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**Flying in Ground Proximity:
Thirteen Case Studies of Aircraft Flight Routes in Canada
1918-1926**

By

SHANNON DREW, B. Sc.

A thesis submitted to
the Faculty of Graduate Studies
in partial fulfillment of
the requirements for the degree of

(Master of Arts)

Carleton University
Ottawa, Ontario
October 23, 2001

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**“Flying in Ground Proximity:
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the degree of Master of Arts

Thesis Supervisor

Chair, Department of Geography and Environmental Studies

CARLETON UNIVERSITY
November 2001

Abstract

Aviation today is an integral part of Canada's transportation and communication network. Within the Canadian consciousness there is a connection between the role of aircraft and the development and exploration of Canada's Northern landscape. However, aviation is a relatively new technology and it has not always provided the same type or level of services.

This thesis investigates the genesis of aircraft's functional role in Canada and the impact of aviation on the construction of a Northern frontier during the formative years following the First World War. To facilitate the investigation the thesis reconstructs the spatial limits of where flights were occurring in relation to Canada's North and examines flight patterns including actual routes utilized throughout Canada from 1918 until 1926. Three key themes are examined to shed light on the factors contributing to the pattern and processes observed: geography, administration and technology.

Through the analysis of the routes and locations of flights it is evident that aircraft were following existing transportation corridors, waterways and railroads, throughout Canada. This reliance on ground based reference tied aircraft to existing areas of development and restricted their role in opening up the Canadian North during this time period.

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Table of Contents

Title Page	i
Acceptance Form	ii
Abstract	iii
Acknowledgments	iv
List of Tables	x
List of Figures	xi
List of Maps	xii
List of Appendices	xiii
<u>Introduction</u>	1

Chapter One

<u>Flight and Geography in Canada During the Transitional Phase</u>	13
1.1. Flight and Aircraft During the Transitional Phase	14
1.1.1. Context.....	14
1.1.2. Categories of Flying in Canada During the Transitional Phase	17
1.1.2.1. Government Military Flying or Military Operations.....	19
1.1.2.2. Government Civil or Civilian Flying.....	19
1.1.2.3. Commercial Flying and Commercial Operations	19
1.1.2.4. Private Recreational Flying.....	20
1.2. Geography: The Construction of Landscape and Frontier Applied to the North in Canada	20
1.2.1. The North in Terms of Landscape.....	21
1.2.1.1. The Link Between Landscape and Power.....	22
1.2.1.2. The Link Between Landscape and Politics	22

1.2.1.3.	The Link Between National Identity and the North	23
1.2.2.	The North in Terms of Perceived Frontier Experience Theories	25
1.2.2.1.	The Political and Settlement Frontier	25
1.2.2.2.	The Remote Frontier	26
1.2.2.3.	The Second Frontier	27
1.2.2.4.	The New Internal Frontier	28
1.2.2.5.	The Eternal Frontier	29
1.3.	Transportation Technology and Regional Geography Applied to the Concept of Canadian North	30
1.3.1.	The Pre-Aircraft Transport Routes and the Extension of the Nation From Sea to Sea	31
1.3.2.	The Location of the Northern Frontier and the Establishment of Infrastructure	33
1.3.2.1.	The Impact of the Missionaries	34
1.3.2.2.	The Impact of the Royal North-West Mounted Police	36
1.3.3.	Transportation and Accessibility to the Northern Frontier During the Transitional Phase	37
1.3.3.1.	Waterways as Dominant Routes to the North	39
1.3.3.2.	Railways as a Technology Restricting the Location of the North	44
1.3.3.2.1.	The Railway Boom in Ontario and Quebec	47
1.3.3.2.2.	The Railway Boom in the Prairies	48
1.3.3.2.3.	The Railway Boom in British Columbia	48
1.3.3.2.4.	The Railway Containing the North Within the Hinterland	49
1.3.4.	Geography of Canada: Uniformity and Diversity	51
1.4.	Locating the Perceived Northern Frontier During the Transitional Phase	52
1.5.	Summary	64

Chapter Two

<u>The Administration and Organization of Flying During the Transitional Phase</u>	66
2.1. Canadian Aviation Emerging From the First World War	67

2.1.1. The Enactment of the Air Board: 1919	68
2.1.1.1. The First Year of the Air Board	69
2.1.1.2. The Appointment of a New Air Board	70
2.1.1.3. The Main Focus of Flying: The Hinterland	71
2.1.1.4. Regulation of Flying in Canada	72
2.1.2. The Air Board's Control Over Flying in the Provinces	73
2.1.3. The Air Board's Establishment and Operation of Air Stations in the Provinces	75
2.1.4. The Air Board's Air Stations in the Hinterland Until 1922	79
2.1.5. The Last Year of the Air Board	82
2.1.5.1. Replacing the Air Board: The Royal Canadian Air Force	83
2.1.5.2. Civilian Air Operations Versus Military Aviation	83
2.1.5.3. Closure of Air Stations in Quebec and Ontario	85
2.2. The Royal Canadian Air Force Years	86
2.2.1. The Air Service in Ontario	87
2.2.2. The Air Service in the Pacific	88
2.2.3. The Air Service in the Prairies	88
2.2.4. The End of Military Control Over Civilian Aviation	89
2.3. Demand for Civilian, Private and Commercial Aviation in Resource Development	91
2.3.1. The Central Region	91
2.3.1.1. The Laurentide Air Service	91
2.3.1.2. Resource Development Companies Venture into Aviation	93
2.3.2. The Prairie Region	94
2.3.3. The Pacific Region	95
2.3.4. Aerial Surveying	96
2.3.5. Aviation in the Resource Sector	97
2.4. Success Stories Throughout the Transitional Phase	98
2.5. Summary	99

Chapter Three

<u>Aircraft and Technology</u>	101
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3.1. Brief History of Flight	103
3.2. Canadian Aircraft Manufacturing: A Void	108
3.3. Military Surplus Aircraft: The Imperial Gift	109
3.4. The Aircraft of the Transitional Phase	115
3.4.1. Instrumentation	117
3.4.2. Flying in the Transitional Phase: The Vagarious Weather	119
3.4.2.1. Pushing the Weather: Pushing the North	119
3.4.3. Aircraft Engines	123
3.4.4. Payload: Fuel Versus Freight Load	126
3.4.4.1. Fuel Caches: A Necessity of Hinterland Travel	127
3.5. Summary	128

Chapter Four

<u>Flight Routes During the Transitional Phase: Historical Case Studies as Viewed in the Geographical Context of the Pacific, the Prairie and the Central Regions</u>	130
4.1. Division of Canada into Regions	131
4.1.1. The North Region	133
4.1.2. The Maritime Region	135
4.2. Transportation Structures and Flying During the Transitional Phase	136
4.2.1. Flying in Ground Proximity	140
4.2.2. Flying in the North	144
4.3. Analysis of Historical Case Studies Applied to the Three Regions	145
4.3.1. The Central Region	146
4.3.1.1. St. Maurice Forest Protective Association Flight Route	146
4.3.1.2. Canadian Aerial Services Flight to Moose Factory	147

4.3.1.3.	Rouyn Gold Rush Flight Route	151
4.3.1.4.	Red Lake Gold Rush Flight Route	154
4.3.2.	The Prairie Region	156
4.3.2.1.	Eastern Prairie Sub-Region	158
4.3.2.1.1.	Manitoba Forest Patrol Flight Route	158
4.3.2.1.2.	Indian Treaty Money Flight Route	160
4.3.2.2.	Western Prairie Sub-Region	163
4.3.2.2.1.	Alberta Forest Conservation Patrol Route	163
4.3.2.2.2.	Jasper National Park Photographic Flight Route	165
4.3.3.	The Pacific Region	167
4.3.3.1.	Vancouver Island Forest Patrol Route	168
4.3.3.2.	British Columbia Railway Belt Patrol Flight	171
4.3.3.3.	Pacific Coast Fishery Patrol Flight	173
4.3.3.4.	White Pine Blister Rust Flight Route	175
4.3.3.5.	Dease Lake Prospecting Flight Route	175
4.4.	Flight Routes: The National Perspective	180
4.5.	Conclusion	194
	<u>Summary Conclusion</u>	197
	<u>Bibliography</u>	235

List of Tables

Table 2.1	Total Number of Aircraft Flying in Canada During the Transitional Phase.....	73
Table 3.1	Registered Civilian Aircraft.....	110
Table 3.2	Registered Federal Government Aircraft.....	112
Table 3.3	Aircraft of the Imperial Gift.....	114
Table 3.4	Weight Allocation of the Curtiss JN-4 (Canadian).....	124
Table 4.1	Regional Flight Route Summaries.....	181
Table App.I.1	Service Ceiling Comparison of Aircraft Operating During the Transitional Phase.....	205

List of Figures

Figure I	The Transitional Phase Situated Within the Canadian Aviation Timeline	3
Figure II	Focus of the Thesis	9
Figure 1.1	Ground Proximity Flight During the Transitional Phase	18
Figure 3.1	Pattern of Aircraft Technical Development 1909-1945	102
Figure 3.2	Common Aircraft of the Transitional Phase	116
Figure App.I.1	Curtiss JN-4 (Canadian)	203
Figure App.I.2	Service Ceiling of Aircraft Operating During the Transitional Phase	204
Figure App.I.3	Avro 504K	207
Figure App.I.4	de Havilland D. H. 4	210
Figure App.I.5	de Havilland D. H. 9a	212
Figure App.I.6	Avro 552a	214
Figure App.I.7	Curtiss HS-2L	217
Figure App.I.8	Vickers Viking IV	222
Figure App.I.9	Canadian Vickers Vedette	225
Figure App.III.1	Stuart Graham's Flight Log	232
Figure App.III.2	Madge Graham's Flight Log	234

List of Maps

Map 1.1	The Location of Religious Missions Established in Canada After 1800	35
Map 1.2	Location of Royal Canadian Mounted Police Detachments Established Prior to 1920	38
Map 1.3	Geological Regions and Major Mineral Producing Areas of Canada Developed Prior to 1927	40
Map 1.4	Major Vegetation Regions of Canada	41
Map 1.5	Major Water Routes in Canada First Travelled by the Fur Traders	43
Map 1.6	Railway Corridor in Canada During the Transitional Phase	46
Map 1.7	Areas of Canada Surveyed Before 1925	54
Map 1.8	Compilation Maps Used to Construct the Limit Of the Perceived North During the Transitional Phase	55
Map 1.9	Generalized Elevations of Canada	56
Map 1.10	Zone of Denordification 1875-1975 Adapted from Hamelin	58
Map 1.11	Zone of Canadian Nordicity Adapted from Bone	59
Map 1.12	Zones of Canadian Nordicity Adapted from McNiven and Puderer	60
Map 1.13	Limit of the Perceived Northern Frontier During the Transitional Phase	62
Map 2.1	The Location of Federal Government Air Stations	76
Map 4.1	The Five Regions of Canada	134
Map 4.2	St. Maurice Forest Protective Association Flight Route	148
Map 4.3	Canadian Aerial Services Flight to Moose Factory	150
Map 4.4	Rouyn Gold Rush Flight Route	153
Map 4.5	Red Lake Gold Rush Flight Route	155
Map 4.6	Manitoba Forestry Patrol Flight Route	159
Map 4.7	Indian Treaty Money Flight Route	161
Map 4.8	Alberta Forest Reserve Patrol Route	164
Map 4.9	Jasper National Park Photographic Flight Route	166
Map 4.10	Vancouver Island Forest Patrol Route	169
Map 4.11	British Columbia Railway Belt Fire Patrol Route	172
Map 4.12	Pacific Coast Fishery Patrol Route	174
Map 4.13	White Pine Blister Rust Research Flight Route	176
Map 4.14	Dease Lake Prospecting Flight Route	178
Map 4.15	Approximate Location and Distance of Flight Routes Presented in the Case Studies	187

List of Appendices

Appendix I	Aircraft of the Transitional Phase.....	202
Appendix II	Sources, References and Aviation Histories.....	227
Appendix III	Flight Logs of Stuart Graham and Madge Graham.....	231

Introduction

The immensity and diversity of the Canadian landscape have made transportation a matter of the utmost importance throughout its history. From the earliest water routes of fur traders and explorers, access to the hinterland was and is critical to secure economic resources and to establish sovereignty (Town 1999). Developed in the beginning of the twentieth century, aviation held the possibility of forming new transportation linkages divorced from the traditional river and rail routes.

This thesis investigates whether Canadian aircraft flying between 1918 and 1926 forged and established new routes within the country and influenced the construction of landscape and the frontier of the North. For the purpose of the thesis, the years between 1918 and 1926 are chosen specifically to demonstrate pivotal events in Canadian aviation prior to the Second World War. The interest of those eight years were marked by changes in aircraft and administrative transition.

For aircraft, the change was from rudimentary to sophisticated, from adapted to design-specific, and from civil to commercial. Within the administrative context, the transition during those eight years was from military to civil, from absence of aviation policy to established policy, from government operations to private business, and from lack of government support to government subsidies for aviation development. Based on the enumeration of successive changes and transitions, the years between 1918 and 1926 are

introduced, within the context of this thesis, as the transitional phase in Canadian aviation history.

Four Flying Phases in Canada: 1909-1939

Through a literature review of Canadian aviation history it is conceivable to divide flying in Canada prior to the Second World War into four distinct phases: development, aerial warfare, transitional and commercial phases. The following review sets the importance of the transitional phase within Canadian aviation history during 30 years from 1909 to 1939. Figure I of the Canadian Aviation Timeline identifies the transitional phase within Canadian aviation history's development prior to the Second World War.

Development Phase: 1909 - 1914

The development phase began on February 23, 1909, with the first flight in Canada (Fuller, Griffin and Molson 1983, p. 25; Milberry 1979, p. 13). This initial phase was characterized by the experimental nature of flying, where the primary goal of aviators was to become airborne, remain aloft and return alive (Glazebrook 1938, p. 453; MacLeod 1974, pp. 102-109; Riddel 1969, p. 40, MacKenzie 1989, p. 5). The development phase ended with the declaration of the First World War in August 1914 (Douglas 1986, p. 21).

Aerial Warfare Phase: 1914 - 1918

The defining characteristic of the second phase was the advent of aerial warfare. During this phase, which lasted until the Armistice on November 11, 1918, aviation in Canada and the world was driven by military necessity (Milberry

Figure I The Transitional Phase Situated Within the Canadian Aviation Timeline 1909 - 1939

1979, pp. 177-178). In Canada, the War Measures Act (1914) prohibited all non-military flying, effectively arresting the development of civilian aviation for the duration of the First World War (Wise 1980, p. 602).

Transitional Phase: 1918 - 1926

The end of the First World War marked the beginning of the third period of flight in Canada, referred to in this thesis as the transitional phase. The transitional phase was characterized by the beginning of civilian aviation, often known as 'bush flying' within Canada. This phase introduced the airplane as a new vehicle in Canadian transportation history. The transitional phase was unique to aviation. It was a phase of experimentation that demonstrated the practical applications of aircraft throughout the nation (Report of the Air Board for 1920, p. 5; McAndrew 1981, p. 88). These formative years of civilian aviation set the direction of future flying in Canada.

By 1926 changes in aviation technology, along with the remodeling of aviation policy by the federal government, altered the structure of the aviation industry and the subsequent use of aircraft (Report on Civil Aviation 1926, p. 5; Lovegrove 1986, p.5). The year 1926 was determinant, marking the final phase of flight prior to the Second World War and introducing commercial aviation for financial gain.

Commercial Phase: 1926 - 1939

Changes during the latter part of 1926 launched the final phase of flight prior to the Second World War. A series of simultaneous changes spearheaded

a thrust towards true commercial aviation within Canada and allowed for the shift away from the traditional transport routes. Those changes were: reorientation of federal government policy, significant advances in technology closing the gap between need and application of aircraft, and the economic climate.

In 1927, the federal government reorganized the administration of Canadian aviation by creating the Directorate of Civil Government Air Operations, and removed civilian flying from the direct control of the Royal Canadian Air Force (Lovegrove 1986, p. 6; Mackenzie 1989, pp. 14-15). While the Directorate of Civil Government Air Operations continued to report to the Department of National Defence, this department was now staffed by civilians. The separation of civilian and military flying continued when on July 1, 1927, Prime Minister McKenzie King split the budget into civilian and military flying operations (Lovegrove 1985, p. 6). This initiated a shift away from the concept that all licensed pilots were military reserve pilots (Milberry 1979, p. 165; Mackenzie 1989, pp. 14-15). The complete transfer of control from the Department of National Defence did not take place until 1936 with the creation of the Department of Transportation (Catomore 1971, pp. 16-17; Milberry 1984, p. 23).

Another administrative change marking the end of the transitional phase and the start of the commercial phase was the introduction of direct programs and subsidies supporting the growth of private aviation. Throughout the transitional phase there was a pronounced lack of Canadian government

programs and subsidies to aid the private aviation sector. In the United States during the same time period government subsidies were common (Whitehouse 1971, pp. 104-105; Satterfield 1969, p. 28; MacKenzie 1989, p 17). After 1927 federal government initiatives further promoted changes in aviation policy.

The construction of a series of airfields and airports was the first step towards establishing an aviation infrastructure allowing continuous wheeled-aircraft service across Canada (Ellis 1959, pp. 109-110). The construction of airfields required significant capital input initially, but more importantly, required continued financial support for maintenance, suggesting long term commitment in a new direction. This also emphasized the importance of wheeled aircraft as opposed to float-equipped, a marked change from previous policy.

The second step was an initiative to assist in the formation of flying clubs announced in September of 1927 (Hotson 1985, p. 73). The subsidy assisted private flying clubs by matching the purchase of an authorized aircraft by the club with the donation of a similar aircraft from the federal government (Molson and Taylor 1982, p. 5; Lovegrove 1986, p. 6). The flying club program commenced in the spring of 1928, (Ellis 1954, p. 290; Hotson 1985, p. 74) and similar to the construction of airfields, promoted the movement away from water-based aircraft (Molson and Taylor 1982, pp. 5-6). This shift was particularly noticeable in the Pacific and Central regions of Canada. The emergence of flying clubs was a return to private recreational flying, reminiscent of the joy-riding and barnstorming phenomenon immediately following the First World War (Foster 1990, p. 21).

The final step was an administrative initiative awarding the first official airmail contract to a privately owned aviation company (Milberry 1979, p. 41; Ellis 1954, p. 364). Prior to 1926, airmail existed in Canada on a sporadic basis, but no official contracts were tendered by the Post Office. During the transitional phase, the federal government denied the economic feasibility of establishing air mail and passenger services (Report of the Air Board 1920, p. 6).

A variety of advances in aircraft technology coalesced after 1927, altering the geographic limits of Canadian aviation and broadening operational application of aircraft (Gowans 1964, pp. 11-12; Nayler 1965, p. 101). With the widespread adoption of the radial engine and the emergence of the enclosed or cabin monoplane, winter flying became physically tolerable and economically viable (Gibbs-Smith 1970, p. 180). When compared to the operational season of the transitional phase, these improvements doubled the length of the flying season, and allowed aircraft to comfortably operate further into Canada's northern hinterland.

Moreover, a wholly new design of aircraft was introduced to Canada during the commercial phase (Kane and Vose 1971, p. 6; Nayler 1965, p. 131). The "light" aircraft was immediately adopted by federal and provincial governments, as well as by commercial and private interests (Molson and Taylor 1982, p. 105). This new breed of aircraft was either designed for, or more adaptable to, Canadian conditions. It was readily converted into either wheel, ski or float configuration. It could be employed in the continued development of the

hinterland or applied to the expanding heartland markets for commercial or recreational use.

Accompanying the advances in aviation were improvements in ancillary aviation equipment, most notably within the field of photographic technology (Sandwell 1930, p. 3; Nayler 1965, p. 247). With the camera's new design and improved definition, and the use of film instead of glass plates, the function of the aerial camera facilitated wider application and greater demand for aircraft services (Sandwell 1930, p. 3; Brant 1971, p. 39).

Taken together, the technological developments that occurred in the commercial phase had a significant impact on true commercial application in Canadian aviation, changed Canadian aviation's geographical context, and extended the limits of aviation northward into the perceived northern frontier. During the troubled years of the Second World War, aircraft helped assert Canadian sovereignty in the North (Milberry 1984, p. 25; Cohen 1981, p. 10). This was accomplished with improved technical abilities of aircraft that allowed them to operate consistently in Canada's true North (Wonder 1972, p. 146; Graham 1996, p. 11; Zaslow 1988, p. 104).

Themes Introduced

Three major themes are examined within the thesis: they are geography, administration, aircraft technology. The three themes when positioned in the following Venn diagram indicate the structure of the thesis and its focus. Supported by a thorough literature review, the themes are presented one by one,

Figure II **Focus of the Thesis**

examined and discussed throughout the thesis to show their impact on the choices of routes flown during the transitional phase.

The genesis for this thesis came from the perusal of the *Canadian Aviation Historical Society Journals* with their accounts by aviation historians and the history makers themselves. It is through these writings that a modern myth about flight was exposed, that is the assumption that flight has always been easy, fast, direct, and independent of weather and terrain. A period, here designated the transitional phase, appears to be critically important to Canadian aviation history as it demonstrates that the realities of flight have not always been easy. It is by an examination of the combined fields of geography, administration and aviation technology that an accurate depiction of flight in this early period in Canada emerges.

Overview of Chapters

The hypothesis of the thesis, that Canadian aircraft flying between 1918 and 1926 forged and established new routes within the country and influenced the construction of landscape and the frontier of the North, is debated within four chapters. These four chapters permit a demonstration of the interaction between geography and administrative history, and the way they affected the field of aviation.

The first chapter deals with the existing factors contributing to the uniquely Canadian pattern of aircraft flight routes. The author presents a view of exploration and development in Canada and how that relates to the introduction

of aircraft. This chapter highlights how existing corridors such as waterways and railway lines were established and utilized prior to the introduction of the aircraft. This chapter also uses existing factors and geographic conditions existing in Canada combined with theoretical discussion to establish the “perceived” location of the Canadian Northern frontier during the transitional phase.

The second chapter examines the political and administrative position, as it relates to aviation, that emerged after the First World War. The administrators and operators dictated why aircraft operated, set the goals of aviation activity and its impact upon future applications of aircraft.

The third chapter examines how aviation technology available between 1918 and 1926 acted as a limiting factor, fostering a dependence on specific flight routes, and how technological decisions reflected the significant impact of regional geography on operational parameters. Physically unlike the continental United States, Canada provided extra challenges during the transitional phase for aircraft that were temperamental and unreliable, had little or no means of communication, and were flown into unpopulated, isolated areas.

The fourth chapter combines the regional geography, actors and agents, and technology in the analysis of actual operations and routes flown between 1918 and 1926. The unique combination of factors discussed in the previous chapters are further confirmed through an examination of thirteen case studies, of actual events undertaken throughout Canada. The author puts into perspective where and why aircraft operated in Canada, how geography and technology

dictated the possible routes. Once situated, the location of flights undertaken in the transitional phase are examined in the context of 'opening up the Canadian North'. In addition, the spatial extent of aircraft flights are analyzed to provide insight into where administrators and operators perceived the Northern frontier was located during this period.

The conclusion discusses the findings of the thesis. It examines how well the information and analysis answers the hypothesis. It also suggests avenues of future research in combining historical geography and Canadian aviation history. Throughout the transitional phase, aviation technology strove to adapt to and fly independently of Canadian geography.

Chapter One

Flight and Geography in Canada During the Transitional Phase

The foundations of the present-day role of aircraft within Canada was laid during the transitional phase. They are geographically driven, technologically bound and uniquely Canadian.

On August 12, 1909, the *Toronto Star* ran an article which stated that:

“You cannot expect a young country like Canada to strike out and adopt a policy...who knows what these aeroplanes can do? We must wait a great number of years and experiment much more before the true use of these machines can be demonstrated” (Fiset, August 12, 1909).

Ten years after the first aircraft flight in Canada, February 23, 1909, aviation continued to strive for a place and purpose in transportation operations, whether civilian or military. During the transitional phase, aviation spread across the settled southern belt and ventured into the fringes of the hinterland, looking for an economically viable niche.

Although the transitional phase is a unique period in transportation history, and in Canadian aviation development, the introduction of the aircraft as a transport vehicle did not initially appear to create new transportation routes within the pre-existing national network of transportation. Instead, the aircraft followed existing economic corridors throughout Canada (Milne 1983, p. 101; Molson 1987, pp. 74-75).

Furthermore, instead of forging new aviation-specific transportation infrastructure, the aircraft co-opted existing linkages and nodes, often situated at the confluence of major waterways, or at the intersections of railroad stations and waterways (Milne 1983, p. 102). To access resources, the aircraft exploited the same routes travelled by the fur traders and settlers in previous years (Gowans 1964, p. 11; MacLeod 1974, p. 106).

Understanding where and why the air transport routes were established, and how the technical abilities of aircraft were affecting flight routes within Canada during the transitional phase, is central to the thesis. It is necessary to elucidate the evolution of, and the transition between, traditional modes of transport such as railroads, canoes and canals, and the advent and implementation of direct flight by aircraft.

1.1. Flight and Aircraft During the Transitional Phase

1.1.1. Context

To understand the context within which aircraft flew during the transitional phase it is important to put aside the notion and image of aircraft in the present-day form. Modern jet aircraft fly above the weather and above Canada as a geographical entity, using sophisticated navigation and communication tools integrated within a complex national network of aerodrome facilities. It is also necessary to remember that advances in aeronautics have developed at a rapid rate. It took less than 70 years between the first flight in a heavier-than-air powered machine and man's first walk on the moon.

Flight and aircraft in Canada at the termination of the First World War were an entirely different concept. Aircraft were made of light wooden frames covered with stretched and doped linen fabric, tied together with bracing and flying wires. They flew during the summer, weather permitting, relied on visual navigation methods, often used pigeons as the primary method of communications, and operated from the most rudimentary facilities.

During the transitional phase there was scant knowledge about the intervening space between existing nodes. For safety reasons, pilots did not stray too far from potential emergency landing areas on or near rivers or lakes (Heathcote 1967, pp. 4-5). Moreover, destinations for flights, refueling caches and overnight camps were linked to existing points located along traditional transportation routes whenever possible.

The aircraft flown during the transitional phase were almost exclusively surplus machines from the First World War (Milberry 1979, p. 20; Ellis 1959, p. 143). The bulk of the aircraft originated from an Imperial gift of approximately 100 machines selected by the British Government (Milberry 1979, 2000, p. 49). However, the original types of aircraft destined for Canada were not suited to the geographical conditions.

The principal characteristic that suited aircraft to Canadian geography was the ability to land and take-off on water. After a period of negotiations between Canada and Britain, Canada received aircraft that could immediately be put to

use throughout the country, taking into account the geographical realities (Hutchins 1972, p. 5; Milberry 1979, 2000, p. 49).

Canada was not the only Dominion to protest the specific type of aircraft donated. Instead of negotiating for different aircraft, the New Zealand Government accepted only 33 from the 100 aircraft offered to them as part of the Imperial Gift (Russel 1986, p. 390). This demonstrated that Canada was not the only nation tailoring the type of aircraft to its national conditions and needs.

By selecting aircraft that operated from waterways, areas of operations were limited. While Canada has an abundance of suitable coastlines, lakes and rivers to land and take-off from, it did not have much suitable land in the hinterland that was easily adaptable for development as aerodromes from which wheeled aircraft could operate. Furthermore, the Canadian federal government did not wish to invest in the construction and maintenance of such facilities.

As a modern nation with a scattered population and far-flung resources, Canada has utilized aircraft in a variety of ways. Today aircraft link locations economically and socially across the country, providing fast and reliable commercial transportation of cargo and passengers. They serve as machines of war and private recreational transport. Aircraft also permit unparalleled access to remote areas. However, when compared, the operational abilities of modern-day aircraft, and the flying realities of the transitional phase are vastly disparate. During the transitional phase the aircraft available did not soar above Canadian geography. Early aircraft flew in ground proximity rather than through the air.

Figure 1.1 illustrates the difference in flying altitude between the transitional phase and modern aircraft.

The principle of direct overland flight, in a straight line from the point of origin to the point of destination or following a great circle route, is not applicable in the context of this thesis. During the transitional phase, the flying seems to have followed established transportation routes

1.1.2. Categories of Flying in Canada During the Transitional Phase

In order to better understand and distinguish between different types of flying undertaken during the transitional phase, it is important to define categories of flying. These categories help clarify the purpose of the flights and the operators of aircraft throughout Canada.

From the literature review several categories of flying in Canada are evident. A review of Canada's flying heritage indicates that flying and aviation operations are comprised of two groups of operators: federal and provincial governments and private interests. Within the government there are two types of flying: military and government civil or civilian operations. Private flying also comprises two different groups: commercial flying and private recreational flying. These different categories are defined as follows.

General Flight in the Transitional Period - 2,500 feet or less

Figure 1.1 Ground Proximity Flight
During the Transitional Phase

1.1.2.1. Government Military Flying or Military Operations

Military flying or military operations refers to aviation conducted by the military for the purpose of national defense or military training. It is important to note that all aircraft designed or operated in Canada from 1918 until 1926 originated as military hardware, or were designed to government military specifications. This even includes those aircraft built specifically for the Canadian civilian market, for example, the Canadian Vickers Vedette (Report of Civil Aviation for 1925, pp. 98-99).

1.1.2.2. Government Civil or Civilian Flying

Government civil or civilian flying refers to flying conducted by the military for civilian purposes and flying conducted by the provincial government. The bulk of the flying undertaken during the transitional phase falls within this category. Government flying, especially in the early part of the transitional phase (See Timeline, p. 3), was made possible by the Imperial Gift of aircraft. The uses of those aircraft were dedicated to the best service of the Dominion, and operated by an appointed Air Board as discussed in Chapter Two. It must be noted that the military, under the direction of the Air Board, was mandated to conduct both military and civilian flying within Canada.

