume 70, file 26. July 21, 1967 draft Satellite Task Force report, p. 1

<sup>41</sup> *Ibid.*, p. 2.

equipment manufacturer. Despite any potential advantages that this might grant to Bell, the common carriers expressed a preference to own and operate the system themselves.<sup>42</sup> They justified their position on the basis of their successful track record of developing a world class communications system, and that they charged reasonable rates to the two television networks, their primary corporate customers. The carriers proffered these arguments to counter any potential criticism that a satellite system owned by them would enable these companies to extend their monopoly and potentially price gouge other users. The carriers proposed a twelve-channel system, which would cost \$42 million for the space segment, including launching the satellites, and \$38 million for the fifty-four earth stations envisioned for this system.<sup>43</sup> They insisted that it be "Canadian designed" and estimated that ninety to ninety-five percent of the system could be constructed by Canadian manufacturers, except for the satellite itself, which the carriers planned to purchase in the United States. The Task Force understood from their meeting with the common carriers that "they are prepared to accept government participation in the ownership of satellites, if necessary, and they accept the need for government regulation."<sup>44</sup>

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<sup>42</sup> NA, RG 97, volume 310, file 5045-0, part 1. Background report prepared for the interdepartmental committee on communications, n.d., p.28. See as well NA, RG 97, volume 71, file 39. August 14, 1967 submission to the Task Force by the Common Carriers, p.2; and NA, RG 97, volume 72, file 54. September 12, 1967 memo from Science Council Chair, O.M. Solandt to Whitehead of the Task Force regarding a call that he (Solandt) had received from the head of the Common Carriers Association, Krupski, p. 1.

<sup>43</sup> NA, RG 97, volume 71, file 39. August 14, 1967 submission to the Task Force by the Common Carriers, p. 4.

<sup>44</sup> NA, RG 97 volume 70, file 32. September 13, 1967 Draft Interim Task Force report, p. 6.

The CBC opposed the carriers' complete ownership of the system, and in particular wanted to be able to control ground stations for which it would be the sole user. The public broadcaster also requested that the costs of distribution be kept separate and identifiable from other charges so that it would not be unduly subsidizing the system. CTV and the independent broadcasters exhibited a mild interest in the system to the extent that it could reduce their broadcast costs. As for the aerospace and electrical industries, the Task Force reported that they "urge very strongly that the system design, development, and manufacture of satellites and earth stations be performed in Canadian industry."<sup>45</sup>

A further complication arose in the summer of 1967 when the Quebec government opened negotiations with France to participate in the Franco-German experimental satellite, *Symphonie*. The federal government viewed these talks as an incursion into its purview of international relations. However, the Quebec government maintained that it required access to French-language satellite channels and that its discussions with France enabled the province to influence future international allocations of channels and broadcast frequencies. Quebec officials intimated to the media that the province felt obligated to pursue its interests as it believed the federal government would too readily accede to whatever the United States position might be in any future INTELSAT arrangements.<sup>46</sup>

The federal Task Force on satellites sent delegations to Europe in October 1967, during which they discussed Quebec's claims that it had reached an agreement

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<sup>45</sup> *Ibid.*, p. 8.

concerning its participation in *Symphonie* with their French and German hosts. The German representative expressed doubt that any solid cooperation existed, and found Quebec's interest in the project difficult to fathom as *Symphonie* would have no commercial application, and its transmissions were intended for Francophone Africa, not North America.<sup>47</sup> At the October 9, 1967 meeting between Task Force members and the Director General of the Centre National d'Etudes Spatiales (CNES), General Aubiniere, he raised the issue of France-Quebec cooperation and told Task Force members "that he was anxious to keep us informed and to work with Ottawa in technical matters, that the discussions were so far at a very preliminary stage, and that he had no concept of what Quebec wanted and had to offer." Apparently there had been only a "brief exchange between Quebec and Paris." Aubiniere believed that the provincial government sought opportunities for Quebec technicians to train at CNES, and perhaps secure contracts for *Symphonie* components with Quebec firms.<sup>48</sup>

Given the French and German reassurances that negotiations had not progressed as far as press reports indicated, senior federal officials in the Department of Communications and the Science Secretariat of the Privy Council Office concluded that it was better for domestic and international politics that the federal government

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<sup>46</sup> Frank Howard, "More French on TV, Quebec Believed Forcing Ottawa's Hand with Satellite Deal," *Globe and Mail*, June 13, 1967, p. B16.

<sup>47</sup> NA, RG 97, volume 60, file 10, "Reports on Visits to Europe." October 6, 1967 telegram from Canadian embassy in Bonn to Ottawa, re: Satellite Development: Cooperation Between France and Quebec, p. 1.

<sup>48</sup> NA, RG 97, volume 69, file 10, "Reports on Visits to Europe." Report of the "Visits to Technical Establishments in France by Task Force on Satellites, October 9-10, 1967," p.1-2.

not be perceived as blocking the talks between France and Quebec.<sup>49</sup> The federal strategy proved effective, and by January of 1968, the Johnson government in Quebec conceded that the federal government possessed jurisdiction regarding the transmission of communications, and hence any satellite program. The Quebec government attempts to involve itself with the *Symphonie* project reflected similar impulses as those that guided the Canadian satellite program. The desire to enhance its industrial capacity indicated an expansive nationalism, while the goal of protecting French language and culture was a rear-guard, or defensive action.

Ultimately the Task Force's recommendation to Cabinet that "a Canadian domestic satellite system be established for initial service in 1971" was accepted and the government issued its *White Paper on a Domestic Satellite Communication System for Canada* on March 28, 1968.<sup>50</sup> The *White Paper* announced that a new crown corporation would be created to own and operate the system to balance interests among the common carriers and other users of the system, to promote research and development in conjunction with other government efforts to do so, and to ensure that federal control prevailed. The *White Paper* enunciated the state's power to guide and develop a society. Its architects construed communications as integral to the country's destiny and concluded that "a domestic satellite

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<sup>49</sup> See NA, RG 97, volume 72, file 5. October 11, 1967 memorandum for file by J.R. Baldwin, re: "Position of Federal Government re: Franco-Quebec Collaboration in Satellite Field;" and NA, RG 97, volume 72, file 5. October 19, 1967 memorandum from Chapman to J.R. Whitehead (Science Secretariat) re: Use of Symphonie Satellite by Quebec."

<sup>50</sup> NA, RG 97, volume 71, file 48. October 1967 draft of Task Force report, p. v.

communication system is of vital importance for the growth, prosperity and unity of Canada, and should be established as a matter of priority.”<sup>51</sup>

Given the urgent need to secure both launch facilities and claim a Canadian orbital parking spot, the *White Paper* recommended that discussions begin immediately with the U.S. for launch services. Canada needed to reach a bilateral agreement with the Americans before approaching INTELSAT and the ITU.<sup>52</sup> Consistent with Canadian foreign policy at the time, the Task Force members recommended that the option of a European launch facility be explored and that relations with the European space agencies be maintained.

Preliminary discussions with the United States for use of its launch facilities began in March 1967, and a formal meeting occurred between Task Force members and American officials in July 1967.<sup>53</sup> Generally, the Americans were open to Canada purchasing launch facilities from the U.S. on the condition that Canada continue to support INTELSAT. The U.S. State Department favoured an open system under international control to promote its larger national security goals vis-à-vis the USSR. The Americans welcomed Russian membership in INTELSAT, and sought to

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<sup>51</sup> *White Paper on a Domestic Satellite Communication System*, p.8.

<sup>52</sup> NA, RG 97, volume 72, file 5. Record of Decision from Cabinet meeting held September 13, 1968 regarding approval to proceed with negotiations with the United States government for launch facilities. On October 25, 1968, Canada and the U.S. reached an agreement in principle regarding this. See NA, RG 97, volume 311, file 5045-1. October 25, 1968 draft aide memoire, which detailed that “the representatives of the United States Government indicated that the United States would be willing to provide on a cost reimbursable basis the launching services required, using available launch vehicles, upon request made by the Canadian government within 18 months of the date required for the launching services,” p. 1.

<sup>53</sup> NA, RG 97, volume 69, file 10. Report of the July 26-27, 1967 meeting in Washington.

ensure that no competing system be created in which non-aligned nations could attempt to play the Americans and Soviets against one another. As more countries like Canada established their own satellite systems, it created pressure on the United States to relegate some of its controlling interest in INTELSAT. U.S. State Department officials signaled to the Canadian delegation that it was prepared to end its majority control of INTELSAT shares and open COMSAT to non-American participation.

Like the Canadian government, the Johnson Administration grappled with the complex policy choices posed by the possibility of creating a domestic communications satellite system. However, in the United States, the issues were further complicated by the lobbying attempts of the Ford Foundation and the Carnegie Commission to establish a public broadcasting system. When the ABC television network applied to the FCC for its own communications satellite in 1965, the American telecommunications regulator responded by establishing a public inquiry. Given the far-reaching implications of a satellite system, the FCC sought to establish whether it had the legal authority to license non-governmental satellite communications, and, if so, what the technical feasibility of such systems might be. The FCC also opened its inquiry to more general concerns under the heading of "other comments," which the Ford Foundation used to promote its ideas concerning educational television.<sup>54</sup> During the FCC's public hearings held throughout 1966 to April 1967, the Carnegie Commission proposed that a Corporation for Public

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<sup>54</sup> NA, RG 97, volume 310, file 5045-0, part 1. Background report prepared for the interdepartmental committee on communications, n.d., p. 23.

Television be created. The Carnegie plan was not contingent on the development a communications satellite system, and was therefore quickly endorsed by the U.S. government. On January 28, 1967, President Johnson sent notice to Congress of his intent to submit the *Public Television Act 1967*.

In August of that year, Johnson addressed Congress on an array of telecommunications issues, including his desire that any domestic system created should support current global communications arrangements. Despite this 1967 policy statement, there would be no resolution on the issue of a U.S. domestic communications satellite system under the Johnson Administration. In 1970, the Nixon government indicated that it favoured a free-market, not a publicly supported system. Several months after this announcement, a number of American companies like AT&T, Western Union, RCA, and Hughes, on their own or through joint ventures, applied for permission to create a domestic communications satellite system. However, no decisions were taken until 1972, when the FCC adopted a policy of open entry and satellite systems were established.

The U.S. delay represented the sharp contrast between the American and Canadian policy approaches to developing a communications satellite system. While both governments were sensitive to the political economy implications of the new technology, and the need to balance the interests of the public with that of the broadcasters and telecommunications carriers, Canadian officials were more willing to intervene in the market to ensure that Canada would benefit industrially and culturally. This generation of senior bureaucrats emulated the nationalism that inspired the creators of Canada's public broadcasting system. Graham Spry's

aphorism, the “state or the United States,” applied equally well to the policy directions chosen in 1968 as those of the 1920’s.<sup>55</sup>

The 1968 *White Paper on a Domestic Satellite Communication System for Canada* expressed the federal government’s desire to maintain the unity of the country through the extension of television and other telecommunications to French-speaking Canadians, and to the North. The Pearson/Trudeau vision of a bilingual nation would be accomplished through a technological system that “naturally” met all of Canada’s survival challenges. Satellites would triumph over geography, population, and unity crises. However, Ottawa’s vision was challenged by the Quebec government, which also sought to enlist satellite technology as a tool of nationalism. Ottawa and Quebec were driven by the same expansive desire to enhance economic opportunity and secure a means of transmitting culture, as well as by the defensive reflex to build walls around their cultural and industrial bases.

The ultimate irony of these nationalistic stances was that the success of the satellite program was contingent on integration within a North American aerospace and telecommunications market. Even though numerous internal analyses projected that, at most, sixty percent of the satellite could be designed and constructed within Canada, politicians distorted that estimate and promoted the project as “100% Made in Canada.” What price would Canada pay to ensure a “national” system? As we

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<sup>55</sup> For an overview of Graham Spry’s, and his fellow members of the Canadian Radio League’s, successful efforts to establish a public broadcasting system in Canada, see Frank W. Peers, *The Politics of Canadian Broadcasting 1920-1951* (Toronto: University of Toronto Press, 1969).

shall see, the newly appointed Minister of Communications, Eric Kierans, was forced to address that very question.

## Chapter Five

### *Confronting the Dilemma of North American Economic Interdependence*

*A hundred percent Canadian built satellite will come with a price tag; both in dollars and in the length of time it takes to build. A hundred percent foreign built satellite will come more cheaply and more quickly, but bring with it no benefits to Canadian scientists, engineers, industries.<sup>1</sup>*

The Honourable Eric Kierans,  
Federal Minister of Communications  
To the Men's Canadian Club in Edmonton  
January 1969

*How much should you pay for it [a telecommunications satellite]? We have a tariff that varies between twelve and fifteen percent. If I take Mr. Houlding's [President of RCA, Montreal] first bid at sixty-two million dollars against thirty to thirty-one million dollars, that's an extra one hundred percent [...] All I'm trying to put straight here is that waving the flag might cost you an extra one hundred percent.<sup>2</sup>*

The Honourable Eric Kierans,  
Federal Minister of Communications  
Interview on CBC-TV, "Summer Weekend"  
July 1970

The video record of the Minister's interview with "Summer Weekend" host Ralph Thomas portrayed an agitated Kierans attempting to explain why the government was favouring a bid from an American company to build Canada's first domestic telecommunications satellite rather than a proposal from the Montreal-based

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<sup>1</sup> Referred to in a *Montreal Star* article, February 9, 1972, p.6.

<sup>2</sup> National Archives of Canada (hereafter NA), Audio-Visual Collection, "Summer Weekend." ISN: 13622, Ref. no.1984-0074, V1 8403-0137.

RCA. Within the span of eighteen months the federal Minister of Communications appeared to have recanted his position completely on the desirability of a completely “100% Made in Canada” telecommunications satellite and the price premium to be paid to reach such an objective. While it may have seemed that the Minister and the federal government were reversing a long-held policy objective of promoting Canadian industrial participation in the burgeoning space field, the government’s ultimate choice of Hughes Aircraft of California to build *Anik 1*, Canada’s first telecommunications satellite, was consistent with the realities dictated by the integrated North American defence and aerospace markets. Rather than demonstrating the limits of economic independence, the Hughes decision served to underscore the complexity of Canadian-American relations and to challenge the thinking of even such staunch nationalists as Eric Kierans.

Heightened feelings of nationalism were evident during the celebration of Canada’s Centennial. A 1967 poll revealed that nearly seventy percent of Canadians believed that their government did not act sufficiently independently of the United States, and that more should be done to reverse the pattern of American foreign ownership in the country.<sup>3</sup> That same year, the Department of Trade and Commerce developed *Guidelines* regarding the levels of foreign investment in Canada. These political currents exerted pressure, and created heightened expectations, on policy makers as they implemented the policy goals contained in the 1968 *White Paper on a Domestic Satellite Communication System for Canada*.

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<sup>3</sup> J.L. Granatstein and Norman Hillmer, *For Better or For Worse: Canada and the United States to the 1990's* (Mississauga, Ont.: Copp Clark Pitman, 1991), p. 239.