1.1.2.3. Commercial Flying and Commercial Operations

Commercial flying and commercial operations refers to aviation undertaken for the purpose of commerce or profit by the private sector. In the period discussed, commercial operations included resource related flying and

private business flying, under government contract. Commercial flying included companies such as Laurentide Air Service, which were formed specifically to meet the commercial demands of forest surveys and mapping (Molson 1983).

1.1.2.4. Private Recreational Flying

Private recreational flying refers to the individual use of aircraft for pleasure, that is, not business related purposes. Recreational flying includes rural exhibition flying activities, also called 'barnstorming', so popular during the early 1920's (Foster 1990, p. 21). It also includes those flights undertaken for the purpose of setting aviation records and of pushing the aviation envelope, particularly long distance endurance flights (Molson 1964, p. 107).

1.2. Geography: the Construction of Landscape and Frontier Applied to the North in Canada

In Canada, the North is conceived of as a physical North and a perceived North. The frontier, in this thesis is the divide between 'South' and 'North'. The physical North is defined as a geographical region lying north of the 60th degree of latitude. The perceived North goes beyond this physical concept. It means a landscape and frontier imbued with meaning and linked to the national identity of Canada. Neither the landscape nor the frontier are static. Relative to Southern Canada, the North's location is historically specific, a result of political, social, technological, and economic influences. The meanings of this landscape and the frontier is examined within Canadian cultural geography.

1.2.1. The North in Terms of Landscape

The Canadian North can be construed as a constructed landscape. This is predicated in part on the notion that the landscape is a powerful idiom for representing national identity. The North as a region, distinct in terms of landscape, represents something of the Canadian national identity (Prescott 1987; Hamelin 1979; Bone 1992).

The distinctiveness of landscape draws on physical and cultural geography (Muir 1998, p. 263; Schein 1997, p. 662). Landscape can be analysed in scientific texts using specific variables to delimit the extent and nature of specific elements using quantitative analysis as the route to explanation. Alternatively, it can be approached in more qualitative terms. Under this rubric a number of approaches can be used but increasingly post-modern approaches have been used where the emphasis is not upon landscape per se but upon the underlying forces which shape it. In particular post-modernism argues that landscapes are not received; they are actively created, often by power elites. This places a necessary emphasis upon human action. However, this thesis is not explicitly post-modernist though the emphasis upon government rhetoric, supposed achievement and especially the perception of the North is echoed in post-modernist thought.

“It has given rise to some useful studies of the ways in which false (or created) perceptions of environmental character have influenced the colonization of a particular landscape and how mistaken impressions of the past have conditioned interpretations of history” (Muir 1998, p. 266).

Examining the perceptions of the landscape through subjective approaches provides insight into the underlying linkages between landscape, politics and power.

1.2.1.1. The Link Between Landscape and Power

Hasson (1996, p. 146) argued that it is the hegemony of the elite that creates perceptions and shapes particular landscapes. The acknowledged link between power and landscape allows the landscape to be used more easily by those in power to further national or political agendas. This is possible because, as Daniels (1993) explained: "...landscape serves as a vast repository out of which symbols of order and social relationships, that is ideology, can be interpreted (and controlled) by those who know the language" (pp.182-3).

"Landscape is likely to feature prominently in any discussion of place, because it constitutes a crucial component of the sense of place" (Muir 1998 p. 268).

The adoption of a Canadian 'Northern landscape' informs Canadian's perceptions of identity, both in a regional and national sense (Bruce 1999, p. 91). The symbols associated with the Northern cultural landscape contribute to the articulation of national attitudes and policies. As Daniels (1993, p. 5) remarked, landscapes 'picture a nation'.

1.2.1.2. The Link Between Landscape and Politics

As shown Hasson (1996, p. 147) argued that landscape representations and narratives are structured by the elite. He also suggested that dominant groups play an ideological and political role by providing legitimization, and in

doing so consolidate their control. It is certainly true that since the eighteenth century painters and poets have helped narrate and depict Canada's national landscape. Scholars, historians, mapmakers, geographers, engineers, architects and archeologists, have all been enlisted in describing landscape (Daniels 1993, p. 5). The aim of a narrative created and maintained by the elite is not to provide an accurate description of a historical or geographical reality, but to evoke feelings and emotions. In the Canadian North, this includes the legitimization of colonial and frontier attitudes. The symbolic meaning, power, politics, and perception of the landscape all contribute to that 'sense of place'. They reflect and constitute society, culture and identity (Schein 1997, p. 662).

1.2.1.3. The Link Between National Identity and the North

"National identities are largely defined by 'legends and landscapes', by stories of golden ages, enduring traditions, heroic deeds and dramatic destinies" (Daniels 1993 p. 5). Bruce (1999, p. 106) and Daniels (1993, p. 5) both suggested that unique regional identity within a country contributes to the formation of national identity. These regional landscapes and identities can serve as icons of moral order, aesthetic harmony and frontier. Particular landscapes also achieve the status of national icons. The construction of the Northern Canadian landscape has a rich body of literature both fictional and non-fictional, as well as other communication forms, that articulate regional identity and contribute to national identity.

“There was a wealth of material dealing with the North and many writers, artists, scholars, social scientists and scientists have devoted serious, often lifelong, effort to the study, exploration, celebration and above all, representation of the North. In a more general sense, of course, there has long been a deeply held belief among southern Canadians that ‘North’ defines us as Canadians” (Grace 1996, p. 1).

Margaret Atwood (1995) in *Strange Things: The Malevolent North in Canadian Literature* explains that “Canadians have long taken the North for granted” even though “ we have invested a large percentage of our feelings about identity and belonging in it” (p. 115). It is ironic that Canadians link their national identity to the North, a landscape that the great majority have never visited, nor ever will visit.

The ‘North’ is a construct formed by southern Canadians, a mix of myth, legend, history and geography, sentimentalizing a history of civic imperialism. The reality of the North is characterized by benign neglect on the part of the government, punctuated by cycles of economic exploration, resource development and political interference (Hamelin 1979, pp. 33-34; Bone 1992, pp. 13-14). The value of the North lies in the South’s ability to exploit its resources and the seemingly unlimited capacity of the ‘North’ to generate emotional and marketable images of a ‘distinct’ Canadian identity. During the transitional phase the use of aircraft to propel development out of the southern regions helped construction of landscape and helped disseminate images.

1.2.2. The North in Terms of Perceived Frontier Experience Theories

The meaning of the term 'frontier' has undergone several changes within the geographical literature, shifting from describing border regions, through settlement areas, to newer connotations of a developing region.

1.2.2.1. The Political and Settlement Frontier

Historically, two dominant notions of frontier exist in geographic studies. The original European use of frontier was simply that of a border. However in the United States, the term is used to denote settlement regions following Turner's thesis (1962 reprint, first published in 1893). Friedmann has described the political frontier as a static frontier, differing in several respects from settlement frontiers (Friedmann 1996, p. 8). Political frontier regions are often associated with negative notions of periphery, compared to more positive connotations of 'openness' and 'newness' associated with settlement frontiers (Kimmerling 1989, pp. 267-268; Kellerman 1987, p. 230).

Settlement frontiers in the Turnerian mode consist of five dimensions: land, socio-spatial dynamics, institutions, social relations and polity. Settlement frontiers represent not only an advance of settlement activity into new areas, they contribute to the construction of new social and cultural frameworks. While many aspects of Canada's frontier are drawn from these traditional definitions and meanings, the Northern frontier is also a product of further shifts in the definition (Kellerman 1997, p. 232).

1.2.2.2. The Remote Frontier

One of the new definitions identified by Kellerman (1997, p. 232) is linked with the exploration of remote areas rather than settlement within the region. Northern Canada, Alaska and Antarctica provide examples of this frontier definition. Kellerman's 'Remote frontier' draws from the settlement frontier themes of remoteness and environmental hostility, however actual settlement activity and social development are seen to develop. These peripherally located frontiers constitute landscapes targeted for regional development. Where settlement frontiers or political frontiers are applicable to some nations, the Canadian North as a 'remote frontier' continues to have an impact on the culture and national identity of Canadian society.

The majority of literature on the 'remote frontier', applied to the Canadian North, has been the work of Southern Canadians writing for a southern audience. "General interest in northern literature has historically been driven by the exoticism of the region...the strangeness of the place, vast, open, seemingly barren and desolate..." (Coates and Morrison, 1996 p. 6). Much of the narrative around the 'North' also includes ideas of the Canadian Northern frontier, as stated by Graham (1996):

"The North is too cold, too remote, too difficult, to become civilized or urbanized. We (Canadians) believe, therefore, that our frontier is permanent; it will remain forever our 'true north strong and free' " (p. 191).

There is no single mental image of the North, nor a definite physical location (Hamelin 1979, pp. 3-13; Bone 1992, pp. 1-3; Wonders 1972, pp. 137-18). Images and location of the North undergo parallel development. On the spatial level, they are overlapping and discontinuous (Wonders, 1972, pp. 137-146). Despite the physical realities, it is the mythic conception of the region that has become a national symbol.

1.2.2.3. The Second Frontier

Canada created a second frontier within its boundaries, changing from the West in the nineteenth century to a northward push in the twentieth century. In both situations images of the pioneering process and development were promoted, exhibiting and inculcating values associated with frontier landscapes (Hasson 1996, p. 155).

“Canada coveted the territory (Rupert's Land) for its colonial ambition, driven by descriptions of the riches of the land and the tales of newcomers' epic struggles to capture them (the riches)” (Ray 1996 p. 212).

The developing myth of the frontier of Northern Canada, like the frontier of America in the nineteenth century, suggested that the North represented the true wealth of the nation in a similar material sense. Forests, rivers and vast expanses of land were all viewed as resources. Canada's expansion northward saw “the expanse of territory” as the ‘Northern’ periphery to a southern core (Wonders, 1972, pp. 137-138). The North, unlike the American and Canadian West, was unable to separate itself from heartland, and continues to be regarded as a frontier (Zaslow 1988). McCannon (1995) stated that: “...uncivilized and

unknown, the Arctic was the Soviet Union's ultimate frontier, the very end of the world" (p. 26). This statement can be applied to Canada.

1.2.2.4. The New Internal Frontier

The new internal frontier is a central Canadian vision of the North as a vast warehouse to be exploited. The recent northern political history compresses basic national issues and fundamental patterns of Canadian development. It highlights our colonial heritage, incorporating the role of the state to build the national economy, and the reinstatement of a northern version of the National Policy to further development (Abele 1987).

The northern territories were administered for decades as colonies of the South, at first hesitantly, and then with more vigour after the Second World War (Hamelin 1979, pp. 89-90).

This vision of the North is modelled economically on the West of fifty years earlier. Northern minerals, forests and other resources fuelled the national economy like 'western' wheat in an earlier period. The expansion of the frontier was propelled by technology and government incentives that made developing remote resources increasingly feasible after 1914 (Zaslow 1988, p. 369).

"Government projects attracted southern attention and researchers to the North, but only sporadically, at distinct times and to specific places" (Graham 1996, p. 189).

As the ability to access the North grew, there was an administrative shift from pure exploration to more scientific operations. These were associated with

the exploitation of resources and a demand for more knowledge about the frontier.

1.2.2.5. The Eternal Frontier

In the spirit of pioneers and settlers who exploited arable land and other resources crucial to development, Canadians are conditioned, by the country's vast extent, to expect the frontier process to continue indefinitely. "The frontier is more than a geographic area; it is a way of life, a habit of mind" (Ray 1996, p. 214). The North encourages this notion of eternal frontier with continuing discoveries in natural resources, as the perceived physical line defining North advances towards the Arctic Ocean. All of these frontier images contribute to an understanding that Canada's development historically can be seen as a progression of frontiers, spatially and through time. While the terminology and focus of the particular frontier images may vary, the underlying notion of a frontier remains constant. This first defined the limits of the westward expansion and then the division between Canada South and North.

The evolution of Canada's twentieth century frontier experience resembles in many ways the classic American nineteenth century example. While the American West was driven forward by individualistic private enterprise, the Canadian shift from western agriculture to northern forestry and mining, resulted from Canadian government and corporations pushing the frontier more than particular individuals (Zaslow 1988). Another significant difference was the importance of technology in the 'opening' of the North during the transitional

phase, whether it is applied to aircraft, resource development, transportation infrastructure, or cartographic renderings.

As with the Soviet struggle in their North, there was recognition of technology's leading role in the exploitation of the frontier. "Modern technology has rendered the physical mastery of the space" (Wonders 1972 p. 137). In both the Soviet and Canadian cases, the support of the government served to legitimize the cultural glorification of the machine, including the introduction and use of aircraft in the transitional phase in Canada (Wonders 1972, p. 138).

These ideas have fostered a national conception of a frontier North (Graham 1996, pp. 190-191). The relationship between Canadian identification with the northern landscape, and the sporadic attention displayed by Southerners towards actual events and conditions in the North, underlies the myth of attaching value, whether in resources or adventure, to the conceptions of that regional landscape.

1.3. Transportation Technology and Regional Geography Applied to the Concept of Canadian North

Canada's growth as a nation is not limited to the territorial acquisition that fostered the development first of a western and then northern frontier. It is based, in part, on technologies that access the resources of its regions, whether for settlement or resource extraction. "The national history of Canada can be written around the theme of changing technologies, from the river economy of fur, to the national economy of wheat..." (Watkins 1970, p. 268).

The theme of transportation has always held a central place in Canadian development. Wonders (1972, pp. 137-138) equated transportation to the initial method of unifying Canada, while Seimens (1968) stated: "...the settlement and indeed the economic development of the provinces as a whole has on occasion been seen in terms of the development of transportation..." (p. 30). It is the relationship between transportation technology and the regional geography through which access is sought, that defines the landscape and frontier of Canada.

"The importance of 'place' and more particularly the ease with which one can travel from one place to another is an essential ingredient in an expanding economy. Accessibility is part and parcel of man's material process" (Sealy 1968, p. 20).

This is especially true for the Canadian North.

"Northward expansion was furthered at every step by improving technology...innovations and improvements in transportation and communication have an impact on the North that was completely past calculating" (Zaslow 1988, p. 369).

1.3.1. The Pre-Aircraft Transport Routes and the Extension of the Nation from Sea to Sea.

In understanding the pattern and extent of pre-aircraft transport routes and accompanying infrastructure, it is acknowledged that the North during the transitional phase was substantially different from the modern perception of it (Hamelin 1979, p. 7).

Canada made substantial changes to its form throughout the 1870's and 1880's, incorporating areas into provinces and gaining new territory, and

consequently changing the location of the 'North'. From the cradle of the St. Lawrence and the Great Lakes, Canada's development has followed a north, north-westerly direction.

In the post-Confederation period, the 'North was identified as anything beyond Lake Nipissing (Hamelin 1979, p. 26). However, this has been juxtaposed with vast acquisitions of northern territory. On July 15, 1870, control of Rupert's Land and the North-Western Territory were ceded to Canada (Usher 1982, p. 424; Zaslow 1971, p. 1). Previously the Hudson Bay Company under monopoly charter administered Rupert's Land. Its transfer to Canada opened up the region to settlement and other forms of economic development beyond the fur trade.

On July 20, 1871, the colony of British Columbia entered the union, completing the east-west extent of the Dominion (Usher 1982, p. 424). The British crown transferred jurisdiction of the Arctic Islands to Canadian control in 1880, completing the northern acquisitions. During the 1880's the Dominion of Canada established Manitoba as a province, and controlled several other Districts which in 1905 would become the prairie provinces: Alberta and Saskatchewan.

Canada's attention during the last part of the nineteenth century and the early twentieth century focused on peopling the southern agricultural prairies, establishing institutions and integrating these areas into the developing Canadian economy.

Until the westward development was complete, the 'North' was of secondary importance. The completion of the trans-continental Canadian Pacific Railway in 1885 ended the first major phase of Canadian expansion (Zaslow 1971, p. 77). The railway firmly established the political extension of the nation from sea to sea. The development of prairie farmlands and pacific forest might have continued to draw resources away from the 'North', but the discovery of gold in a little known area of the Dominion prompted political attention and resulted in the Yukon Territory Act in June 13, 1898 (Coates and Morrison 1985, p. 61).

While the government of the day was primarily concerned with issues of sovereignty and the collection of revenues generated through mining, measures taken to establish Canadian authority and fully open the Klondike to development shifted the line dividing the Canadian north and south upwards as access, knowledge and interest in the region spread.

1.3.2. The Location of the Northern Frontier and the Establishment of Infrastructure

As Zaslow (1971) reflected "'North' and 'North-West' are more than geographical expressions. They constitute a process, the advance of frontiers and frontier experience" (p. xi). It is essential to picture the building of Canada as a 'North' and 'North-Westerly' process in order to understand why the spread of transportation technology, as well as settlement and development, followed this pattern across the nation. As Hamelin (1979) pointed out, Canada is

characterized by: "...development of linear forms of settlement along routes of penetration, rivers, railway lines..." (p. 66), elucidating the link between transportation and development.

The establishment of infrastructure can be examined as one of the measures to assess where the Northern frontier is located. In the 'North' missionaries and the North-West Mounted Police were the most prominent figures in the early development of infrastructure.

1.3.2.1. The Impact of the Missionaries

Missionaries provided education and religion, and established hospitals in some areas. They were the moral voice of the south extending northward in an effort to reform the wicked prospectors, fur traders and heathens. One can debate whether the Protestant or Catholic missionaries in the 'North' were more effective, but it cannot be denied that as a group, missionaries affected the development of the 'North', and the movement of the northern frontier. By 1860 churches were firmly established along the edges of civilization following the traditional waterway routes of fur traders (Zaslow 1971, p. 71). Missionaries co-opted fur trade infrastructure by locating themselves at the junction of navigable rivers. These hubs were often located in conjunction with Hudson Bay Company posts. Earlier they had served as the interaction points between fur traders and Indians, now they promoted the interaction between missionaries and Indians as well (Town 1999). The location of religious missions established after 1800 throughout Canada can be seen on Map 1.1.

**Map 1.1 The Location of Religious Missions in Canada
Established After 1800**

Source: Compilation of the author based upon *Philips' Historical Atlas of Canada*, J. W. Chalmers, W. J. Eccles, H. Fullard, eds., George Philip and Sons Ltd., London, 1966, p. 26.

Missionary activity heightened awareness and transmitted information about the region and its people to the south. Knowledge about resources and possibilities for settlement affected development decisions. Missionaries provided an early link between the 'North' and the Canadian south, and helped form the edge of the frontier.

As missionaries continued their work, the Canadian government began to take more formal steps to learn about and to assert sovereignty over the vast territory comprising the Dominion. In 1873, on July 1st, the Department of the Interior was inaugurated and Clifford Sifton was the appointed minister (Zaslow 1971, p. 23). The Department of the Interior was created to manage and develop the Canadian hinterlands. While on the prairies this meant settlement and agriculture, the path of development in the 'North' was less defined.

1.3.2.2. The Impact of the Royal North-West Mounted Police

In an effort to increase government knowledge of the 'North' geologists were sent to explore the area and report back on potential resources. In 1884 and 1885 the Geological Survey Branch of the Department of the Interior sent a team to the Hudson's Bay area. In 1897, Southern Baffin Island was explored, and in 1899, a group went into the Northwest Territory and surveyed Great Slave Lake (Zaslow 1971, pp. 80-81). While these surveys furnished the government with a great deal of new information, they did not represent a permanent infrastructure on the northern frontier. The Royal North-West Mounted Police

became the first permanent federal administrative body in the Canadian North (Usher 1982, p. 425).

The Mounted Police administered the frontier. They represented Canadian sovereignty and oversaw the development of the northern frontier (Morrison 1985, pp. 5-7). The duties of the Mounted Police ranged from mail delivery to census taking, to actual policing. After 1890, the Canadian government chose the Mounted Police to establish Canadian control over the gold rush in the Yukon, and later to establish permanent forts along Hudson's Bay and much of the Arctic (Morrison 1985, p. 7).

Located along the water routes, the Mounted Police detachments controlled the hubs of the infrastructure. During the transitional phase of Canadian aviation, Mounted Police interest in the possible application of aircraft for patrols and transportation began, but it was not until the commercial phase that the practical use of aircraft was established. (Morrison 1985, p. 3; Steele 1936, pp. 347, 357). The location of Mounted Police detachments established prior to 1920 is featured on Map 1.2. After 1920 the name of the Royal North-West Mounted Police was changed to the Royal Canadian Mounted Police (Canadian Encyclopedia 1999, p. 2045).

1.3.3. Transportation and Accessibility to the Northern Frontier During the Transitional Phase

Transportation and accessibility played a crucial role in the Canadian northern frontier's development. The northern frontier combined special locational advantages. Resources such as mineral deposits and rich

Map 1.2 Location of Royal North-West Mounted Police Detachments Established in Canada by 1920

Source: Compilation of the author based upon Steele, H., *Policing the Arctic*, London, Jarrolds Publishing, 1936.

timber stands, were combined with adoption of transportation technologies, like steamboats, railways and aircraft, to improve the economic development of the region, as this development was predicated on accessibility (North 1955, p. 251; Sealy 1968, p. 20). Map 1.3 shows the geological regions of Canada and the mineral producing areas developed by 1927 while Map 1.4 depicts the forest regions of Canada.

The limited development and settlement of the 'North' was attributed to issues of accessibility. Dawson in 1896 wrote that: "there were other reasons for this slackness of development in the north which need not be detailed here but chief among them was the absence of requisite transport facilities" (p. 214). The constraints of traditional northern water routes, combined with demands of commercial viability, forced entrepreneurs to focus on extraction of commodities high in value and low in weight, such as furs and gold (Innis 1936, p. 175).

1.3.3.1. Waterways as Dominant Routes to the North

From Confederation into the transitional phase, the waterways first travelled by fur traders continued to be the dominant transportation routes used to penetrate the North. In the transitional phase anyone entering the hinterland, used waterways (Milne 1983, pp. 100-108).

"Year by year the frontier of Canada is moving back. But beyond the present frontier still lie extensive areas of wilderness where-if we accept the aeroplane-the methods of transport used further south have not yet penetrated. Here one must adopt the same methods that have been in use by the voyagers" (MacDonald 1931, p. 3).

Map 1.3 Geological Regions and Major Mineral Producing Areas of Canada Developed by 1927

Source: Compilation of the author based upon *An Historical Atlas of Canada*, L. J. Burpee, ed., Thomas Nelson and Sons Ltd., 1927, p. 31. Chapman, J. D., *Natural Resource Development in Canada 1970-1975, Geological Regions and Mineral Producing Areas*, in *Reading in Canadian Geography*, 3rd edition, Robert M. Irving, ed., Holt, Toronto, Rinehart and Winston of Canada Ltd., 1978, p. 211.

Map 1.4 **Major Vegetation Regions of Canada**

Source: Compilation of the author based upon Putnam, D., *Canadian Regions: A Geography of Canada*, 8th edition, Toronto, J. M. Dent and Sons Ltd., 1968, p. 22.

Morse (1969) stated that: "...there is, in sum, a close correlation between the main fur trade route across Canada and the border of the shield" (p. 28). He felt that: "...the whole area east of the Rockies, comprising three quarters of Canada presents no serious barriers to canoe travel" (p. 27).

These fur trade routes were concentrated within three major river basins: the St. Lawrence, the MacKenzie and the Hudson Bay. Together they provided drainage for 75 per cent of Canada's surface water (Morse 1969, p. 27). More importantly, between the three basins, the portages all met the criteria of directness, gradient and footing. No main portage was much over 1500 feet (457 m) in altitude and the single biggest drop was 700 feet (213 m), at the end of the Methye portage into the MacKenzie basin (Morse 1969, p. 27). "The really amazing feature of Canadian geography...the rivers are not only closely connected but...are entirely navigable" (Morse 1969, p. 27). The major river routes travelled by fur traders are indicated on Map 1.5.

After 1880, there was an increase in the construction of overland trails and wagon roads along the northern frontier which further linked traditional river systems together and linked waterways to the newer rail lines. Examples of these overland linkages included a hundred-mile trail connecting Edmonton to Athabaska Landing, and another series of trails which connected the Churchill, Athabaska, and Peace river systems (Zaslow 1971, p. 56).

After the 1880's, many water routes were improved through the use of better vessels. The Hudson's Bay Company ran three shallow draft boats that

provided the only commercial transportation from Athabaska Landing through the lower Athabaska, lower Peace and Slave and Mackenzie rivers, with connecting wagon roads between the systems (Morrison 1985, p. 77). In the Yukon in 1899, 20 steamboats operated between Dawson and Whitehorse, making 200 trips and transporting 13,583 tons of freight. A second leg from Dawson to St. Michael had 32 steamers, whose larger capacity transported 13,191 tons of freight in only 63 trips that same year (Innis 1936, p. 213).

1.3.3.2. Railways as a Technology Restricting the Location of the North

Unfortunately, water access has seasonal limitations as well as route restrictions. At the turn of the century, railways were viewed as the next technological step in economic advancement. Zaslow (1971) felt that, at the time, the railway was the: "...sole hope for development of the North-West" (p. 26). The railroad in Canada contributed to the pace and rate of change as well as influencing the shape of regional economic activity (Heymann 1965, p. 31; Vance 1995, p. 245; Zaslow 1971, p. 28). Therefore, the decision to implement the rail lines in any given region had a significant impact there.

While settlement possibilities had long been recognized from geographic surveys of the northern parklands of Manitoba and Saskatchewan, the Canadian Pacific Railways selected a southerly route across Canada, effectively halting the agricultural development of the northern prairies (Regehr 1976, p. 25). To illustrate the path of railway development established by 1926 across

Canada, Map 1.6 shows the extent of the railway corridors throughout the Dominion.

The lack of spur lines extending north from the trans-continental line continued to be a contentious issue throughout the region's development. There were valid reasons why railways followed the routes they did, such as fears of American incursion, but it diverted the course of settlement and investment, as well as drawing attention away from the 'North', and therefore slowed the northward advance of the frontier.

"Security, settlement and economics underpinned the next great Canadian transportation advance. The railroad and the concept of nationhood are forever linked in the Canadian consciousness as the sea to sea linkage was established by rail" (Vance 1986, p. 247).

Prior to 1850, there was little coherent development of rail lines. However, with the completion of the trans-continental Canadian Pacific Railway, in 1885, there was a national recognition of the importance of transportation technology in economic development. Industries, such as mining and agriculture, lobbied for railway access into regions of high production, in hopes of lowering the cost of transporting the extracted resources.

Unfortunately, railway lines required a great deal of infrastructure to function, and access to different regions was of course limited to established pathways (Heymann 1965, pp. 18-33).

Map 1.6 Railway Corridor in Canada During the Transitional Phase

Source: Compilation of the author based upon *An Historical Atlas of Canada*, L. J. Burpee, ed., Thomas Nelson and Sons Ltd., 1927, p. 27. *Philips' Historical Atlas of Canada*, J. W. Chalmers, W. J. Eccles, H. Fullard, eds., George Philip and Sons Ltd., London, 1966, p. 36-37. *The Canada Year Book 1926*, Ottawa, Thomas Mulvey Printer to the King's Most Excellent Majesty, 1926.

1.3.3.2.1. The Railway Boom in Ontario and Quebec

The railway boom in the early twentieth century added thousands of miles to Canadian transportation systems (Friesen 1993, p. 292). In Ontario and Quebec, the impact of railway construction was especially important for the mining industry. New railway construction slowly permitted mining to move inland and northward, away from the shore of the Great Lakes (Saarinen 1991, p. 156). Mining on the Shield was uniquely linked to railway development. Some mineral discoveries, and the subsequent growth of mining areas, were a direct result of the surveying and laying of railway lines. One example was the 1886 development of the Sudbury Basin in conjunction with the construction of the Canadian Pacific Railway (Saarinen 1991, p. 158-159). Other railway lines chased the mining frontier northward, like the Timiskaming and Northern Ontario Railway which "...began from North Bay in 1902 and reached Cobalt the following year, but the railway could not keep up with the mining frontier" (Gentilcore 1972, p. 44).

Saarinen (1991) stated that the four major railways constructed on the shield between 1889 and 1932; the Canadian Pacific, the Canadian National, Algoma Central and the Ontario Northern Railways: "...transformed the wilderness of the shield to a resource frontier" (p. 156).

The pattern of rich mineral discovery in an area followed by the construction of the subsequent railway for bulk transportation, was repeated in Quebec's Rouyn-Noranda district. Claim staking began in 1923, but it was not

until 1927 that Noranda opened a smelter. This was partly in response to the construction of two railway branch lines linking the Canadian National Railway at Taschereau, and westward to the Ontario Northland Railway at Swastika, Ontario (Brouillette 1952, p. 165).

1.3.3.2.2. The Railway Boom in the Prairies

A smaller railway boom in the prairie branch lines in the 1920's added another 2,000 miles (3218 km) on to Canadian transportation routes, further pushing the agricultural and resource extraction frontier northward in that region (Friesen 1993, p. 292).

1.3.3.2.3. The Railway Boom in British Columbia

Further west, in British Columbia, railway construction created more linkages between transport accessibility and economic activity. Great swaths of partly timbered and partly arable land, totalling 13 million acres, were ceded as land grants to the Canadian Pacific Railway. Part of the original terms of union, this 25 mile (40 km) wide belt on either side of the rail line was effectively opened for development following the construction of the railway (Seager 1996, pp. 208, 221). This was echoed on Vancouver Island where the land grant for the construction of the Esquimalt and Nanaimo Railway encompassed 3,300 square miles of the largest stand of high quality Douglas fir in the province (Hardwick 1963, p. 14). Dalichow (1972, p. 25) stated that it was not until the First World War and the opening of the Panama Canal in 1914, that western trade and resource exploration began in earnest. After 1915, the Canadian Northern

Railway (today the CNR) completed its northern section with the Great Trans-Pacific Railway, and linked the Peace River down to Vancouver, further opening up new areas (Dalichow 1972, p. 25; Seager 1996, p. 216). Other smaller railways were constructed during the same time in British Columbia, especially in the Kootenay mining region centered around the towns of Trail and Rossland (Seager 1996, p. 222).