The *White Paper's* publication instigated a flurry of activity. First, the Trudeau government established a new Department of Communications, which entailed a significant re-organization of government activities relating to telecommunications regulation and research. Secondly, it created Telesat Canada, a public corporation, to manage the telecommunications satellite system.<sup>4</sup> Thirdly, it chose RCA of Montreal to conduct the Project Definition Phase (PDP) of the satellite project. It was evident that only two Canadian firms possessed the requisite experience and personnel to undertake the PDP. While Northern Electric had performed extensive sub-contracting with Hughes Aircraft of California (Hughes), which held the prime contract on the *INTELSAT IV* satellite, RCA Limited of Montreal was heavily favoured to win the PDP contract in Canada. The American subsidiary worked extensively on the Alouette-ISIS programs, and demonstrated a solid track record in the export market including the construction and installation of India's INTELSAT ground station.<sup>5</sup> RCA also seemed to have greater potential for long term growth, particularly in international sales, than Northern Electric. Most significantly, the company appeared to receive backing from its American parent company. Cabinet was informed that "although RCA (Canada) is a completely owned subsidiary of RCA in the U.S.A., the Canadian company has been encouraged by the U.S. parent to sell energetically outside of Canada, including the U.S.A, and is

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<sup>4</sup> Telesat was established after long deliberations by government to create a corporate entity that would balance the interests of the public with that of two competing sets of private interests: the broadcasters and the common carriers.

<sup>5</sup> NA, RG 20 (Department of Industry) volume 1838, file IRA 9122-01, pt. 2. November 28, 1968 note to file by J.R. Mercier, "Canadian Industrial Satellite Communications Capability."

in fact the designated communications spacecraft systems facility for RCA sales in world markets.”<sup>6</sup> For all intents and purposes, the Canadian government treated RCA as domestic firm, which it supported to increase national technological competence. In May 1969, the federal government issued a contract to RCA Limited of Montreal to begin the PDP stage of the satellite. Eric Kierans and his senior officials assumed that RCA would win the prime contract to construct the satellite once the PDP was completed.<sup>7</sup>

However, there were some indications that RCA might not be up to the challenge of producing a “100% Made in Canada” satellite within the price range that the Telesat Board considered economically viable. In 1965, government officials expressed concerns over RCA’s shaky management structure. Cost increases plagued both the *ISIS-A* and *ISIS-B* satellites, and according to DRTE officials the fault lay with excessive slips in satellite component deliveries from the prime contractor, RCA. They conceded that these delays were due in part to the Vietnam war, which meant that electronic components were more difficult to procure due to increased U.S. military demand for them. Yet DRTE officials contended that the “major cause of the increase appears to be the inexperience of the prime contractor in carrying out technical projects of this complexity [...] RCA Victor is clearly at fault on both

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<sup>6</sup> NA, RG 97 (Department of Communications) volume 311, file 5045-1.

April 28, 1969 Memorandum to Cabinet, “Spacecraft Contracting Policy,” p. 2

<sup>7</sup> Kierans biographer Jamie Swift related that Allan Gotlieb, Deputy Minister of Communications at the time, recalled that “nobody dreamed that RCA wouldn’t get [the satellite] contract.” Jamie Swift, *Odd Man Out: The Life and Times of Eric Kierans* (Vancouver: Douglas and McIntyre, 1988), p. 232.

technical and management grounds.”<sup>8</sup> The company’s mixed performance record and pattern of weak management would come to plague it during the selection process for *Anik 1*, the putative “100% Made in Canada” satellite that was shortly to embroil the Cabinet in a protracted debate on autarky.

In the meantime, the government continued to be very optimistic about the satellite’s industrial potential as Cabinet was advised in the December 1967 Satellite Task Force report that fifty to sixty-five percent Canadian content could be achieved. The Task Force also projected that the price premium on a “Made in Canada” satellite would be about twelve percent. However, these perceptions began to change as of March 1970 when Telesat officials and Board members became concerned about RCA’s escalating price estimates. Telesat received two of the three PDP proposals from RCA, which indicated that the satellite would cost \$70 million.<sup>9</sup> In addition to this far higher-than-anticipated expense, concerns were raised about RCA’s judgement in securing the right type of Canadian content. For nearly a year and a half, the Aerospace, Marine and Rail branch of the Department of Industry, Trade and Commerce (ITC) expressed reservations about RCA’s plan to subcontract the satellite’s entire mechanical sub-systems to the American firm, TRW. ITC officials believed that, should the RCA procurement plan be allowed to continue, it would inhibit Canadian industry’s ability to develop competence in this integral area of

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<sup>8</sup> NA, MG 31, J43 (John H. Chapman papers), volume 5, file 7, “Chapman, J.H. DRTE Correspondence, January-March 1967.” April 1, 1967 report to the Treasury Board on the ISIS Scientific Satellite Program, p. 1.

<sup>9</sup> NA, RG 97 volume 190, file “T-9, Telesat, pt. 2.” March 23, 1970 letter from D.A. Golden (President of Telesat) to John Chapman, re: Communications Satellite Program.

satellite design.<sup>10</sup> When Telesat president, D.A. Golden, briefed senior government officials as to his company's concerns about RCA's ability to deliver, Alan Gotlieb, Deputy Minister of the Department of Communications, assured him that "the Department's position on the satellite program was consistent with that of Telesat."<sup>11</sup>

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<sup>10</sup> Senior officials in the department of Industry, Trade and Commerce (ITC) attempted for over sixteen months to have their concerns about RCA's plan to sub-contract key systems to the American TRW firm addressed, but to no avail. The lengthy measures that these officials undertook provide insight into the formal and informal power structures of the federal bureaucracy. Department of Communications officials maintained the lead on the satellite project, and they apparently did not wish to concede to criticisms that ITC raised concerning the RCA bid. See NA, RG 20, volume 79, file IRA 9122-03-1, accession # 1983/84/294, "January 30, 1969 Review of RCA Ltd. and Northern Electric Approaches to Canadian Content in Communications Satellite Proposals - Mechanical Aspects" by the Aerospace, Marine and Rail branch of ITC, p. 1. This internal assessment compared the proposals of Northern Electric, which planned to sub-contract the mechanical systems to a number of Canadian firms, with what they deemed to be RCA's more "cautious" approach of sub-contracting to the American firm TRW. ITC officials felt so strongly about this issue that they raised it through a formal exchange of letters between the Assistant Deputy Minister of Operations at ITC to his counterpart in the Department of Communications on April 16, 1969. See NA, RG 20, volume 79, , file IRA 9122-03-1, accession # 1983/84/294, April 16, 1969 letter from Robson G. Head, Assistant Deputy Minister (ADM), Operations, Department of Industry, Trade and Commerce to G. Bergeron, Assistant Deputy Minister, Department of Communications, Re: Telesat Canada. The issue had still not been addressed to the satisfaction of the Department of Industry by January 13, 1970, when an internal ITC memorandum from the Director General of the Aerospace, Marine and Rail branch to the ADM of Operations was written to register concerns about the long term implications for Canadian industry. See RG 20, volume 79, file IRA 9122.04, accession # 1983-84/294. January 13, 1970 memorandum from J.C. Rutledge, General Director of the Aerospace, Marine and Rail Branch of ITC to R.G. Head, Assistant Deputy Minister, Operations, ITC, re: "Use of Canadian Industry in Telesat and Other Domestic Satellite Programs."

<sup>11</sup> NA, RG 97 volume 218, file 97, Telesat Canada Board. Minutes of the April 14, 1970 Telesat Board Meeting. Golden held meetings with Alan Gotlieb, Deputy Minister of Communications; the Prime Minister's Principal Secretary, Marc Lalonde; the Deputy Minister of Finance, Simon S. Reisman; the Secretary of the Treasury Board, A.W. Johnson; and the Clerk of the Privy Council, R. Gordon Robertson. Despite their concerns over cost estimates, Golden observed that "the three primary objectives of the undertaking – extended French language broadcasting,

At the same time that Telesat realized that RCA costs would be considerably higher, the publicly owned corporation received advanced word that Hughes would be submitting an unsolicited bid at a substantially lower price. Dr. J.H. Chapman, newly appointed to the post of Assistant Deputy Minister, Research, at the Department of Communications, and one of Telesat's interim Board of Directors, as well as Dr. H. Von Baeyer of Telesat, spoke with Hughes representatives at a meeting of the American Institute of Aeronautics and Astronautics held April 6-8, 1970 in Los Angeles. The Hughes' officials told Chapman and Von Baeyer that they would be making a firm proposal of \$23 million (U.S.). Telesat president D.A. Golden characterized the Hughes bid as a double-edged sword. On the one hand it would restore the economic viability of the Canadian satellite system; on the other, it would limit Canadian participation in new technological development, which had been the major impetus for the program. Golden brought the impending Hughes bid to the attention of Eric Kierans, the man ultimately responsible for the satellite program. The Telesat president met on April 10, 1970 with Kierans, his Deputy Minister, Allan Gotlieb, Dr. Chapman, Gilles Bergeron (also an Assistant Deputy Minister with the Department of Communications), and Richard Gwyn, the Minister's Executive Assistant. Kierans indicated his willingness to entertain the Hughes proposal and agreed that "a very serious examination would have to be made of it."<sup>12</sup>

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improved northern communications and significant participation in new developments in space technology – remained unchanged [and for that reason] the government would most likely wish to continue with the program.", p. 2.

<sup>12</sup> *Ibid.*, p. 3.

The American aerospace giant submitted its plan for a twelve-channel satellite to Telesat on April 17, 1970. While it contained no specific Canadian content, Hughes officials indicated a willingness to increase Canadian participation because this was a stated goal of the program.<sup>13</sup> Paul Visher, Space System Division Associate Manager at Hughes, demonstrated a highly detailed knowledge of Canadian industrial competency in this sector and provided ideas as to which Canadian firms might receive sub-contracts. Visher suggested that Canadian companies could gain a long-term advantage in working with Hughes and questioned whether there would be sufficient demand to support a total satellite industrial base in both Canada and the U.S. since, in his view, the demand for satellites would be relatively low.<sup>14</sup>

Ultimately RCA did not win the prime contract because the Hughes bid was both technically superior and much less expensive. RCA's own spotty track record in managing the *ISIS A* and *B* contracts undermined its position as well. While Canadian firms were well placed to compete internationally in areas where they had developed competence, they could not match the competitive advantage enjoyed by the American aerospace giants, which had full access to the mammoth U.S. defence and space programs.

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<sup>13</sup> NA, RG 97 volume 218, file, "Telesat Canada Executive Committee." April 17, 1970 letter from Hughes Aircraft of California to D.A. Golden, Telesat President, Hughes' letter indicated that "we are aware of the stated desire for Canadian Industry participation in the first domestic communications satellite program. Although, not a part of this offer, we are prepared to modify this offer by subsequent amendment to permit Canadian Industry participation. Upon your selection of desired Canadian subcontractors for this purpose, we will be pleased to enter into negotiations with them for specific portions of this program," p. 2.

<sup>14</sup> NA, RG 97 volume 218, file, "Telesat Canada Executive Committee." April 21- 22, 1970 minutes of the Telesat/Hughes Meeting, p.1-2.

While the political level of the Canadian government chose to view the *Anik1* project as a “100% Made in Canada” endeavour, the bureaucratic cadre usually described the Canadian content of the satellite program in more realistic terms. In 1967, senior mandarins at the Department of Transport (DOT) expressed doubts about the feasibility of Cabinet’s nationalistic ambitions. While DOT senior officials had no concerns regarding Canadian industry’s ability to build the ground station portion of the system, they estimated that the satellite would require a public subsidy of “tens of millions” to match the sophistication of American suppliers. In light of these competitive obstacles faced by Canadian industry, George Scott, the Assistant Deputy Minister, Air, at the Department of Transport, advised his Deputy Minister that it:

may be prudent therefore to consider, as an alternative, a supply arrangement wherein only certain portions of each satellite are made in Canada. This is not to say that an R&D effort on satellite communications with some Government support, should not be organized in due course with long term objectives, but these need to be carefully worked out in collaboration with those responsible for operating the system and also those responsible for operating policy. Prestige or scientific and manufacturing enhancement should not be the only determining factors.<sup>15</sup>

From the first draft report of the Task Force on Satellites in October 1967 to the issuance of the 1968 *White Paper on a Domestic Satellite Communication System for Canada*, Cabinet ministers were advised that Canadian firms could produce ninety percent of the ground segment portion of the system, while the satellite would likely

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<sup>15</sup> NA, RG 20 volume 1765, file P80001-5895/S1-3, pt. 1. June 7, 1967 department of Transportation memorandum from the Assistant Deputy Minister (ADM), Air George Scott to the Deputy Minister (DM) John Baldwin, pp. 1-2.

contain a maximum of sixty percent Canadian content.<sup>16</sup> In November 1967, the Department of Industry provided a detailed appraisal of Canadian industrial capacity that indicated areas in which Canada possessed significant competence (e.g. electrical systems relating to satellite design), but also where no Canadian capacity existed (e.g. “position and orientation” components).<sup>17</sup> Politicians, pressured by the currents of economic nationalism, saw fit to portray the satellite project as “100% Canadian” even though they had been briefed numerous times that actual Canadian content in the space segment would be significantly less than that. The temptation to simplify the message to amplify its appeal to the voting public must have been simply too great.

However, two of the immediate consequences of mythologizing the satellite system as “100% Canadian” were a bitter and protracted Cabinet debate, and a barrage of negative media attention concerning the government’s decision to select the Hughes bid. The origins of this political conflict about how best to promote Canada’s economic development were partly based in the conflicting mandate of Telesat Canada, the corporation established to manage the satellite

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<sup>16</sup> NA, RG 97, volume 71, file 48, September 13, 1967 Draft Conclusions from the Satellite Task Force, p. 22. These estimates were based on a six channel satellite design, not the twelve channel proposal that Hughes submitted in 1970. See as well NA, RG 20, volume 1765, file P8001-5895/S1-3, part 1. November 30, 1967 memorandum from E.A. Booth, to E.A. McIntyre, re: Canadian Domestic Communication Satellites, p.1. Booth summarized the meeting of the Cabinet Committee on Communication Satellites in which members were briefed to the effect that sixty percent Canadian content on the space segment was the likely maximum.

<sup>17</sup> NA, RG 20, volume 1768, file P. 8001-404/42, part 3. January 2, 1969 “Report on Canadian Industrial Capabilities in Satellite Communications.” This report provided the same estimate of ninety percent Canadian content for the ground segment, and sixty percent for the space segment, and projected a thirteen percent increase in price and a ten to eighteen month delay if a high Canadian content strategy was pursued.

telecommunications system. Under the terms of the *Telesat Canada Act*, the corporation was charged with ensuring the highest level of Canadian industrial participation in the satellite program, provided that this did not conflict with the commercial nature of the company.<sup>18</sup> It soon became apparent that both goals could not be met as anticipated, or as the economic nationalists in Cabinet envisioned.

The Hughes bid presented the Department of Communications with a complex challenge. John Chapman wrote to his Deputy Minister, Allan Gotlieb, that “the conclusion to be drawn is that a Canadian electronics firm alone, cannot compete in the satellite R&D field; it requires an associated competence in the mechanical area, such as is possessed in house by Hughes, or the CRC [Communications Research Centre], or previously by RCA/SPAR.”<sup>19</sup> The reality of an integrated North American industrial complex was clear to Chapman:

The use of U.S. satellites for the first generation Telesat, where the U.S. proposal is both technically superior and much less expensive, does not presuppose that Canadian industry cannot supply satisfactory products for subsequent generations of satellites, providing that the necessary new technology is developed and made available in Canada, and that the faults in organization and management are corrected. U.S.

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The report also estimated that a satellite design created by a U.S. firm would result in twenty percent Canadian content, p.1.

<sup>18</sup> *Telesat Canada Act*. 1968-69, c.51, s.1. sub-section 5(2) “The company shall utilize, to the extent practicable and consistent with its commercial nature, Canadian research, design and industrial personnel, technology and facilities in research and development connected with its satellite telecommunications systems and in the design and construction of the systems.”

<sup>19</sup> NA, RG 97 volume 311, file 1021-C184. April 17, 1970 memorandum from John Chapman, Assistant Deputy Minister, Research, to the Deputy Minister, Alan Gotlieb, re: Telesat Satellite, Comparison of RCA and Hughes Proposals. The Canada Communications Centre was a federal laboratory created at the same time as the Department of Communications. Most of the former Defence Research Telecommunications Establishment (DRTE) was transferred to the new research facility.

technology does not have an inherent superiority over Canadian technology; in chosen fields Canadian technology has been competitive and sometimes markedly superior (e.g. STEM devices, small gas turbine).<sup>20</sup>

Chapman attempted to shift government thinking from the “100% Made in Canada” approach to encompass a strategy in which Canadian economic interests would be better served in the long run by sub-contracting and integrating within a North American space products market.<sup>21</sup> In the same way that the defence-related industries prospered under a similar arrangement, the aerospace sector would thrive by specializing in certain sub-systems which could be exported to the U.S. and other countries. While a sound long-term strategy, the government was about to face a barrage of criticism that it was selling out Canadian interests.

One such outburst came from RCA executive Jack Sutherland who telephoned John Chapman in early May, after meeting with Telesat officials to discuss a second offer from RCA. This revised proposal shaved \$10 million off the original bid, but the RCA price tag remained double that of Hughes’. Sutherland argued that it would be “an ‘unfair situation’ to throw RCA out now,” especially considering that “there is no other program on the horizon for the industry, no Defence, no Communications and no Broadcast work. Losing this contract will virtually wipe out RCA in Canada.”<sup>22</sup> Sutherland reminded Chapman that RCA had proceeded on good faith based on the original project-definition contract with the federal government. He

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<sup>20</sup> *Ibid.*

<sup>21</sup> Swift, *Odd Man Out*, p.233.

ended their conversation with an impassioned patriotic call to arms, and insinuated to Chapman that should Telesat accept the Hughes' proposal it would be a cowardly act on the government's part. He portrayed his company as a heroic nation builder that erected a continental microwave system under conditions of great uncertainty, and had done so proudly as "there is risk in being a Canadian!" Sutherland warned Chapman that:

The consequences of a failure to obtain this contract would be very serious for this company [...] The satellite program is essential to make the whole operation viable. Layoffs will be necessary if the contract is not obtained. 400 employees will be directly affected. The whole of the 1,600 man division may be closed. The RCA Research & Development Laboratories, with 60 or 70 people, would be closed out as part of this layoff.<sup>23</sup>

Despite the spectre of media headlines emblazoned with the news that technical and scientific personnel had been fired due to government intransigence, in mid-May 1970, the Telesat Executive Committee recommended that the Hughes offer be accepted. They rejected RCA's proposal due to higher cost, and also because the Telesat Board members were worried about RCA's weak project management structure. One board member queried whether Hughes was dumping American technology by deliberately lowering its price. Telesat president D.A. Golden assured

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<sup>22</sup> NA, RG 97 volume 311, file 1021-C184. May 12, 1970 memorandum to the Minister (Kierans) from the Assistant Deputy Minister, Research (Chapman), re: Telephone call from Jack Sutherland, RCA Limited.

<sup>23</sup> *Ibid.*, p.2. He reminded Chapman that RCA built the microwave system for the railways in "21 months and [it had] outperformed the Bell system."

the rest of the board that Hughes' proposal contained a twenty-five percent profit margin, which he believed could hardly be considered an unfair business practice.<sup>24</sup>

On July 3, 1970, J.D. Houlding, president of RCA of Montreal, wrote to the head of Telesat to formally withdraw the company's bid. Houlding adopted a highly patriotic tone, much as Sutherland had done with Chapman two months earlier, and argued that it was unfair for RCA to have to compete with an American industrial giant like Hughes that benefited from the larger and more lucrative U.S. defence and military programs.<sup>25</sup> Shortly thereafter, RCA submitted a new bid, which included a price estimate of \$35 million (on a cost-plus or fluctuating basis) and an estimated fifty percent Canadian content in design and manufacture. The Hughes' counter-offer

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<sup>24</sup> NA, RG 97 volume 218, file "Telesat Canada Board." Minutes of the May 13, 1970 Telesat Board Meeting, p.3.

<sup>25</sup> Economic nationalist interpretations of these events have permeated government, business, and media circles. Three separate accounts [Swift, *Odd Man Out*, p. 234; Lydia Dotto's, *25 Years at Spar Aerospace Limited: A Heritage of Excellence* (Toronto: University of Toronto Press, 1992), p. 89; and a *Montreal Star* article on February 9, 1972, "How Hughes got Telesat Contract: RCA parent axed local bid," p.6] repeated the claim that in fact RCA of Montreal was ordered to withdraw its bid for the Canadian satellite by its American parent company. According to these accounts, RCA was recently thwarted by IBM from entering the computer market and was therefore unwilling to risk another head-to-head competition with the leader in the satellite sector, Hughes Aircraft. The *Montreal Star* article quoted B.A. Walker, Director General of the Technological and Systems Planning Branch of the federal Department of Communications, who addressed a winter 1972 Science Council of Canada staff seminar about the impact of multi-national corporations on Canada R&D. Walker's allegations were similar to those made by DRB staff member, D.W. Simpson, a decade earlier when he protested RCA's selection as the prime contractor for *ISIS A*. See NA, MG 31, J43, volume 12, file 16, "ISIS Program -Development of Publicity 1962-1965." November 22, 1962 memorandum from F.W. Simpson to DIR, "Comments on the IMS (Ionosphere Monitor Satellite)." For an overview of the RCA American parent company's competitive position in the late 1960's, see Margaret Graham's, *RCA and the VideoDisc: The Business of Research* (Cambridge: Cambridge University Press, 1988) and Robert Sole's, *RCA* (New York: Stein and Day Publishers, 1986).

was a \$28 million firm-price bid with twenty percent Canadian content and a plan to include Northern Electric and Spar Aerospace as sub-contractors in ten other projects. Even though the revised RCA proposal appeared to be only slightly more expensive, since it entailed a cost-plus price structure, Telesat's expenses could have escalated enormously as no price ceiling would be imposed on RCA under this type of contract. The Telesat Board believed that it could not entertain such a risk and maintain commercial viability. The company's president David Golden used similar reasoning to reject a last minute bid from the newly created Spar Aerospace firm of Toronto.<sup>26</sup>

Golden pressured the government to render a decision quickly as the Hughes offer would remain in effect for only two months. He reminded Kierans and his officials that a delay in contract selection of even a few weeks could mean that the entire project would be set back a year or more. By early July 1970, Cabinet faced the choice of accepting Telesat's recommendation to proceed with the Hughes bid, or countermand that decision, and instead accept RCA's revised offer. While RCA was definitely the weaker contender from both commercial and cost perspectives, the selection of Hughes would not only attract public criticism, it would run counter to the economic nationalist beliefs of a number of Ministers and a growing segment of the public. Despite his own nationalist leanings, Kierans came to support Telesat's recommendation in favour of the Hughes bid.<sup>27</sup> Arrayed against Kierans were a

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<sup>26</sup> NA, RG 97 volume 218, file Telesat Canada Board. July 9, 1970 letter to Kierans from Golden.

<sup>27</sup> Kierans' biographer observed that the Minister believed that "RCA had made an uncompetitive bid on a job that they may not be able to do," and concluded that "in

number of strong Cabinet members including the former Industry Minister, Bud Drury, who was Walter Gordon's brother-in-law, and two Quebec Ministers, Bryce Mackassey, the Minister of Labour, and Jean-Luc Pépin, the Minister of Industry, Trade and Commerce.<sup>28</sup> The fact that Mackassey and Kierans had become bitter political enemies following a protracted postal dispute in 1969 added to the contentious atmosphere.<sup>29</sup>

In the meantime, word of division among the Cabinet began to reach the media. The *Financial Post* noted that a "very powerful influence of ministers such as Industry Trade and Commerce's Jean-Luc Pepin and Treasury Board President C.M. (Bud) Drury" favoured RCA. The *Post* reported that these Ministers argued forcefully that "this is one of the few chances open to Canada to move into a dramatic new area of technology. To miss this opening, the argument goes, is to waste all the work that has been done on earlier Canadian satellites for the government and would probably assure that Canada remains a second-class force in space science." Dr. O.M.

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spite of the nationalist arguments in favour of RCA, Kierans backed the decision of the Telesat Board and fought hard for the Hughes bid." Swift, *Odd Man Out*, p. 233.

<sup>28</sup> A number of the political memoirs and insider accounts from the Trudeau era recounted the influence and strong backing that Drury enjoyed. See Mitchell Sharp, *Which Reminds Me: A Memoir* (Toronto: University of Toronto Press, 1994); Don Jamieson, *A World Unto Itself: The Political Memoirs of Don Jamieson, Volume II* (St. John's: Breakwater, 1991); Paul Martin, *A Very Public Life, Volume 2* (Toronto: Deneau Publishers, 1985); Keith Davey, *The Rainmaker: A Passion for Politics* (Toronto: Stoddart, 1986); and Richard Gwyn, *The Northern Magnus: Pierre Trudeau and Canadians* (Toronto: McClelland and Stewart, 1980).

<sup>29</sup> In his memoir, Don Jamieson concluded that Kierans, then Postmaster General, was the fall guy for the government in the postal dispute. See *A World Unto Itself*, p. 125.

Solandt, the head of the Science Council of Canada, weighed into the fray by stating that a decision to award the contract to Hughes would be "complete madness."<sup>30</sup>

The International Union of Electrical Workers also denounced any suggestion of awarding the contract to an American company, as it would represent "an irretrievable loss of the aerospace communications industry for Canada."<sup>31</sup> Not surprisingly, the *Montreal Star* took RCA's part, as the company was located in that city. The *Star* reported RCA President John D. Houlding's position that a Canadian company should win the bid as "the federal government wants the contract to remain in the country; if it doesn't the telecommunications industry in Canada could die and a lucrative position in the international market will be lost. Several hundred highly-skilled electronics scientists also may lose their jobs."<sup>32</sup> Cabinet was obviously concerned about potential job loss, particularly with regard to scientific and technical personnel. Telesat estimated that if RCA were to win the contract some 240 jobs would be created over two and a half years. However, the company also forecasted a \$250 million increase in total program costs from 1970 to 1981 if RCA were awarded the contract and prices were allowed to escalate at even a "modest three percent per year."<sup>33</sup>

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<sup>30</sup> Clive Baxter, "Emotions Satellite High Over Who Builds Telesat," *Financial Post*, July 11, 1970, p.1.

<sup>31</sup> Swift, *Odd Man Out*, p. 233.

<sup>32</sup> Dick MacDonald, "RCA Sure Satellite to be Built in Canada: If Moved, Hundreds of Scientists Could Lose Jobs," *Montreal Star*, July 11, 1970, p.1.

<sup>33</sup> NA, RG 97, volume 218, file "Telesat Canada Board." July 15, 1970 letter to Kierans from Golden. The Telesat President based his estimate on projections provided by Hughes as to the number of staff that the California company would need to hire to complete the project.

On July 31, 1970, during a ten-hour meeting, Kierans leveraged these long-term cost considerations, as well as the threat of his own resignation, against the objections of his economic nationalist colleagues. He eventually persuaded Cabinet to choose Hughes.<sup>34</sup> With *Anik 1*'s launch in November 1972, Canada became the first country in the world to operate a domestic satellite telecommunications system. The selection of an American firm over a Canadian-based one had not impeded that particular goal, nor did it retard industrial development in the aerospace sector. From an economic development perspective, Cabinet's selection of Hughes was the right choice despite the criticism that it attracted at the time.

In any event, the selection of Hughes over RCA was only a temporary set back for the Montreal company, as it was able to benefit from the federal government's ongoing investment in satellite research and development. Shortly after the Cabinet decision to develop *Anik 1*, the Canadian government developed an agreement with NASA to build the experimental "Communications Technology Satellite" (CTS, later known as *Hermes*). RCA received a large share of the work on the CTS, partly in compensation for it not being selected as the main contractor to build the first *Anik*. Moreover, as a result of its efforts on the CTS, RCA was better placed than Hughes to work on the *Anik B* contract in 1975 as this second satellite required more powerful high frequency channels, with which RCA had greater expertise.<sup>35</sup> Two other

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<sup>34</sup> Swift, *Odd Man Out*, p. 235. Swift related that Kierans deployed another fear tactic by intimating that should Cabinet select RCA, the company's lack of competence might lead to the satellite exploding during its launch.

<sup>35</sup> While the RCA American parent company won the \$19.5 million *Anik B* contract, RCA of Montreal performed \$6.3 million worth on the project as the main sub-contractor, which meant that thirty percent of the contract was completed in Canada.

Canadian firms benefited directly from the decision to procure the satellite from Hughes. Both Northern Electric and Spar gained invaluable experience on the *Anik 1* contract and the subsequent projects in which Hughes agreed to involve them. As such, the Hughes decision did not represent a policy failure. It did, however, more firmly establish the continental integration of the aerospace and satellite sectors.

Protestations of Canadian nationalism by RCA executives aside, in 1970 Canada did not possess sufficient industrial capacity to build a "100% Canadian satellite."<sup>36</sup> As Department of Communications officials realized, the smarter strategy was to accept the reality of an integrated North American market and to concentrate on Canadian strengths rather than pursue an autarkic policy that would have most likely ended with the same self-defeating results as those of the AVRO- Arrow program. Instead of a heavily subsidized program grown too expensive to support any longer, Canada developed a successful aerospace and defence sector with projected annual sales of nearly \$26 billion in 2002.<sup>37</sup>

Deciphering Canadian-American relations, particularly in the area of economic development and the effects of continentalism, is far more complex than the economic nationalists would lead one to believe. Canadian industrial development benefited from continental integration within a North American market; yet, that same

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<sup>36</sup> Satellites constructed for Telesat contained only fifty percent Canadian content even as recently as a decade ago. See Roy M. Dohoo, "The Development of Canadian Satellite Communications," in Thomas L. McPhail and David C. Coll, eds., *Canadian Contributions to Telecommunications: An Overview of Significant Activities* (Calgary: University of Calgary Graduate Programme in Communication Studies, 1986), p.45.