1.3.3.2.4. The Railway Containing the North Within the Hinterland

While there was a great demand for expanded railway routes to increase access to areas and open new regions, the cost of railway lines was high, and development relatively slow. The extent and coverage of Canadian railway routes never matched the density of United States railway development (Vance 1995, p. 246).

Taking into consideration the infrastructure and transportation routes in place prior to the transitional phase, the Northern frontier in Canada was located well within the provincial boundaries, and did not extend further than 60 degrees North latitude, except in isolated pockets of development such as the Klondike (Hamelin 1979, p. 26; Zaslow 1971, p. 278; Phillips 1967, p. 109). Across Quebec, Ontario and Manitoba, the North seemed to be contained well below the limits of the pine belt (White 1925, p. 10). In the west, economic interest kept much of the focus of both economic and transport development well below the 60 degrees North latitude that marked the northern border of the provinces.

These established transportation routes potentially played a vital role in transitional phase aviation. They conceivably provided known corridors along which were points of settlement and infrastructure. The railway lines and river routes that led into the North were points of access into the hinterland.

The characterisation of aircraft flying in the North, during the transitional phase, refers to the specific location of a perceived North at this time. The perceived North of the transitional phase should not be confused with the perceived North in Canada today. The Northern frontier as presented earlier in the chapter, the division between the North and the South, was and is not fixed. It is conceivable that the references to flying in the Canadian North made during the transitional phase were not describing aircraft operations above the 60th parallel, but referred to a perceived North located within the provincial boundaries.

Aircraft during the transitional phase were active in varying degrees across the nation. They went up to the edge of the tree-line on the Canadian Shield in Quebec, Ontario and Manitoba; in Saskatchewan and Alberta, into the areas above Edmonton and Saskatoon; and in British Columbia, rarely further than the coastal town of Prince Rupert, located right below the Alaskan Pan Handle. However, Canadian geography asserted far more influence on flying than might be surmised from a simple comparison between flight routes and the Northern frontier.

1.3.4. Geography of Canada: Uniformity and Diversity

Aircraft in Canada, like many other advances in technology, were a reflection of the regional geography within which they operated. The statement made by the editor of the *Vancouver World* on May 27, 1912 captured that sentiment. "...In this land of 'magnificent distances' as it has been called, the flying machine will develop as an outcome of the environment" (Duffy and Crane 1980, p. 1).

Unfortunately Canada is not a uniform entity. Innis wrote that: "Canada exists in spite of her geography" (Innis 1972, p. 1). Many historians and geographers have described Canada in terms of a thin band of settlement hugging the American border: "...placed there by their dogged loyalty to the Crown but held there by climatic limits" (Vance 1995, p. 245). And even that line of settlement: "...is broken by the Rocky Mountains and the rocky highlands of the Canadian Shield" (Innis 1972, p. 1). Bone (1972) stated that combining the colonies and territories into a single nation: "...ran against the grain of geography" (p. 91). Wonders (1968) simply wrote that: "...settlement in Canada has essentially been a struggle against the forest" (p. 473).

Nation building and settlement across the entire country may be contrary to the natural flow of geography, but one thing that can be agreed on is the uniqueness of Canada's waterways (Canada Year Book 1919, p. 85; Diem 1991, p. 13; Morse 1969; Innis 1972, p. 1). The Canada Year Book (1919) describes

Canadian waterways as: "...one of the most vital elements of it's national existence" (p. 14). Even with this agreement on Canada's most defining geographic feature, the landscape of Canada is still too diverse to study as a whole. Localized conditions and regional variations are too disparate. There is no "common continuous and geographically comprehensive pattern" (Vance 1986, pp. XI).

1.4. Locating the Perceived Northern Frontier During the Transitional Phase

The purpose here is to define the North in the transitional phase. The approach used combines the theoretical concept of landscape and frontier with the historical development of the physical characteristics of Canada. The North in Canada has been shown to be constantly shifting, so it is important to locate this frontier during the transitional phase so that its location can then be utilized to evaluate if aviation was operating in, or opening up the Canadian North. This was done using the cartographic evidence presented in this first chapter.

First a map of the areas developed during the transitional phase in Canada was compiled. To do this, the location of the religious missions from Map 1.1 and the Royal North-West Mounted Police detachments on Map 1.2 were compared, and overlapping locations and concentrations were identified. The main area of overlap was found to be located in Alberta and Saskatchewan. These areas were compared with the routes followed by the fur traders, as seen on Map 1.5, and the striking degree of locational convergence was noted. Next the areas surveyed before 1925 was added (Map 1.7). The only area of overlap

was in southern Alberta. The next layer added was the railway corridor from Map 1.6. In the Central region the railroad corridor overlapped the areas surveyed. In the Prairies the Royal North-West Mounted Police and religious missions were found to fall within the railway corridor. The second largest concentration in the Yukon was determined to be an outlier created by the gold rush phenomenon of the Klondike, and not representative of the overall emerging pattern of development and was therefore disregarded. The compiled map of Canadian development areas is located on Map 1.8A.

A second map was generated dealing with the physical conditions of Canada using Maps 1.3, 1.4 and 1.9. It is simple to identify the emerging patterns, as the natural features are all interrelated. Areas of similar vegetation exist in areas of common geology and elevation. For example, the Boreal Forest region is located mostly on the Canadian Shield, and does not exist in areas higher than 4,000 feet. The result of this compilation appears as Map 1.8B.

When this is compared with Map 1.8A, the first compilation map, there are further trends in the association of different features. When examining the location of the fur trade routes, Map 1.5, and the Canadian railway corridor in 1926 on Map 1.6, it is clear that the transport corridors of Canada prior to the introduction of the aircraft were generally located in areas of low relief. Even though the railway corridor spanned the Rocky mountains, it is well established that the railway followed specific routes through mountain passes. In the Prairie region the railway corridor was confined to the Mixed Woods and Prairie

Map 1.7 Areas of Canada Surveyed Before 1925

Source: Compilation of the author based upon *Philips' Historical Atlas of Canada*, J. W. Chalmers, W. J. Eccles, H. Fullard, eds., George Philip and Sons Ltd., London, 1966, p. 41.

A

B

C

Map 1.8 Compilation Maps Used to Construct the Limit of Perceived North during the Transitional Phase

Map 1.9 Generalized Elevations of Canada

Source: Compilation of the author based upon Putnam, D., *Canadian Regions: A Geography of Canada*, 8th edition, Toronto, J. M. Dent and Sons Ltd., 1968, p. 7.

Parklands vegetation regions. In the Central region the railway corridor fell within the limits of the Boreal forest. In addition, the mineral producing areas across Canada developed before 1926 (Map 1.3), were located within or adjacent to the railway corridor. There is also a significant degree of overlap with mineral producing areas and low elevation levels. The resulting areas of commonality were extracted from the compilation maps (Maps 1.8A and 1.8B). These were compared to the overlapping area extracted from the third compilation map of Canadian Nordicity, presented as Map 1.8C, in turn derived from the conceptualisation of Hamelin (1979), Bone (1992) and McNiven and Puderer (2000) (Maps 1.10, 1.11 and 1.12). All three contribute to defining where the Canadian North begins, deriving the locations of the North from a combination of physical, social and cultural factors.

The first map of Canadian Nordicity utilized is Map 1.10, Hamelin's map (1979, p. 37) depicting the shift of Canada's Northern frontier from 1875 to 1975. Superimposed on this region were the zones of Nordicity from Bone (1992, p.10), shown on Map 1.11, and McNiven and Puderer's (2000, pp. 26-27) zones of Nordicity on Map 1.12. From the compilation of these maps it is evident that Hamelin's (1979) Northern frontier in 1975 corresponds closely to Bone's (1992) zone of Near North and McNiven and Puderer's (2000) zone of Southern Transition as shown on Map 1.8C. This region of commonality drawn from these authors is considered for the purpose of this thesis to represent the limits of the Northern frontier today.

Map 1.10 Zone of Denordification 1875-1975
Adapted From Hamelin (1979)

Source: Compilation of the author based upon Hamelin, L. E., *Canadian Nordicity: It's Your North, Too*, Montreal, Harvest House, 1979, p. 37.

Map 1.11 Zones of Canadian Nordicity Adapted From Bone (1992)

Source: Compilation of the author based upon Bone, R. M., *The Geography of the Canadian North*, Toronto, Oxford University Press, 1992, p. 16.

Map 1.12 Zones of Canadian Nordicity Adapted From McNiven & Puderer (2000)

Source: Compilation of the author based upon Vincent, Mary, & Fick, Steven, "What is North? Two Geographers Define Canada's True North", *Canadian Geographic*, September/October 2000, p. 27.

When the limits of the Northern frontier, Map 1.8C, were superimposed over the amalgamation Map 1.8A of the development, and Map 1.8B of the natural features, there was a startling degree of congruity.

It is from this congruence of features between Map 1.8A, 1.8B and Map 1.8C, that the Northern frontier of the transitional phase is derived. As illustrated on Map 1.13, the transitional phase's Northern frontier appears as three zones which the literature indicates proceed from east to west. The breaks of the zones represent the significant changes in either the development of the zones or simply the effects of natural features. Based upon the procedures outlined above the zones have been systematically defined, the criterion for the direction of the Northern frontiers was perhaps less stringent but nonetheless indicative. The arrows on the transitional phase's Northern frontier, Map 1.13, therefore indicate the direction of development in a linear sense.

In the zone marked 'A' on Map 1.13, the Rocky Mountains are a significant barrier to the flow of development from the east, and combining this with the access afforded by the coast with its mild weather, one can argue the frontier development in the Pacific region is actually moving from the coast inland in a north, north-east direction. This direction of frontier growth was further enhanced by the completion of the Panama Canal, and accompanying shifts in international trade patterns just prior to the transitional phase.

The other break in the frontier between zone 'B' and 'C', indicated on Map 1.13, is a subtler division. The break between the Central region and the Prairie

Map 1.13 Limit of the Perceived Northern Frontier during the Transitional Phase

region is based on the differences in administration and geography. Due to its older and more developed administrative infrastructure, the Central Region did not use the Royal North-West Mounted Police as administration in its northern areas. In addition, religious missions located in the Central region were generally established prior to 1800, and do not appear on Map 1.2. In the Prairies these two groups, particularly the Royal North-West Mounted Police, had a more significant role in defining the North.

Geographically, the Central and Prairie regions, were bounded on the North by the Canadian Shield/Boreal forest. The advance of the Northern frontier into this region was and is strongly affected by the physical conditions. In the Prairies, the Canadian Shield and the Boreal forest are much further north, allowing a wider area between the American border in the south and the limit of the North to be developed. The Central region is a much narrower band of concentrated development. This narrowing can be seen especially across the top of Lake Superior and Lake Huron (Map 1.13). These factors led to the decision to depict the Northern frontier during the transitional phase as a series of zones, rather than the more traditional continuous line running across the entire nation.

By basing the Northern frontier of the transitional phase on the location of pre-existing areas of development, and corresponding physical features supported by the definitions of Nordicity presented by Bone (1992, p. 10), Hamelin (1979, p. 37) and McNiven and Puderer (2000, pp. 26-27), the

conclusions drawn from the results of the research can locate the North at a particular point in time.

The perceived Northern frontier during the transitional phase lay well below the provinces' northern boundaries, following the trends previously stated by Wonders (1972, p. 137), Hamelin (1979, pp. 3-13), Bone (1992, pp. 1-3) and Graham (1996, p. 182). By the start of the transitional phase, the nation was already linked along an east-west axis, and it had shifted to a northern frontier. The location of the Northern frontier on Map 1.13 will be applied to the analysis of the actual flight routes, in Chapter Four, to determine whether Canadian aircraft flying between 1918 and 1926 forged and established new routes within the country and influenced the construction of landscape and the frontier in the North.

1.5. Summary

The North is a landscape with special meaning and significance in Canada. However, the location of the Canadian North and the Northern frontier changed through time.

The location of the North played a key role in aviation during the transitional phase because aircraft and aircraft operations were perceived to be taking place in the North. It continues to be a common perception in Canada that aircraft opened up the North. Understanding the uniqueness of Canadian geography, and the location of pre-existing transport corridors and nodes of infrastructure, help to establish whether aircraft were co-opting these locations as

part of their flight routes, or if geographic conditions affected the choice of flight routes.

Chapter Two

The Administration and Organization of Flying during the Transitional Phase

The political decisions made during and after the First World War by Canadian administrators formed the foundation of flying policy during the transitional phase. Their decisions regarding how and where to use aircraft shed insight on motivations, economic and otherwise, as well as insight into the selection of destinations. Therefore this chapter examines the administration and organization of flying during the transitional phase and their implications regarding aircraft route selection.

The large role the federal government played both in an administrative capacity and as an operational organization figured significantly throughout the transitional phase. While private aviation developed across the nation, it was government operations that dominated, particularly during the first part of the transitional phase. Private and commercial aviation endeavours undertook more work and more varied operations in later stages of the transitional phase. Government aviation and private companies often found themselves in direct competition with regards to the type of work undertaken. However, it was the initial aviation policy decisions of the federal government, in an administrative capacity, that set the tone for aviation development.

2.1. Canadian Aviation Emerging from the First World War

During the First World War, Canada operated two military air services: the Canadian Air Force and the Royal Naval Air Service. The federal government decided it would no longer operate a military air force, and disbanded both units after the Armistice, November 11, 1918, but it continued to be involved with aeronautical initiatives both nationally and internationally. During the Versailles Peace Conference, the first International Convention for Air Navigation, of which Canada was a signatory, was tabled. It stipulated that “the contracting parties recognize that every power has the complete and exclusive sovereignty in the air space above its territory” (Lukkarinen 1969, p. 47). Although this statement was not very specific it served international needs. Prior to the 1930's aviation was a regional means of transport, rather than an international one.

At home, Canada initiated its first aviation policy on April 29, 1919, when the Hon. A. K. MacLean moved for leave to introduce a bill authorizing the appointment of a temporary air board to establish national aeronautical regulations for Canada (Hutchins 1972, p. 2). On June 6, 1919, the federal government established the Air Board of Canada. This was partly in response to the International Convention for Air Navigation, and partly to define a national aviation policy. The Air Board was conceived of as a temporary regulatory body to control all flying in Canada and to prepare regulations governing civilian flying within Canada (Milberry 1984, p. 17). The Air Board Act was the Canadian

government's first assertion of power over civilian aviation (Catomore 1971, p. 16).

2.1.1. The Enactment of the Air Board: 1919

In 1919 the British government offered selected dominions a gift of surplus military aircraft. This transformed the Air Board from a purely regulatory body into a 'hands-on' establishment that would operate these aircraft so that their use and service would benefit the entire nation (Milberry 2000, p. 49). In addition to the Imperial gift from the British War Office, Canada received aircraft classified as war trophies from England, some of which still exist today in Canadian museums. Canada also received a donation from the United States Naval Flying Corps of 12 aircraft and 25 surplus engines abandoned at the United States air station in Halifax, Nova Scotia, at the close of the First World War.

With the determination that the Air Board should operate these aircraft of the Imperial Gift for the nation, those surplus aircraft remaining from the decommissioned Canadian Air Forces were also made available for use (Hutchins 1972, p. 5; Molson and Taylor 1982, p. 10; Milberry 2000, p. 50). The Air Board was now poised to set the direction of aviation operations across Canada. Their decisions on how and where to use aircraft would affect whether people perceived aircraft as a toy for stunt flying, a recreational vehicle or a significant new force in transport and economics in Canada.

2.1.1.1. The First Year of the Air Board

The first Air Board appointed June 6, 1919, included: the Hon. A. L. Sifton as Chairman, Colonel O. M. Biggar as Vice-Chairman; and as members the Hon. S. C. Mewburn, the Hon. C. C. Ballantyne, Dr. R. M. Coulter, Mr. J. A. Wilson and Mr. E. S. Busdy (Report of the Air Board for the Year 1920, p. 4). During the first year they drafted 12 clauses that determined the direction the Air Board's operations should take, and defined the broad phrase "...to supervise all matters connected with aeronautics" , outlining duties that included:

"...to study the development of aeronautics in Canada and abroad, to undertake technical research, construct and maintain government air stations, to control and manage all aircraft and aerial equipment for His Majesty's Service, to operate services which the Governor in Council approves of, to prescribe Canadian aerial routes, assist federal agents in any operations that require aerial support, secure Canadian rights in any international air routes established, to co-operate on the air defense of Canada with officers from the Department of Militia and Defense and Naval Services, co-operate with foreign governments regarding air services, investigate and report on commercial air services established and operated in Canada, draft aeronautical regulations pertaining to the control and operation of aircraft in Canada, and perform air operations for the Governor in Council as required" (Report of the Air Board 1920, pp. 4-5).

In 1919 the Air Board completed Canada's air regulations that were the foundation of Canadian aviation policy until the end of the Second World War (Report of the Air Board for the Year 1920, p. 4). The Canadian Air Regulations became law on January 1, 1920 (Milberry 1984, p. 17). The first Air Board completed outlining its duties and regulations, and resigned, April 19, 1920.

2.1.1.2. The Appointment of a New Air Board

Order in Council, Number 826 on April 19, 1920, appointed a new Air Board. The mandate of the reorganized Air Board was summarized in the first official report from the Air Board from 1920.

“The Board exists for three purposes: the regulation of civil aviation, the conduct of civil government operations, and the air defense of Canada including the organization and administration of Canadian Air Force” (Report of the Air Board for the Year 1920, p. 4).

To this end, the Air Board was divided into three branches. The first branch was Flying Operations. This branch conducted and directed Air Board civilian flying operations. The second was the Civil Aviation Branch, which controlled all non-government civilian flying in the country. The last branch was the Canadian Air Force, which operated the flying and training for military purposes (Report of the Air Board for the Year 1920, p. 4; Milberry 1984, p. 18).

One of the key actors involved in setting the tone and direction of civilian aviation development, specifically government operations and governmental flying, was John Armistead Wilson. Serving as the Secretary for the Air Board from 1920 until 1922, and as the Controller of Civil Aviation until 1941, J. A. Wilson strongly advocated early federal involvement in civilian operations. Wilson and another influential figure in determining the direction of air operation in Canada, Major C. C. MacLaurin, together felt that the real foundation of a country's air power lay in the widespread development of civilian aviation. This included commercial and private operations, along with an aircraft industry that in

turn would provide the foundation on which a military air force might later be built (Douglas 1986, p. 35).

2.1.1.3. The Main Focus of Flying: The Hinterland

It was through the efforts to demonstrate the worth and possibilities of employing aircraft in the hinterland that bush flying became the main focus of federal government flying development. In 1932, Wilson wrote:

“We...put the whole of our energies into flying in our northern hinterland. ...the North country offered a field of development where aircraft could play an immediate useful part. More has been learned of northern Canada in the past 10 years than in the preceding 300 years” (Wilson Papers 1932).

J. A. Wilson, and consequently the Air Board, focused the fields of development in the hinterland, including forestry surveys, forest timber typing, aerial mapping and photography, transportation into remote regions, and other aerial observations (Mackenzie 1989, pp. 14-15). Such operations gave the federal government the greatest return on its money, as well as providing a service to the nation. Perhaps the most important consideration in conducting civilian types of flying operation was cost.

Infrastructure costs were reduced by developing the hinterland. The decision was made to focus on flying with float equipped water-based aircraft that took advantage of the vast number of lakes, rivers, and coastlines in the country, thus avoiding the cost of building airport facilities and infrastructure for wheeled aircraft (MacKenzie 1989, p. 23; Lovegrove 1985, p. 5; Douglas 1986, p. 65).

To further justify the use of aircraft for public services and identify where aircraft would be most immediately useful, the Air Board conducted a study in November 1919. The survey suggested which services could be performed more effectively and economically by aircraft than by existing methods. The report released in January 1920 consistently indicated air service was most useful in the "...less settled and less thoroughly explored portions of Canada, where aircraft can be used for surveys and forestry patrols" (Report of the Air Board for the Year 1920, p. 5). The Air Board's decision to actively control aerial opportunities for the public service meant that the administration of Canadian aviation's development during the transitional phase rested largely in the hands of military authorities.

2.1.1.4. Regulation of Flying in Canada

Decisions made at the end of the First World War drew the federal government into the business of flying. The first real operational season for the Air Board was 1920. The first year of the Air Board's flying operations was also the first year of government imposed regulations on private flying in Canada. In addition to the publication of *'The Canadian Air Regulations'*, the Air Board required the licensing of pilots, air engineers and navigators, as well as the licensing, inspection, certification, identification and registration of all aircraft in Canada (Canadian Air Regulations 1920, Section 4, pp. i-iii). This information provided a census of aircraft types, and of geographic distribution of both military and civilian aircraft flying in Canada from 1920 onward, through the transitional

phase. Table 2.1 provides a total count of the number of aircraft registered in Canada, broken down by civilian and military operated.

Table 2.1 Total Number of Aircraft Flying in Canada During the Transitional Phase

Registered	Number of Aircraft for the Year:											
	1920 ¹		1921		1922		1923		1924		1925	
Civilian	68	53%	76	42%	56	39%	55	38%	69	45%	40	28%
Military	60	47%	103	58%	86	61%	90	62%	85	55%	103	72%
Total²	128	100%	179	100%	142	100%	145	100%	154	100%	143	100%

Notes: 1) Registration for military and civilian aircraft came into effect in 1920.
2) The total number of registered aircraft per year

Sources: Ellis, John. *The Canadian Civil Aircraft Register 1920-1928*, Canadian Aviation Historical Society, Ottawa, 1972.
Griffin, J. A. "Register of Canadian State Owned Aircraft" *The Canadian Aviation Historical Society Journal* 1964 vol. 2, pp. 27-31.

The assignments flown by the Air Board in 1920 were designed to demonstrate the potential use of aircraft in the vast, diverse and undeveloped regions of the Dominion. The major task of the Air Board was to win the support of the public and relevant government departments through practical application, marketing and public relations (Douglas 1986, p. 67).

2.1.2. The Air Board's Control Over Flying in the Provinces

Provincial control over natural resources in various regions facilitated the strong role of government civilian flying. The Prairie region benefited the most from government flying because the Dominion controlled the natural resources in

Alberta, Saskatchewan and Manitoba. This resulted in the domination of government flying to the exclusion of commercial flying. Private aviation companies simply could not compete with the federal government's monopoly or financial resources.

In the Central region, where the provinces of Ontario and Quebec had provincial control over their natural resources, the federal government demonstrated the possible roles of aircraft in different fields of work. After several years, the federal government withdrew their services, leaving room for the development of provincial and commercial interests. The federal government flying in the Central region was undertaken for the provincial government on a repayment basis.

In the Pacific region, the province of British Columbia also had provincial control over natural resources. However, unlike the Central region, British Columbia relied on federal governmental flying for its aviation needs throughout the entire transitional phase. The continuation of federal government flying in the Pacific region was directly related to federal control of the railway belt, a land grant that was part of the terms of union for the construction of the Canadian Pacific Railway. The railway belt encompassed over ten million acres of timbered and arable land. In addition to the control over the railway belt, the federal government was also involved with monitoring and overseeing fishery interests along the West Coast. Both of these responsibilities warranted the continued presence of the federal government in flying operations.

In return for provincial financial support, the federal government rendered flying services to the provincial forestry agencies. British Columbia paid \$20,000 while Quebec and Ontario contributed \$15,000 each for the first year (Report of the Air Board for the Year 1922, p. 7; Hutchins 1972, p. 59). This arrangement was beneficial on several levels for federal government flying. It provided some much needed supplementary funding, since operating aircraft during the transitional phase was an expensive undertaking.¹ Flying for the provincial governments also demonstrated the potential use and application of aircraft in other venues, justifying the federal government's involvement in the activity.

2.1.3. The Air Board's Establishment and Operation of Air Stations in the Provinces

To prove the capabilities of the aircraft, the Air Board established a number of air stations to conduct federal government operations. The location of these stations across Canada is shown on Map 2.1. Vancouver station was established on May 15, 1920, at Jericho Beach, British Columbia. The station, set on the water, was situated for the use of flying boats and float equipped aircraft. In the first season, the Air Board's intention was to undertake such services as forestry protection, aerial surveys, photographic

¹ The cost of buying one used Curtiss HS-2L flying boat in 1921 was \$23,000, more than 10 times the price of a new car.

Map 2.1 The Location of Federal Government Air Stations

Source: Compilation of the author based upon various Reports of the Air Board and Reports on Civil Aviation

surveys, fishery patrols and transportation of individuals and goods to less accessible districts. The Vancouver station was very much a coastal facility, with few flights penetrating the coastal mountain range. Spatial repercussions of administrative decisions about the location of bases defined much of the range of operation, and indicated what areas the administration felt aircraft could be put to the most profitable and practical use.

The second air station was established at Morely, Alberta, in the foothills of the Rocky Mountains. It was the only federal air station to build facilities solely for wheeled aircraft. Morely was located to "...provide better protection in Dominion Government forest reserves on the eastern slopes of the Rocky Mountains" (Report of the Air Board for the Year 1920, pp. 8-9).

Three more air stations were located in the Central region. The first, located at Camp Borden, Ontario, was not a true air station, but a military base that served as the site for the Canadian Air Force's training activities. It was also the location where most of the Imperial gift aircraft were received, erected and flight tested. Camp Borden did not participate in government civilian flying, however it did supply men, machines and spare equipment for these activities.

The second air station was near Ottawa, Ontario, at Rockcliffe. The Ottawa air station had facilities for both wheeled and float equipped aircraft. It served as the headquarters for the Air Board and as the research and development centre for federal government civilian operations.

The third air station was established as an air harbour at Roberval, Quebec. Roberval's primary objective in the first season was to: "...facilitate the exploration of the forest areas north and west of Lake St. John" as well as undertake: "...photographic surveys of major water courses" (Report of the Air Board for the Year 1920, pp. 9-10). These mandated activities set a distinct spatial area for flying in Quebec.

The final air station established was on the East Coast, used the facilities of the Canadian Naval Air Service station from the First World War at Halifax, Nova Scotia. During the 1920 season, this air station was maintained by the Air Board's operations branch for the erection and repair of flying boats and float equipped aircraft, and thus performed extremely limited operations (Report of the Air Board for the Year 1920, p. 9).

From these air stations the Air Board and the federal government set the direction of aerial work that monopolized the transitional phase.

"From the very first the machine of the air was devoted to the greatest national service, the conservation and exploration of the immense natural resources which constitute the country's wealth and her hope of future greatness" (Chicanot 1928, p. 268).

The adoption of the aircraft as a new tool did not alter the general direction of Canadian development. From the fur trade to the wheat boom, the focus of growth and Canadian wealth was perceived to lie in the extractable resources. Aircraft were just the latest tool to access and obtain information about those

resources. Throughout the transitional phase, but most notably in the initial years, the aircraft was an improved method of observation rather than an organized means of transportation.

2.1.4. The Air Board's Air Stations in the Hinterland Until 1922

It was already apparent by 1920 that the development of civilian aviation led by the Air Board differed from the European example where inter-city service was established soon after the First World War (Davies 1964, p. 83; Report of the Air Board for the Year 1921, p. 4; Mackenzie 1989, p. 14). There was a difference of opinion between Canada and Europe regarding where the greatest return for aerial service lay, but even more significant was the difference in the geographic and demographic conditions (Davies 1964, p. 83, Wilson 1926, p. 438). Europe, with a higher density population, as well as smaller distances to travel, could feasibly instigate mail and passenger services and expect financial returns (MacKenzie 1989, p. 14). However, the smaller and widespread population in Canada did not support these types of services.

While airmail is often identified with early aviation, it was not part of the early vision of Canadian air services during the transitional phase.

“The importance of air mail and passenger service was not lost sight of, but inquiries have shown that the establishment of an organized system of air transportation throughout the country would entail very large capital and operating charges, but with little promise of adequate returns” (Canada Year Book 1925, p. 262).

With the continued lure of natural resources, and the high cost of establishing airports for wheeled aircraft, the Air Board directed flights into the hinterland throughout the transitional phase.

The Air Board's efforts to gain the interest of other government departments and persuade them of aviation's potential benefits were all too successful. The Air Board received so many requests for an assortment of operations that it had to arbitrate between equally justifiable demands.

With the increase of activities several new air stations were established in 1921, as seen on Map 2.1. At the request of the Commission of Conservation and the Department of Lands and Forests of the Ontario Provincial Government, the Air Board established an air station for water-based aircraft at Sioux Lookout. The purpose of this new air station was to make a forest survey of the timber area lying east of the Manitoba border and north of the Transcontinental Railway in the pine belt (Report of the Air Board for the Year 1921, p. 10). This dictated the spatial area of concentrated flying for both the federal and provincial governments in western Ontario. Sioux Lookout air station became the busiest flying base in Canada during the transitional phase.

The Department of the Interior requested another air station be constructed in 1921(see Map 2.1). It was established on the south eastern shore of Lake Winnipeg, at Victoria Beach, Manitoba, to serve as a base for forest fire

patrols flown between Lake Winnipeg and the western boundary of Ontario (Report of the Air Board for the Year 1921, p. 9).

The other air station operated by the Air Board in the Prairie region, in Morely, Alberta, was moved to High River, Alberta (see map 2.1). Although Morely was conveniently located near the railway, high winds and turbulence resulting from the proximity to the Rocky Mountains played havoc with the wire bracing between the wings of the aircraft. This made operations, particularly take-off and landing, difficult and dangerous (Report of the Air Board for the Year 1921, p. 11). High River, Alberta was not as prone to high winds as Morely, but was still situated close enough to the National Forest Reserves to allow adequate access for forest fire patrols. These fire protection flights covered the Crows Nest, Bow and Clearwater forest reserves. In addition to forestry protection flights, High River air station supported reconnaissance work over Jasper National Park. All of the operations at High River station in 1921 were conducted by the federal government for the Department of the Interior.