<sup>37</sup> Industry Canada, "Strategis" Business Information Web Site. Aerospace and Defence statistics, <http://strategis.ic.gc.ca/SSG/ad03753e.html>. The 2002 sales figures

specialization and pattern of sub-contracting created a degree of vulnerability and reliance on the United States. The Hughes decision, as Minister Kierans convinced his Cabinet colleagues, was not so much an issue of surrender to a stronger power as taking the longer view of Canadian economic development within a continental context. While not a "100% Made in Canada" satellite, the Hughes built *Anik I* was a positive step in the development of Canada's telecommunications and aerospace sectors.

However, the heightened expectations created by describing the project in such nationalistic terms had a lingering negative effect. The extensive media coverage of the government's choice of the Hughes tainted the decision with the stain of failure. No matter that RCA of Montreal was one of the American-owned subsidiaries so demonized by the economic nationalists, in this case the self-appointed champions of Canada's survival were willing to portray the company as *pur laine*. RCA executives also attempted to sway government decision making by emphasizing its contributions to such nation building efforts as the construction of the telecommunications microwave network. The power of cultural consciousness was such that politicians, business owners, and media pundits were willing to cloud reality with the perception that strengthened east-west linkages could be forged solely by nationalistic claims. Canada's expansive-defensive dynamic had guided policy and opinion makers down the treacherous path of nation building within a continental context. We now examine the underpinnings of this particular oscillation on

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forecasted \$4.7 billion, or eighteen percent of the total, would be in domestic sales, and the remainder in exports.

government decision making to further expose its impact on policy outcomes, as well as to provide insight on how the national consciousness sustains itself.

## Chapter Six

### *Charting the Canadian Mind: The Confluence of "Colony" and "Empire" in National Consciousness*

In the preceding chapters we reviewed what occurred in the development of Canada's research and communications satellites. We now examine more closely the policy motivations that led to these outcomes. Despite nearly a century of nationhood, the Canadian mentality of the 1960's unfairly compared itself with the leading Anglo metropolises of Great Britain and the United States, which resulted in a self-defeating inferiority complex and anti-colonial outlook. At the same time, Canada, in keeping with the rest of Western culture, was affected by an imperial drive that impelled politicians and government officials to seek ways to ensure that the country expanded and developed. Thus, the consciousness that affected Canadian policy and opinion makers oscillated between a defensive and expansionary nationalism, which affected outcomes in several ways, some positive, and others less than salutary.

The confluence of "colony" and "empire" accounted for the paths pursued by successive Canadian governments in the post-1945 period. These deeply held, and often contradictory, beliefs were evident in government promotional materials, public reports and internal memoranda, as well as in the media coverage and scholarly accounts produced in this period. Indeed, the interaction of policy beliefs and scholarship often generated a form of *policy loop* in which historical interpretations affected policy makers' mindsets and choices. This could be observed when politicians and bureaucrats, who sought ratification of their decision to construct a

domestic telecommunications satellite system by invoking the nation building efforts of earlier eras, echoed the findings of historians like Donald Creighton who counseled the necessity of strong east-west ties to sustain the country. This loop was completed when policy debates concerning Canadian scientific “under-development” pollinated scholarly perceptions about Canada’s World War II industrial record. Historical accounts about this topic written in the 1970’s displayed an uncritical acceptance of the then prevailing interpretation that Canadian R&D had been impeded by American foreign ownership. Thus, the expansive-defensive consciousness was perpetuated as perceptions affected choices, and subsequent experiences maintained beliefs.

Throughout this chapter, we will decode the symbols and messages deployed by policy makers and scholars to examine the Canadian consciousness more deeply. Such an extended analysis is intended to provide insight into the impact of an overly negative mentality, and to suggest how such a pessimistic outlook might be re-balanced by considering successes as well as failures.

An expansive imperial drive marked the immediate post-World War II era in Canada. Successive governments consciously attempted to consolidate the industrial and diplomatic gains made during the war and to use these to enhance the country’s prestige. While Canada initially de-mobilized at the end of World War II, the Cold War, and in particular the 1950-53 Korean conflict, placed defence issues high on the government’s agenda once again. The Defence Research Board (DRB)’s mandate focused on defence preparedness, but also on the transfer of technological discoveries to the civilian economy. Defence research remained one of the federal government’s highest R&D expenditures well into the 1960’s.

Canada's foreign policy also reflected an expansionary drive as the country sought to steer a "middle course" among the former imperial leviathans like France and Britain and the new Soviet and American superpowers. To serve its interests, Canada adopted the posture of "useful internationalism" and cooperated with other middle powers and the developing world in order to extend its influence. In keeping with this strategy, the county also ensconced itself in the many multi-partite organizations in which Canadian diplomacy excels.<sup>1</sup>

These nation-building efforts were evident in Canada's early forays in space. In 1957, the success of the Churchill rocket range prompted the government to consider a proposal to open the research facility to the international community of space researchers. Senior Defence Research Telecommunications Establishment (DRTE) staff members were tasked with developing this idea to boost Canada's international position and its presence in world affairs. Their brief argued:

Through use of rockets for high altitude research, Canada will increase her prestige, particularly among the neutral and the more backward nations, and will thereby be better able to press her foreign policy as representative of the smaller powers. Canada will also be in a position to demand a voice in international decisions on the question of the upward extension of the limits of sovereignty.<sup>2</sup>

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<sup>1</sup> Recent reviews of Canada's Cold war experience offered insight into Canada's participation in post-WWII mutli-partite institutions like the North Atlantic Treaty Organization (NATO). See Greg Donaghy, ed., *Canada and the Early Cold War, 1943-1957* (Ottawa: Department of Foreign Affairs and International Trade, 1998), and Robert Bothwell, *The Big Chill: Canada and the Cold War* (Toronto: Irwin Publishing, 1998). See as well John W. Holmes, *The Shaping of Peace: Canada and the Search for World Order 1943-1957* (Toronto: University of Toronto Press, 1982).

<sup>2</sup> National Archives of Canada (hereafter NA), MG 31, J43 (J.H. Chapman papers), volume 9, file 6, "DRTE Rocket Research 1957-1961." November 29, 1957 draft paper by Chapman, "A Canadian High Altitude Rocket Program," p. 2.

While this idea was eventually abandoned, it provided a useful glimpse into the DRB mindset, and the widely held policy consensus that defence research and technical developments could be used to enhance Canada's reputation and promote its foreign policy goals. This "imperial drive" suffused the government's defence industrial plans, and resulted in successes like the Alouette-ISIS program as well as expensive failures like the AVRO-Arrow fighter jet that was canceled in 1959.

The Western variant of the imperial drive also demanded a policy of openness and dedication to other democratic ideals. This commitment to information sharing was present in DRB's frequent media campaigns, the continual issuance of press releases, and the many public talks delivered by its senior officers.<sup>3</sup> The Board employed a full time public relations officer, Curtis Yool, and permitted access to sensitive research such as when Canadian newspapers carried accounts of DRTE's efforts to track *Sputnik* in the fall of 1957.<sup>4</sup> While it could be argued that the DRB -- and by extension all government departments and agencies -- shared this type of information to legitimize its function to the voting public, the policy of media

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<sup>3</sup> For instance, satellite project leader John Chapman alone gave dozens of talks on the Alouette-ISIS program to groups as diverse as the Ottawa Kiwanis association to science students at Concordia and the University of Toronto. See for example, NA, MG 31, J43, volume 1, file 39. November 19, 1962 presentation at the University of Toronto to commemorate the addition of the one millionth book to the university's library. Chapman told his audience that "it will be years before all that *Alouette* has already given us will be properly assessed and put into place, but the end result will be a great flood of new knowledge, which will be recorded in this library, and the other libraries around the world where scientists work," p.11.

<sup>4</sup> "Canada First: Ottawa Traces Orbit," *Globe and Mail*, October 9, 1957, p.1. The *Globe* reported that the "dead tired scientists have been working day and night on the project since the object was launched Friday."

openness was consistent with the Western Cold War strategy to promote a tradition of transparency in contrast to the secretive and authoritarian Soviet bloc.<sup>5</sup>

DRB officers were evidently well drilled in the necessity of public relations activities. For instance, there were lengthy internal consultations as well as coordination with NASA's public relations wing concerning the selection of a name for the first Canadian satellite. In March 1961, John Chapman recommended that the "PRO [public relations officer] should discuss the use of this name with the NASA public relations officials when publicity arrangements at the time of launching are being discussed." He suggested the name "voyageur," which he deemed "a word with a typical Canadian connotation."<sup>6</sup> Instead of the east-west transportation ties symbolized by that term, the DRB chair selected a wildlife symbol, the lark or "Alouette," which was evocative of Canadian identification with the wilderness and its survival mythology.

The DRB organized an even more ambitious public relations effort to mark the opening of the Prince Albert Radar Laboratory (PARL) in June 1959. PARL was located in Prime Minister Diefenbaker's riding, and the government used it to highlight achievements in advanced technology, Cold War preparedness, and

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<sup>5</sup> For instance, NASA's mandate stressed that U.S. space efforts be "devoted to peaceful purposes for the benefit of all mankind," and that the Agency would maintain openness and information sharing with its international partners. See Richard Hirsch and Joseph Trento, *The National Aeronautics and Space Administration: Praeger Library of U.S. Government Departments and Agencies* (New York: Praeger, 1973), p.149.

<sup>6</sup> NA, MG 31, J43, volume 4, file 13, "Chapman, J.H. DRTE Correspondence, January-July 1961." March 24, 1961 memorandum from Chapman (for the Chief Superintendent of DRTE) to Chair of DRB re: possible name for the topside sounder satellite.

Canada's close partnership with the United States. The ceremony began with the reception of a congratulatory message from President Eisenhower that had been pre-recorded and then transmitted at that moment from the Lincoln Laboratory at the Massachusetts Institute of Technology to the moon's surface, which reflected the signal to PARL located in northern Saskatchewan. This carefully choreographed public relations event served as a tangible reminder of how technology was closing the distance between points in North America, and how defence needs and economic desires were shaping a new continental consciousness for the two countries. This transformation had a greater impact on Canada due to its smaller size and its residual colonial consciousness.

The PARL inauguration occurred during a period when close cooperation across the 49th parallel was celebrated in Canada. As the Prime Minister unveiled the commemorative plaque attached to PARL's parabolic antenna, he observed that the facility represented "a great step forward in Canadian-American cooperation in defence of our common freedom." Diefenbaker's speech also revealed his Cold Warrior mentality when he declared that the project would contribute to "expanding opportunities for the maintenance and preservation of our freedom and will ultimately thereby contribute to the attainment of peace which is the objective of all the statesmen of the free world." Eisenhower's message also emphasized the close working relationship between Canada and the United States in "defence research and other fields."<sup>7</sup>

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<sup>7</sup> NA, Audio-Visual collection, "Prelude to Space." John Diefenbaker opens the Prince Albert Radar Laboratory, 1959. Acc: 1989-0283, #ISN: 133451, V19711-0005.

Indeed, the late 1940's and 50's marked a period of intense collaboration between Canada and the United States. The St. Laurent government welcomed U.S. capital to expand the Canadian economy, and embarked on its own ambitious transportation development programs like the Trans-Canada Highway. At the Canada-United States Conference on Mutual Relations held in Washington, D.C. from February 7-8, 1955, the Secretary of State for External Affairs, Paul Martin Sr., told the mainly business audience that Canada favoured good trading and defence relationships between the two countries, and it encouraged investment.<sup>8</sup> This period of relative harmony in Canada-U.S. relations carried over into the early years of the Diefenbaker period, and was apparent in how the Alouette-ISIS projects were positioned as examples of a mutually beneficial working relationship.<sup>9</sup>

While Canada-U.S. cooperation was an important and consistent theme running through the public relations material concerning the satellite projects, there was an even more persistent image imbedded within the press releases. These

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<sup>8</sup> G. Frederick, Stutz, ed., *Report of the Canada-United States Conference on Mutual Relations* (Washington, D.C. : The Chamber of Commerce of the United States and the American Council on Education, 1955), p. 6.

<sup>9</sup> See NA, MG 31, J43, volume 10, file 20, "Satellite S-27 Publicity- Press Release 1959-1961." March 27, 1961 progress report released jointly by the DRB and NASA. The report boasted that "the close association of DRB scientists with their NASA colleagues is a dramatic example of international collaboration in space science which undoubtedly will be extended in the future. The USA in particular has made clear its desire to extend this form of cooperation to other nations," p. 6. See also NA, MG 31, J43, volume 1, file 44, "Chapman, J.H., "The Alouette Satellite, January 1964." Chapman's January 18, 1964 presentation to the Royal Canadian Institute observed that the *Alouette* project had been achieved in "full partnership with the U.S.," p.1. NASA used the opportunity of the ISIS program announcement to emphasize the international cooperative dimensions of the U.S. space program. See NA, RG 97 (Department of Communications), volume 219, file 99, pt. 3. NASA Press Release, January 14, 1964, "Four More Canadian Satellites From US-Canada Agreement.

materials conveyed the message that Canada was an important and early contributor to the international space program, and therefore a significant player and advanced nation scientifically. Yet, within these declarations of national pride, there was the ever present Canadian humility that rather than describe this accomplishment in terms of being a “leading nation,” or among “the first nations,” official publicity materials consistently described Canada as “the third nation after the United States and Soviet Union to build and launch an artificial satellite.”<sup>10</sup> The emphasis on “third nation” was actually a later adaptation, since a 1962 press release referred to the accomplishment as “placing us [...] among the first nations to seek knowledge of outer space by the medium of a satellite.”<sup>11</sup> Most other cultures would exaggerate the importance of such a feat over time, whereas in Canada the reverse occurred as “third nation” became the official designation and was used in the 1968 *White Paper on a Domestic Satellite Communication System for Canada* as well as the Department of Communications’ public relations book, *Alouette*, published in 1970.<sup>12</sup>

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<sup>10</sup> See for example, NA, Audio-Visual collection, CBC Newsfilm pack, catalogue # 8208-0447, ISN: 151298, V18211-0056; NA, MG 31, J 43, volume 1, file 41. January 25, 1963 presentation to a Kiwanis luncheon by John H. Chapman; and NA, MG 31, J43, volume 11, file 33, “Alouette II, Minister of National Defence, November 1965.” November 28, 1965 press release by Paul Hellyer, Minister of National Defence, re: “Successful Launching of Alouette II.”

<sup>11</sup> NA, MG 31, J43, volume 11, file 7, “Alouette- Canada’s First Satellite.” *NASA Facts*, February 12, 1962, p. 2. A 1963 DRB publicity film, “Alouette, Canada’s First Satellite,” also referred to the satellite in more important terms as rendering “Canada a leader among the nations in space research for purposes of peace.” See NA, Audio-visual collection, ISN: 177056 V19104-0074.

<sup>12</sup> In contrast to the rather humble way in which *Alouette* came to be described, *Anik 1*’s launch in 1972 was celebrated as a “world’s first,” which reflected the central importance of communications policy to the Trudeau government’s nation building efforts. See for example NA, Audio-Visual collection, “Launch of *Anik 1*,” 1972, ISN: 11798, V18601-0115, ref no. 1985-0642.

In keeping with the imperial drive mindset, however, DRB press materials also consistently promoted Canadian industrial developments. In his description of the 1959 opening of the PARL radar facility, the video's narrator took pains to emphasize what was specifically Canadian about the project including the Data Analysis Recorder (DAR), which had been built by the DRTE.<sup>13</sup> DRB press materials produced throughout the Alouette-ISIS project era consistently referred to specific Canadian built technology like the STEM antenna and the fact that it had been so widely adopted.<sup>14</sup>

These public relations events also relayed the belief that the U.S. was an important benchmark against which to measure Canadian achievement. At the September 29, 1962 press conference held after *Alouette I*'s successful launch, John E. Jackson, the NASA project coordinator for the satellite, told the assembled reporters and officials that "I would like to point out, which the Canadians from their modesty have not, [...] that from a technological stand point the satellite matches in

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<sup>13</sup> "Prelude to Space." The narrator also remarked upon DRTE's electronics expertise, as the recording instrument used a digital computer to collate the data.

<sup>14</sup> See for example, NA, RG 97, volume 71, file 47, October 16, 1962 press release on *Alouette*. There are similar references in NA, MG 31, J43, volume 11, file 31, "*Alouette II* Launch Press Kit November 1965." This press kit listed all Canadian industrial participation in detail. The Canadian media also demonstrated a similar sense of boosterism, when the *Financial Post* reported that "RCA Advances with Satellite Experiments on *Alouette II*, ISIS," June 6, 1964, p. 67. The *Post* reported that "the two contracts [for experimental ground station and work on *Alouette II* and ISIS satellites] emphasize the importance the government places on preparing Canada for the age of space communications. They also underline the faith Ottawa has in the ability of the Canadian electronics industry to design and manufacture the intricate equipment to track satellites."

complexity anything that the U.S. has launched to date as far as satellites.”<sup>15</sup> The *Ottawa Citizen* repeated Jackson’s comments in its coverage of the launch, which quoted the NASA official as stating that “Canada has suddenly caught up with us in satellite technology.”<sup>16</sup> His compliments were repeated during an October 17, 1962 Radio Canada special broadcast about *Alouette*, in which the reporter observed that “the Americans have said that our satellite is as sophisticated as those in the U.S.”<sup>17</sup>

When the third Canadian satellite, *ISIS A*, was launched in 1968, many Canadian newspapers focused attention on it, including the *Ottawa Citizen*, which gave prominent display to the fact that the Canadian designed STEM antenna had been used as a prop in the American television program, *Mission Impossible*.<sup>18</sup> This choice of central image to promote the importance of the Canadian technology reflected the degree to which the paper’s editors deferred to American popular entertainment as a hallmark of cultural importance. In a similarly themed article in the *Financial Post* published in July 1969, just before the Apollo moon landing, the

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<sup>15</sup> NA, Audio-Visual collection, “Post-launch press conference at Point Arguello, California about the *Alouette I* Satellite,” September 29, 1969. Acc: 1985-0114, #ISN: 272921, R10970 (3). NASA Deputy Director, Dr. Dryden, as well as the DRB chair, Dr. Zimmerman spoke at the press conference, while the American and Canadian projects leaders, Jackson and Chapman, were on hand to answer technical issues. *NASA Facts* (F-12-62) reported that over thirty-six radio stations in Canada carried the press conference, p. 4.

<sup>16</sup> Greg Connolley, “Canada Has Caught Up With Us,” *Ottawa Citizen*, September 29, 1962, p. 2.

<sup>17</sup> NA, Audio-Visual collection, “Satellite *Alouette*.” Émission spéciale animée par Gaétan Barrette qui présente un reportage sur le lancement du premier satellite artificiel canadien, “*Alouette*,” 1962. ISN: 26845, V18609-0019. Barrette also referred to Canada as the third nation in space after the U.S. and the USSR. That this hour-long television program celebrated a federal government program as a “national achievement” is indicative of its pre-Quebec nationalist consciousness.

*Post* stressed the Canadian connection to the event by noting that Heroux of Montreal had constructed the legs that supported the lunar module, and thus its page one headline boasted: "Canadian Legs - First on Moon."<sup>19</sup> While Canadians might resent American dominance in world affairs, a solidly entrenched colonial mentality caused them to consider the U.S. as a cultural metropole against which to measure their own achievements.

Meanwhile, Canada's imperial drive continued to assert its influence throughout the 1960's, as the federal government endeavoured to communicate that the Alouette-ISIS programs were significant national achievements that positioned Canada in the forefront of technological progress. For instance, in 1965, the federal government issued a commemorative postage stamp to celebrate the launch of *Alouette II*. Post Office official, J.G. Cunningham, explained to the CBC that these special issues were authorized "to explain Canada to the world."<sup>20</sup> The stamp, with its illustration of the "Canadian satellite," was typical of both the pride and boosterism associated with an imperial drive.

Certainly, this expansionary impulse was hardly unique to Canada. All western nations have shared this compulsion, and a new variant of the growth imperative appeared by the early 1960's. Badly shaken by the Soviet's launch of

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<sup>18</sup> Tracey Morey, "Alouette's Sister: Third Bird Set to Fly," *Ottawa Citizen*, December 31, 1968, p. 1.

<sup>19</sup> *Financial Post*, July 12, 1969, p. 1.

<sup>20</sup> NA, Audio-Visual collection, CBC Newsfilm pack, catalogue #1977-0280, ISN: 173921 V19612-0116. Cunningham told the CBC that "this particular design was suggested by the National Research Council in 1961 when *Alouette I* was sent into orbit. However, we were too late to commemorate that event [so] we took the idea and we said that we would use it with the next *Alouette* that went up."

*Sputnik* in 1957, the western world scrambled to catch up, and, as a consequence, there was an intense focus on the role of science and technology in ensuring national prosperity and survival. In Canada, the Royal Commission on Government Organization (Glassco) was the first to advocate a systematic policy approach to industrial research and economic development. Previous reviews of Canada's science efforts such the 1951 *Final Report of the Royal Commission National Development in the Arts, Letters and Sciences* (the Massey Commission) recommended better management of government expenditures, but had not considered the broad approach adopted by Glassco and his colleagues in 1963. The Glassco Commission placed science and technology at the forefront of government policy making and argued:

Few matters are of more fundamental importance to the peoples of the economically advanced countries of the world than the enunciation of wise and appropriate national scientific policies. What proportion of the nation's resources should be devoted to research and development and how the money available should be distributed to the various areas of scientific investigation are questions the answers to which may profoundly affect the health, the safety and the economic well-being of the nation.<sup>21</sup>

The Glassco Report captured the growing public interest in science and technology that could be observed at the Canadian Electronics Conference held in Toronto in late 1962. The event attracted thousands of visitors who were drawn to view the "latest electronic equipment developed by manufacturers and distributors throughout the world." CBC news coverage of the event noted that the *Alouette*

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<sup>21</sup> Canada, *Report of the Royal Commission on Government Organization* (Ottawa: Queen's Printer, 1963), p. 217.

satellite “was a top exhibit,” and that large placards attached to its display celebrated that it had been “designed by Canadians.”<sup>22</sup>

Attuned to this developing awareness of how vital science and technology had become to national prosperity, the newly elected Pearson government quickly implemented Glassco’s recommendations and established a Science Secretariat in the Privy Council Office in 1964, and the Science Council of Canada in 1966. The Council’s 1968 *National Science Policy for Canada* reflected the imperial drive consensus that science and technology “will contribute to the realization of the goals of the nation.”<sup>23</sup> The policy vision regarding the importance of science and technology to Canada’s destiny was consolidated by the time that the Canadian Senate Special Committee on Science Policy reported its findings in 1970. The Senate Committee framed its work in terms of the imperial drive precept that nations must innovate to survive. In describing the rationale for its inquiry, the Senate Committee members told Canadians that “the growing dimensions and the increasing speed of the international scientific and technological race [have] become evident. It was important for us to appraise Canada’s participation in what may well be one of the predominant phenomena of the remaining portion of this century.”<sup>24</sup> The Senate report reflected the growing fear among America’s allies that the greatest threat

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<sup>22</sup> NA, Audio-Visual collection, “CBC News Filmpack,” the Canadian Electronics Conference show in Toronto, 1963. Catalogue #1977-0280, ISN: 176789, V19612-0116.

<sup>23</sup> Science Council of Canada, *Towards a National Science Policy for Canada* (Ottawa: Queen’s Printer, 1968), p. 1.

<sup>24</sup> Canada, Parliament, Senate Special Committee on Science Policy, *A Science Policy for Canada: Report of the Senate Special Committee on Science Policy* (Ottawa: Queen’s Printer, 1970), p. 1.

emanated from U.S. technological might, and that Canada and Europe risked losing the race for scientific and industrial achievement behind the American giant.

The consensus that industrial R&D prowess was firmly linked to national destiny could also be observed in the 1972 Private Planning Association of Canada's views on science policy. A forerunner of Canada's leading liberal economic think tank, the C.D. Howe Institute, the Planning Association weighed in with its opinion:

Experience has taught mankind that the use of science and technology -- the application of knowing to doing -- is the normal way of solving national problems, especially those that determine the wealth and strength of a country. Hence Canadians, like other members of modern industrial societies, are deeply interested in the possibilities of using the Janus-like creativity of science and technology for their own national benefit.<sup>25</sup>

By the early 1960's, there was strong consensus in Canadian government and research circles on the necessity of a science policy. However, Canadian negativity and the country's inferiority complex would play a crucial role in undermining the effectiveness of these planning and administrative efforts.

This pessimistic attitude was apparent in 1961, when the Dominion Bureau of Statistics conducted its first survey of Canadian industrial research and development activity. It found that while government funding for R&D declined sharply after the cancellation of the Arrow program, there were nearly twenty more private firms conducting research in 1959 than there had been four years earlier.<sup>26</sup> Despite the

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<sup>25</sup> Phillippe Garigue, *Science Policy in Canada* (Toronto: The Private Planning Association of Canada, 1972), p. 1.

<sup>26</sup> Canada, Dominion Bureau of Statistics, *Industrial Research-Development Expenditures in Canada, 1959* (Ottawa: Queen's Printer, 1961), p.8. In 1955, 451 firms in Canada conducted some form of R&D; by 1959 their number had increased to 477.

report's fairly neutral tone regarding the state of Canada's science and technology infrastructure, opinion makers chose to interpret the results as negative. During the April 24, 1961 broadcast of the CBC program, "Inquiry," several business leaders including Paul Pollock of the Canadian Manufacturers' Association (CMA), and Dr. B.G. Ballard, president of the National Research Council expressed their concerns regarding the survey's findings.<sup>27</sup> They concluded that Canadian business was not conducting enough research and development, nor was private enterprise taking sufficient advantage of the technical discoveries and innovations developed in government laboratories. They also sounded the alarm that should Canadian business fail to conduct higher levels of R&D, it would surrender its ability to remain competitive, it would be unable to attract new talent, and it would lose skilled personnel to other countries.

The panel surmised that this perceived poor R&D track record could be traced to Canadian business owners tendency to risk aversion as they sought guaranteed returns on investment, an impossibility with most research and development programs. The business and government representatives also speculated that perceived low R&D levels were the result of prohibitive costs for smaller firms, the difficulty for many businesses to secure funding for research, and a tax system that discouraged investment. They also argued that proximity to the United States made it too easy to import American developments, and this acted as a disincentive to develop indigenous capacity in Canadian firms.

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<sup>27</sup> NA, Audio-Visual collection "Inquiry, 1961 CBC broadcast." V1 8112-0046, ref # 1993-0182.

Therefore, the early outlook on Canada's R&D capacity emphasized what Canada lacked rather than what it had accomplished. This distorted viewpoint was further clouded by the Canadian tendency to mentally colonize itself to the British and Americans. When the Glassco Commission conducted its analysis of Canada's R&D capacity in international terms, it did so only in relation to the United States and the United Kingdom, two economies more greatly developed than Canada's, especially in industrial terms. Not only were they very different from Canada in terms of size and relative maturity, Canada depended far more heavily on natural resource extraction, an industrial sector that was less likely to invest in research and development.

While there were legitimate reasons to compare Canada with the U.S. and U.K., ultimately these comparisons served to emphasize Canada's shortcomings relative to the American superpower and the former British imperial power. The Glassco Commission science study group used the United States and Great Britain as comparison points because they were Canada's principal trading partners and allies, and they shared many institutional and ideological similarities. The Glassco Commission was also interested in applying the advantages of the British and American defence industrial strategies to Canada, and therefore it was a sound analytical choice to include them as bases of comparison. However, the fact that the study group employed no other measure, like Australia or France, two other countries with which Canada shared a cultural affinity, indicated the mindset affecting Canadian government and business elites, who sought to emulate the two great Anglo metropolises. The effect of this misguided imitation was similar to music students comparing themselves with professional musicians. While they might strive to reach

high levels of accomplishment, focusing on differences in skill and ability could tend to intimidate them, particularly if they had a propensity to interpret these inequalities overly negatively. However, that is precisely what occurred in Canada's case as policy directives focused only on where Canada lagged, not on what had worked well. The Glassco Report was highly influential on the Liberal government, and created an undue sense of urgency to rapidly boost Canadian industrial R&D.

This overly critical perspective was not confined to government circles. The business press also tended to presume, and then highlight, what it perceived as Canada's failures. When the Organization for Economic Cooperation and Development (OECD) published its first review of its members' science policies in 1967, the *Financial Post's* headline declared that Canada's "R&D Spending Lags Behind Effort by Most European nations."<sup>28</sup> This "bad news" emphasis failed to contextualize Canadian achievements in historical terms. At the beginning of the 20th century, Canada had low levels of industrialization, a nascent university structure, and relied on natural resource extraction as the leading sector of its economy. That the country managed to create a reasonably robust industrial research structure in only seven decades, given this rudimentary starting point, was rarely acknowledged or factored into government planning and advice, or in media commentary. Instead, many policy and opinion makers chose to focus on the perceived defects of Canada's R&D base rather than building on its strengths. Nor did many attempt to understand how such remarkable success had been achieved, and the ways in which it could be strengthened and replicated.

While the media's interpretation might be explained in terms of its propensity to focus on controversy, the fact that this alarmist and misleading conclusion carried through to research-based institutions like the Science Council of Canada is not so readily excusable. The Science Council's *National Science Policy for Canada* framed its policy recommendations from the perspective that "industrial R&D activity in Canada is still far below that of most other industrial countries." Yet, the Council admitted in the next sentence: "There are no rules for determining optimum levels for this activity." However, this did not prevent Council members from warning that the "current tendency raises serious doubts about Canada's future ability to compete in the world market for technological products."<sup>29</sup> So, despite any proven analytical base by which to measure appropriate levels of R&D activity, the Science Council spread the fearful perception that Canada was under threat because it "lagged" so far behind other industrial nations.