While some air stations in 1921 concentrated a large proportion of time on a small number of different operations, Vancouver air station provided an example of the varied activities and departments that embraced aviation. Activities were conducted for the following government offices: the Geodetic Survey Branch of Department of the Interior, the Department of Customs, the Department of Fisheries, the Entomology Branch of the Department of

Agriculture, the Department of Militia and Defence, the Water Power Branch of the Department of the Interior, the Vancouver Harbour Commission, and the Public Works Department (Report of the Air Board for the Year 1921, pp. 8-9).

2.1.5. The Last Year of the Air Board

In 1922, the government Air Board continued civilian flying operations in all regions.² This was the last year the federal government operated for the Central region. After 1922, Ontario and Quebec were forced to find other sources to provide continued air support.

While the experimental and pioneering stage of the transitional phase neared its end, new departments and branches of the government continued to find work that aircraft could perform. During 1922, the Air Board added work for the Topographical Survey Branch of the Department of the Interior, National Parks Branch, Reclamation Services, the Geological Survey Branch, the Department of Indian Affairs and the International Joint Commission investigating streams crossing the Alberta-Montana border (Report of the Air Board for the Year 1922, p. 12). The establishment of substations across the country broadened the area patrolled by aircraft. While Canadian aviation continued to expand its range of application, the Air Board reported in 1922 that: "...there has been no great demand for flying operations from the other government

² Flying for the provincial authorities on a repayment basis in Ontario, \$38,000, Quebec, \$4,824, and British Columbia, \$20,000. (Report of the Air Board, 1922, p. 12)

departments in the Maritime Provinces and consequently few operations have been undertaken" (Report of the Air Board 1922, pp. 48-49). However, the temporary nature of the Air Board was about to become evident.

In early 1922 the federal government decided on a policy of centralization regarding the defense services of the Dominion. The goal was to create a more economic organization with better communication, and increase administrative efficiency. A bill creating the Department of National Defense was introduced to the House of Commons. It provided for the incorporation of the Department of Militia and Defence, the Department of Naval Services and the Air Board.

2.1.5.1. Replacing The Air Board: The Royal Canadian Air Force

On January 1, 1923, the Department of National Defence was formed (Report of the Air Board for the Year 1922, p. 9; Milberry 1984, pp. 22-23). The Air Board was dissolved and all flying, including that carried out by the Air Board, was placed under the control of the reorganized Canadian Air Force. The Canadian Air Force was renamed the Royal Canadian Air Force (RCAF) in 1924 (Molson and Taylor 1982, p. 11).

2.1.5.2. Civilian Air Operations Versus Military Aviation

Major-General J. H. O'Brien, Chief of Staff for the Department of National Defence, was not initially in favour of continuing civilian air operations.

"When he first heard of the various civilian operations being carried out, he thought it all nonsense. Then changed his mind and swung to the other extreme, he saw the opportunity to build an Air Force on it and gain public support for a big Air Force through the useful work they were doing" (letter from J. A. Wilson, Controller of Civil Aviation to E. P. Warner, March 26, 1932).

The opinion that civilian work could provide public support to the Canadian Air Force was echoed at the Imperial Conference in 1923, the same year the Department of National Defence was inaugurated. The British Air Minister made it clear to the Canadian Prime Minister that he preferred to have military aviation undertake civilian work, rather than expect any private aviation development to serve a military end in time of need (Douglas 1986, p. 70; Molson and Taylor 1982, p. 17). Performing civilian aerial operations expanded the scope of the Royal Canadian Air Force and provided a justification for funding, and administration from the federal government. As such, the federal government continued to play a central role in the development and direction of Canadian aviation.

The demand for government civil aviation from other departments continued to increase, but the funding and machines available were unable to meet all of the requests. In an effort to acquire the financial support, Wing Commander Gordon, Acting Director of the Department of National Defence, addressed the House of Commons in November, 1923. He said:

"We cannot on our own get the necessary appropriation (aircraft) for the operations...the bulk of our flying is for other departments and consequently we ask for your assistance in obtaining the necessary appropriations. When the Minister in Council says 'Will we cut \$100,000 from the Air Service', the Minister of the Interior, for example, is perhaps not aware that that is cutting it out of his own pocket" (Douglas 1986, pp. 71-72).

Without a guarantee of the number of hours and operations flown in their service, a number of departments continued to object to an increase in financing for the federal government civilian air service. This resulted in a 'catch-22' situation that was not resolved during the transitional phase. Without funding for newer aircraft and equipment the Royal Canadian Air Force could not improve its civilian service, but it could not obtain sufficient funding without materially improving its service. After four years of use, the surplus military aircraft were aging rapidly. Technological limitations impacted flying objectives more and more often.

2.1.5.3. Closure of Air Stations in Quebec and Ontario

The decision to remove RCAF staff from Roberval and Sioux Lookout air stations was in part an effort to decrease costs and to reduce the scope of operations (for location of stations refer to map 2.1) (Report on Civil Aviation 1923, p. 18). The Royal Canadian Air Force reported that these air stations were to be taken over by the provinces and:

“...those provinces which control their own natural resources are vitally interested in this problem (aviation) ...the development of air services as an auxiliary to increase the effort of their ground forces” (Report on Civil Aviation 1925, p. 33).

Pulling out of air stations in Quebec and Ontario concentrated civilian flying by the federal government in the Prairies and Pacific regions from 1923 until the end of the transitional phase.

2.2. The Royal Canadian Air Force Years

In 1924, under the reorganized Royal Canadian Air Force, federal military aviation was divided into three areas: civil operations for departments of the federal government, civil flying for provincial governments and air force training exercises for the military (Canada Year Book 1924, p. 616). The federal government felt that the results of government air service in the first four years of the transitional phase had: “...proved that Canada has perhaps a larger field where aircraft can be used to advantage than any other civilized country” (Report on Civil Aviation 1924, pp. 15-16). The decision to dedicate Canadian aircraft development to the hinterland produced excellent results for the Royal Canadian Air Force. The importance and accentuation of the military's civilian function paid the bills for the entire air force (Lovegrove 1985, p. 6).

2.2.1. The Air Service in Ontario

While the government air service continued its 'normal operations', the outstanding event of 1924 was the entry of the Ontario Provincial Government into the field of aviation.

Prior to 1924, the Forest Service of the Ontario Provincial Government supplemented flying undertaken by the federal government with commercial aerial companies to perform forest surveys, forest fire patrols and other work requested by provincial government departments. Based on the two years experienced since the federal government handed over flying activities to the province, the Ontario Provincial Government deemed it more cost effective to organize the Ontario Provincial Air Services, than to continue with private contracts (Halliday 1974, p. 72; Report on Civil Aviation 1924, p. 13). During the first season of flying, 1924, the Ontario Provincial Air Service purchased 13 Curtiss HS-2L flying boats (description and details are provided in Appendix I), hired 16 pilots and 19 air engineers (Report on Civil Aviation 1924, pp. 39-40).

For flying purposes the province was divided into Eastern and Western districts. The goals of the air service were to conduct an aerial survey in forestry, fire suppression work, mapping and photographic work, as well as training new pilots (Halliday 1974, p. 72). By 1925, the Ontario Provincial Air Service expanded its fleet of aircraft and began an inventory of provincial forest resources lying below 51 degrees North latitude. Fully half of the flying time was

spent on fire protection, but other emerging duties included the increasing demand of the Department of Mines. Five aircraft during the 1925 flying season were put at the disposal of the Provincial Department of Mines to enhance access and transportation into a new gold mining district in Ontario's Red Lake district (Report on Civil Aviation 1925, p. 110). The Ontario Provincial Air Service was a major user of flying boats, and more importantly, another significant force directing aerial work into the hinterland.

2.2.2. The Air Service in the Pacific

Federal government civilian air services continued to have much the same focus during the 1924 season as they had during previous flying seasons. In the Pacific region, aviation advancement by the provincial and federal government departments, as well as the private sector, had not taken place on as large a scale as in Ontario. The RCAF continued to carry out any flying required for the province on a repayment basis. Federal government flying in British Columbia focused on the coastal regions and included fishery protection flights, patrolling the railway belt, fire suppression, aerial photographic work and mapping surveys (Report on Civil Aviation 1924, pp. 52-53).

2.2.3. The Air Service in the Prairies

From High River air station, aerial services were similar: aerial forestry surveys, photographic work, much of it for the National Parks Branch, and other flights for the Topographic and Geodetic Surveys Branch. The other air station at

Victoria Beach, in Manitoba, along with sub-stations including Cormorant Lake', Norway House and Lac du Bonnet, concentrated on fire suppression work and aerial forestry surveys.

Photographic work in the Manitoba area provided the Topographical Survey Branch with aerial photographs of water courses. In addition the RCAF ferried treaty monies to Indian bands throughout the region (Report on Civil Aviation 1924, p. 56). The administrative decision to establish more permanent sub-stations expanded the spatial limits of aviation in Manitoba northward, penetrating farther into the hinterland.

2.2.4. The End of Military Control over Civilian Aviation

By 1926, the transitional phase was drawing to a close and the focus of government aviation policy shifted. Specialization in RCAF civilian flying occurred in response to continued operational requests from other departments. The air operations in Manitoba were divided and a special self-contained photographic unit formed to meet the growing demand for aerial photography throughout the eastern prairies (Report on Civil Aviation 1926, p. 56). Government flying expanded to include a larger portion of aerial transportation into remote mining regions, the major emphasis being the Ontario Red Lake district (Report on Civil Aviation 1926, p. 110).

In 1926 there was growing and vocal dissatisfaction with the role the government played in civilian air operations, especially the military control over

civil and private licensing and operations. J. A. Wilson, as the Controller of Civil Aviation for the RCAF, shifted his position on the involvement of the government in civilian operations. He now felt that the goals of implementing government civil aviation had been achieved and that the continued monopolization of government flying by the RCAF was having a detrimental effect upon civilian aviation. "So long as the RCAF claims priority in all the Dominion Government flying to the exclusion of legitimate civilian aviation, civil development is retarded to that extent" (Wilson Papers, 1932).

By the end of the transitional phase it was politically unpopular to have the Canadian military regulating civilian flying. In response, the federal government once again reorganized aviation's administration. It formed the Directorate of Civil Government Air Operations in 1927, reporting directly to the Department of National Defence rather than the RCAF. The complete transfer of civilian aviation's control from the Canadian military took place in 1936 when the administration of civilian aviation was transferred to the Department of Transportation (Catomore 1971, pp. 16-17; Milberry 1984, p. 23; Shaw 2001, p. 86).

2.3. Demand for Civilian, Private and Commercial Aviation in Resource Development

The domination of the federal government in civilian duties during the transitional phase had a significant impact on the type and viability of private and commercial aviation. From the end of the First World War until the end of the transitional phase, no subsidies were granted for private or commercial development. "Civilian aviation has had to 'fly by itself' in Canada" (Report on Civil Aviation 1924, p. 29). In addition to the lack of direct federal support for civilian aviation, companies across the country had to compete with government for work, usually to the detriment of the private entrepreneurs.

2.3.1. The Central Region

2.3.1.1. The Laurentide Air Service

The aviation companies that did successfully operate during the transitional phase pioneered techniques and pushed the envelope of flying in Canada. One of the key innovators in applying previously military aerial operations to the benefit of commercial endeavours was Ellwood Wilson, Chief Forester of the Laurentide Company of Quebec. Ellwood Wilson was interested in obtaining a 'birds-eye view' of Quebec's forest, and made a number of statements to the effect that techniques developed for aerial warfare were: "...lessons instructive even to the lumber industry (that) must not be wasted" (Wilson 1919, p. 16). C. C. MacLaurin's interest was facilitated by the concurrent

interest of Wilson who, in 1919 proposed an experimental aerial forest survey to the St. Maurice Forest Protective Association of Quebec (Douglas 1986, p. 65).

The tangible success of Ellwood Wilson and C. C. MacLaurin's early experiment demonstrated the worth of employing aircraft in the realm of forestry, and the aircraft's utility in civilian operations (Milberry 1979, p. 25; Brant 1971, p. 39).

At the end of 1920, the St. Maurice Forest Protective Association pulled out of Wilson's scheme, but the Laurentide Company took over the sponsorship, continuing experimentation with the application of aircraft to the field of forestry. By 1920, Ellwood Wilson formed a separate company, Laurentide Air Service (Milberry 1979, p. 25; Douglas 1986, p. 65). Two surplus Curtiss HS-2L flying boats under contract from the federal government formed the core of the Laurentide Air Service's fleet during 1920 (Molson 1983, p. 69).

Laurentide Air Service operated almost exclusively in the Central region. It conducted operations such as forest type mapping, reconnaissance and forest fire protection patrols for private firms and provincial agencies in Ontario and Quebec. The company's main base was at Grand' Mère Quebec, but they flew contracts as far west as Sault-Sainte-Marie, Ontario. Other major contracts for the company were with the Spanish River Pulp and Paper Company and the Ontario Provincial Government Forestry Department.

In Quebec, Laurentide Air Service undertook contracts for the Laurentide Company, as well as for the Quebec Provincial Government (Report on Civil Aviation 1923, pp. 13-14; Molson and Taylor 1982, p. 4). As the first successful commercial aviation company in the Central region, Laurentide Air Service expanded its area of operation until 1924. However the loss of its largest source of contracts, the Ontario Provincial Government, due to the formation of the Ontario Provincial Air Service, reduced the company to a minor role in the further development of commercial aviation.

2.3.1.2. Resource Development Companies Venture into Aviation

During the first years following the Armistice, several other forestry companies formed their own flying divisions in the Central region. These in turn broke away to form commercial aviation companies on their own. One such company was the Quebec-based lumber company, Price Brothers Limited. From 1920 until 1922, Captain D. S. Quigley conducted their aerial operations. During 1922, Capt. Quigley formed the Dominion Aerial Exploration Company. It operated five government leased flying boats from the former federal government air station at Roberval, Quebec (Report on Civil Aviation for 1923, pp. 17-18). Dominion Aerial Exploration Company, like Laurentide Air Service, had a provincial government as their primary client. The difference between the two was that Dominion Aerial Exploration Company was reliant on the Quebec

provincial government; the Laurentide Air Service on the Ontario provincial government.

The bulk of the work undertaken by the Dominion Aerial Exploration Company consisted in surveying the upper waters of various rivers, paying special attention to the merchantable timber readily accessible to these rivers. The water courses were used not only to assist the aircraft's navigation, they were also the routes by which the natural resources were extracted. The rivers were the 'highways' of the bush along which commerce and transport moved. The Dominion Aerial Exploration Company continued to operate for both private interest and the provincial government within Quebec until it was purchased by Canadian Airways Limited in 1926 (Report on Civil Aviation 1926, pp. 23-24).

2.3.2. The Prairie Region

While in the Central region several commercial ventures were establishing themselves in the same fields of operations as the federal government's civilian flying, non-government aviation was developing very differently on the Prairies.

After the Armistice aircraft were cheap and pilots enthusiastic (Foster 1990, p. 21). Throughout the country, but particularly in the Prairie region, many commercial companies sprang up (Ferguson 1979, pp. 7-8). Their chief business was joy-riding, or barnstorming. The Prairie region was particularly conducive to joy-riding. The lower relief and plentiful fields for landing sites were ideal for the small, private wheeled aircraft utilized. Unfortunately, the bulk of

these endeavours were neither successful nor long lived. Once the novelty wore off there was little to sustain demand for this type of flying (Foster 1990, pp. 21-23; Morgan 1930, p. 486; Report of the Air Board for the Year 1922, p. 8). The inability to expand into more viable areas such as passenger transportation was due to several factors. There was a lack of support, as well as demand, from both the public at large and the government, but equally important was the fact that the swift transition from joy-riding to a transportation mode simply exceeded the aircraft technology available.

2.3.3. The Pacific Region

In the Pacific region private flying groups also developed after the First World War. However barnstorming and joy-riding were not as prevalent as in the Prairies. This was largely due to geographic conditions such as the mountains and ocean that prevented easy access from one venue to another (Corley-Smith 1989, p. 113; Duffy and Crane 1980, pp. 47-48). There was little commercial success in the Pacific region throughout the transitional phase. One of the first and longest running commercial successes was the international airmail route from Vancouver, British Columbia, to Seattle, Washington. The first flight was conducted March 3, 1919, by Eddie Hubbard and Bill Boeing (Ellis 1954, p. 156). The service continued sporadically, supplementing airmail with joy-rides to provide extra income over the next several years (Corley-Smith 1989, p. 126).

As in the Prairie region, the Air Board and federal government civilian flying operations severely limited opportunities for competing commercial companies in British Columbia. Unlike Quebec and Ontario, the federal government did not withdraw its services in 1922, and the province continued to rely solely on the federal government air service to fulfill its requirements until 1926. While the British Columbia provincial government controlled its natural resources, the results were the same as in the Prairie region. Flying operations were dominated by the federal government air service to the exclusion of commercial flying.

The latter half of the transitional phase saw the establishment of a greater number and variety of commercial flying activities. These later companies filled niches created in expanding markets and took advantage of new avenues of development.

2.3.4. Aerial Surveying

As the usefulness and profitability of aviation was proven, the demand for aerial application grew for reconnaissance work (mapping and photography) and transport into remote regions, primarily into mining areas.

By 1924, and onwards there was sufficient demand for aerial photography for private companies to specialize. Incorporated in 1924, the Fairchild Aerial Survey Company (Canada) Limited focused exclusively on photographic work. Their client list was extensive, as were their jobs. This company completed work

for various departments of the federal government, the Quebec and Ontario provincial governments, as well as work for specific cities and private companies, in both the hinterland and heartland. Other aerial photographic companies were established before the end of the transitional phase and operated in the Central region. These included Brock and Weymouth of Canada, and the French based Compagnie Aérienne Franco-Canadienne.

2.3.5. Aviation in the Resource Sector

The shift to specialization also included the development of air transport companies. During 1925 and 1926 no less than five companies were incorporated to provide access to mining regions. Most were concentrated to provide access to Rouyn, Quebec, or Red Lake, Ontario, following the discovery of gold. However, 1926 also marked the beginning of commercial aviation in resource development, in both the Prairie and Pacific region. Pacific Airways Limited, operating out of Vancouver, was the first private company to be awarded a government fishery patrol contract (MacLeod 1974, p. 110; Duffy and Crane 1980, pp. 21-22). At the same time in Alberta, Northern Syndicate Limited was formed to provide transportation for mineral prospecting in northern Alberta and into the Northwest Territories (Report on Civil Aviation 1926, p. 27). These early western entries into resource-based flying were significant milestones heralding the end of the transitional phase.

2.4. Success Stories Throughout the Transitional Phase

Throughout the transitional phase private aviation companies of all types struggled to find an economically viable niche. Those companies that concentrated on passenger services and joy-riding met with limited success. Those that paralleled the federal government's air service developmental focus met with some prosperity. The various successes had a specifically geographic expression. Administrative choices made at the provincial and federal government level regarding use of aircraft were the major determinant in this commercial viability. In the Pacific and Prairie regions, the government air services monopoly left no room for parallel development of viable commercial firms. It was only in the Central region, where the federal government chose to withdraw air services in 1922, that commercial aviation projects undertaking competing operations were viable. Those who hoped for the rapid establishment of express mail or passenger routes quickly realized the difficulty of operating such services in a country where the large centres of population were few, and separated by wide tracts of unsettled territory (Sandwell 1938, pp. 34-35; Wilson 1926, p. 391).

The *Canada Year Book 1924* stated that:

“Civilian aviation with no appropriation of aid from the government soon proved that passenger services and exhibition flying alone were not sufficient to make a success out of commercial flying. The result is a slow and steady growth of really useful flying; aviation in aid of forest conservation, patrolling of forest fires, mapping, surveying unexplored timberlands” (pp. 615-616).

While these types of flying were beneficial to Canadian development, the direction of aviation into the hinterland was more than just a lack of funds to support passenger service and exhibition flying. The regional geography, demographics and aviation technology available all conspired to motivate the operators and administrators to develop the hinterland, and continued the Canadian tradition of resource based economies.

2.5. Summary

The administrators and operators in the transitional phase were instrumental in shaping and directing aviation's place and purpose within the Canadian landscape. Essentially they controlled flying, both where it was conducted and for what purpose. The major role the federal government played in aviation's development formed the basis of the transitional phase's flying. The conscious decision to apply aircraft technology to the development of the hinterland and the Northern frontier, when compared to the actual spatial extents of flights, allows insight into the perceived location of the Northern frontier. Therefore the location of the Canadian North as seen by the administrators

during the transitional phase can be determined to some extent by the location of flight routes discussed in Chapter Four.

In addition to the decision about utilizing the aircraft in the hinterland, administrators and operators also decided on particular goals and mandates that aircraft could complete. They selected where the aviation infrastructure on the ground was established, including the sites for air stations, sub-bases, fuel caches and flight destinations. These choices set definite spatial limits to aircraft flights and directed aircraft along specific pathways.

As well as establishing the necessary ground facilities, administrators and operators selected and flew specific aircraft types with their associated technical limitations. Again, the federal government's plans reflected their limited choice of aircraft types, but moreover, widely introduced aircraft as a useful tool to the Canadian public throughout the country. As an experimental new technology, the high cost of owning and operating aircraft was prohibitive. The federal government was instrumental in its popularization across Canada. Without government intervention the growth and development of the 'useful' application of aircraft, and its role in resource development, would have been greatly retarded.

Administrators and operators determined where aircraft would be beneficial, and through their selection of destinations and purposes of flight, played a key role in the establishment of flight routes.

Chapter Three

Aircraft and Technology

Interest in aviation was a nation-wide phenomenon that garnered the attention of private individuals and governments who explored the possibilities associated with engine-powered flight. Almost two decades of experimentation and technological innovations in Canada preceded the transitional phase of 1918 to 1926, yet the aircraft were still limited by the available aviation technology. The physical range of aircraft in Canada was also limited by the logistical infrastructure.

The technological limitations of aircraft interacted with the regional geography to form regionally specific flight paths. How far, how fast, how high, and how reliably the aircraft could fly affected where they could fly, the time it took to get to their destination, and the location and frequency of establishing infrastructure. While modern aircraft can fly over intervening geography, the aircraft of the day were prisoners of their own limited ability, and flew in close proximity to the ground.

The pattern of technological advances in Canadian aviation was not a steady curve. Instead, it was punctuated by periods of rapid development. As Figure 3.1, the author's impressionistic view of change shows.

Figure 3.1 Pattern of Aircraft Technical Development 1909-1945

Source: Compilation of the author based upon Gibbs-Smith, C. H., *Aviation: A Historical Survey*, London, Her Majesty's Stationary Office, 1970, p. 18, 180-192. MacKenzie, D., *Canada and International Civil Aviation*, Toronto, University of Toronto Press, 1989, p. 7. McArthur, N. M., "Vickers Canadian Bombardier: Seventy Years of Innovation, Adaption & Achievement", *The Canadian Aviation Historical Society Journal*, 30:77. Naylor, J. L., *Aviation: It's Technical Development*, London, Peter Owen/Vision Press, 1965, p. 101.

From 1909 until 1914, there was a steady growth in aircraft development through experimentation and innovation. During the First World War, 1914 to 1918, aircraft design benefited from focused research and development as a result of military necessity. The result was a large technological advance over a short period of time. The Second World War, 1939 until 1945, resulted in a similar phenomenon. The economic recession following the First World War depressed the rate of aircraft development (Foster 1990, p. 23). It was only towards the end of the transitional phase of 1918 to 1926, and into the commercial period of 1926 to 1939, that rapid technological growth patterns re-appeared. While the Great Depression of the 1930's may have affected the rate of aircraft sales, it did not slow aviation's technological development.

From the first Canadian flight in 1909, until the beginning of the transitional phase in 1918, aviation technology in Canada advanced. To appreciate how quickly the technology changed, it is necessary to provide a brief history of flight.

3.1. Brief History of Flight

Less than 100 years has passed since the Wright brother's famous flight at Kitty Hawk, North Carolina. In that time the aircraft has assumed a pre-eminent role in worldwide transportation, and within Canada. The aircraft has several important roles, and historically, a very clear place within Canada's consciousness.

Lighter-than-air flying endeavours began in France when the Mongolfiers brothers developed hot-air balloon flight in 1783. By 1835, Canadians were launching unmanned balloons, the first ascending from Kingston on May 18th, 1835 (Fuller, Griffin and Molson 1983, p. 1). The first piloted aerial balloon flight in Canada occurred in 1840, when Louis Lauriat of Boston ascended from Saint John, New Brunswick, travelling 21 miles (33.8 km) before descending (Fuller, Griffin and Molson 1983, p. 3). Improvements to balloon transport continued into the twentieth century, culminating in the huge dirigible airships produced by Germany and Britain prior to the Second World War. The development and interest in balloons was scattered around the world, and while coincidental to aircraft development, the science and technology was not particularly applicable (Gibbs-Smith 1970, p. 10). Unfortunately balloon technology was not applied or developed in Canada during the transitional phase.

Advances in heavier-than-air machines, airplanes, were made possible through improvements in the technology available to propel the flight. With powered flight, a force not only pushes or pulls the craft, it also lifts it. For airplanes this power is derived from an onboard engine. Therefore, the development of successful aircraft was dependent on technological improvements in engine design. A successful aircraft engine was required to complete the evolution of the glider into the airplane (Vance 1986, pp. 535-536).

The international benchmark occurred on December 17, 1903, when the Wright brothers successfully flew the world's first airplane (Milberry 1979, p. 12). The Wright's biplane had a 40 foot, 4 inch wingspan (12.2 m) and a 12 horsepower engine driving two propellers, and it managed to cover a distance of 120 feet (36.5 m) in 12 seconds on the first flight (Vance 1986, p. 537; Kane and Vose 1971, p. 2).

From 1903 until the First World War, flight itself remained the goal. Before 1914 aviation was in a purely developmental and experimental stage, and few paid attention to aviation's potential uses (Mackenzie 1989, p. 4). Along with advances in flight technology in the United States and Canada, parallel work took place in Europe. By 1908 the sharing of technological information between the Wrights and two Frenchmen, Henri Farman and Gabriel Voisin, facilitated the creation of an aircraft which was capable of carrying more than one passenger (Vance 1986, p. 538).

In pursuit of powered heavier-than-air flight in Canada, Alexander Graham Bell established the Aerial Experimental Association on October 1, 1907 at his summer home in Baddeck, Nova Scotia (Parkin 1964, p. 40). Through the efforts of the Aerial Experimental Association, Canada's first powered heavier-than-air vehicle, the Red Wing, flew in Hammondsport, New York on March 12, 1908 (Fuller, Griffin and Molson 1983, p. 23). After that success, the Aerial Experimental Association flew the first aircraft in Canada. On February 23, 1909, the Silver Dart flew for 0.8 km at Baddeck, Nova Scotia, under the control of pilot

J. A. D. McCurdy (Milberry 1979, p. 13; Fuller, Griffin and Molson 1983, p. 25). With this flight J. A. D. McCurdy became the first citizen of the British Commonwealth to fly an aircraft.

Alexander Bell's research association accomplished its task of achieving flight, and dissolved in 1910. This was only the beginning of Canadian aviation development. The concept of manned flight held great appeal, and a nation-wide interest in aviation followed.

In the few years prior to the outbreak of the First World War, exhibition flying sprang up at fairs and other public events across Canada. Toronto saw its first airplane 1909, in an exhibition flight by a U.S. pilot and aircraft. In Western Canada, Charles Hamilton made the first flight on March 25, 1910, in Vancouver, and on March 26th made a significant return cross-country flight from Vancouver to New Westminster (Milberry 1979, p. 17). In Winnipeg, on July 15, 1910, spectators on a windy day were privy to the first public airplane crash in Canada when the single scheduled flight of the day was unsuccessful (Milberry 1979, p. 17; Fuller, Griffin and Molson 1983, p. 37).

In accordance with the experimental nature of this early flying, fully half the machines flown in Canada from 1910 to 1912 crashed (Milberry 1979, p. 18). The Canadian public and press were enchanted with the uncertain nature of flying that only enhanced the appeal of these flying exhibitions across Canada. Barnstorming was born as crowds enjoyed the aerial displays of the first aviators.

The declaration of War in August, 1914, forever altered the developmental path of aviation technology, transforming aircraft from a spectacle to a weapon of war. The achievements and advances in aviation technology between 1914 and 1918 were necessarily a military phenomenon. As the Report on Civil Aviation 1924 stated:

“The huge expenditure on aircraft and the necessities of the fighting service resulted in a tremendous development in aircraft; the range, power, speed, maneuverability and size all increased greatly” (p. 5).

However the Canadian repercussions of the First World War were far greater than simply advancement in aviation technology. The First World War provided the technical and administrative foundations for the transitional phase, as well as the machines that were flown in Canada. Military surplus aircraft and parts were relatively inexpensive and plentiful: civilian designed and built aircraft, where they existed, were essentially pre-war vintage. Military surplus aircraft were put to immediate use in Canada (Air Board Report for the Year 1920, p. 3; Mackenzie 1989, p. 7). The end of the First World War also saw the demobilization of trained pilots, crews and air engineers into the civilian population.

3.2. Canadian Aircraft Manufacturing: A Void

An aircraft construction industry commenced with the successful flight of Alexander Graham Bell and his Aerial Experimental Association's "Silver Dart" in 1909. Through the development phase, 1909 to 1914, Canada continued to both design and construct aircraft on an individual basis.

The first Canadian foray into aircraft manufacturing on a production line scale was with Canadian Aeroplane Ltd. Inaugurated on December 1, 1916, the company produced 2,900 airplanes in its 21 months of operations (Sullivan 1919, p. 44). Unfortunately, Canadian Aeroplanes Limited did not continue manufacturing aircraft after the Armistice, and with its closure ended aircraft manufacture in Canada for six years.

Originally a ship building firm, Canadian Vickers Limited of Montréal, Québec, undertook an erection contract, and subsequently aircraft repair contracts, for the Vickers Viking in 1923 (details and diagram are provided in Appendix I). In 1924, the company entered the field of aircraft design and manufacture when aircraft designer W. T. Reid was seconded from the British parent company to its Canadian subsidiary.

During the transitional phase, Canadian Vickers was the only company within Canada to manufacture aircraft on a production basis. By 1928, Avro 594 Avian IV's, Fairchild FC-2's and de Havilland D. H. 60 Moths were being imported into Canada and erected by Canadian companies (Molson & Taylor 1982, pp. 33-34; Hotson 1983, p. 74).

Between the termination of the First World War and the onset of manufacture of the Canadian Vickers Vedette in 1925, the only available aircraft were war surplus aircraft, primarily designed for training (Avro 504k's, Curtiss JN-4's (Canadian) or patrol bombers (Curtiss HS-2L's, de Havilland D. H. 4's and D. H. 9's, for details on specific types of aircraft, refer to Appendix I).

As early as 1920, aircraft operated both by the government and by private companies or individuals had to be inspected and registered. It was from this registry that the total number of specific aircraft can be ascertained for a certain year, and for the entire transitional phase. Tables 3.1 and 3.2 list the type and number of civilian and government aircraft registered in Canada. While an aircraft's contribution was not wholly a function of sheer numbers, it is easy to see that for civilian aviation the most popular aircraft in Canada was the Curtiss JN-4 (Canadian).

3.3. Military Surplus Aircraft: The Imperial Gift

In order to understand how the aircraft's technical limitations dictated where and how aircraft flew through Canadian regional geography it is essential to look at the individual aircraft operating.

The Imperial gift was intended to stimulate the development of national air forces by providing free equipment to selected dominions to form the nucleus of a future air force. Thus, the gift included surplus military aircraft, engines, spare parts and tools. There is no historical agreement on the exact composition of the finalized Imperial gift decided upon June 4, 1919. The discrepancies were due to

Table 3.1 **Registered Civilian Aircraft¹**

Aircraft Type	1920				1921			
	Pacific	Prairies	Central	Total	Pacific	Prairies	Central	Total
Aeromarine 40 L			1	1			1	1
Avro 504K		3	2	5		3	2	5
Avro 548		2		2		3		3
Boeing B-1	1			1	1			1
Boeing CL-4S	1			1	1			1
Curtiss F			1	1				0
Curtiss HS-2L			5	5	1		4	5
Curtiss JN-2				0			1	1
Curtiss JN-4	3	22	23	48	3	20	25	48
Curtiss Seagull			1	1			1	1
Curtiss Standard J-1		1		1	1	1		2
Junkers-Larsen JL- 6				0			3	3
Martinsyde A			1	1			2	2
Nieuport 81.E2				0			1	1
Norman Thompson 2B				0		1	1	2
Sopwith Dove			1	1				0
Total	5	28	35	68	7	28	41	76

Aircraft Type	1922				1923			
	Pacific	Prairies	Central	Total	Pacific	Prairies	Central	Total
Avro 504K		2	2	4		2	2	4
Avro 548		2		2		1		1
Boeing B-1	1			1	1			1
Boeing CL-4S	1			1				0
Curtiss F				0				0
Curtiss HS-2L	1		4	5			11	11
Curtiss JN-2				0				0
Curtiss JN-4	4	17	13	34	3	14	12	29
Curtiss M-F Seagull				0			1	1
Curtiss Standard J-1	1	1		2	2			2
Dayton-Wright			1	1				0
Junkers-Larsen JL- 6		1	1	2			1	1
Loening Air Yacht			1	1			1	1
Martinsyde A			1	1			1	1
Norman Thompson 2B		1		1		1		1
Thomas-Morse Scout				0		1		1
Vickers Viking IV			1	1			1	1
Total	8	24	24	56	6	19	30	55

Notes: 1) Military aircraft were highly mobile across the country where as civilian aircraft were regionally or locally based.

2) Shaded aircraft are detailed in Appendix 1

Source: Ellis, John. The Canadian Civil Aircraft Register 1920-1928, Canadian Aviation Historical Society, Ottawa 1972.

Table 3.1 Continued

Aircraft Type	1924				1925			
	Pacific	Prairies	Central	Total	Pacific	Prairies	Central	Total
Aeromarine 40 L				0			1	1
Avro 504K		2	2	4		1		1
Avro 548		1		1				0
Boeing C-672				0	1			1
Curtiss Experimental				0			2	2
Curtiss HS-2L			25	25			18	18
Curtiss JN-2				0				0
Curtiss JN-4	2	10	13	25	1	2	7	10
Curtiss M-F Seagull			1	1			1	1
Curtiss Standard J-1		2	1	3		1		1
de Havilland D.H. 9a			1	1				0
Fokker C II				0			1	1
Huff-Daland Petrel			1	1			1	1
Junkers-Larsen JL-6			1	1				0
Loening Air Yacht			1	1			1	1
Norman Thompson 2B		1	2	3			2	2
Thomas-Morse Scout		1		1				0
Vickers Viking IV			1	1				0
Westland Limousine III			1	1				0
Total	2	17	50	69	2	4	34	40

Aircraft Type	1926			
	Pacific	Prairies	Central	Total
Aeromarine 40 L			1	1
Avro 504K		2		2
Boeing C-672	1			1
Canadian Vickers Vanessa			1	1
Canadian Vickers Vedette			1	1
Curtiss Experimental			2	2
Curtiss HS-2L	1		20	21
Curtiss JN-4		2	11	13
Curtiss Lark			1	1
Curtiss M-F Seagull			1	1
Curtiss Standard J-1		1	1	2
Fokker C II			1	1
Fokker Universal		1		1
Loening Air Yacht			2	2
Norman Thompson 2B			2	2
Schreck			2	2
Stinson Detroiter			1	1
Thomas-Morse Scout			2	2
Vickers Viking IV		1		1
Total	2	7	49	58

Source: Ellis, John. The Canadian Civil Aircraft Register 1920-1928, Canadian Aviation Historical Society, Ottawa 1972.

Table 3.2 Registered Federal Government Aircraft¹

Aircraft Type	1920	1921	1922	1923	1924	1925	1926
Avro 504 K	28	41	27	30	34	34	30
Avro 504 N	-	-	-	-	2	2	2
Avro 552A	-	-	-	-	1	14	14
Avro Wright	-	-	-	-	-	1	1
Bristol F.2B	1	2	2	1	1	1	1
Curtiss H-16	-	-	1	1	1	-	-
Curtiss HS-2L	5	16	17	15	13	19	15
Curtiss JN-4 (Can.)	1	9	8	8	-	-	-
Canadian Vickers Vedette I	-	-	-	-	-	1	1
Canadian Vickers Vedette II	-	-	-	-	-	7	4
Canadian Vickers Varuna	-	-	-	-	-	-	1
de Havilland D.H. 4	3	11	10	9	9	6	6
de Havilland D.H. 9a	10	7	7	6	6	-	6
Fairey Transatlantic	1	-	-	-	-	-	-
Felixstowe F3	-	5	6	4	-	1	-
Martinsyde F.6	-	-	1	1	1	5	-
S.E. 5a	10	10	5	5	5	3	5
Sopwith Camel	-	-	-	-	3	-	3
Sopwith Snipe	-	1	1	1	-	8	-
Vickers Viking IV	-	-	-	8	8	-	7
Total	59	102	85	89	84	102	96

Notes: 1) Military aircraft were highly mobile across the country where as civilian aircraft were regionally or locally based.

2) Shaded aircraft are detailed in Appendix 1

Source: Griffin, J. A.. "Register of State Owned Aircraft" *The Canadian Aviation Historical Society Journal*, 1964, vol 2, pp. 27-31.

several factors. There was no confirmation on what was actually shipped from Britain to Canada. The aircraft sent were not as a single installment, but as a series, and finally the aircraft were not sent as a whole unit, but an assemblage of various spare parts intended to be erected and tested in Canada.

Consequently, not all of the aircraft were ever assembled, and to complicate matters further, interchangeable parts were assembled on various aircraft (Hutchins 1972, p. 5). Putting together different aircraft pieces to form a single aircraft is one of the stumbling blocks to tracking the life of an aircraft. The discrepancies in the number and type of aircraft received are demonstrated on Table 3.3 Aircraft of the Imperial Gift.

In addition to the Imperial gift, the Canadian Government also received approximately 10 Curtiss JN-4's (Canadian) from the Department of Militia and Defence, and 12 Curtiss HS-2L flying boats abandoned by the United States Naval Flying Corp's anti-submarine stations in Halifax and North Sydney, Nova Scotia (Milberry 2000, p. 49; Molson & Short 1995, p. 18).

The 10 JN-4's and 12 HS-2L's, along with the Imperial gift, formed the core of the Canadian federal government aircraft. These specific types of aircraft reflected the focus of the Canadian government operations towards water-based activities (Milberry 2000, p. 50). This trend, and recognition of the geographic nature of Canada, was perpetuated through to the end of the Second World War with the National Defence Policy that stipulated that all military aircraft must be capable of conversion into float configurations (Milberry 1997, p. 22).

Table 3.3 **Aircraft of the Imperial Gift**

Aircraft Type	Sources:				
	Hutchins 1972, p. 6.	Fuller, Griffin and Molson 1983, p. 95.	Milberry 1984, p. 18.	Milberry ¹ 2000, p. 49.	Shaw 2001, p. 3 & 31.
Avro 504k	62	62	62	62	62
de Havilland D.H. 4 and D.H.9	23	24	12	23	21
SE 5a	12	12	12	12	11
F3 Felixstowe	8	11	8	8	11
Curtiss H.16	2	2	2	2	1
Bristol F2 B	2	1	2	2	2
Sopwith Snipe	1	1	-	2	2
Fairey IIIc	1	1	1	1	-
Curtiss JN-4	-	-	3	-	-
Curtiss HS-2L	-	-	12	-	12
Total	111	114	114	112	122

Notes: 1) The difference between Milberry 1984 and 2000 is a result of confirmation of the data by Canadian military aviation historian Hugh Halliday in the latest publication.
 2) Shaded aircraft are detailed in Appendix 1.

3.4. The Aircraft of the Transitional Phase

To clarify the image of the aircraft flying during the transitional phase it is essential to remember what they looked like. Most were open cockpit bi-planes of fragile appearance. They were of composite construction; cloth covered light wooden frames held in alignment with stressed and adjustable wires. The fabric skin, the finest linen available, was covered with cellulose acetate and/or cellulose nitrate, commonly referred to as 'aircraft dope', to form a rigid impermeable outer shell. The most frequently mentioned aircraft in the thesis, and those most important to transitional phase activity, are illustrated in Figure 3.2.

The upper and lower wings were separated with wooden inter-plane wing struts, and externally with bracing wires, called landing wires or flying wires, depending on their particular orientation. The Curtiss HS-2L has been jokingly referred to as 'the flying forest', due to the number of interplane wing struts. Another comment on the H-boat was that if a pigeon was able to make its way free from the maze of inter-plane wing struts and the external wing bracing wires, the machine was improperly rigged. The external wing bracing wires on a Curtiss HS-2L weighed some 800 pounds (363 kg) (Duffy & Crane 1980, p. 16; Shaw 2001, p. 17). Wings were also internally braced, with stressed wires running diagonally between each wing rib. After each flight, particularly if it was through turbulent air or the aircraft was involved in a rougher landing, all external bracing wires were checked and adjusted so that the aircraft remained in true

Figure 3.2 Common Aircraft of the Transitional Phase

alignment.

During the transitional phase the aircraft employed, almost exclusively, open cockpits. The introduction of the Fairchild FC-2 cabin monoplane into the Canadian market in 1928 initiated a gradual change away from open cockpits to the enclosed cabin aircraft (Molson & Taylor 1982, pp. 305-306). Open cockpits were uncomfortable for the pilots, crew and passengers.

“...the deafening roar of high powered motors, paralyzing cold, the stupefying effects of rarified air at high altitudes, the deadly fumes of carbon monoxide, and the blistering effects of the winds of hurricane velocity” (Bilstein 1983, p. 120).

3.4.1. Instrumentation

Typical navigation instruments found in aircraft of the transitional phase were rudimentary at best. They included an airspeed indicator, an altimeter and magnetic compass, but the most reliable and important instrument was often the pilot's own watch or clock (Bilstein 1983, p. 117; Sims 1976, p. 126). The altimeters available typically registered 1000 feet (305m) for each half an inch around the periphery of its scale. Since it was “more sensitive to changes in temperature than it was to altitude, pilots had to be mathematicians, statisticians or magicians to interpret readings” (Kane & Vose 1971, p. 20).

The problems associated with magnetic compasses in Canada were not limited to crude instrumentation. The further north travelled, the greater the difference between the true north pole and magnetic north, and the less reliable

the magnetic heading became (Sims 1974, p. 125). This problem plagued aviation until after the Second World War and the successful development and adoption of the gyrocompass. During the transitional phase, when the air was rough on easterly or westerly headings, the magnetic compass oscillated all the way from north to south. As one of the principal tools for maintaining the correct course in the air, the magnetic compass was supplemented by visual reference, or 'eyeball' check of the sun's position in relationship to known landmarks (Sims 1974, p. 125; Kane & Vose 1971, p. 20; Bilstein 1983, p. 118).

All aircraft gauges, even the gas gauges, were regarded at all times with suspicion (Sims 1974, p. 125). Standard practice was to physically dip the fuel tanks with graduated sticks to ascertain the true quantity of fuel within the tanks. Most instruments carried on the aircraft were subject to interference from temperature, moisture and vibration.

The instrumentation available was inadequate both technologically and mechanically to fly by instrument alone. With poor instrumentation it was necessary to fly by visual references on the ground. The first instrument flight (blind flight) did not take place until 1929 in the United States, made possible through the development of the gyro-horizon and directional gyroscope (Gibbs-Smith 1970, p. 192).

3.4.2. Flying in the Transitional Phase: The Vagarious Weather

Inclement weather was a major limitation to flying in this period, with flying essentially a summer activity. On encountering adverse weather such as fog, clouds, heavy rain, thunderstorms, turbulence or snow squalls, the aircraft had to land for safety reasons. The aircraft were simply unable to challenge the weather as modern aircraft do.

3.4.2.1. Pushing the Weather: Pushing the North

“mon pays, ce n'est pas un pays, c'est l'hiver...” sings Gilles Vignault (“my country is not a country, it's winter...”). The reality of Canada is the climate. Without reliable winter flying most of Canada's aerial operations were restricted to fair weather flying from the late spring until early fall, before ‘freeze up’. The short operating season was viewed as one of the greatest handicaps of the ‘early days’ (Report on Civil Aviation 1926, p. 7). Overcoming the cold and snow was one of the primary technological goals of the transitional phase.

The first successful use of skis for landing in the Canadian snow took place during the winter of 1917-1918. The experimental landing gear were designed by Canadian Aeroplanes Limited (Fuller, Griffin and Molson 1983, p. 84). Throughout the transitional phase significant advances in aircraft ski technology continued. The primary goal was the reduction of weight. The skis still had to bear the load of the aircraft, but not add significantly to the empty weight of the machine, or add drag. By 1924, ski design had progressed to provide:

"200 pounds (91 kg) per square foot loading on the skis, they can now allow turning and tail movement. For the material on the bottom of the skis, duraluminum is used. However there is some trouble fitting amphibian aircraft with skis due to the weight from a higher axle" (Report of Civil Aviation 1923, p. 52).

Great efforts were made during the transitional phase to make winter flying a reality. In 1921 an investigation of flying conditions in the Canadian Arctic was organized. A crew was sent north (by ship) to check climatic and natural topographical conditions. The conclusion was that the cold weather was not insurmountable and that:

"...when the need arises, with special machines and precautions, aircraft can be operated to advantage in the Arctic regions of Canada. Now what is required is the provisions of aircraft specially built to meet conditions in northern Canada. The aircraft now in use are obsolescent war machines" (Report of the Air Board for the Year 1922, pp. 50-51).

Winter flying experiments by the federal government began in earnest during the winter of 1923-24 in Alberta. It was seen as a technological problem with a technological solution. The greatest stumbling block was the available engine technology. As long as the open cockpit was adequately screened and the pilot properly clothed, the engine was the only drawback. The engines used were predominantly water-cooled, and the radiators had a tendency to freeze sitting overnight and perform poorly in extreme cold weather conditions. The regular procedure for cold or sub-zero flights was to drain the engine of water, gasoline and oil at night to avoid expansion damage. In the morning the fluids were heated over a cook stove or fire before being replaced in the engine. Each

cylinder was primed with fuel before swinging the propeller (Blanchet 1930, p. 656; Milne 1984, p. 4; Molson 1987, p. 74). Very little anti-freeze was available, and if available the anti-freeze had a very low boiling point, especially above sea level. Engines invariably overheated too quickly to implement anti-freeze as a reliable solution (Report on Civil Aviation 1923, p. 56).

The problems associated with water-cooled engines and winter flying persisted throughout the transitional phase. The introduction of reliable American air-cooled radial engines designed during the First World War provided an alternative to water-cooled engines for winter operations (Nayler 1965, p. 146). Although not widely adopted in Canada during the early transitional phase, radial air-cooled engines allowed reliable winter flying in the next phase of Canadian aviation. The available and inexpensive surplus water-cooled engines limited the adoption of the newer air-cooled engines, and in turn limited aviation operations during the winter. "Winter flying is not impracticable but its uses are more limited and only now beginning to develop" (Report on Civil Aviation 1924, p. 29).

Advanced technology was seen as the key to overcoming all types of weather across Canada, not just winter. It was felt that "without technical improvement there can be little progress in aviation under present conditions" (Report on Civil Aviation 1924, p.15). Repeatedly there was the assertion and implication that aviation technology could provide solutions to the unique flying conditions present in Canada. There was the assumption that through the

application of special aircraft designs and modifications, the natural conditions would no longer be limiting factors in the advance of aeronautics.

“Aviation’s extension is now largely a matter of funds and the design of types of machines specially suited for the work” (Report on Civil Aviation 1923, p.6).

“People demand that the methods of transportation they use shall be safe, reliable and economical. When these three points are met the problems of aerial transportation will be solved. Further progress in all three directions depends on the aeronautical research and on aircraft and engine design more than on any other factors” (Report on Civil Aviation 1925, p.5).

Mechanical flight and aviation technology in Canada has advanced from the few hundred metres flown at Baddeck, Nova Scotia, in 1909 to the hundreds of miles flown in surplus military machines and the advent of modern aircraft. Throughout aviation’s development Canada has been a wholesale borrower of technology, adapting and combining existing elements, new ideas and new machinery to suit specific needs and conditions (Newall 1986, p. 1).

Aircraft technology bound the aircraft to the regional geographic conditions. All flights had to consider weather, navigable routes, safe landing and take-off sites and possible obstructions to reaching their destination. The conditions present in Canada dictated the choice of aircraft operated and the direction and focus of technological inquiries. While the aircraft was only a tool, the behaviour and mechanical capabilities affected motivation and operational choices, and therefore influenced the jobs undertaken. Ultimately flights in Canada were channeled along routes that met the technological limitations.

3.4.3. Aircraft Engines

In no other form of transportation is engine failure so likely to have serious consequences, or engine-weight economy so important (Nayler 1965, p. 141). There are several inter-related aircraft engine factors, the most important is the ratio of engine weight to horsepower output. The more horsepower an engine can produce without increasing weight, or significantly increasing the rate of fuel consumption, the greater the benefit to the flight dynamics. However, when the engine produces greater power, but with a corresponding increase in size and weight, the increase of power is essentially lost because it must be used to lift the increased weight of the engine. The goal in aircraft engine design is to have more available power dedicated to the operation of the aircraft; faster flight, higher flight, and more payload/cargo (Bilstein 1983, p. 115). The higher the power to weight ratio, the more successful the engine design.

During the transitional phase the weight of the engine was a significant proportion of the total weight of the aircraft. For example, the maximum weight that the engine of the popular Curtiss JN-4 (Canadian) could lift was 1,920 pounds (872.7 kg). Of that 1,920 pounds, 29 percent was the engine itself. The Curtiss JN-4's (Canadian) engine weighed more than half as much as the entire airframe. A lighter engine that could produce the same amount of horsepower would increase the performance of the aircraft, and thus the amount of payload dedicated to cargo rather than crew or fuel. The percentage of weight allocation is located on Table 3.4.

Table 3.4 Weight Allocation of the Curtiss JN-4 (Canadian)

	Weight in pounds	Weight in kilograms	Percentage of Total Weight
Engine	541.5	246.1	28.2%
Fuel & Oil	154	70	8.0%
Crew of 2	330	150	17.2%
Miscellaneous	44	20	2.3%
Airframe	850.5	386.6	44.3%
Total	1,920	872.7	100.0%

Source: Bowers, Peter M. *Curtiss Aircraft 1907-1947*, Putman, London, 1959, pp. 150-156.

There were other aircraft engine considerations which need to be mentioned because they are intertwined with the struggle for engine performance. Reliability, ease of maintenance, and the cooling method of an engine all affect performance significantly (Report on Civil Aviation 1925, p. 5; Nayler 1965, p. 141).

While the reliability of the aircraft engine during the transitional phase was less than desirable, it certainly allowed aircrews a chance to broaden their mechanical horizons. The chance of encountering engine problems was so likely, that if any aircraft was capable of carrying a second person, he was invariably an air engineer. He performed double duty as photographer, navigator, or any other task, but most importantly had to be ready to address the

inevitable engine problem (Milberry 1979, p. 28; McArthur 1992, p. 77; Chicanot 1928, p. 268). The surplus engines required a complete overhaul after no more than 40 hours of flight, with a total life expectancy of as little as 100 hours in most cases (Knight 1970, p. 120).

With the mechanical vagaries of aircraft engines, ease of maintenance became a central issue. Availability of parts and ease of access to the actual engine while still attached to the aircraft were important factors in aircraft engine design, and when possible, the choice of engines to install into the airframe.

Another significant problem with engines operating in Canada was the performance at higher altitudes. Most engines during this period were developed and tested at sea level. Very little of Canada is actually at sea level, and when engines operated at ground level (already above sea level where the air is denser) and then were flown to several thousand feet the carburettors had difficulty obtaining enough air to operate the engines at full power. The supercharger, which forces an increasing volume of air into the carburettor to approximate sea level air pressure was invented in France during the transitional phase, but would not be perfected until the 1930's (Bilstein 1983, p. 108). This dramatically limited the maximum height at which aircraft could operate. As a result mountains and heights of land were significant barriers to direct flight. Aircraft engines could not propel the aircraft above them, so flight routes had to be selected through lower mountain passes and around heights of land.

The difficulty with aircraft engines persisted throughout the transitional phase. It is important to remember that many of the engines were not new when they were sent to Canada after the Armistice. The limitations inherent in the military surplus engines used during the transitional phase were perpetuated in part by the cheap, available military surplus. The lower powered, heavy engines of the First World War were so plentiful that there was no incentive to integrate advances in engine design during the transitional phase. There was a pronounced tendency in the 1920's to design aircraft to accommodate these surplus engines, rather than more technically advanced engine designs (McArthur 1992, p. 77; Molson and Taylor 1982, p. 35).

“Aircraft with a greater range of speed must be produced so that low stalling and landing speed (which allow for shorter landings and take-offs) may be combined with a good cruising speed. A greater proportion of their gross weight must be paying load” (Report on Civil Aviation 1925, p.5).

All these factors were directly related to power and payload which were the heart of the technological battle to stay in the air.

3.4.4. Payload: Fuel Versus Freight Load

Payload is the weight of freight an aircraft can carry. It is interdependent with fuel and as such limits an aircraft's endurance. The greater the fuel load, the less the aircraft's freight load will be; the greater the freight load the less the aircraft's fuel load will be. The fuel load directly dictates the aircraft's range.

The largest portion of the total payload for aircraft in extended flight during the transitional phase was fuel; gasoline and oil. The larger the aircraft, the

greater the payload, the more fuel burned and the lower the resulting aircraft's endurance. As a result, the distance between fuel caches was a freight limiting factor.

In 1919, there were no convenient gas stations for aircraft throughout the hinterland. Another logistical problem was that there is a distinct difference between automobile and aviation gasoline. Aviation gasoline has a much higher octane rating than automobile gas. In a number of instances the aviation gasoline was specially blended and engine specific (Countryman 1982, p. 111). In emergencies, or when no other gasoline was available, automobile gasoline was used, to the detriment or complete ruination of the aircraft engine. Occasionally mothballs were added to automobile gasoline to attempt to raise the octane level sufficiently to use in aircraft (Bilstein 1983, p. 105). All fuel was filtered through chamois to remove physical impurities that may have led to fuel line blockages and subsequent engine failure.

3.4.4.1. Fuel Caches: A Necessity of Hinterland Travel

Unless aircraft were returning to the base of operations that the flight originated from, they needed to refuel upon reaching the limit of their endurance. The necessity of fuel caches was stressed repeatedly in accounts of the period. The Report of the Air Board for the Year 1922 stated that they:

“...cannot insist too strongly on the advantages of such sub-stations...it extends the radius of air machines...permits pilots to take advantage of fine weather of short duration. Time and money thus saved as on each flight (from the substation rather than home base) we had 130 miles (208 km) less to cover” (pp. 45-46).

To establish the fuel caches most of the gasoline went out in 4-gallon cans. There were two cans to a case, weighing a total of 70 pounds, (31 kg) transported by Natives in their canoes. That was, until the Natives realized what they were transporting, punched holes in the cans with a nail, and used the gasoline for their small outboard motors on the canoes (Milne 1983, p. 106). Where possible, fuel was supplied bulk, in barrels transported by train, barge or tractor train. However, ninety percent of fuel caches throughout Canada were established by canoe (Maxwell 1973, p. 92). If fuel caches were established by canoe, logically the aircraft must have been water-based. Strategic placement of these fuel caches implied prior knowledge of both the watercourse and the limitations of the aircraft in use.

3.5. Summary

The aircraft flown during the transitional phase had an important and significant impact on the spatial limits of aviation within Canada. The performance of aircraft was and is limited by technological capabilities. It was the mechanical abilities of the aircraft flown between 1918 and 1926 that had to be taken into consideration when determining the purpose, route and destination of flights undertaken.

Operational limitations introduced in this chapter had direct impacts on the application and use of aircraft during the transitional phase. Throughout this phase weather was a major limiting factor because aircraft technology could not

challenge it. This restricted aircraft to fair weather, summer flying. Winter operation remained a purely experimental endeavour. In addition to the limited flying season, transitional phase aviation technology tied aircraft to pre-established ground based infrastructure. The reliance on ground based infrastructure was a function of the reliability and range of the effective application of aircraft, especially in the less heavily populated hinterland.

Finally, the technological capabilities of aircraft, when examined within the context of regional geography, resulted in areas of optimal flying. How high, how far and how reliably a particular aircraft could fly was imposed over the physical conditions of the landscape. Mountains and heights of land became barriers to flight, and geography conducive to possible landing sites or sites of ground based infrastructure was more desirable to fly over.

Aviation technology and aircraft performance dictated the need for flight routes and imposed particular limits on aviation's application throughout Canada. Administrators sought to select the best type of aircraft from those available to accomplish their mandates by recognizing and working with the aircraft's limitations.

Chapter Four

Flight Routes During the Transitional Phase: Historical Case Studies as Viewed in the Geographical Context of the Pacific, the Prairie and the Central Regions

Throughout the previous chapters it is evident that the administration and in particular government agencies set the goals of aircraft flight during the transitional phase. These flights were constricted by particular technological limitations associated with the aircraft available. The interaction between geographic conditions, administrative goals, safety considerations and the mechanical unreliability of aircraft affected where transitional phase aircraft were able to fly.

In order to pursue the question whether aircraft during the transitional phase forged and established new transport routes, the author has chosen thirteen historical case studies with which to explore the issue.

Each of these thirteen cases represents situations where flying was accomplished through a unique combination of transport corridors, waterway systems, resource locations, administrative mandates and with specific types of aircraft.

In order to maintain the flow of text at this point detailed information about the sources used in this chapter is provided in Appendix II. However, in general it can be said that the chapter relies upon government reports tabled at the time, memoirs and reflections of the period published in *Canadian Aviation Historical*

Society Journal, and the flight logs of pilots and navigators. These are compiled and analysed for specific regions of the country, or at least for the regions ultimately presented, since two regions were excluded. The first part of this chapter therefore provides justification for their removal and a general discussion of regionalisation as an analytical tool.

4.1. Division of Canada into Regions

The regions of analysis for the case studies consist of the Central, Prairie and Pacific regions, as referred to in Chapter Two. This was done so that the analysis could consider the physical and administrative differences across the nation. Limiting the analysis to a national level could not highlight patterns and processes unique to individual regions

Regions are a traditional tool used by geographers that subdivide a space into more manageable areas for the purpose of description or analysis. Regions are defined by set criteria and these criteria have a significant effect on what form the regions will take (Robinson 1981). The definition of region is plagued with difficulty. The examination of regions raises the question; do regions exist, do they form 'demonstrable entities'? Overwhelmingly, it is the focus on variations over space and place which dominate regional discourse (Putnam 1968; Robinson 1981, 1991, p. 19; Archer 1993, p. 498; Laycock 1972, p. 1).

In defining regions, variations over space and place address both site and situation concepts. Where site refers to local conditions, situation refers to the broader interaction of factors between areas (Ullman 1974). Regionalisation

often fosters a misleading impression of uniform conditions. While many areas labelled regions do not exhibit distinctiveness and homogeneity, they may have similar dominant characteristics. Putnam (1968) stated that: "...it is fairly obvious that geographic regions of any size cannot be delimited on the basis of homogeneity alone. Instead we must admit that relationships are more powerful cement than similarities" (p. 40). It is the choice about how regions are constructed that provides recognizable unity: these vary from person to person and in terms of intention.

The current discussion and literature produced by Canadian geographers about the regions of Canada has concentrated on subdividing Canada into smaller more cohesive regions for study and analysis (Robinson 1991, p. 19). Different foci of analysis and study result in different regional divisions or different regional divisions reflect different criteria for delimitation.