This inferiority complex expressed itself in many ways. For instance in 1968, the *Ottawa Citizen*, treating the *ISIS-A* launch in a dismissive manner, remarked that because the American space program had already landed people on the moon that "Canada's next space shot is hardly likely to set the world on fire."<sup>30</sup> While most Canadians would agree that a refreshing self-honesty is preferable to an unrelenting atmosphere of boosterism, this under-appreciation was paralyzing. Thus, when the Science Council of Canada surveyed over 12,000 Canadian scientists in 1984, most

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<sup>28</sup> *The Financial Post*, November 25, 1967, p. 16

<sup>29</sup> Science Council of Canada, *Towards a National Science Policy for Canada*, p. 19.

<sup>30</sup> Tracey Morey, "Alouette's Sister: Third Bird Set to Fly," *Ottawa Citizen*, December 31, 1968, p. 1.

expressed a pessimistic outlook on "Canada's capacity to realize its potential and exploit the benefits of emerging technologies. The outstanding image that emerges is one of timidity, passivity and dependence."<sup>31</sup> This pessimistic outlook was likely influenced by J.J. Brown's 1967 study of Canadian invention. Brown concluded that the Canadian "failure" to innovate was caused by the country's conservatism and tendency to risk aversion.<sup>32</sup>

This negative self-image has also seeped into Canadian scholarship. As recently as 1994, in an otherwise quite balanced account of Canada-U.S. foreign relations, historians John Herd Thompson and Stephen J. Randall felt compelled to deride Canada's view of itself as a "middle power." In their opinion, that term "exaggerates the political, economic, and especially the military power of Canada in the world arena. Under what criteria could Canada be considered a 'middle' power in the post-1945 era, for instance, in comparison to the economic and military capabilities of such non-superpowers as Israel, South Africa, India and even Iran and

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<sup>31</sup> Guy Steed and Scott Tiffin, *A National Consultation on Emerging Technology* (Ottawa: Ministry of Supply and Services, 1986), p.8. In their analysis of the survey results, Scott Tiffin and Mary Wallis attributed the scientists' gloomy outlook to a cultural mythology based on a "consistent set of values and beliefs that perpetuates a negative national self-image." Tiffin and Wallis, "Negative Myth-Making: Canada's Self-Image and its Implications for Scientific and Technological Development," *Journal of Canadian Studies*, vol. 24, no. 1 (1989).

<sup>32</sup> J.J. Brown, *Ideas in Exile: A History of Canadian Invention* (Toronto: McClelland & Stewart, 1967). Christian de Bresson challenged Brown's findings in a 1981 article in which he argued that Brown had used a rather dubious typology that "define[d] innovation and inventing in a way as to lose their distinction." See de Bresson's "Have Canadians Failed to Innovate?: The Brown Thesis Revisited," in *Journal of the History of Canadian Science, Technology and Medicine*, vol. 6, no.1 (1982): 10-23.

Iraq in more recent years?"<sup>33</sup> While Thompson and Randall made a solid case in terms of Canada's military strength, their dismissal of the country's economic importance and its diplomatic influence suggested that they have, at least to some extent, inculcated the self-effacement that pervades Canada's cultural consciousness.

Canadian self-doubt was also reflected in the way in which historical interpretations tended to accentuate the negative regarding Canada's wartime technological accomplishments. Writing in the 1990's, military historian and Canadian nationalist, Desmond Morton, castigated Canadian-built radar units as "inferior" and Lancaster planes as "heavier and more dangerous to their crews than British-produced planes."<sup>34</sup> While his interpretation of Canadian industrial incompetence may be valid, his conclusions regarding Canada's post-war defence industries contradicted his earlier observations about the weaknesses in Canada's wartime output. Morton classified the post WWII trend towards North American integration, that he believed was consolidated by the 1959 Defence Production Sharing Agreement (DPSA), as "a retreat from the industrial and technological

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<sup>33</sup> John Herd Thompson and Stephen J. Randall, *Canada and the United States: Ambivalent Allies* (Athens and London: The University of Georgia Press, 1994), p. 2.

<sup>34</sup> Desmond Morton, *A Military History of Canada* (Toronto: McClelland & Stewart, 1990), p. 184. In his *Arms, Men and Governments: The War Policies of Canada, 1939-1945* (Ottawa: Queen's Printer, 1970), C.P. Stacey recounted that the Canadian crown corporation, Research Enterprises Limited (REL), produced 667 sets of the Mark II C radars. The British retained their own sets, which were smaller and more mobile, and redistributed 600 of the Canadian radars to its allies, including Russia. Stacey reported that the British War Office found the Canadian "equipment was good, but that it would have been better had there been closer technical liaison between Britain and Canada in the early days of its development," p. 510. He concluded that it was difficult to assess the Canadian contribution as it was a "*contribution* [original emphasis] -- a share and necessarily in most cases not a major share, in a great and complicated joint effort," p. 512.

competence [Canada] had mobilized by 1945,” and that the signing of the DSPA left Canada “militarily and economically close to the status of an underdeveloped nation.”<sup>35</sup> Professor Morton cannot have it both ways, however. Either Canada’s achievements in WWII were of sufficient competence to be lamented, or, if we accept his assessment that Canadian technological competence severely lacked during WWII, the DSPA should be celebrated as saving Canadian military personnel from exposure to “shoddy” and “dangerous equipment.”

In contrast to the defensive nationalism evident in Professor Morton’s interpretation, the 1950’s marked a more celebratory period in which historians often over-accentuated Canadian accomplishments in the war. For instance, Wilfrid Eggleston heralded Canadian participation in the Allied scientific efforts of World War II as that of “a fully qualified member of a strong team rather than of a subordinate or an inferior.”<sup>36</sup> The post-War mood favoured the promotion of a sense of independence and nationhood that had been hard won on the battlefields. Nearly fifty years later, historian Donald Avery provided a more tempered assessment of Canada’s experience and referred to the country as occupying the status of “junior partner in the Anglo-American alliance [that] had neither the capability nor the responsibility of bringing most of these weapons into battlefield use.”<sup>37</sup> Avery acknowledged, however, that National Research Council president C.J. Mackenzie

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<sup>35</sup> Morton, *A Military History of Canada*, p. 270.

<sup>36</sup> Wilfrid Eggleston, *Scientists at War* (Toronto: Oxford University Press, 1950), p. 253.

<sup>37</sup> Donald H. Avery, *The Science of War: Canadian Scientists and Allied Military Technology during the Second World War* (Toronto: University of Toronto Press, 1998), p. 257.

and his colleagues were able to protect Canadian interests and avoided being “mined at will by British and American defence officials.”<sup>38</sup>

Even as the imperial drive encouraged an expansionary outlook during the 1950's, an under-current of defensive nationalism emerged. While the St. Laurent government pursued a cooperative foreign policy with the United States and encouraged American foreign investment, the 1957 Gordon Commission expressed doubts about the direction that the country was pursuing. Gordon articulated the precise dilemma posed by greater economic interdependence with the United States. On the one hand, “the increase in United States investment in Canada accompanied as it has been by new technology and managerial skills, has clearly resulted in a faster rate of economic growth than would have otherwise been possible.” However, in Gordon's assessment, increased American direct investment “has led to United States residents acquiring a controlling interest in many of our largest and fastest growing industries.”<sup>39</sup>

A decade later, when Canadian antipathy towards the U.S. became pronounced, more radical economic nationalists portrayed American ownership of key sectors like oil production as a form of neo-colonial occupation. Yet, the 1950's was not the first era with a marked increase in the number of American-owned subsidiaries operating in Canada. The country's own protectionist and manufacturing preferment policies established in the late nineteenth century created conditions that

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<sup>38</sup> *Ibid.*

<sup>39</sup> Canada, *Final Report of the Royal Commission on Canada's Economic Prospects* (Ottawa: Queen's Printer, 1957), p. 41.

attracted U.S. firms to establish branch plants behind the Canadian tariff wall.<sup>40</sup>

Despite the phenomenon's origins in Canadian commercial and industrial policy, many economic nationalists in the late 1960's insisted on viewing branch plants as a form of deliberate American domination.

By the 1970's, that mentality began to affect scholarly perceptions as historians accepted the conclusion that perceived low levels of Canadian industrial R&D were caused by American branch plant ownership. The dean of Canadian military history, C.P. Stacey, attributed Canada's lack of defence preparedness prior to WWII to the fact that "as so many Canadian firms were subsidiaries of American or British corporations, comparatively little industrial research or development was then conducted in Canada, and of what was done a quite negligible amount had military significance."<sup>41</sup> Writing of his wartime experience in 1975, former National Research Council president, C.J. Mackenzie described Canada as "terribly vulnerable" before World War II due to "our branch-plant complex." Yet Mackenzie contradicted himself with the example that he used. He stated that the only Canadian firms capable of producing radar sets in 1940 were American owned subsidiaries, which implied that the U.S. plants were among the few technically advanced industries in operation in Canada at this point, and belied the wide-spread belief that these firms did not contribute to the Canadian economy in this way. Mackenzie

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<sup>40</sup> Michael Bliss, "Canadianizing American Business: The Roots of the Branch Plant," in Ian Lumsden, ed., *Close the 49th Parallel: The Americanization of Canada* (Toronto: University of Toronto Press, 1970), p. 32. Contrary to then current perceptions that the "branch plant problem" had originated in the 1930's, Bliss traced the roots of the American foreign ownership to Macdonald's 1878 National Policy.

<sup>41</sup> C.P. Stacey, *Arms, Men and Governments*, p. 507.

expressed further regret that, in his view, Canada wasted an important opportunity to develop its science and technology base in the interwar period because it “remained happy to take advantage of a prosperity based on branch-factory industrial pattern that brought modern technological “know-how” in certain fields, but little competence in industrial research or innovation: between the two wars, Canada remained essentially a scientific colony.”<sup>42</sup> The economic nationalist consciousness was also evident in W.E. K. Middleton’s explanation that the industrial research model envisioned for NRC never materialized because in the “the branch plant structure of Canadian industry ... research and development was left to the parent companies.”<sup>43</sup>

Mackenzie’s successor at the NRC, E.W.R. Steacie, acknowledged how Canada benefited from exposure to American technical know-how, but lamented that this “resulted in scientific colonialism at a time when political colonialism was disappearing.” While Steacie recognized the time lag in the development of the two economies, he did so in a rather pejorative manner by noting that the differences in Canada’s R&D base could be explained by the “normal course of development in a relatively backward country next door to the most highly industrialized nation on earth.”<sup>44</sup> The consensus regarding the impact of Canada’s “branch plant economy” on

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<sup>42</sup> Chalmers J. Mackenzie and Mel Thistle, ed., *The Mackenzie-McNaughton Wartime Letters* (Toronto: University of Toronto Press, 1975), p. 134 and 147.

<sup>43</sup> W.E. Middleton, *Physics at the National Research Council of Canada, 1929-1952* (Waterloo: Wilfrid Laurier University Press, 1979), p. 193.

<sup>44</sup> J.D. Babbitt, ed., *Science in Canada: Selections from the Speeches of E.W.R. Steacie* (Toronto: University of Toronto Press, 1965), p.116. The quoted extract was from Steacie’s speech to the Montreal Canadian Club on December 8, 1958. More recent scholarship by business historian Graham Taylor provided a better balanced picture of American owned subsidiaries activities in Canada. See Graham Taylor, “Charles F. Sise, Bell Canada, and the Americans: A Study of Managerial Autonomy,

industrial innovation was apparent in the Science Council of Canada's 1971 report, *Innovation in a Cold Climate*. The Science Council concluded that as Canadian industrial development occurred in a "forced environment of tariff protection," there was a tendency to "import technology" through "direct foreign investment," and thus Canadian industry had few incentives to innovate.<sup>45</sup>

In keeping with the Canadian inferiority complex, there has been a tendency for scholars to exaggerate failure and to ignore accomplishments.<sup>46</sup> A telling example of this is the almost complete absence of Canada's satellite program from recent survey texts of Canadian history, and the nearly ubiquitous reference to the 1959 cancellation of the AVRO-Arrow fighter plane project in these same treatments of modern Canada. While the drama of the Arrow cancellation merited attention, so does

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1880-1905," in the *Canadian Historical Association Papers* (1982): 11-30; "Management Relations in a Multinational Enterprise: The Case of Canadian Industries Limited, 1928-1948," in *Business History Review*, vol. 55, no. 3 (Autumn, 1981): 337-358; "From Branch Operation to Integrated Subsidiary: The Reorganization of Imperial Oil under Walter Teagle, 1911-17," in *Business History*, vol. 43 (no. 3) (1992): 49-68; and "Negotiating Technology Transfers within Multinational Enterprises; Perspectives from Canadian History," in *Business History* vol. 36 (no. 1) (1994): 127-158.

<sup>45</sup> Science Council of Canada, *Innovation in a Cold Climate: The Dilemma of Canadian Manufacturing* (Ottawa: Queen's Printer, 1971), p. 28.

<sup>46</sup> In his *Continental Divide: The Values and Institutions of the United States and Canada* (New York: Routledge, 1990), Seymour Lipset observed that in biblical terms the Canadian outlook is more like Noah's, with its grim acceptance of and preparation for difficult survival conditions, whereas the U.S. mentality reflects Adam, or new beginnings. The Canadian mentality is also quite Job-like, in that it tends to find nobility in its suffering, which, not incidentally, assuages any taint of being the "loser" or in any way "dependent." The Canadian obsession with the issue of dependency could also be explained in gender terms, as most of the scholars who write about Canadian-American relations are male. Any perceived weaknesses would serve as an affront to the norms of masculinity, and would therefore manifest as the type of self-contempt found in these interpretations.

the equally important story of the inception of the Canadian space industry and communications satellite system.

Even though one could argue that the AVRO-Arrow cancellation received so much scholarly focus because it generated considerable commentary at the time of its cancellation, it was equally true that the Alouette-ISIS and *Anik* programs attracted significant media attention. Additionally, Doris Jelly's history of Canada's early satellite program, *Canada: 25 Years in Space*, was available to researchers as of 1988. It is not unreasonable to suppose that the authors of the following histories could have drawn sufficient material from Dr. Jelly's account to include at least one paragraph on the satellite programs.<sup>47</sup>

Yet, the seven survey texts published between 1990 and 2000 contain no mention of Alouette-ISIS, nor *Anik 1*. These overviews include the 1992 edition of *Destinies: Canadian History Since Confederation*, which mentions neither the satellite program nor the Arrow cancellation. The remaining six -- 1990's *The Structure of Canadian History* and *Canada Since Confederation*; 1993's *History of the Canadian Peoples*; 1997's *A Short History of Canada* and the two published in 2000 *Our Century: the Canadian Journey in the Twentieth Century* and *The Illustrated History of Canada* -- all address the Arrow cancellation, but provide no reference to the research and communications satellite programs.<sup>48</sup>

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<sup>47</sup> Doris Jelly, *Canada: 25 Years in Space* (Montreal: Polyscience Publications in co-operation with the National Museum of Science and Technology, 1988).