Natural physiography as a base for regional geography is prevalent in the decisions regarding Canadian regions. Putnam (1968, p. 4) felt that for special purposes, single factor regions based on land form, climate, vegetation and soil, provide regions that have well defined limits and strong physical homogeneity. Even the Canadian Year Book (1919, pp. 84-85) divided Canada into five sections based on physical characteristics. Physical features alone are not applicable to all studies. A combination of both physical and human factors were presented by Griffith Taylor in 1947, dividing Canada into a tiered system of 20 regions (Putnam 1968, p. 6).

Given this, regions should not be established solely on the basis of physiography and climate. Moreover, given the importance of administrative structures, it would not be meaningful to recognize many small regions which however interesting would not be a meaningful tool of analysis for something which was essentially organized provincially. The analysis at this point is organized at this level which most Canadians would accept as the first, most significant level of regionalisation. (Robinson 1991, pp. 19-20; Matthews 1983, p. 99). These are not geographically uniform regions, but they do provide political and administrative homogeneity. Considering both geo-political factors regarding provincial jurisdiction over resources, and physical similarities make it possible to formulate a division of Canada into five regions: the Pacific region, the Prairie region, the Central region, the Maritime region and the Northern region, as seen on Map 4.1. Many of these are “regions of conveniences and boundaries are arbitrary, yet realities known” (Putnam 1968, p. 41). Each region is introduced and discussed in the analysis presented in the following pages, with the exception of the North and Maritime regions. These are excluded from the analysis of this thesis. The reasoning behind this decision is as follows.

4.1.1. The North Region

The North region has been designated as the area above 60 degrees of latitude across Canada. The North region is not to be confused with the location of the Northern frontier during the transitional phase depicted on Map 1.13, which is well within provincial limits. The salient reason for excluding the North region

Map 4.1 **The Five Regions of Canada**

in the analysis of flight routes during the transitional phase, is that a review of the literature revealed an almost complete absence of aviation that far north. Less than a handful of Canadian flights crossed the 60th parallel during the transitional phase. This simply does not provide enough data to evaluate route selection for an entire region. As such, for the purpose of this thesis, the 'North' region was excluded as a region of analysis.

4.1.2. The Maritime Region

The Maritime region, comprised of Nova Scotia, New Brunswick and Prince Edward Island, was also excluded. Newfoundland, which of course did not become part of Canada until 1949, well after the transitional phase, was naturally omitted as well. There are several reasons for this exclusion, chiefly the marked lack of flying activity conducted in these provinces relative to other regions. This lack of aviation was apparent in both civilian and government operations. The lack of flying activities can be related to the geography of the region. In the other Canadian regions aviation development was directed into the less settled hinterland for the purpose of furthering economic development of untapped natural resources. The smaller size and advanced historical development of the Maritime provinces had reduced the size of its hinterland. What little hinterland existed was already accessible with the established transport infrastructure of the railroad. Therefore aircraft had no niche to fill when compared to the other regions. The extremely limited number of flights and differences in geography resulted in little information regarding flight route

selection for the region. Therefore the Maritime region was excluded for the purpose of this thesis.

4.2. Transportation Structures and Flying Routes During the Transitional Phase

Transportation is the spatial organization of the interactions between economic, social, political and geographic aspects of a region (Taafée 1973, p. 1; Ullman 1974). The convergence of these factors creates explicit transportation structures. Historical transportation geography attempts to understand the processes that created the resulting routes (Taafée 1973, p. 1; Putnam 1968; Wonders 1968). Investigating Canada through the use of regions does not diminish the central role transportation has played in Canadian development (Putnam 1968; Sealy 1968; Seimens 1968; Stager 1972; Wonders 1968). The examination of transportation and regions reflects the operation of processes over space.

“There is an explicit spatial expression in the case of transportation, as an aspect of the organizational area, there is a focus on the spatial structures formed by these nodes and attempts to understand the processes that have created them” (Taafée 1973, p. 1).

Vance (1986) wrote that: “...this search for the historical geography of transportation...is predicated on the belief that the horizons of that realm are as extensive geographically as they are in time” (pp. xii).

Aircraft flight routes are not a current emphasis in transportation studies because improvements in technology and infrastructure have liberated them from the influence of physical geography. Rather the emphasis has been to focus on

particular linkages and flows which comprise transport networks. These networks operate from aviation specific hubs or centres to endpoints, and the analysis often starts with a pattern of connections and moves to the process which underlies those patterns. It is through the analysis of mainline and local service destinations, frequency and levels of services that these networks are evaluated (Sealy 1968; Blainey 1966; Barry 1979; MacKenzie 1989; Courtney 1971, 1985; Davies 1964).

Unfortunately, this type of network analysis is totally unsuitable for the transitional phase. There were few established aviation specific hubs, and little or no inter-connection between them. Each one operated independently to serve the immediate area. Moreover, this type of analysis cannot examine the unique spatial phenomenon generated by aircraft flying within ground proximity. The routes of aircraft flying in this manner, as opposed to modern methods, were not straight lines connecting two locations. These unique flight routes were a product of geography, administration and transport technology. Kane and Vose (1971) stated that:

“...air travel knows few physical obstacles and it decreases the time of transport so greatly and made it possible to travel over obstacles such as mountains, deserts, swamps and ice caps, which make surface travel slow and costly, if not impossible” (p. 3).

How true this statement is of transitional phase flying is questionable. Kane and Vose (1971, p. 6) stated that air transportation can only develop as far as facilities permit. The experience of Kane and Vose was of course American, where circumstances were quite different to Canada. Their statement would

seem to pre-suppose an airport infrastructure; in Canada there was little possibility of such facilities.

Canada's decision to focus early on water-based aircraft was founded on specific Canadian physical geographical conditions and allowed more flexibility for landing locations in regions naturally endowed with lakes, rivers and forests. This decision removed the need for airport construction and lowered the cost of employing aircraft, but the resultant routes were not necessarily transferable to inter-city use (MacKenzie 1989, p. 14). The use of float planes was not a viable option in other countries due to differences in regional geography. While the United States and Australia had similar issues of distances to overcome, basic differences in regional geography dictated different approaches in aviation development. The only nation that had comparable issues with geography and scale, and similar problems in aviation development as Canada, was the USSR's Siberia.

Differences in regional geography, such as flying over populated versus unpopulated areas, mapped or unmapped areas, influenced the rate of aircraft penetration and the type of aircraft used. Regional conditions such as the dryness in Australia and the availability of relatively level, cultivated agricultural areas in the United States, resulted in a reliance on wheeled aircraft; in contrast geography led to a Canadian dependence on water-based aircraft (Blainey 1966, p. 297).

In the existing Canadian aviation literature, in addition to recognition of the appropriateness of particular aircraft to particular geographical circumstances, there is also a recognition of the early dependence on geography for more than just landing sites, but also as an aid in navigation. This navigational reliance was based on visual ground references used by the pilot and crew to maintain course and to locate the aircraft's position. References to this type of navigation are present in much of the literature and often referred to in an offhand, assumed manner. Kane and Vose (1971, p. 21) used the phrase 'flying the iron beam' which literally meant following a railway line. This is a common reference, and no account of early flying in Canada would be complete without at least one story of how during bad weather a pilot flying the iron beam had to climb suddenly to avoid a head on collision with a train. Sutherland (1978) wrote that: "...through the mountains as well as over other portions (of the first flight by a single aircraft across Canada in 1926) the railroad was a great help to them in navigation" (p. 15). Kane and Vose (1971, p. 20) related the same phenomenon:

"...with no navigational aid, no aerial signposts, no radio the pilot could strap a road map to their thigh and if there were no clouds, fog, rain or snow to obstruct the view, they could look over the side of the cockpit and locate a river, railroad track, a distinctive barn or other landmark and thus determine their course."

This quote illustrates more than just a dependence on the regional geography and known routes. It also reveals how low the aircraft flew, to be able to pick out distinctive barns.

The uniqueness of flying in Canada during the transitional phase was predicated in part on the uniqueness of Canadian regional geography (as discussed in Chapter 1). Transitional phase flight routes were an explicit spatial structure that resulted from the convergence of the themes of the thesis: geography, administration, aviation technology.

4.2.1. Flying in Ground Proximity

In 1920, most forms of transport in Canada relied on following previously or permanently established routes, be they railroads, rivers, roads, or trails. "You had to know where you were going, and see where you were going because you had no navigation of any kind except what you could see..." (Duffy & Crane 1980, p. 48). Aircraft relied on visual, ground-based navigation to travel from place to place. Without information from either maps, instruments or visual references on direction about distance, obstacles and route markers, travelling from one point to another was impossible. Technology at this time could not provide accurate instrumentation or information on which to base a flight course. Moreover, the new perspective aircraft provided, looking down on the world, placed new challenges on locating ground based markers.

Several factors came into play when choosing a flight route during the transitional phase. Aircraft's reliance on navigation aids that are visible from the air resulted in specific air routes. A simple ground reference that was clearly visible from the air was not always satisfactory for ground proximity flying. The technical capabilities of the aircraft necessitated routes that provided potential

emergency landing areas, as a safety precaution for the unreliable engines or rapid environmental changes occurring with the onset of inclement weather. The routes could have neither too tight a turn or too steep a grade, as sudden changes taxed the engines and aircraft beyond their abilities. Numerous references indicated that upwards of one half hour circling was required for a Curtiss HS-2L to obtain 2000 feet (610 m) in elevation (West 1974, p. 8; Flight Log Madge Graham 1919; Duffy & Crane 1980, pp. 19-20; Daily Work Diary of the St Maurice Forest Protective Association 1919, Aug 5 and 12.).

The route requirements resulted in either the establishment of new aviation specific flight paths or the use of pre-existing transport corridors as flight guides. Flying into an area without any prior knowledge or maps was tantamount to flying blind and hoping to locate the flight's destination. This was simply irrational and dangerous, especially when pilots and crews may not have known the area from the ground, let alone from the novel perspective of the air. Aircraft were and are expensive to operate and even more expensive to lose through accident or misfortune. Sending one into an unexplored area, without a firm idea of its destination or objective, simply did not happen during the transitional phase.

The quality and availability of cartographic information and existing maps played an important role in route determination. Therefore the extent of mapped areas, and the detail included, had immediate consequences for aircraft adapting available maps to select the specific routes.

Coverage was the most limiting factor. Large areas of Canada were not surveyed or mapped at the beginning of the transitional phase (See Map 1.7 in Chapter One). What little had been mapped was often inaccurate due to the survey methods employed. Sandwell (1938) related the passenger's comment after their first flight in an aircraft. "I could see the whole country spread out below me just like a map" (p. 61). Unfortunately the new perspective did not necessarily correspond to, and in many cases contradicted, existing map detail (MacLeod 1974, p. 106; Milne 1983, p. 102).

With the new perspective gained from flying, and the introduction of aerial photography to the field of mapmaking, discrepancies between existing maps and aerial photographs brought attention to errors and inaccuracies of current maps.

"In at least one instance after seemingly hopeless struggle to coax the aerial photograph to correspond with the (existing) ground map by artificial distortion and enlargement, it was discovered that the particular city map was so much in error that the photos had originally been the more correct" (Sandwell 1938, p. 63).

If a legally surveyed city map could be so inaccurate, questions arise regarding the accuracy of maps of the hinterland areas and their potential value as the basis for visual ground references and routes.

From comments regarding hinterland maps and maps of the 'North' used by pilots during the transitional phase, several things become clear. Routes were based on previously established transport corridors, such as major river and lake systems and railway lines, as they were often the only features indicated on the

maps (Molson & Taylor 1982, p. 2; Sandwell 1938, pp. 3-4). The remaining areas were blank space and classified as 'unexplored' (Sims 1976, p. 125; Duffy & Crane 1980, p. 48; Molson & Taylor 1982, p. 2, Maxwell 1973, p. 92).

Pilots relied heavily on visual memory and accrued personal and regionally-specific cartographic knowledge as the basis of their routes. They were also expected to sketch in prominent features or notable points as they flew.

The maps of major transport corridors had distinct advantages for aircraft co-opting them for air routes. They provided no surprises for pilots. In addition the major waterway systems that were travelled and mapped were most likely third and fourth order rivers. These provided shallower grades and larger visual references that could be easily located and followed from the air, and were often large enough for emergency landing sites. If a forced landing occurred, these larger, well travelled rivers were also more likely to have settlements located along them, or at least a greater likelihood of meeting with other travellers.

The same was true for railway lines. The grade seldom exceeded one or two percent, and most curves found on major lines were no sharper than five or six degrees (Davis & Foote 1953, p. 672). Furthermore, if forced to land near a railway line, the pilot and crew knew what route could return them to civilization. The low grades and easy visibility of such corridors made them the routes of choice to follow when available.

If it is true that aircraft during the transitional phase were reliant on ground navigation and pre-established infrastructure, this casts doubt on their ability to be utilized in exploration work and the opening up the North.

4.2.2. Flying in the North

In Canadian aviation and transport history, there was an assumption that aircraft during the transitional phase operated in the unexplored and less populated areas of the North. Aircraft are credited with 'opening up the North' and providing unparalleled access into remote areas for the purpose of resource development and exploration (Canada Year Book 1919; Canada Year Book 1927; Report on Civil Aviation 1923; MacKenzie 1989; Putnam 1968; Sandwell 1938).

This assumption is supported by such statements as: "...exploration work...is being carried northward by aircraft" (Sandwell 1938, p. 74) and "...the chief development of Canada was 'bush flying', the opening up of the Northland and other remote areas" (Putnam 1968, p. 380).

As presented in Chapter Two, many of the administrative and operational mandates instituted for aircraft during the transitional phase suggest that, at this time, regional development and useful aircraft operations occurred in proximity to the fringes of settled Canada and overlapped areas of existing economic development.

"We deliberately turned our backs on inter-city service and put the whole of our energies into flying our northern hinterland...the North country offered a field of development where aircraft could play an immediate useful part" (Wilson Papers, 1932)

By examining the spatial limits of transitional phase aviation based on the routes the aircraft flew, conclusions can be drawn regarding the accuracy of the concept that aircraft at this time were 'opening up the North'. The analysis that follows examines flight routes and their underlying factors as viewed in the geographical context of the Pacific, the Prairie and the Central Regions.

4.3. Analysis of Historical Case Studies Applied to the Three Regions

In order to assess flight route patterns during the transitional phase, thirteen case studies were selected. The specific flights were chosen for two reasons, the primary one was the totality of information about the flight route, the secondary reason, the representative value of the flight route. The piece meal nature of the research resources, as detailed in Appendix II, was a significant limiting factor in finding complete route information. However, a survey of the literature of the less complete flight routes in each region supported those chosen for the case studies as being typical and representative of flights for the region. Often the reason that the entire flight route was recorded or preserved historically was that some aspect of the flight or route was particularly significant to Canadian aviation development. This was particularly true for private or commercial operators.

4.3.1. The Central Region

The Central region is made up of the provinces of Ontario and Quebec, both of which had provincial control over natural resources since Confederation. While the physical geography of the Central region is less characteristically homogeneous than the Pacific mountains or flat Prairies, it does have some distinct geographic similarities. The region is dominated by the Canadian Shield, or Laurentian Plateau. With low relief seldom exceeding 1,500 feet (457 m), this is a gently sloping topography inundated with countless lakes, rivers and streams.

Unlike the Pacific and Prairie regions, for the bulk of the transitional phase the Central region's administrative mandates and flying objectives did not rely on the federal government. Provincial and private interests drove the selection of flying destinations and operations. In both Ontario and Quebec, the provincial governments and private companies used aircraft to aid forest conservation and resource development, as did all the regions. The route selected for the case studies in the Central region offers some contrast to federal government flying that dominated flying operations in other regions.

4.3.1.1. St. Maurice Forest Protective Association Flight Route

The earliest bush flying and first post war private application of aircraft to resource development was undertaken in the summer of 1919. These first forays into bush flying were administered by the St. Maurice Forest Protective Association. There was a large degree of experimentation and uncertainty

associated with this first application of aircraft technology to the field of resource development, and particularly forest conservation.

The pilot for the St. Maurice Forest Protective Association was Stuart Graham. The aircraft flown was a Curtiss HS-2L flying boat, on loan from the Air Board of the federal government (Shaw 2001, p. 7). It is Stuart Graham's flight log, and the log of his wife and navigator Marguerite (Madge) Marie Graham that provide the flight routes where these first forest patrol flights in Canada were being conducted. Selections from their flight logs are presented in Appendix III and illustrate the uncertainties of flying in these early years.

The forest patrol flight routes set many of the patterns seen throughout the transitional phase. As seen on the flight route Map 4.2, the pilot closely followed major waterways and railway lines as route guides. Once established the routes were followed by subsequent flights. The established route was based on the capabilities and safety considerations associated with the aircraft flown. As well the routes were based on the historical and statistical occurrence of previous forest fire activity (Reeves, 2001).

4.3.1.2. Canadian Aerial Services Flight to Moose Factory

In the early part of 1922 resource promoter and prospector John Mack contracted Canadian Aerial Services, and with an Avro 504, three-seater aircraft made a groundbreaking flight from Cochrane to Moose Factory (Fuller 2001, Downwind, #14).

Map 4.2 St. Maurice Forest Protective Association Flight Route

Source: Reproduced with permission of the author. Reeves, A. I., "Aerial Forest Fire Detection Patrols in Quebec: 1919", publishing pending *Canadian Aviation Historical Society Journal*, 2002.

The flight is notable for the number of milestones. The first milestone was the time of year when the operation took place, several flights were made between February 4 and February 13, 1922. The winter flying was made possible through the use of skis on the aircraft and by replacing the Avro 504's standard water-cooled engine with an air-cooled radial engine.

The pilots, Roy Maxwell and Hervé St. Martin, were to conduct an aerial survey of the area around Moose Factory and make deliveries to the Hudson Bay post located there. The entire flight route followed the Abitibi River covering 250 miles (400 km) round trip, in one day, as the flight route marked on Map 4.3 depicts. Following the river was the only option given that:

“the latest maps of this district (James Bay) show large unexplored areas, at a glance make plain that practically all the work done has been in the vicinity of water courses, the only routes traveled” (Maxwell 1973 p. 92).

The length of the flight was the limit of the Avro 504's range on one tank of fuel and any problems, even a strong headwind, would result in the aircraft running out of fuel before reaching Cochrane. The time saved by using an aircraft was substantial. The average flying time in the air was about 2 ½ hours, compared with the eleven days by dog team for the same route (Report of the Air Board 1922 p. 16). Unfortunately, on February 13, 1922, 95 kilometres (60 miles) out from Cochrane, the engine oil froze and the plane had to make an emergency landing on the frozen river. Due to the mechanical problems Maxwell and St. Martin were unable to fulfill the terms of the contract within the time limitations set out. The resulting litigation over the default of the contract was the

Map 4.3 Canadian Aerial Services Flight to Moose Factory

Source: Compiled by the author based upon *Report of the Air Board for the Year 1922*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 16. Fuller, G. A., 2001, *Downwind*, Number 14, Canadian Aviation Historical Society, Montreal Chapter, Montreal.

first commercial breach of contract suit pursued in Canada (Fuller 2001, Downwind, #14).

The flight route, while setting many firsts in Canadian aviation, still followed many of the established patterns of transitional phase flights. To save wear and potential harm, the aircraft was shipped by rail to North Bay, then to Cochrane on the Temiskaming and Northern Ontario Line. The flight path followed a major waterway to and from the destination. Not only did the waterway provide a visual guide, it was used as a site for the forced landing.

4.3.1.3. Rouyn Gold Rush Flight Route

Beyond aircraft's application to forestry related work, the Central region developed aviation flight routes from points along the closest railway line into the developing mining regions. The first route was to Rouyn, Quebec, in 1924, and then Red Lake, Ontario, in 1926 at the end of the transitional phase. In these cases individuals with enough money could pay a dollar or more per pound of cargo or passenger to travel by air.

Laurentide Air Service was the first to capitalize on the opportunity and became the first recognized regular conveyance of passengers and cargo, inaugurating the route on May 23, 1924 (Report on Civil Aviation 1924, p. 13; Thomas 1996, p. 82). Initially, the established route originated from the Canadian Pacific railhead at Angliers, Quebec, and proceeded via Lake Osisko. However, by July 31, 1924, the base of operations was moved to Haileyberry, where there was better anchorage (Milberry 1997, p. 55). Laurentide flew the

sixty mile route, as seen on Map 4.4, using a Curtiss HS-2L and charged \$60 dollars one way. The flight lasted on average an hour (Milberry 1997, p.55; Molson and Short 1995 p. 50). The comparable ground-water route to Rouyn required several portages and took two to five days depending on the direction (Molson and Short 1995, p. 51).

In January 1925, flying a de Havilland D.H. 9a on skis, a winter run was attempted. This was a short lived venture. After only three days of flying the aircraft crashed and could not be salvaged (Molson and Short 1995, p. 51). After this incident, Laurentide ceased operation and sold its Curtiss HS-2L to a new aviation company, Northern Air Service. Northern Air Service flew the Rouyn route until August of 1925, when the HS-2L, their only aircraft, caught fire (Milberry 1997, p. 55; Molson and Short 1995, p. 51). Other companies continued to provide air service into Rouyn for the next several years.

Because the Rouyn gold strike happened earlier during the transitional phase, it illustrates not only the advent of mining transport by air, it also reveals how aircraft actually competed with other available forms of transportation. While the only alternative to transport was canoe or dogsled, aircraft provided an economically viable service. However, once branch lines of the railroad were constructed to Rouyn in 1927, aircraft's advantage was nullified. The considerably less expensive and only slightly slower train eliminated the demand for air service, and the route was closed (Molson & Short 1995). The Laurantide Air Service's regular route to Rouyn was credited with setting mining

Map 4.4 Rouyn Gold Rush Flight Route

Source: Compiled by the author based upon Caldwell, C. S. Jack, 1995, "Freelancing in the Air", *The Canadian Aviation Historical Society Journal*, vol. 33, no. 2, p. 42. Milberry, L., 1997, *Air Transport in Canada*, CanAv Books, Toronto, p. 55. Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1924, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 13.

development ahead by about two years (Caldwell 1995, p. 42). Ironically, by speeding up the mining development, aircraft hastened the end of their own usefulness in the process.

4.3.1.4. Red Lake Gold Rush Flight Route

The Red Lake district gold discovery and development followed the same pattern of transport preference, with the aircraft providing an intermediary method prior to the establishment of bulk transport by rail. The later Red Lake gold strike displayed the emerging capabilities of aircraft, namely to be consistently flown in the winter.

The Red Lake route was flown both winter and summer initially by Jack V. Elliot's Air Service, the route he followed is shown on Map 4.5 (Molson 1987, pp. 72-74; Milberry 1997, pp. 35-36). The first flight was on March 3, 1926, by a JN-4 (Canadian) on skis. Jack Elliot related:

"In case of a forced landing we carried snow shoes and a substantial package of sandwiches. As the trip was made always within sight of the sleigh trail we would have been able to get to it – and – meet a dog team before too great a time" (in Molson 1987, p. 73)

Advances in engine technology were responsible for the ability to operate consistently in winter conditions. However, winter flying in this instance was partly a result of economic motivation. 'Gold rushes', as the name suggests, required quick action to capitalize on the momentum. Companies had to seek out any advantage to benefit financially from a gold rush, in this case a technical advantage. Without such motivation, the adoption of new technology was slower. By comparison the Ontario Provincial Air Service did not even begin

Map 4.5 Red Lake Gold Rush Flight Route

Source: Reproduced with permission of the *Canadian Aviation Historical Journal*. Molson, K. M., "Jack V Elliot and His Air Service", *Canadian Aviation Historical Society Journal*, vol. 25, Issue #3, 1987, p. 75.

winter flying trials for another two years.

Even though the route was relatively short, the limited range of the Curtiss JN-4 (Canadian) meant that fuel acquisition was a prime consideration. Jack V. Elliot told the *Hamilton Spectator*: "our tanks carried enough fuel for the trip in and we covered the floor with one gallon cans of gas for the trip back....we had no maps, all we knew was that Red Lake was shaped like a rabbit" (from Molson 1987, pp. 72-73). Red Lake, 125 miles (200 km) north of the Trans-Continental Railway, was wholly unmapped until 1923, when the area was included as part of an initial survey by the federal government flying operations, in conjunction with the Manitoba-Ontario Boundary project (Report on Civil Aviation 1925, p. 35).

Once again flights originated from the railroad, and followed established transport corridors, waterways, as flight route guides, adhering to the transitional phase flight route pattern.

4.3.2. The Prairie Region

The Prairie region consists of three provinces; Alberta, Saskatchewan and Manitoba. They occupy the interior or central plains and the region is characterized primarily by low relief. Most importantly for this survey, the three prairie provinces shared the same administrative structure during the transitional phase. The Prairie provinces, unlike the other Canadian provinces, had:

"...all Crown lands, mines and minerals and royalties incident thereto and the interest of the crown in the waters within the Province under the North-West Irrigation Act of 1898 shall continue to be vested in the Crown and administered by the Government of Canada for the purpose of Canada." (Alberta Act, c. 2 s. 21)

Consequently, between the inception of the Prairie provinces and 1930, the federal government controlled the natural resources. Jurisdiction over natural resources was subsequently transferred to the provinces through a number of acts in 1930 (Banks 1986, pp. 10-11), but in this time frame, this administrative homogeneity strongly defined the Prairie region.

In the Prairie region, like the Pacific, federal government administrative mandates and agenda dictated the destinations and areas aircraft flew. However, different geographic conditions resulted in regionally specific flight routes.

In the Prairie region flying was primarily for forestry conservation, as part of the Department of the Interior's administrative mandate. However, forestry was not a significant part of the overall economy. Aircraft patrols were nonetheless a highly visible public service and therefore deemed worthwhile.

This mandate combined with geographic differences between the eastern and western extent of the Prairie region, necessitated separation of the region into two sub-regions for analysis: the Eastern Prairie sub-region and the Western prairie sub-region. Each sub-region had a federal government air station: Victoria Beach, Manitoba, in the east and High River, Alberta, in the west. These served as operational hubs for flights within each sub-region.

It is the location of the Canadian shield with its wealth of lakes that underlies one of the major differences distinguishing the Eastern sub-region from the Western. The focus of flying objectives is the other distinguishing

characteristic between the sub-regions. Comprising of all of Manitoba and the northern portion of Saskatchewan, the Eastern sub-region lies mostly on or at the edge of the Canadian shield. The many lakes and rivers in the Eastern sub-region demanded exclusively water-based aircraft. Route selection and flying destinations resulted from a mandated focus on fire patrol of merchantable timber on the Canadian shield, treaty money deliveries and objectives that furthered the construction of the Canadian National Railway line pushing north to reach Hudson Bay.

To succeed with their operation over the Canadian shield in the Eastern sub-region, the federal government utilized flying boats in forestry patrols and treaty money deliveries. Routes established to accomplish these flights throughout the Eastern sub-region were based on waterways.

The Western sub-region covers the Great plains and includes Alberta and the lower portion of Saskatchewan. The lack of suitable water sites for landing resulted in the use of land-based, wheeled aircraft in this sub-region. The flying operations in the Western sub-region focused more on the conservation of forest reserves and national parks than on merchantable timber protection.

4.3.2.1. Eastern Prairie Sub-Region

4.3.2.1.1. Manitoba Forest Patrol Flight Route

As illustrated on the Map 4.6, the forest fire patrol route was located in the hinterland, but still linked with established settlements such as Norway House

Map 4.6 Manitoba Forestry Patrol Route

Source: Compilation of the author based upon Milne, A. J., 1983, "Pioneer Survey Flights in Northern Manitoba and Saskatchewan", *The Canadian Aviation Historical Society Journal*, vol. 21, no. 4, pp. 101-106. *Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1924*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 66-69. *Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1925*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 64-65.

and The Pas (Report of the Air Board 1921, p. 9; Report of the Air Board 1922, p. 29). These nodes were co-opted as sub-bases for patrols. Once established throughout the Eastern sub-region the forestry fire patrol routes were numbered and followed carefully (Milne 1983, p. 101; Report on Civil Aviation 1924 pp. 66-69). The Eastern sub-regions forestry patrols were focused in areas of high return and high fire risk. However, in addition to areas of high fire risk, the timber patrolled had to be extractable by river or rail. Thus, the flight routes in the region were closely tied to non-aviation, ground based resource development and existing transport corridors.

The federal government started the transitional phase flying Curtiss HS-2L and F.3 flying boats for these operations. However, this area was one of the first to receive some of the post-war designed civil aircraft. The first, the Vickers Viking arrived in 1924 (Report on Civil Aviation 1924, p. 66)

It is in the Eastern sub-region where reports abound about the difficulties encountered in the change of perspective from ground surveying to air navigation (Milne, 1983, p. 106). Pilots routinely carried Dominion Land Surveyors, with long experience in the area, to guide the aircraft over the maze of waterways (Wilson 1926, p. 430; Report on Civil Aviation 1925, pp. 64-65).

4.3.2.1.2. Indian Treaty Money Flight Route

Flying to deliver Indian Treaty money is an example of both a typical flight route in the Eastern sub-region and the difficulties of navigation. The route for delivering treaty money is marked on Map 4.7, and travels along a route

Map 4.7 Indian Treaty Money Flight Route

Source: Compilation of the author based upon Milne, A. J., 1983, "Pioneer Survey Flights in Northern Manitoba and Saskatchewan", *The Canadian Aviation Historical Society Journal*, vol. 21, no. 4, p. 102. *Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1923*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 31-32.

connecting Hudson Bay posts where the monies were delivered and distributed (Report of the Air Board 1922, p. 31). There was a vast number of intersecting waterways and the pilots had to rely on inaccurate maps (Wilson 1926, p. 430; Report on Civil Aviation 1923, pp. 31-32). The surveyor aboard the aircraft: "...could not identify the different routes or lakes when he was flown directly over them or when a landing was made" (Report on Civil Aviation 1923, p. 32). Knowing where to fly is crucial with limited fuel range and uncertain means of communication.

"When we wanted to get to Island Lake we got no clear idea at all from the map. However we reasoned that if we could figure where the Hudson Bay traders were likely to travel it would help us. We had to guess where they might have gone knowing that they would be most likely to use waterways feeding into the Hudson Bay. We would come down low and check the direction of water flow and likely location until we were on the right track...We found it was 60 miles farther east than on the map" (Milne 1983, p. 102).

Efforts spent on ascertaining water flow direction and descending and climbing, all wasted fuel. This coupled with inaccurate maps indicating a lake where fuel caches were located 60 miles (96 km) out of position (an hours flying time), could easily mean an emergency landing as fuel limits were reached, not to mention the task of returning to civilization even if safe landing occurred.

It was not only the shift from ground to air that caused problems in locating destination, it was also the shift in travel speed. The translation of travel time and distance from weeks in canoes to hours in aircraft was problematic for navigation.

4.3.2.2. Western Prairie Sub-region

4.3.2.2.1. Alberta Forest Conservation Patrol Route

Flying within the Western sub-region was defined by the availability of landing areas. Good flying was defined by access to good landing. The use of wheeled aircraft throughout the Western sub-region severely limited landing sites when flying over forestry reserves on fire patrol. The lack of possible emergency landing sites made it apparent why: "...mechanical efficiency is essential in a country of this nature where the terrain is rough and safe landing grounds are few and far between" (Report of the Air Board for the Year 1922, p. 37).

Flying was easier away from the forest and mountainous terrain of the Rockies.

As a result of restricted landing sites, routes over forest reserves were constrained and closely followed for safety reasons (Report on Civil Aviation 1924, pp. 59-61). Following the same route minimized the danger of losing the crew or aircraft while fulfilling the Department of the Interior's mandate (Report on Civil Aviation 1923, pp. 24-25). The forest reserve flight routes from High River were well established: unlike other routes it was known that they were flown twice daily. Flight routes appear on Map 4.8. The machines left the base in the morning, and flew to the limit of either Crow's Nest or Bow River reserve, where the sub-station was located, either Eckville or Pincher Creek (Report of the Air Board 1922, p. 29). Flying either a de Havilland D.H.4 or a D.H.9a, the pilots landed, refueled and waited at the sub-base until the afternoon, then returned over the same route. These routes ran north-south parallel to the

Map 4.8 Alberta Forest Reserve Patrol Route

Source: Compilation of the author based upon Report of the Air Board for the Year 1922, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 37-38. Report on Civil Aviation including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1924, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 59-61.

foothills of the Rocky Mountains and did not rely heavily on rivers and railways. However, these forest patrol routes were closely associated with the existing forestry infrastructure of Ranger stations and ground-based forest patrol routes.

4.3.2.2.2. Jasper National Park Photographic Flight Route

Another focus of flying in the Western sub-region was photographic flights. Unlike the forest patrols, the photographic operations conducted over Jasper National Park, followed pre-existing corridors. This can be seen on Map 4.9, the Jasper National Park flight route. The corridors not only led the aircraft to its flying objective, but railway lines that the de Havilland D.H.4 followed were constructed with grades and curves that the aircraft's performance could match.

Agricultural development in the more settled regions of the prairies meant that aerial work was easier and flight routes less restricted, as good landing grounds were available almost everywhere. Navigation remained central in route selection when emergency landing was available (Shaw 2001, pp. 33-34). The low relief made flying easy but navigation more of a challenge. Without marked features of relief, visual contact with the ground became even more important. In the Western sub-region, east-west flights could follow railway lines (Hutchins 1972, p. 48). For north-south flight route guides, pilots repeatedly referred to using the sectional survey lines characteristic of Western Canada (Foster 1990, p. 23; Report on Civil Aviation 1924, pp. 61-62). These were readily visible from the air, especially when they intersected railway lines.

Map 4.9 Jasper National Park Photographic Flight Route

Source: Compiled by the author based upon Report of the Air Board for the Year 1922, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 38. Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1924, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 61-62.

In the Western sub-region the low relief appeared to lend itself to the adoption of direct flight, especially over more settled areas. However it was the very lack of visual references and the change in visual perspective when flying, that kept aircraft travelling ground referenced flight routes.

4.3.3. The Pacific Region

The Pacific region follows the provincial boundary of British Columbia. The land forms of British Columbia are diverse, running from coastal areas to mountain ranges. Physically, it has been described as "a sea of mountains, with flat topography restricted to small areas of mountain trenches, a few places in the uplands and very limited strips of river valleys" (Dalichow 1972, p.5). Hardwick (1963, p. 3) described it in terms of waterways, mountains and forests. Unlike other regions the hinterland and the frontier of the Pacific region was developing in an north-east direction away from the coastline. This was directly related to the accessibility and mild weather of the Pacific coastal area. The parallel Coastal mountain range was the barrier to advancing inland. Development of the region spread first north before looking inland (Hamelin 1979, pp. 33-37).

The spatial limits of flying areas within the Pacific region were determined by administrative mandates. It was the federal governments interest and agendas that set the goals and destinations of the vast majority of flights. Flights such as fisheries and customs patrols were pursued, but forest conservation was the primary mandate in the Pacific region, and this dictated destinations for the

largest number of aerial routes from the beginning of the transitional phase onward.

4.3.3.1. Vancouver Island Forest Patrol Route

The most heavily patrolled area for forestry protection lay along the coastline between Vancouver Island and the Mainland. The large stands of Douglas fir and White pine on both shores warranted the cost of aerial patrols that monitored forest fires and the spread of disease, such as White Pine Blister Rust (Wilson 1926, p. 456). Patrols undertaking these objectives were based at the Vancouver air station at Jericho Beach (Shaw 2001, p. 12).

As seen on Map 4.10, a specific route for aircraft forestry patrol was established along the west coast of the Pacific region. Any inland portions of the patrol again followed specific inlets, in part for ease of navigation and partly as a result of geographic constraints (Hutchins 1972, p. 41).

This particular route displays many of the characteristics of transitional phase air routes, and was established to accommodate the technical abilities of the aircraft flown. Vancouver air station utilized several Curtiss HS-2L flying boats. As a Curtiss HS-2L pilot reported, for coastal duties:

“...HS-2Ls are good machines...(however) their ceiling is limited to 6,500 feet and obvious are the disadvantages of using them in a district where there are peaks from 7,000 to 10,000 feet in height” (Report on Civil Aviation 1923, p. 23).

The maximum ceiling under ideal conditions might be higher, but the aircraft became waterlogged as the season went on, adding up to 1,000 pounds of weight. The Coastal mountain range on the east and the Vancouver Island

Map 4.10 Vancouver Island Forest Patrol Route

Source: Compiled by the author based upon *Report of the Air Board for the Year 1922*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 36.

mountains on the west were the physical boundaries of the patrols. In addition to the physical barrier presented by the mountains, the flight route was further restricted by the mercurial weather changes.

Fog and rain reduced visibility dramatically and had immediate, and often fatal, consequences for pilots flying aircraft routes based on the visual ground references of the shore line. An old axiom of coastal flying was that the majority of flying accidents result from bad weather and fog; encountering it, challenging it, or ignoring it. Following the coast line provided a margin of safety if an emergency landing was required for either climatic or mechanical reasons (Mallot 1970, p. 18).

A coastal route also linked the flight of the aircraft with existing settlements and infrastructure. This was beneficial for two reasons. Firstly, coastal settlements could be established as reference points of aircraft ground facilities with fuel caches and safe harbours. Secondly, throughout Canada during the transitional phase, it was recognized that there were two leading causes of forest fires: railroads and humans (MacMillan and Gutches 1910, p. 4). Thus, fire patrols that connected with settlements or follow railway lines were patrolling areas of higher fire risk.

Once established, the Forest Patrol route was followed by subsequent flights. It provided no surprises for pilots and there were known safe landing areas and fuel caches along its length. The route was predicated on local knowledge and experience about areas of higher fire risk and valuable timber

stands. No part of the flight route extended beyond what was known or achievable. This route was based on pre-existing naval and railway corridors, and did not forge new linkages.

4.3.3.2. British Columbia Railway Belt Patrol Flight

The secondary area of forestry patrols mandated by the federal government corresponded with sections of the CPR railway belt running through central British Columbia as seen on Map 4.11. The single Avro 504k flying from either Kamloops or Sicamous patrolled the area associated with a high risk of forest fires corresponding with the railway belt. Clyde Leavitt, Chief Fire Inspector for the Board of Railroad Commissioners stated in 1912, "It is a truism that railroads are the most frequent cause of fires in any timber area through which they pass" (Leavitt 1913, p. 5). The problem of fire on the railroad systems persisted well into the 1930's when the changeover from coal-burning to oil-burning locomotives was completed (Vance 1995, p. 167). However, patrolling the railway belt had a lower priority than the coastal area, mostly because flights on the coast could accomplish multiple tasks for the federal and provincial agencies, whereas flights along the railway belt had only one purpose. For financial reasons patrols were limited to the peak fire seasons (Report of the Air Board 1922, pp. 8-9 & 26; Report on Civil Aviation 1923, p. 24).

Map 4.11 British Columbia Railway Belt Fire Patrol Route

Source: Compiled by the author based upon Report of the Air Board for the Year 1922, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 8-9 & 36. Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1923, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 24.

4.3.3.3. Pacific Coast Fishery Patrol Flight

Along with forestry, the Pacific region's other concern was fishery patrol and conservation. Fishery flying operations fell within the same coastal area as the coastal forest patrol route. The same concerns, constraints and aircraft type in forestry patrols, affected the fishery patrol. The difference between the routes is only apparent in the extent of area covered as seen on Map 4.12.

Fishery patrols became a higher priority mandate in the middle and late parts of the transitional phase. Prior to 1923, fishery patrols were incorporated into other flights undertaken primarily forestry patrols and limited to the northern extent of Vancouver Island. After 1923, the federal government extended the area of operation northward from Alert Bay to Prince Rupert. The extension of a flight route beyond Vancouver Island for fishery patrols maintained the characteristics of the route of the coastal forestry patrols, linking infrastructure with settlements and salmon canneries along the west coast (Shaw 2001, p. 69).

The coast was unique in that flying over stretches of water may have encouraged the adoption of direct, point to point flight similar to marine traffic, using marine charts. However, aside from the odd flight or stretch of established flight routes, coastal flight paths, during the transitional phase, remained tied to the coastline.

Map 4.12 Pacific Coast Fishery Patrol Route

Source: Compiled by the author based upon Shaw, B. S., 2001, *Photographing Canada from Flying Canoes*, General Store Publishing House, Burnstown, p. 69. *Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1923*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 38.

4.3.3.4. White Pine Blister Rust Flight Route

The Entomology Branch of the Department of Agriculture used a Curtiss HS-2L, in the summer of 1922, to investigate the spread of White Pine Blister Rust¹. To conduct the research the HS-2L would be flown as high as possible and a slide covered with Vaseline would be exposed. The slide would later be examined for spores. The projects goal was to track the spread of the disease (Report on Civil Aviation 1925, pp. 52-53).

Map 4.13 clearly demonstrates that the route flown for this flight followed major waterways the entire way, as well as a portion of the railway along the Squamish River to Howe Sound (Report on Civil Aviation 1925, pp. 52-53; Wilson 1926, p. 456). This patrol route linked the aircraft flight path to points of established settlement, and provided possible emergency landing sites.

The area patrolled and the route used were both based on prior knowledge and experience regarding the purposes of the flight, as well as the geographic conditions of the area of interest. For example aircraft could not go beyond coastal mountain ranges that rose higher than their service ceiling.

4.3.3.5. Dease Lake Prospecting Flight Route

In 1925, a mining expedition sponsored by United States mining interests, Northern Syndicate Limited, contracted Canadian pilot Jack Caldwell and a Vickers Viking IV from Laurentide Air Service for prospecting work in Northern

¹ White Pine Blister Rust is a disease with serious economic repercussions, as the White Pine is highly valuable. The disease is spread by wind driven spores to an intermediate host, *Ribies sp*, a species of shrub. To capture the spores crossing the coast range the flight had to achieve maximum altitude. White Pine Blister Rust virtually wiped out all stands of White Pine on the West Coast.

Map 4.13 White Pine Blister Rust Research Flight Route

Source: Compiled by the author based upon *Report of the Air Board for the Year 1922*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, p. 36. Wilson, J. A., 1926, "Canada From the Air", *National Geographic*, vol. L, no. 4, p. 456.

British Columbia (Shaw 2001, pp. 81-82; Report on Civil Aviation 1925, pp. 30-31). This flight illustrates a route selection based on pre-existing corridors, and highlights the aircraft's potential role in 'opening up the North'.

The mining company, Northern Syndicate Limited, had already decided on a destination and an area within which the prospecting was to occur. It was into the area of Northern British Columbia around Dease Lake, which strongly suggests prior geographic knowledge. Unfortunately, the pilot and crew of the Viking found the "available data on the country painfully fragmented" (Caldwell 1995, p. 46). The cartographic information about an area was not always sufficient to be the basis of a flight route.

For cost saving and safety measures, the aircraft was not flown the length of the coast to Prince Rupert, but dismantled, shipped by train, and re-assembled at Prince Rupert, the terminus of the Canadian National Railway (Ellis and McIntyre 1967, p. 19; Wilson 1926, p. 450). Shipping the aircraft by reliable ground transport to the closest point near the destination saved flying costs and wear on the plane and reduced the possibility of loss due to crash or engine malfunction.

Once the aircraft had been erected and tested, there was a delay as they waited for the ice to break up on Dease Lake before setting out (Caldwell 1995, p. 47). Once the flight was underway, the aircraft and crew followed the coast up to the mouth of the Stikine River that linked up with Dease Lake. This route as illustrated on Map 4.14, allowed them to fly by way of the Stikine Valley through

Map 4.14 Dease Lake Prospecting Flight Route

Source: Compiled by the author based upon Ellis, F. H. & McIntyre, M. L., 1967, "Vickers Viking MK.4, G-CAEB", *The Canadian Aviation Historical Society Journal*, vol. 5, no. 1, p. 19. Caldwell, C. S. Jack, 1995, "Freelancing in the Air", *The Canadian Aviation Historical Society Journal*, vol. 33, no. 2, pp. 46-48. *Report on Civil Aviation Including Civil Operations for Other Government Departments Undertaken by the Royal Canadian Air Force for the Year 1925*, F. A. Acland Printer to the King's Most Excellent Majesty, Ottawa, pp. 30-31.

the barrier of the coastal mountains and on to Telegraph Creek (Shaw 2001, p. 82; Caldwell 1995, p. 47). From this point the pilot noted two crucial factors in future route selection. First, the aircraft passed over 70 miles (112 km) of route devoid of landing places, a noteworthy fact for future flights. From Telegraph Creek the pilot made an important observation. The aircraft maintained 3000 feet (914.4 m) of altitude, but he found that at the arrival at Dease Lake they were only 500 feet (152.4 m) above the lake (Caldwell 1995, p. 47). Flying so close to the ground provided no margin of safety should something go wrong.

The increasing gradient over flight routes had two possible results: the pilot either continued to force the aircraft to climb and maintain a steady height above the ground until reaching the service ceiling, or as in this case, the pilot maintained a constant altitude above sea level and hoped he did not have to climb too suddenly in order to rise above obstacles. The higher the elevation an aircraft operates, and the closer to its service ceiling, the greater the loss of power and manoeuvrability. The reduction in aircraft performance can have serious consequences if sudden obstacles are encountered.

The final noteworthy aspect of this flight was the procurement of supplies and fuel. A scow was chartered to transport supplies and equipment from the Hudson's Bay post at McDames on the Dease River to the Laird post at the junction of Laird and Dease Rivers. It took the scow 20 days to make the trip and the aircraft three hours (Caldwell 1995, p. 47; Ellis & McIntyre 1967, p. 19). The total prospecting trip took 96 hours of flying time (Shaw 2001, p. 82.). This is a

graphic example of how aircraft changed the perspective of the landscape; not only did the aircraft elevate the viewer, it also changed travel time and the perspective of travel time drastically.

The prospecting flight to Dease Lake definitely relied on waterways as route guides. However, while the flight and flight route introduced aircraft to the area for the first time, it was not an exploratory flight in terms of opening up areas previously unknown.

4.4. Flight Routes: The National Perspective

From the regional perspective it is evident that particular factors associated with each region, related to geography, administration and, or technology, influenced the pattern of the flight routes establishment.

The Central region flight routes adhered to existing transport corridors. However, the administrative mandates and motivations for flight route were unique to the region. Forestry interests continued to be the focus for the majority of the routes, but the emergence of private commercially viable companies began to broaden flight destinations to incorporate other natural resource developments such as mining. This region was the only region where private commercial companies successfully operated throughout the transitional phase, as seen on Table 4.1 Regional Flight Route Summaries.

Flight routes and the spatial limits of flying in the Central region extended from the railway lines and the Great Lakes-St Lawrence system following the waterways into the hinterland. The Canadian Shield with its multitude of lakes

Table 4.1 Regional Flight Route Summaries

Central Region Flight Routes

	St. Maurice Forest Protective Association	Canadian Aerial Service Flight to Moose Factory	Rouyn Gold Rush Flight Route	Red Lake Gold Rush Flight Route
Company/ Operator				1) Laurentide Air Service 2) Elliot-Fairchild Air Service 3) Jack V. Elliot's Air Service
Aircraft Type	St. Maurice Forest Protective Association	Canadian Aerial Services	Laurentide Air Service	Curtiss JN-4 and Aeromarine
Average Speed	Curtiss HS-2L	Avro 504	Curtiss HS-2L	60 mi \ 100 km and 57 mi \ 91 km
Flight Date	60 mi \ 100 km	75 mi \ 120 km		March 3 1926
Visual Route Guide	July and August 1919	February 4 - 24 1922	May 23 1924	
Natural				
Manmade	Rivers	Rivers	Rivers \ Lakes	Rivers \ Lakes
Availability of Emergency Landing Sites	Railway			
Availability of Fuel Caches	Partial length of the route	Entire route	Partial length of the route	Partial length of the route
	Lake Shea	none established	none established	none established

Table 4.1 Continued

Prairie Region Flight Routes

	Manitoba Forest Patrol Flight Route	Indian Treaty Money Flight Route	Alberta Forest Conservation Patrol Route	Jasper National Park Photographic Flight Route
Company/ Operator	Federal Government	Federal Government	Federal Government	Federal Government
Aircraft Type	Curtiss HS-2L and Vickers Viking	Curtiss HS-2L and Vickers Viking	de Havilland D.H. 4 and D.H. 9a	de Havilland D.H. 4
Average Speed	60 mi \ 100 km and 80 mi \ 128 km	60 mi \ 100 km and 80 mi \ 128 km	72 mi \ 115 km and 70 mi \ 113 km	72 mi \ 115 km
Flight Date			July 30 1923	May 30 1920
Visual Route Guide				
Natural	Rivers \ Lakes	Rivers \ Lakes	Parallel to mountains	Rivers
Manmade				Railway
Availability of Emergency Landing Sites	Entire route	Entire route	End points only	Partial length of the route
Availability of Fuel Caches	Norway House, Cormorant Lake, The Pas	Norway House, God's Lake, Island Lake,	Eckville or Pincher Creek	Edmonton

Table 4.1 Continued

Pacific Region Flight Routes

	Vancouver Forest Patrol Route	British Columbia Railway Belt Patrol Flight	Pacific Coast Fishery Patrol Flight	White Pine Blister Rust Flight Route	Dease Lake Prospecting Flight Route
Company/ Operator	Federal Government	Federal Government	Federal Government	Federal Government	Laurentide Air Service
Aircraft Type	Curtiss HS-2L	Avro 504	Curtiss HS-2L	Curtiss HS-2L	Vickers Viking
Average Speed	60 mi \ 100 km	75 mi \ 120 km	60 mi \ 100 km	60 mi \ 100 km	80 mi \ 128 km
Flight Date	July - August 1921	July - August 1922	Seasonal	August 1924	June 1 - 24 1925
Visual Route Guide					
Natural	Coastline		Coastline	Rivers \ Lakes	Coastline \ Rivers \ Lakes
Manmade	Railway	Railway		Railway	
Availability of Emergency Landing Sites	Entire route	End points only	Entire route	Partial length of the route	Partial length of the route
Availability of Fuel Caches	Alert Bay, Powell River, Nanaimo	Sicamous,			Wrangell, Telegraph Creek, Laird Post

and rivers played a large role in determining flight paths. Once the railways ended, the waterways were relied upon for navigation. In Ontario flight routes extended as far north as Moose Factory on James Bay. During the transitional phase flight routes in Quebec did not extend past the height of land near 54 degrees North latitude. It is evident that once the flying objectives were identified, routes were geographically dependent and limited by aircraft technology.

Throughout the Prairie region it was once again the administrative objectives of the flights that dictated the destinations and areas of operation, and the geography of the sub-regions that set the routes travelled to accomplish these objectives. However, there were very few viable private operators in the Prairie region. A few private operators concentrated unsuccessfully on joy-riding and exhibition flying. Aircraft operations relating to the development of natural resources were monopolized by the federal government civil flying. Federal government flying, especially the flights relating to forestry protection, were not economically justifiable by themselves in this region. They did serve a second purpose, namely as a visible demonstration of the federal government's presence in the hinterland.

The Western sub-region was a mix of aviation specific routes and routes based on transport corridors. Aviation specific routes were associated with areas where pre-existing corridors were absent, but these routes were tied to other

established infrastructure, in this case ranger fire stations, lookouts and ground patrol routes.

The aviation routes in the Eastern sub-region were distinctly linked to major waterways and lake systems. There are no instances during the transitional period of aviation specific routes established in this sub-region. As previously stated, navigation over the myriad waterways was difficult enough.

The flights occurring during the transitional phase in the Pacific region were route bound. Flights along the coast and in the interior did not establish new lines of transportation, they followed pre-existing corridors. These aviation flight routes were selected because they adhered to administrative, technical and geographic limiting factors.

The mountains, the Coast Range and the Rockies were barriers to flight routes. This coupled with the mild weather along the coast allowed aircraft to range along coastal regions further north, and throughout more of the year, as seen on Table 4.1.

Similar to the Prairie region, the Pacific region's flights were dominated by federal government civil operations. It was only in the final years of the transitional phase that commercial aviation started to become economically viable. As with the Prairie region, the extent of activities served not only the obvious purpose of the flights themselves, be it fishery or forest protection, but also showed the flag along the Canadian West Coast.

All of the case study flight routes are shown on Map 4.15 and accompanying table with approximate distances. From this information it is apparent that federal government flights were on average 40 percent longer than private commercial flights. This indicates that government organized flights had a higher level of necessary ground support, such as fuel caches and pre-established intermediate stops along the routes. With the exception of the Dease Lake prospecting flight and St. Maurice Protective Association flight, the private commercial flights were completed without intermediary fuel cache stops, most on a single tank of fuel. Better ground support and ground based infrastructure established by the federal government was a direct result of superior funding.

While Map 4.15 shows only the thirteen case studies, through the survey of the literature it was evident that in the Pacific region and the Prairie region the other flight routes flown did not extend the area covered by flights to a large degree. In the Central region there was a greater density of aircraft flight coverage. This was largely due to the operations conducted by the Ontario Provincial Air Service and contracts for the Quebec provincial governments Forestry Branch. This greater coverage did not extend past the perceived Northern frontier as shown on Map 1.13. The flight information available about the Ontario Provincial Air Service's operations unequivocally fits the pattern of transitional phase flight. However, there are few complete descriptions about specific operations. Coverage in Ontario as described by the Report on Civil Aviation (1926, p. 34) stated that: "Air travel throughout the whole

Map 4.15 Approximate Location and Distances of Flight Routes Presented in the Case Studies

Source: Compiled by the author.

northern part of the province as far as 150 miles (the return fuel range of most aircraft types) north of the railway is thus made easy.”

By the end of the transitional phase in Quebec flights radiated along waterways associated with Lake St. John. There was a distinct lack of flights east and north-east of Quebec city (Bondurant 1930, p. 340).

However, while the degree of aircraft flight coverage varied regionally, a comparison of the type of aircraft flown in the case studies (Table 4.1) highlights and reinforces what aircraft were instrumental in resource development. These are the same aircraft presented in detail in Appendix I, and though their overall numbers were not high, as presented on Table 3.2 and 3.3, when compared with all other aircraft registered in Canada, their affect on route development during the transitional phase was significant. Much of what the reports tabled by the federal government referred to repeatedly as “useful work” was carried out by these flights (Report of the Air Board, 1926, p. 12).

The other pattern apparent from analysis of the case studies is the emergence and growth of mining and prospecting's use of aircraft, as well as aircraft's link to viable commercial aviation companies, as seen on Table 4.1. The purpose of all non-government flights in the case studies, with the exception of the St. Maurice Forest Protective Association flights, was related to mining and prospecting, particularly for gold. The bulk of these flights were conducted later in the transitional phase, after 1924, and all originated from a railway station. Gold mining and prospecting during the later part of the transitional phase had

the potential for high enough returns to support the cost of utilizing aircraft for transportation.

The case study analysis demonstrates that prospecting can be considered more of a frontier activity than forestry. Two of the three flights above the perceived limit of the Northern frontier were prospecting flights. While flights related to forestry work passed over areas of established activity, prospecting flights often ventured into new areas. As well, the forestry industry is one of larger business, whereas mining, especially gold mining at this time, tended to be entrepreneurs staking individual claims. Another reason for the trend of utilizing aircraft to access new mining areas was the speed aircraft travel could provide. The phrase 'gold rush' captures the sense of urgency associated with staking a claim. During the latter part of the transitional phase aircraft were in a position to capitalize on this phenomenon in Rouyn and Red Lake.

By laying out the case study flight routes on a single map and comparing them with the location of the perceived Northern frontier during the transitional phase, it is possible to evaluate where aviation was operating in relation to the perceived location of North during the transitional phase. From this comparison, the validity of the statement that aircraft 'opened up the North' can be assessed during the transitional phase.

During the transitional phase aircraft did not connect the nation along the east-west axis. There was very little east-west aircraft traffic. Aircraft had limited capabilities, restricted range, meagre cargo capacity and high operating costs.

As such they could not compete with established railroad service along this axis. Geographically the Rocky Mountains were a physical barrier to flight at this time. Flight routes did not traverse them with any frequency, and when a flight did stretch from Alberta to British Columbia, aircraft had to follow a mountain pass low enough for the type of aircraft flown.

From Map 4.15 it is apparent that the pattern of flight routes across the nation flew along a north-south axis. Only three of the thirteen case studies were located above the limit of the Northern frontier. This percentage of flight extending beyond the perceived Northern frontier, 23 percent, was consistent with the survey of the literature of flight destinations in all the regions. As stated, two of these were involved with prospecting, and the third was the Indian Treaty money delivery flight undertaken as part of federal government civil operations. All three of the flights into the North shared crucial factors such as connecting with established nodes of Hudson Bay posts and utilizing rivers and waterways as their navigational aids. The prospecting flights were completing exploratory work, transporting those individuals interested in potentially new mineral producing areas.

The ten other case studies lie below the perceived limit of the Northern frontier. Six of the routes were established for the purpose of forestry protection, and all but one of the six were flown by the federal government. This monopolization by the government in conducting aerial forestry operations below the Northern frontier of the transitional phase was prevalent in all the regions, be

it the federal government in the Pacific and Prairie regions, or the provincial government in the Central region. Only in Quebec was the bulk of the forestry flying for the provincial government contracted out to private commercial companies. In addition to government involvement in forestry related aviation, there was also a degree of uniformity in the type of aircraft flown for forestry operations. It was only in the Western Prairie sub-region and the British Columbia Railway Belt patrol route where land-based aircraft were flown. For the other regions, and for forestry work generally, the Curtiss HS-2L (Appendix I) was utilized more often than any other aircraft.

Like the flights that ventured above the perceived northern frontier, the southern flights point of origin was often associated with railway stations. The reason for this was that whenever possible an aircraft would be transported by train to the closest convenient demarcation point, saving wear on the aircraft and preventing potential mishaps en route, as well as saving flight costs. By placing the base of operation near or at a railway station, trains could also efficiently transport the fuel needed for flying operations.

Of the four non-forestry related flights, the two commercial flight routes were both established for the same purpose: transporting people and supplies into new gold mining areas of Rouyn and Red Lake. These relatively short runs were made economically viable by the phenomenon of the gold rush. However, once the railroad was constructed to service the area, the aircraft was no longer

a viable mode of transport. The speed advantage garnered was not enough to justify the expense and lack of cargo space.

The last two types of flight in the case study represent some of the other work undertaken by aircraft during the transitional phase. The fishery patrol route, like the Indian Treaty money flight, was another assertion of federal government presence in the more remote areas of Canada. It was also the beginning of adopting the aircraft as a tool of policing. During the transitional phase fishery patrols often doubled as Custom's flights. However, it was not until after the transitional phase that the use of aircraft by the Royal Canadian Mounted Police would take aircraft further into the Canadian North.

The final flight, the photographic flight to Jasper National Park, represents another type of flying conducted during the transitional phase. The federal government and entire private companies undertook aerial photographic work, as mentioned in Chapter Two. Because of the nature of the work, flight routes were difficult to find, more often it was the focus of the photographic mission that was detailed.

Photographic work was extremely prone to problems associated with weather and the mechanical vagaries of the aircraft. The goal was to fly parallel lines at the same altitude, straight and level. For example, due to the difficulties involved, Jasper National Park was the objective of a minimum of two separate photographic flights during the transitional phase. Aerial photography was still in its infancy during the transitional phase, but it was a significant branch of

technology related to aviation's development, and worth representation within the case studies selected.

Following the pattern of operators, the vast majority of commercial aerial photographic companies operated in the Central region. While in the Pacific and Prairie regions it was the federal government undertaking this work.

Photographic flight routes, or at least the destinations mentioned, fit the pattern of where flight routes were established in relation to the perceived Northern frontier. At this time there were at least one hundred flights as the records of the Air Board reveal. Analysis of this indicates that 92 percent of the destinations were below the limit of the perceived North (Northern frontier indicated on Map 4.15).