<sup>48</sup> See R.D. Francis, Richard Jones, and Donald B. Smith, *Destinies: Canadian History Since Confederation* (Toronto: Holt, Rinehart and Winston of Canada, 1992). For those who do address the Arrow cancellation, but not the satellite program, see John L. Finlay and D. N. Sprague, *The Structure of Canadian History* (Scarborough,

When we consider that these texts are intended for use in first year university Canadian history courses, the omission of the research and communications satellite programs and the attention paid to the AVRO-Arrow program help to explain how the myth of Canadian technological incompetence is perpetuated. Admittedly, the history of Canada's science and technology past is poorly developed, and this could illuminate why few historians have paid much attention to this facet of Canadian development when they produce these general surveys. However, the undue attention

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Ont.: Prentice-Hall Canada Inc., 1990); J.L. Granatstein, et al., *Canada Since Confederation* (Toronto: McGraw-Hill Ryerson, 1990); Margaret Conrad et al., *History of the Canadian Peoples* (Mississauga, Ont.: Copp Clark Pitman, 1993); Desmond Morton, *A Short History of Canada* (Toronto: McClelland & Stewart, 1997); Craig Brown, ed., *The Illustrated History of Canada* (Toronto : Key Porter Books, 2000); and Robert Bothwell and J.L. Granatstein, *Our Century: The Canadian Journey in the Twentieth Century* (Toronto: McArthur, 2000). Finlay, Sprague, Granatstein, and Bothwell attributed the Arrow cancellation to cost overruns and the lack of potential buyers for the plane. Morton proffered an additional explanation by arguing that the project met its demise because of Diefenbaker's suspicions about the "Liberal contractor" entrusted with the project. See his *A Short History of Canada*, p. 255. The scholars who wrote *Canada Since Confederation* emphasized the continentalist implications of the Arrow cancellation by linking it with the first Defence Production Sharing Agreement (DPSA). They concluded that these events meant that "there would be Canadian jobs, but defence production would be organized on a continental basis, with the major decisions on military equipment made in the United States," p. 471. In contrast to these surveys developed for university classes, the current grade ten history text developed for Ontario students does emphasize Canada's technological past by highlighting Canadian aviation and space achievements on its front cover. See Bradley Cruxton and W. Douglas Wilson, *Spotlight Canada* (Don Mills, Ont.: Oxford University Press, 2000). Indeed, they devote several pages to the space industry and the satellite program, and focus on *Anik 1* and the origins of the Alouette- ISIS program. However, they made a minor error with regard to satellite policy. It refers to the Chapman Report as being commissioned in 1969, when in fact the Study Group on Upper Atmosphere and Space Programs was established in 1966, and reported in 1967. See pp. 426- 427. Michael Bliss's more specialized survey of Canadian business history, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto: McClelland and Stewart, 1987), also referred to *Anik 1*, and noted that its launch placed Canada in the forefront of satellite telecommunications, p. 496.

paid to the AVRO-Arrow cancellation relative to other technological accomplishments would indicate that the Canadian consciousness has been more greatly disposed towards "failure."

The perception that Canada has contributed very little to science and technology could also illuminate why this sub-field of Canadian history has not evolved. Very little has changed since the late 1970's when the first meeting of the Society for the Study of the History of Canadian science and technology occurred. R.A. Jarrell and N.R. Ball, who edited the collection of papers presented at this 1978 conference, observed the inferiority complex that affected interpretations of Canadian science and technology. They reflected that most scholars believed that "anything done here was, in any event, a pale imitation of more creative work done elsewhere." Jarrell and Ball conjectured that the dearth of scholarship regarding Canada's science and technology past accounted for the fact that "this country does not have a coherent science policy ... because it is unconscious of its science history."<sup>49</sup> Over twenty years later, their observations remain relevant as to both the state of historical interpretation and to the development of science policy.

We have reviewed earlier how the 1963 Glassco Commission recommendations marked the inception of a science policy in the federal government. However, the Glassco Report created a lasting distortion regarding Canada's science and technology base by only comparing the country's record with that of the more developed and much larger American and British economies and defence structures.

Glassco's timing was also unfortunate in that many of the weaknesses it identified relative to Canadian defence industrial policy were addressed by the time its recommendations were made public, as was revealed in a 1968 report by the Economic Council of Canada.<sup>50</sup>

The Glassco Report also placed undue weight on the fact that government laboratories conducted a higher proportion of the country's total R&D efforts than was the case in the United Kingdom or the United States. While U.S. government facilities accounted for only fourteen percent of all American scientific research performed in 1959, the American government funded a large portion of the industrial research performed in private companies through its space and military programs.<sup>51</sup> The Glassco Report and subsequent analyses by the Science Council interpreted these differences as a pronounced weakness in Canadian R&D, and therefore shunned any further reliance on government laboratories as a viable science strategy.

The Glassco Commission's influence was extended as members of the science study group like Dr. Weir and Dr. Whitehead assumed senior positions with the government's internal advisory body, the Science Secretariat of the Privy Council Office. The Liberal government quickly enshrined Glassco's distorted interpretation

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<sup>49</sup> R.A. Jarrell and N.R. Ball, eds., *Science, Technology and Canadian History: The First Conference on the Study of the History of Canadian Science and Technology* (Waterloo: Wilfrid Laurier University Press, 1978), p. ix and xiii.

<sup>50</sup> Canada, Economic Council of Canada, *Science, Technology and Innovation* (Ottawa: Queen's Printer, 1968). The report concluded that "it is now clear that a favourable business climate and changing attitudes towards R&D activities in industry were factors which contributed to the relatively rapid growth and development of industrial laboratories and R&D activities in Canada after 1960. The ... special assistance programmes established by the federal government to encourage industrial R&D activities also made contributions," p. 45.

that Canada had a serious R&D deficit and should act quickly. Influential Cabinet ministers like Maurice Lamontagne, Walter Gordon, and his brother-in-law, C.M. (Bud) Drury, used the newly created Department of Industry to create numerous incentive programs to encourage Canadian industry to undertake research. Some of these worked well, such as the Defence Industrial Research (DIR) Program, but many were poorly conceived and monitored. This frenzied approach resulted in a surfeit of programs that tended to “cancel each other out or [were] incompatible with one another.”<sup>52</sup>

In their haste to foster industrial and regional development, policy makers ignored the lessons of successful programs like Alouette-ISIS. The early satellite program demonstrated that creating R&D capacity takes time and hands-on support to develop skill and experience in the private sector. It also revealed that companies benefited from exposure to market pressures to maintain a competitive edge against the heavily subsidized American and European space programs. Rather than apply the insights gained from Alouette-ISIS, the Departments of Industry and Regional Economic Expansion relied on fast-track programs like tax incentives and massive subsidies to private companies to locate in the Atlantic Canada and western regions.<sup>53</sup>

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<sup>51</sup> Glassco Report, table 2, p. 198.

<sup>52</sup> Science Council of Canada, *Innovation in a Cold Climate*, p. 38. This assessment was corroborated by reviews undertaken by Christopher Green, *Canadian Industrial Organization and Policy* (Toronto: McGraw-Hill Ryerson, 1980), who noted that federal and provincial policies were “too numerous to list,” and Richard French, *How Ottawa Decides: Planning and Industrial Policy-Making 1968- 1980* (Toronto: James Lorimer & Company, Publishers, 1984).

<sup>53</sup> For an overview of Canada’s regional development programs, see Donald Savoie, *Regional Economic Development: Canada's Search for Solutions* (Toronto: University of Toronto Press, 1992).

As government performed research was considered passé, there were fewer attempts to replicate the success of the early satellite program and the development of Canada's space industries. The expansionary imperial drive focused the government's attention on science policies and enhanced its desire to emulate the success of the United States and Great Britain. Yet, when combined with the Canadian inferiority complex and presumption of failure, these conclusions had the deleterious effect of over-emphasizing the "problem" of Canada's industrial R&D base, which was further magnified by the Canadian tendency towards defensive nationalism and the focus on the mistaken notion that the pattern of American foreign ownership impeded the development of Canada's R&D base.

By the late 1960's these prescriptions regarding the need for greater national control of technological innovation was widely adopted within policy circles. The idea to develop a domestic communications satellite system reflected the imperial and nationalistic drives to develop "Canadian" technology. The 1967 Chapman Report expressed the perception that Canada must innovate to survive and urged government to "develop competitive technologies [to] resist the erosion of national control over the essential fabric of our national structure."<sup>54</sup> The Science Council of Canada's report on communications satellites also stressed this need for Canadian control, and declared:

The national interest of Canada demands that Canadian scientists and technologists be enabled to play their part: that Canadian labour be used in Canadian plants to manufacture at least a fair share of the equipment; that Canadian organizations operate the systems, and that

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<sup>54</sup> Canada, Science Secretariat, Privy Council Office, Special Study No. 1, *Upper Atmosphere and Space Programs in Canada* (Ottawa: Queen's Printer, 1967), p. 4.

Canadians reap the benefit of the discovery and development of their resources.<sup>55</sup>

When he spoke to the Canadian Association of Broadcasters in April 1967, Prime Minister Pearson's remarks also reverberated with this growing consensus that Canada needed domestic satellite communications system to "avoid a new kind of domination from abroad."<sup>56</sup>

This pronounced nationalism also accounted for Ottawa's attention on Canada's northern regions in the post-1945 era. Public administration specialists have concurred that there was a greater interest in Canada's northern regions following World War II.<sup>57</sup> The lingering presence of the American military heightened concerns about Canadian sovereignty in the area, and the prospect of mining and other natural resource developments excited considerable interest. In

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<sup>55</sup> Science Council of Canada *Report No. 1: Space Program for Canada* (Ottawa: Queen's Printer, 1967), p. 7.

<sup>56</sup> "Satellite Possibilities Exciting, Says Pearson," *Montreal Gazette*, April 20, 1967, p. 2.

<sup>57</sup> There was a great deal of interest about northern policy among Canadian political scientists throughout the 1980's when the federal government indicated its intent to address long-standing administrative issues in the country's northern regions, especially regarding the Yukon and North West Territories' aspirations to greater autonomy. In June 1988, the department of Indian and Northern Affairs issued *A Northern Political and Economic Framework* (Ottawa: Supply and Services Canada, 1988), which led to the eventual division of the North West Territories and the creation of Nunuvut. For details of federal northern policy in the 1950's and 60's, see Frances Abele and E.J. Dosman, "International Cooperation and Northern Development," *Canadian Public Administration*, vol. 24, no. 3 (1981); Louis-Edmond Hamelin, "Managing Canada's North: Challenges and Opportunities, Rapporteur's Summary and Comments," *Canadian Public Administration*, vol. 27, no. 2 (1984); Mike Moore and Gary Vanderhaden, "Northern Problems or Canadian Opportunities," *Canadian Public Administration* vol. 27, no. 2: (1984); and Frances Abele and Katherine Graham, "Plus Ce Que Ca Change... Northern and Native Policy," in Katherine Graham, ed., *How Ottawa Spends 1988-89* (Ottawa: Carleton University Press, 1988).

1948, the federal government created the Advisory Committee on Northern Development (ACND), and in 1953 it established the Department of Northern Affairs and National Resources (DNANR) to administer the growing number of federal programs directed towards northern development. In 1963, the Glassco Commission recommended better coordination of federal activities in this region, and in 1966 the Advisory Commission on Development in the Northwest Territories (the Carrothers Commission) advocated a more strategic vision on northern development.<sup>58</sup> By the late 1960's, the combined concerns of protecting Canadian sovereignty and the expansionary drive to develop its resources created an intense focus on northern issues in most government policy discussions.

This was certainly the case with the 1968 *White Paper on a Domestic Satellite Communication System for Canada*, which was filled with references to expanding communications services to northern Canada in order to facilitate economic development<sup>59</sup> That vision was apparent in the public relations efforts that the Department of Communications undertook to celebrate *Anik 1*. The government invited several young Inuits to attend its launch and tour the Telesat Canada control facilities in Ottawa.<sup>60</sup> The image of Aboriginal youth engaging with scientists and

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<sup>58</sup> Canada, *Report of the Advisory Commission on Development in the Northwest Territories* (Ottawa: Queen's Printer, 1966).

<sup>59</sup> Canada, Department of Industry, *White Paper on a Domestic Satellite Communication System for Canada* (Ottawa: Queen's Printer, 1968), p. 34.

<sup>60</sup> See NA, Audio-visual collection, "Space, Time and *Anik 1*." July 1973 television program hosted by Lloyd Robertson on the world's first domestic commercial communications satellite, *Anik 1*. ISN: 11795, V18601-0116, ref no. 1985-0642. The satellite's name, *Anik*, means brother in Inuktitut and reflected the government's aspirations for northern development and its belief in the "promise" of a technologically advanced future.

technicians reflected the government's aspirations to link northern development with a vision of a unified and economically advanced nation.

The many policy dimensions encompassed by the 1968 *White Paper on a Domestic Satellite Communication System for Canada* indicated the extent to which politicians and bureaucrats viewed the proposed satellite system as a panacea for the country's unity crisis, as well as a defence against U.S. commercial and cultural dominance, and as an opportunity to foster growth. The federal government treated the satellite project as an idealized form of nation-building that traced its roots to the nineteenth century. Key policy documents such as the 1967 Chapman Report and the 1968 White Paper were filled with references that likened satellite communications to earlier transportation systems such as the railways. The Chapman Report argued that space technology should be harnessed to the national interest as "the 'iron horse' had conquered the prairies in fulfillment of the promise of Confederation."<sup>61</sup> The media also relied extensively on transportation metaphors when it drew parallels between the CPR and *Anik 1*, and preached that communications were essential to Canada's development. A 1968 feature in the *Ottawa Citizen* claimed that "from the beginning, national survival has hinged on the transportation of men, materials, and information along a narrow east-west band hugging the 49th parallel for more than 3000 miles."<sup>62</sup>

Policy makers also invoked warfare images to stress the importance of technological nationalism to survival. During a presentation to Carleton University students in 1967, John Chapman claimed that the space age represented a new

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<sup>61</sup> Chapman Report, p. 93.

battlefield in which engineers and managers acted as “shock troops” and their that arsenals included “automation, electronics, computers and chemicals, and the computer is a fifth column.”<sup>63</sup> David Thomas’s 1983 overview of the computer industry in Canada also employed a warfare analogy. He portrayed the computer industry as caught in life or death contest in which “victory [against IBM] will mean the survival of [Northern Telecom], and also of Canada as a well-spring of high-technology invention.” Thomas revealed his imperial drive mindset when he linked the corporate struggle with national well-being and counseled that “defeat might mean loss of the principal source of strength and renewal for most of the country’s high-technology industry.”<sup>64</sup>

What few policy or opinion makers have questioned, however, is how national can capital be? The profit motive that underlies the capitalist system emphasizes private interests over community concerns. Even publicly-owned corporations are exposed to market forces to some degree and must conform to capitalist norms to participate in an international system dominated by the logic of competition and the drive to edge out any perceived threat. Yet, as business historian Michael Bliss has argued, calls to nationalism by Canadian companies have often proved successful.<sup>65</sup>

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<sup>62</sup> “Looking to Tomorrow’s Confederation: Accent on Communications,” *Ottawa Citizen*, October 26, 1968, p. 8.

<sup>63</sup> NA, MG 31, J43, volume 5, file 8, “Chapman, J.H. DRTE Correspondence, April - May 1967.” May 14, 1967 Presentation by Chapman to Carleton University, “Social and Economic Implications of a Canadian Space Program,” p. 1.

<sup>64</sup> David Thomas, *Knights of the New Technology: The Inside Story of Canada’s Computer Elite* (Toronto: Key Porter Books, 1983), p. 17.

<sup>65</sup> In his *Northern Enterprise*, p. 512. Bliss noted that business interests favoured the rhetoric and policies associated with economic nationalism in order to reduce competition.

Indeed, even with their technically inferior and costlier proposal, RCA of Montreal executives' lobby efforts and patriotic rhetoric almost succeeded in having their company selected as the main contractor on the *Anik 1* satellite. That RCA of Montreal was one of the dreaded American branch plants so excoriated by economic nationalists revealed yet another layer of the paradox that enveloped Canada-U.S. relations and Canadian political economy debates.

Indeed, at first glance the selection of the American company Hughes Aerospace over the Canadian-based RCA of Montreal, might seem to represent an abandonment of the nationalistic perspective that pervaded federal policy circles in the late 1960's. It was not, however, as the ultimate goal was to establish a communications satellite system under Canadian control. The much less expensive and more technologically advanced Hughes's bid made that particularly nationalist goal feasible. Also, the federal government negotiated with Hughes to ensure maximum Canadian content in the new satellite.

Misleading expectations marred what was an essentially successful policy as federal Communications Minister, Eric Kierans, fell victim to his own nationalistic rhetoric. He promoted the satellite project as "100% Made in Canada," which inflated government officials' estimates of the satellite portion of the system by nearly fifty percent. The "100%" characterization reflected nationalistic aspirations that were apparent since the 1956 Gordon report, which exhorted the government to "Canadianize" its industries in order to survive. The Hughes decision revealed the extent to which Canada's technologically advanced industries were interdependent

with the United States, and the power of perception to shroud a largely effective program with the taint of failure.

The satellite contract selection process also exposed the contradictions that fueled the particular Canadian oscillation and its expansive and defensive forms of nationalism. During the 1950's, Canada pursued many cooperative programs with the United States that were designed to enhance Canada's defence preparedness and develop Canada's economy. When this increased interdependence with the United States began to be viewed in more negative terms, economic nationalists called for greater Canadian ownership and less reliance on the U.S. Yet the very American strengths that Canadian economic nationalists despaired of were the same ones that benefited Canada's space and other advanced technology industries. By misreading the policy landscape, adopting a misplaced sense of urgency, and surrendering their agency to the American metropole, economic nationalists attenuated their own vision of greater Canadian innovative capacity. Their haste and mis-diagnoses wasted valuable resources, and, ultimately, discredited interventionist industrial policies.

## *Conclusions*

Cold War defence concerns motivated Canadian policy makers to enter the space age alongside the American and Soviet superpowers. The U.S.S.R.'s launch of *Sputnik I* in October 1957 triggered a massive sense of insecurity in the capacity of Western science and technology and provided the Soviets with a tremendous tactical advantage in the use of missile technology. Space became militarized.

The scientists at the Defence Research Telecommunications Establishment (DRTE), a branch of Canada's Defence Research Board (DRB), quickly mobilized to track the Soviet satellite and used the data for defence preparations against inter-continental ballistic missiles (ICBMs). The sense of urgency created by the Soviet breakthrough proved to be a sufficient impetus for Canada to develop an agreement with the newly established U.S. National Space and Aeronautics Agency (NASA) to build its own satellite, *Alouette I*.

Aside from strategic defence concerns, the mandate of the DRB was to promote Canadian defence industrial competence and to encourage, where possible, the transfer of military technological breakthroughs to the civilian economy. The DRB (established in 1948), the Department of Defence Production (DDP, established in 1950), and Canadian Arsenals Limited (CAL, established in 1950) all served the dual goal of promoting defence preparedness and Canadian industrial growth. The DRB grew out of the experience of World War II and the National Research Council's (NRC) involvement with the British and American research effort. C.D. Howe, Minister of Munitions and Supply, and C.J. Mackenzie, who served as

president of the NRC during the war and who marshaled Canada's meagre scientific resources into a meaningful contribution to the Allied cause, sought to further enhance Canada's technological competence in the post-1945 era. Mackenzie favoured returning the NRC to a civilian focus, and argued successfully for the creation of a new defence-oriented research organization, the DRB. Canada's participation in the Korean War led to increased defence expenditures and a further reliance on defence industrial planning to promote economic growth. Thus, DRB's mandate was consistent with an *imperial drive* to survive and expand.

As they worked from 1959 to 1962 to produce Canada's first artificial satellite, the DRTE scientists and engineers broke new technological ground and matched anything that the U.S. could produce at that time. The first *Alouette* satellite was meant to function for one year, yet, it did so for ten and provided millions of pieces of data that were used by researchers around the globe. Canada's technical achievement garnered several prestigious international awards including the Dellinger Gold Medal in 1966 and the International Engineering Association award twenty years later. The two private sector companies involved in the satellite project, de Havilland and RCA of Montreal, parlayed the innovations they developed for *Alouette* into many international sales. de Havilland's STEM (storable, tubular extendible member) antenna was incorporated into the American space program, while RCA provided equipment for the burgeoning communications satellite industry in the United States.

Based on the resounding success of the first *Alouette* in both scientific and industrial development terms, the federal government agreed to a more extensive

cooperative program with NASA. ISIS (International Satellites for Ionospheric Study) and *Alouette* were so successful because they were based on a long established record of research excellence in ionospheric research in Canada, DRTE's world class scientific and engineering talent, and sound project management abilities. DRTE modeled its strategy of gradually transferring skills and knowledge to the private sector from other successful DRB programs. However, this system of working side-by-side private sector technicians and engineers did not always operate smoothly. As one DRTE official reflected in the mid-1960's, the first *Alouette* was so successful because it was in a sense hand-crafted. The later satellites experienced more difficulty in the design and construction phases because of the necessary learning time and loss of project control that occurred when the projects were transferred to the private sector.<sup>1</sup>

Overall, however, the industrial development component of the *Alouette*-ISIS program proved to be far-sighted. One of the main criteria upon which DRB senior managers based their decision to enter into the ISIS agreement with NASA was the Canadian space industries' abilities to secure markets for their products. DRB planners understood that a subsidized government program was doomed to failure unless companies could become self-sustaining. The Canadian domestic market was too small to support a Canadian space products industry, and government planners perceived that it was highly unlikely Canada would develop a space program as large as that in the United States. From the inception of Canada's early space program,

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<sup>1</sup> NA, RG 97, volume 219, file 99, "Alouette-ISIS Space Program, pt. 3." April 1, 1965 draft report to the Treasury Board, re: ISIS Satellite Program, p. 1.

Canadian companies were required to compete in the American and European markets, which served them well in the long run.

There were some weaknesses in the program, however. Rather than incorporating university participation -- particularly the training and employment of new scientists -- in the program from its inception, DRTE planners had to react to university demands for participation in the program. This oversight was strange since there were high levels of cooperation and interchange between the DRTE and other upper atmosphere research programs at the Universities of Saskatchewan, Toronto, and Western Ontario. In any event, university researchers were involved, but on their ability to produce excellent research rather than on nationalistic criteria that favoured Canadian university participation for mere inclusion's sake.

Alouette-ISIS also suffered from the drawbacks attendant to most government programs designed to foster industrial R&D. At some point policy makers have invested so much in one firm that it becomes awkward to turn to other companies, even when difficulties begin to appear. For example, RCA of Montreal, which was selected as the main contractor on the second *Alouette* as well as *ISIS A* and *B*, experienced management problems throughout the construction of the three satellites, which caused delays and cost escalation. Yet, since RCA of Montreal possessed the greatest level of satellite expertise in Canada, it was best placed to be considered for the prime contractor position for the *Anik 1* satellite once the government committed to creating a domestic telecommunications satellite system in 1968. However, during the final stages of the selection process for *Anik 1*, the weaknesses of the Canadian

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firm relative to the U.S.-based Hughes Aerospace were revealed when it lost the contract to the American aerospace giant.

Even with their overall success, the Alouette-ISIS programs attracted the scrutiny of the Royal Commission on Government Organization (Glassco) in the early 1960's. The Glassco Commission expressed reservations that the satellite program had grown beyond its defence mandate, and therefore recommended that any civilian-based projects undertaken by the DRB be transferred to the NRC.

The Glassco Commission also focused on defence industrial programs in general and raised concerns about the low levels of research contracted to private firms and DRB's greater emphasis on basic science relative to applied work. Glassco observed that senior defence officials assumed that Canadian industry was incapable of producing high quality weapons, and concluded that these attitudes formed one of main barriers to higher levels of private sector participation in defence research. However, the timing of the Glassco Commission's research was unfortunate as it did not take into account new programs like the Defence Industrial Research (DIR) program, which was created in 1961 to take advantage of the new terms of the second Defence Production Sharing Agreement (DPSA) with the United States. According to the Economic Council of Canada, after seven years, the DIR had contributed significantly to the growth in the number of Canadian firms undertaking R&D.

The Glassco research team that was responsible for reviewing Canada's scientific research record created even greater, and eventually quite damaging, policy distortions when they compared Canada's track record with only the United States and Great Britain. While Canada shared a number of cultural and ideological

affinities with these two countries, their more advanced and larger economies relative to Canada's constituted an unfair comparison. Rather than compare Canada with more similar economies or take into account its historical reliance on natural resource extraction, a sector far less reliant on R&D than secondary manufacturing, this attempt to duplicate the American and British successes proved untenable. The choice of the two imperial cultural and economic metropolises also reflected the colonial mentality deeply imbedded in the Canadian psyche.

One of the other lingering effects of the Glassco Commission findings was the emphasis placed on the perceived low levels of private sector R&D, and the rather pejorative outlook on government based R&D. Since the U.S. and Great Britain were both less reliant on government R&D, the Glassco Commission tended to downplay its value to scientific and industrial progress. Again, without taking Canada's particular circumstances and historical development into account, the Glassco Commission, and those who adopted its findings, placed an undue sense of urgency on the need to develop industrial R&D.

Indeed, Glassco's findings were contradicted by the Organization for Economic Cooperation and Development (OECD) when it reviewed Canada's science and technology base in the late 1960's. The OECD concluded that Canada R&D resources had progressed well, and that, in particular, the country was well placed to take advantage of advances occurring in electronics and manufacturing research, which had been fostered in large measure by federal laboratories and industrial support programs.

However, the Glassco Commission proved to be very influential on the Pearson and early Trudeau governments. In 1964, the recently elected Liberal regime created the Science Secretariat of the Privy Council Office, and, in 1966, it established an external advisory body, the Science Council of Canada. While the Liberals were the first federal political party to adopt this approach to economic growth, the New Democratic Party of Canada (NDP) soon became an avid promoter of science policy. The NDP enjoyed a fair amount of influence in the late 1960's and early 1970's, partly because the Liberal party viewed it as its main rival for the growing youth vote.

Influential members of the Liberal Party like Walter Gordon found many allies within the NDP, who agreed with him regarding the causes of the perceived weaknesses in Canada's industrial R&D base. The economic nationalist school of thought, despite evidence to the contrary, concluded that Canada's purported "technological under- development" was caused by the country's "branch plant economy." It conjectured that American corporate headquarters prevented Canadian subsidiaries from undertaking research in order to keep them dependent on the parent company or prevent competition from them. While there were significant levels of American ownership in Canada during the 1960's and 1970's, especially in key sectors like energy and secondary manufacturing, earlier studies by economists Lindeman and Safarian found that in fact these firms conducted research. The review conducted of Canada's scientific base by the OECD in the late 1960's also concluded that American-owned firms performed R&D.

The unduly pessimistic portrait of Canadian R&D created by the Glassco Commission, and the unfounded accusations of the economic nationalists, pressured the Pearson and early Trudeau governments to embark on ambitious nation building programs. In the 1960's, based on this widely held consensus that Canadian industry performed insufficient R&D, the Departments of Industry and Regional Economic Expansion initiated numerous programs to diversify Canada's industrial and economic base and create employment. Unfortunately, few of these initiatives were as well planned and executed as the carefully managed Alouette-ISIS satellite programs. Additionally, their unwarranted sense of urgency caused policy makers to opt for "quick fixes" like the poorly monitored R&D tax incentive programs, which could not match the efficacy of the research satellite programs that relied on the gradual transfer of skills and knowledge to industry.

By focusing on the wrong issue (branch plant ownership) and exaggerating the problem of private sector R&D, government planners undermined their attempts to enhance Canada's scientific and technological capacity, and may have in the long run contributed to the neo-conservative agenda to discredit state interventions of this type. Thus, the paradox of economic nationalism was that it weakened Canadian initiative rather than strengthen it, as was the purported intent.

The Liberal governments of the 1960's and 1970's pursued ambitious, expansionary agendas, which were exemplified by their decision to develop a domestic satellite telecommunications system. Politicians and senior bureaucrats construed satellite communications as natural for Canada, and believed that it offered a technological solution that would respond to the challenges posed by the country's

vast geography, sparse population, the unity crisis generated by Quebec nationalism, and competition from American broadcasters and telecommunications companies.

As early as 1963, there was a strong consensus among opinion makers within academia, business, and government about the importance of expanding Canada's space research program. They argued that these public investments were necessary to prevent "brain drain" to the United States, and ensure Canada's future prosperity. Indeed, the impetus to expand Canada's space program was consistent with the emerging imperial drive consciousness, which deemed scientific and technological prowess as the key to national growth and prosperity.

By 1966, the many calls for an expanded space research program converged on the idea of constructing a domestic telecommunications satellite system to meet Canadian industrial and cultural requirements. The government also experienced pressure from entrepreneur Kenneth Soble, who proposed the creation of a third television network in Canada based on a domestic satellite system. Soble was soon joined by other private sector interests like the telecommunications carriers, who also urged the government to develop such an ambitious infrastructure.

These combined forces caused Canada to construct the world's first domestic telecommunications satellite system. The government's policy directions were steered by a uniquely Canadian consciousness that was generated by the contradictory imperial drive to expand, and the defensive nationalism to protect itself from more powerful countries like the United States. However, the distortions and fears perpetuated by the economic nationalist school of thought frustrated these economic

development plans. Rather than the progressive path that they believed they were creating to serve Canadian interests, they undermined their own vision.

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