As far as the statement that aircraft "opened up the Canadian North", the analysis suggests that this was not the case, although aircraft operations in the Northern frontier supported the development of the North. The evidence here supports the notion that aircraft relied on established ground-based infrastructure such as fuel caches and sub-bases. They continued to use and link existing non-aviation nodes such as Hudson's Bay trading posts, ranger stations and established settlements. They also relied on existing transport corridors as visual flight guides. Instead they were confined primarily to areas of existing development. Thus while they did not explore in the strictest sense, they did assist in exploration providing continuous confirmatory evidence. However, this does not exclude the possibility that the image of aircraft and their visible use

in resource development was utilized to represent advances in development of the hinterland and construction of an image of the Northern landscape.

4.5. Conclusion

Through analysis of transitional phase flight routes a number of patterns emerge. The primary defining feature of these flights was their reliance on ground referencing. The flight routes were predicated on prior geographic knowledge or information. This information not only informed the pilot and crew of the aircraft about the route markers and geographic conditions, it was the basis for the purpose of the flight.

The destination or purpose of the flight set the spatial limits of the operation and limited possible route selection. The vast majority of flight destinations across Canada were tied to an economic purpose. The aircraft was and is a tool employed to accomplish these tasks. The purpose of the bulk of flights during the transitional phase was closely connected to resource development, primarily forestry and mining.

The fact that all flights during the transitional phase were based on previous knowledge, information and experience means that they cannot be considered to have a "solely" exploratory function in terms of 'opening up the North'. The aircraft routes were confined to corridors and areas of existing economic development. While aircraft were definitely operating in the Northern frontier, as seen on Map 4.15, they were following the path of established

economic interest and development. Unlike the railroad, flight routes did not create or stimulate economic activity along their path.

Once a flight route was established it was followed repeatedly. All of the case study flight routes, except the Dease Lake prospecting flight and Canadian Aerial Services flight to Moose Factory, were followed consecutively. The re-use of flight routes was linked to other re-occurring patterns. One of the central factors creating these patterns was safety. The defining characteristic of safe flying was emergency landing sites. A route that provided known emergency landing areas was superior to routes with limited landing alternatives, as seen in the comments regarding availability of landing areas in the Prairie regions.

In addition to emergency landing site access, safety concerns linked with the poor to non-existent means of communicating between the aircraft and the base of origin also resulted in re-use of established routes (Molson and Taylor 1982, p. 3). In case of an emergency, flying a pre-existing route meant that others would know where to look for the pilot, crew and aircraft if something went wrong. Linking the flight routes to aviation transport corridors also increased the chance of connecting with other travellers and being transported back to civilization. This was one of the key reasons Jack Elliot gave for following the winter sleigh trail to Red Lake.

Another factor that significantly affected decisions about flying safely was the weather. Unique regional climatic condition reinforced the restriction of routes to those that provided emergency landing sites. The onset of any bad

weather was a serious problem for the pilots and crews of transitional phase flying. As a rule, transitional phase flights were conducted during fair weather only. The open cockpits combined with the need to see the ground for both navigation and to simply land the aircraft, meant that even low level clouds, fog and smoke from forest fires obscured the view, and made flying hazardous. The onset of more severe weather was potentially deadly (Report of the Air Board 1922, p. 46; Report on Civil Aviation 192, pp. 61-62; Dillon 1961, p. 25; West 1974, p. 78).

Weather had other repercussions for transitional phase flying. It controlled the time of year when transitional flying could be done. The vast majority of flights were limited to the summer months due to technical limitations detailed in Chapter Three and Appendix I. The number of possible flying days in a season was weather dependent because flights were restricted to fair weather flying days. The weather also affected the purpose and need for flying. Wet seasons in regions where the majority of flights were based on forest fire detection reduced the need for and the number of aircraft patrols (Report of the Air Board 1921, p. 11).

The available aircraft technology as a limiting factor was another re-occurring pattern in the determination of flight routes. The abilities of specific aircraft had to be considered when a flight route was selected. The geographical information about a route would narrow the possible types of aircraft flown from the poor selection available. Heights of land and mountain ranges were barriers

Summary Conclusion

The thesis investigated whether aircraft flying between 1918 and 1926 forged and established new transport routes within Canada and influenced the construction of landscape and the frontier of the North. To examine this question elements of Canadian geography, aviation administration and aircraft technology were drawn together to provide supporting evidence of the conditions that contributed to the selection of aviation routes and the role of aircraft in the development of the Northern frontier.

Canadian geography and the historical development of Canada as a nation provided the foundation and the physical conditions that aircraft would have to fly over and interact with. Some physical conditions were barriers to flight in the form of mountains and heights of land, but others facilitated the expansion of flight. Rivers and lakes became route markers and visual guides, providing landing sites and harbours. Agricultural fields were also co-opted as landing areas. Pre-existing transport routes often formed the corridors that aircraft travelled and provided access to existing ground-based infrastructure. Significant features both geographical and man made were utilized to locate aircraft within the landscape. The conditions of Canada set the stage and established some of the limits to flying during the transitional phase. Aircraft flying between 1918 and 1926 did not soar above the influence of physical geography, but flew along the ground.

Aircraft's administration and operators set the direction and purpose of civil aviation in Canada after the First World War. The salient decision, to apply aircraft to work in the 'hinterland' instead of concentrating and supporting the development of inter-city passenger or express service, set Canadian aviation apart from Europe and the United States. The administrators and operators provided aviation a spatially explicit focus and resource-based operational niche. Administrators and operators determined the purposes of flying and selected the destinations and areas over which aircraft flew. Therefore they had a significant effect on possible route selection. In addition to decisions about where aircraft operated, administrators and operators chose what types of aircraft were flown. These decisions were based on what types of aircraft were available and affordable, as well as which aircraft most closely met the requirements of a particular purpose.

Moreover, administrators and operators produced the rhetoric that aviation, as a new technology, was involved in and facilitated the 'opening of the Canadian North'. The description of the role of aircraft in Canada was linked to efforts to justify the application of a new, expensive and experimental technology. Linking the use of aircraft with the Northern landscape and the frontier perpetuated the association between technology, natural resources and the continuing development of an internal Northern frontier already existing within the Canadian consciousness.

The last facet that was examined in order to provide an understanding of the factors that contributed to the selection of flight routes during the transitional phase was the technical abilities of the aircraft flown. The technical limitations interacted with the decisions of administrators and operators and the physical geography and existing development conditions within Canada. The type of aircraft and its capabilities restricted and dictated the possible routes flown. However technical limitations included more than the type of aircraft. How high, how far and how fast the aircraft could fly, all contributed to route selection and the corresponding establishment of ground based aviation infrastructure needed to support the technical limitations of the aircraft flown.

It was the technical limitations of the aircraft available, the decisions of administrators and operators and the unique conditions of Canada that coalesced to form the framework within which aviation activity occurred during the transitional phase.

From the findings of the analysis it is apparent that from 1918 until 1926, aircraft were not forging or establishing new links throughout Canada. During the transitional phase, aircraft linked existing areas of development and infrastructure nodes utilizing existing transport corridors. It cannot be overstated how important visual ground references were for the successful completion of flights. It is this reliance on known routes and dependence on ground-based support that prevented aircraft from functioning as a vehicle for pure exploration. However, the novel perspective aircraft provided, did allow for new and different types of

observations about little explored areas away from the banks of the river or beyond the horizon of the railway. In addition to the change in perspective, the use of aircraft significantly reduced travel time. This was most evident in the hinterland, where methods of transport, other than rail, took days or weeks to cover the distance aircraft flew in hours.

During this time aircraft were just beginning to venture beyond the perceived Northern frontier. The majority of flights undertaken between 1918 and 1926 were located well within the limits of the Northern frontier. Those that flew into the North did so in areas where the flight routes were closely tied to existing infrastructure. The advent of civil aviation in Canada has led to the use of aircraft to represent accessibility and development of the North. The rhetoric and references to where aircraft were flying in Canada during the transitional phase strongly suggests that aviation was supporting the construction of a Northern landscape within Canada. This landscape was centred on a notion of Northern development made possible by advances in technology.

The research and historical reconstruction of flight routes during the transitional phase was a challenge. Flight routes leave no visible trail across the landscape; they are ephemeral. Like piecing a puzzle together, the snippets of information remaining about this salient period in Canadian aviation history revealed more questions than answers. The central question resulting from the thesis is: how long after the end of the transitional phase did aircraft continue to

rely on pre-existing transport corridors as flight routes, when did direct flights outnumber route specific flights?

The application of geographic inquiry to Canadian aviation history has barely been explored. The scope for further research is enormous. Especially intriguing is the possibility of combining aviation history and the growth of a particular resource industry, such as forestry.

Appendix I

The Aircraft of the Transitional Phase

Land Aircraft

Curtis JN-4 (Canadian)

The Curtiss JN-4 (Canadian), commonly referred to as a 'Canuck' for those Canadian built aircraft and a 'Jenny' for those built in the United States, was widely available and relatively inexpensive due to the quantities of aircraft and parts left over from the First World War (Molson and Taylor 1982, p. 5). Many small commercial companies sprang up throughout the country. Their chief business was 'joy-riding', stunt flying, and barnstorming. The Curtiss JN-4 (Canadian) was the most common choice for these operations. The Canuck/Jenny was a two-seater wheeled biplane convertible into float-configuration, as seen on Figure App I.1. With a 90 horsepower engine, the Canuck/Jenny could carry a maximum of 300 pounds (136 kg). This payload of 300 pounds included pilot and passenger or pilot and freight (Parrot 1963, p. 79; Bowers 1979, p. 155). The aircraft cruised at 60 miles per hour (96 kph), could climb 266 feet per minute (81 meters) to a maximum ceiling of 7,000 feet (Ellis 1954, p. 179; Bowers 1979, p. 155, Molson & Taylor 1982, p. 233). For comparison with other transitional phase aircraft see Figure App I.2 and Table App I.1. In practical terms this relegated the Curtiss JN-4's to flying through mountain passes in the Rocky Mountains and Coast Ranges rather than over these obstacles.

Figure App I.1 Curtiss JN-4 (Canadian)

	Imperial	Metric
Span	43 ft 7 in	13.3 m
Length	27 ft 4 in	8.3 m
Height	9 ft 10 in	3 m
Tare Weight	1,390 lb	632 kg
Gross Weight	1,920 lb	873 kg
Wing Area	352 sq ft	107 sq m
Cruising Speed	60 mph	96 kph
Maximum Speed	75 mph	120 kph
Rate of Climb	267 ft per min	81 m per min
Service Ceiling	6,500 ft	1981 m
Engine	90 hp Curtiss OX-5	

Sources: Bowers, P. M., 1979, *Curtiss Aircraft 1907-1947*, Putnam, London, pp. 150-156. Ellis, F. H., 1954, *Canada's Flying Heritage*, University of Toronto Press, Toronto, p. 179. Parrott, D. F., 1963, "The Early Development of Air Transport in the Red Lake Gold Fields of Ontario", *The Canadian Aviation Historical Society Journal*, no. 4, pp. 78-79.

Figure App I.2 Service Ceilings of Aircraft Operating in the Transitional Phase

Sources: Compiled by author see individual aircraft figures in Appendix I

**Table App I.1 Service Ceiling Comparison
of Aircraft Operating during the Transition Phase**

Type of Aircraft	Maximum Service Ceiling		Climb Rate (per minute)		Minimum Time to Climb to Service Ceiling ¹
	feet	metres	feet	metres	minutes
Curtiss JN-4 (Can)	7,000	2,154	266	82	26
Avro 504k	16,000	4,923	700	215	23
Vickers Viking	9,000	2,769	528	162	17
Can. Vickers Vedette	13,000	4,000	450	138	29
Curtiss HS-2L	10,900	3,354	180	55	61
de Havilland D.H. 4	22,000	6,769	1,000	308	22
de Havilland D.H. 9a	13,500	4,154	345	106	39

¹ Minimum time was only possible to obtain under specified atmospheric conditions, when the aircraft was mechanically in top form and if aircraft was not carrying its maximum load. In aviation a sustained climb from take-off to the aircraft's service ceiling was never accomplished in a single climb, but undertaken in several steps. A sustained climb was too taxing on engines, overheating was a problem and burnt more fuel than a more gradual approach to gaining altitude.

The Curtiss JN-4 could be operated on floats or with wheels. When outfitted with wheels it was most often flown on the prairies, or in southern Ontario and Quebec, where cultivated fields could be used as landing and take-off areas. The lack of ground facilities combined with the federal government's unwillingness to subsidize or fund the construction of such facilities for wheeled aircraft until after 1927, severely limited development in this technical direction. Poor performance and limited capacity for cargo or passengers also handicapped the Curtiss JN-4's use as a commercial vehicle.

Avro 504k

One of the most common and widely used aircraft for both civilian and government use was the Avro 504k. Another surplus war machine, the Avro 504k comprised the largest part of the Imperial gift (see Chapter Three, Table 3.3). In 1920 at Camp Borden, 17 of the 62 Avro 504k's received from the British government were assembled and put into use (Report of the Air Board for the Year 1922, p. 44-45). It became the standard trainer for the Canadian Air Force and its successor the Royal Canadian Air Force (RCAF) (Molson and Taylor 1982, p. 49-50). The Avro 504k outperformed the Curtiss JN-4, having a faster cruise speed (see Figure App I.3), as well as a significantly higher rate of climb and with a higher service ceiling as illustrated on Figure App I.2 (Tate 1968, p. 63). The faster more powerful Avro 504k had three hours of endurance, giving it a range of 200 to 250 miles, depending on weather conditions (Jackson 1990, p. 71).

The range and climb of the aircraft were essential considerations in assigning particular aircraft to work situations. The vast majority of aircraft operations in the transitional phase were connected to observations, such as forest fire patrols, aerial photography, surveying or forest type mapping. The aircraft had a finite amount of time in the air, and the less time consumed by climbing to the working altitude, and the faster the aircraft could get to the work site, the more time could be spent on the actual objectives of the operation.

Figure App I.3 **Avro 504 K**

	Imperial	Metric
Span	36 ft	11 m
Length	28 ft	8.5 m
Height	10 ft 5 in	3.2 m
Tare Weight	1,231 lb	559.5 kg
Gross Weight	1,829 lb	831.4 kg
Wing Area	330 sq ft	100.5 sq m
Cruising Speed	75 mph	120 kph
Maximum Speed	95 mph	152 kph
Rate of Climb	1231 feet per min	375 m per min
Service Ceiling	16,000 ft	4877 m
Engine	130 hp Cleget 9B	

Sources: Bruce, J. M., 1991, *Avro 504K*, Albatros Production. Ltd., London, p. 35. Jackson, R. T., 1990, *Avro Aircraft Since 1908*, Putnam, London, p. 71. Molson, K. M. & Taylor, H. A., 1982, *Canadian Aircraft Since 1909*, Putnam, London, pp. 49-53. Tate, H., 1968, "On Building the 504K", *The Canadian Aviation Historical Society Journal*, vol. 6, no. 3, pp. 63-67.

As with all things commercial, time was money, and aircraft were at least as expensive to operate and maintain during the transitional phase as they are now. Therefore better performance mechanically resulted in a higher return on financial inputs.

While the Avro 504k had a range of approximately 200 miles (320 km) and endurance of three hours, the actual operational time was much shorter. With a half an hour of flying time always reserved for emergency and another half an hour consumed by take off, climb, descent and landing, the actual flying time was cut to two hours. This did not include time spent travelling to and from the work site. Therefore, an Avro 504k leaving and returning to the base of operations had a total radius of action of one hour, or 70 to 75 miles (112 to 120 km) from the base. One way to overcome the limitation in range was to have substations at strategic locations where gasoline and oil caches would be available to refuel the aircraft.

While it outperformed the Curtiss JN-4 in the air, the Avro 504k had a weak undercarriage and could not withstand repeated landings on rough ground. Unfortunately rough ground described the bulk of the landing fields available (Daville 1971, p. 54). Because of the wear induced by repeated landings, the Avro 504k was converted and replaced for observation work in 1924, but remained a trainer for the RCAF throughout the transitional phase.

de Havilland D. H. 4

The de Havilland D.H. 4 aircraft was used extensively for forestry patrols in the western Prairies. As part of the Imperial gift all 12 D.H. 4's were converted from double seaters into single seaters equipped with air to ground wireless radio sets (Jackson 1962, p. 41; Shaw 2001, p. 264). The one way radio communications sets were so heavy they replaced the second pilot/navigator, but made reporting forest fires fast and efficient when they were in range of the receiver. Unlike the Avro 504k, which was float as well as wheel and ski capable, the D.H. 4 did not operate from water bases as shown on Figure App I.4. Therefore, it operated from High River, Alberta, a land-based air station. One of the advantages of the D.H.4 and the reason for its selection for forest patrols in western Alberta was the D.H. 4 had a higher service ceiling than most other aircraft available. Its service ceiling was 19,500 feet to 23,500 feet (5,944 meters to 7,163 meters) depending on the engine being used. Its high ceiling combined with a strong rate of climb (See Figure App I.2 and Table App I.1) allowed the D.H.4 to patrol within the Rocky mountains with more vertical room to spare than the Avro 504k. The D. H. 4 completely outperformed the Curtiss JN-4. The D.H.4 had a total endurance of three hours and so like the Avro 504k a working time of two hours. The D. H. 4 was faster than the Avro 504k and could cover 220 miles (352 km) in one direction weather permitting, a radius of action of 110 miles (176 km) (Jackson 1962, p. 44). Unfortunately the D.H.4 did not

Figure App I.4 **de Havilland D.H. 4**

	Imperial	Metric
Span	42 ft 4 in	14.7 m
Length	30 ft 6 in	9.3 m
Height (Liberty)	10 ft 3 in	3.1 m
Tare Weight (Liberty)	2,391 lb	1,087 kg
Gross Weight (Liberty)	4,297 lb	1,953 kg
Wing Area (Liberty)	440 sq ft	134.1 sq m
Maximum Speed (Liberty)	120 mph	192 kph
Rate of Climb (Liberty)	1,000 ft per min	305 m per min
Service Ceiling (Liberty)	20,000 ft	6,769 m
Engine	375 hp Rolls Royce Eagle VIII or 400 hp Liberty 12	

Source: Jackson, A. J., 1962, *de Havilland Aircraft Since 1915*, Putnam, London, pp. 37-44.

stand the test of time and by 1924 it showed such deterioration that they were all permanently grounded in Alberta. The deterioration was a result of wood shrinkage caused by the drier climate in Alberta; similar structural problems were not encountered in England.

de Havilland D. H. 9a

The machine used at High River air station in conjunction with the de Havilland D.H. 4, was the de Havilland D.H. 9a, as shown on Figure App I.5. The D.H. 9a was also used as a wheeled aircraft for fire patrols. It had a lower service ceiling, as seen on Figure App I.2, but it could travel faster and further, increasing its radius of action. Unfortunately the D.H.9a had a slow rate of climb and took up to an hour to reach its operational ceiling (Report on Civil Aviation 1925, p. 54). The larger D.H.9a could carry the pilot and 1,300 pounds (608 kg). Full tanks of gasoline, oil and water reduced the payload to 680 pounds (310 kg) (Jackson 1962, p. 87). After four years of use the Report on Civil Aviation 1923 (1924) recommended that "their useful life is now short and should be replaced by a smaller lighter type of machine" (p.30). The replacement for the de Havilland D.H.4 and the de Havilland D.H.9a was the Avro 552a.

Figure App I.5 de Havilland D.H. 9A

	Imperial	Metric
Span	45 ft 11 in	13.7 m
Length	30 ft 3 in	9.2 m
Height	11 ft 4 in	3.5 m
Tare Weight	2,705 lb	1,229.5 kg
Gross Weight	4,223 lb	1,919.5 kg
Wing Area	486 sq ft	148 sq m
Maximum Speed	118 mph	189 kph
Rate of Climb	345 ft per min	106 m per min
Service Ceiling	13,500 ft	4,154 m
Engine	375 hp Rolls Royce Eagle VIII	

Source: Jackson, A. J., 1962, *de Havilland Aircraft Since 1915*, Putnam, London, pp. 77-87.

Avro 552a

A two-seater biplane, the Avro 552a was a modified Avro 504k airframe and was wheel, float or ski equipped depending on the season and the geography it was to fly over as shown on Figure App I.6. The greatest modification was to the engine power, doubling the horsepower of the Avro 504k. The Avro 552a was to replace heavier, slower aircraft with a lighter, smaller and more cost efficient patrol aircraft. However the Avro 552a could not escape the problems of its predecessors. The increased engine power required a larger, heavier engine adding approximately 300 pounds (136 kg) to the empty weight of the machine. In addition the greater power consumed more fuel than the Avro 504k (Molson and Taylor 1982, p. 54).

A reoccurring and serious problem with aircraft performance related to the Canadian climate was airframe wood shrinkage. Although the majority of aircraft flying in Canada during the transitional phase were assembled here, the machines were constructed elsewhere, primarily Britain and the U.S.. The different climatic conditions in Canada, more extreme temperatures, operation in higher elevations and variations in humidity, caused the wooden airframes, especially those built in Britain, to shrink and warp. This resulted in safety problems with loose fittings, severe vibrations while flying, and loosening of the wire rigging bracing the wings (Molson and Taylor 1982, p. 55).

Figure App I.6 **Avro 552 A**

	Imperial	Metric
Span	36 ft	11 m
Length	28 ft 11"	8.81m
Height	10 ft 5 in	3.17 m
Wing Area	320 sq ft	97.54 sq m
Engine	200 hp Wolseley Viper	

Source: Molson, K. M. & Taylor, H. A., 1982, *Canadian Aircraft Since 1909*, Putnam, London, pp. 53-55.

The de Havilland D.H.4 and the de Havilland D.H.9a were grounded due to these persistent problems. The performance of both Avro aircraft were also negatively affected by climate related changes in airframe stability (Jackson 1962, p. 38; Molson and Taylor 1982, p. 55).

Flying Boats

The flying boat, with a hull shaped like a boat that rested in the water, was a machine which could utilize the lakes and rivers as natural landing and take off facilities, thus saving money on the construction and maintenance of wheeled aircraft facilities. Canadian geography seems to lend itself to the operation of flying boats, with a multitude of lakes, rivers and long coastal waters.

Geographic influences, coupled with an administrative mandate of operating in the hinterland and the potential cost saving in infrastructure, ensured the adoption and adaptation of the flying boat within Canada (Molson and Taylor 1982, p. 3; Hutchins 1972, p. 41).

Ironically, the most influential and widely used flying boat for both private companies and federal and provincial governments was one of the most unreliable, lumbering machines to operate in Canada during the transitional phase.

Curtiss HS-2L

The Curtiss HS-2L flying boat, commonly referred to as the H-boat, was constructed at the end of the First World War, 1917-1918 (Molson 1966a). It had a conventional biplane construction with Sitka spruce spars, pine ribs, a hull

planked with mahogany, and all the fabric covered surfaces were finished with cellulose acetate dope and two to four coats of cellulose nitrate to seal and strengthen the shell (Molson 1966a, p. 68; Duffy & Crane 1980, p. 16). Figure App I.7 provides a diagram of the Curtiss HS-2L and gives its dimensions.

The Curtiss HS-2L was introduced into Canada in 1918 at the United States Naval Station in Halifax, Nova Scotia, where it carried out anti-submarine patrols until the war's end (Report of the Air Board for the Year 1921, p. 10). The United States government left 12 Curtiss HS-2L and 25 engines in Nova Scotia that were subsequently donated to the Canadian federal government. These formed the core machines flown by the federal government for civilian operations. The first HS-2L flying boat employed in 'bush flying' in Canada was a federal government aircraft under contract to the St. Maurice Forest Protective Association in 1919. The last HS-2L on the Canadian civil aircraft registry was flown by the Ontario Provincial Air Service in 1932 (Molson 1994, p. 68).

The HS-2L was a large bi-plane. The span of the upper wing was 74 feet (19.53m), almost the length of an Olympic swimming pool. The lower wing was 10 feet shorter, 64 feet (16.9 m). The Curtiss HS-2L was equipped with a large Liberty 12 engine with a range of 300 to 360 horsepower. This engine was supposed to produce enough power to enable the aircraft to have a maximum speed of 85 mph (138.6 kph). However pilots that flew the H-boat said she took off, cruised and landed at one speed, 60 mph (104 kph).

Figure App I.7 **Curtiss HS-2L Flying Boat**

	Imperial	Metric
Span (Upper)	74 ft 1 in	22.6 m
Span (Lower)	64 ft 1 in	19.5 m
Length	39 ft	11.8 m
Height	14 ft 7 in	4.5 m
Tare Weight	4,359 lbs	1,981.4 m
Gross Weight	6,223 lbs	2,828.6 m
Wing Area	803 sq ft	244.7 sq m
Maximum Speed	82.5 mph	132 kph
Rate of Climb	180 ft per min	55 m per min
Service Ceiling	10,900 ft	3,354 m
Engine	360 hp Liberty 12	

Sources: Bowers, P. M., 1979, *Curtiss Aircraft 1907-1947*, Putnam, London, pp. 103-105. Molson, K. M., 1966, 'The 'H'-Boats in Canada', *The Canadian Aviation Historical Society Journal*, vol. 4, no. 3, pp. 67-70. Molson, K. M. & Short, A. J., 1995, *The Curtiss HS Flying Boats*, National Aviation Museum, Ottawa, pp. 134-135.

This was only 10 mph (16 kph) over the stall speed where a crash could occur (Bowers 1979, p. 101-102; Milberry 1979, p. 30-31; Molson & Short 1995, p. 26). To really put the aircraft's abilities in perspective, imagine it flying at 60 mph. The HS-2L would be flying at the same speed as a migrating Canada goose, and would be moving slower than some species of ducks (Kortright 1967, p. 180-181).

The Curtiss HS-2Ls were large hard-handling flying boats and required a minimum crew of two just to fly. With two cockpits the H-boat could accommodate a crew of three to four people plus supplies. The engine was uniformly unreliable and required a complete overhaul after only 40 hours of flying (Knight 1970, p. 119). As a reflection of the H-boats propensity for mechanical failure, a report from 1925 listed the cargo to always include; 16 pounds (7.3 kg) of ordinary tools, four pounds (1.8 kg) of engine tools, 31 pounds (14 kg) of engine parts (i.e., gears, screws, rocker arms, etc.), 111 additional pounds of various repair items (wire, emery paper), plus a blow torch, aircraft dope and spare fabric (Halliday 1974, p. 76). The idiosyncratic nature of the HS-2L was so well-known that those awaiting arrivals learned not to be apprehensive when it was overdue. If late, the HS-2L was no doubt floating on a lake somewhere with the crew making repairs (Milberry 1979, p. 30-31). The Ontario Provincial Air Service, in its first year of operations with 13 HS-2L's, recorded 43 forced landings due to engine failure (Halliday 1974, p. 76). The

technological deficiencies of the HS-2L were the root of many of the flying safety measures instituted during the transitional phase.

Despite its long narrow wings the Curtiss HS-2L had a poor glide ratio, dropping a thousand feet every mile (190 meters per km) (Heathcote 1967, p. 4). Such a low glide ratio coupled with an unreliable engine had significant effects on safety issues when flying. The avoidance of low level flying, and flight routes no more than two miles away from landable water provided a precious safety margin (Heathcote 1967, p. 4-5). Avoiding low level flying and remaining within easy gliding distance of a possible landing site were adopted as general safety rules by bush pilots. They were mandated as part of standard operating procedure by the Ontario Provincial Air Service for all aircraft flown, not just the Curtiss HS-2L. These safety considerations, especially the proximity to suitable landing areas such as waterways and lakes for floatplanes and flying boats, reinforced the links between navigable waterways and aerial routes. Unknown rivers and lakes provided many hazards for landing such as depth of water, currents and hidden obstacles. Rivers and lakes previously explored, traveled and perhaps mapped were far safer and therefore more likely to be utilized as flight routes.

Another part of the safety margin pilots observed religiously were take off and landing consideration. While the specifications for the Curtiss HS-2L note that with a full load the aircraft could “unstick”, or lift-off from the water, in 38 seconds, this did not reflect the reality of the bush experience where a 20 minute pre take-off run was the norm (Molson and Short 1995, p. 21-22; Daily work

Diary of the St Maurice Fire Protective Association 1919, August 25 and August 31). The high landing speed, long taxi and slow rate of climb, required to take off caused serious problems for emergency landing. (Refer to Figure App.I.2 and Figure App.I.7 and to Table App.I.1)

“It is a paradox that although Ontario has thousands of lakes, all too few were big enough for the sluggish ‘H-boat’. Some fancy side’slipping could get you in but how would it clear the ever present tall trees at the end of the uncomfortably short take-off run?” (Heathcote 1967, p.69).

Many crews landed and found themselves in just that predicament. To lift off and climb above the trees, one crew was required to cut a 200 foot (52.8 metre) swath through standing timber for a quarter of a mile (76.2 metres) with hand axes (Milberry 1979, p. 31).

Yet with all of these drawbacks, the Curtiss HS-2L was utilized from the east coast to west coast by private and public operators throughout the transitional phase. Amazingly, as the federal government started to phase out their use in 1924, the Ontario Provincial Air Service bought into the ‘H-boat’, operating 20 different machines over the next eight years, 1924-1932 (Report on Civil Aviation 1926, p. 34; Molson 1966a,). With a sturdy design and capacity to take the abuse and rigors of bush flying, the HS-2L opened up the possibilities of aviation in Canada’s hinterland, and led the way for many better and modern machines.

Vickers Viking IV

As the surplus First World War aircraft aged and required greater financial and mechanical upkeep, the federal government looked to aircraft designed after the First World War to replace the aging machines. In 1922 several leading British aircraft designers visited Canada “and as a result of their personal investigation they realized that machines built for European conditions do not necessarily suit those in Canada” (Report on Civil Aviation 1923, p.39). The Vickers Company of England followed specifications required by the Canadian Air Force produced the first aircraft designed to better meet the needs and conditions present in Canada. The Vickers Company was awarded a contract for eight Vickers Viking Mark IVs in February 1923 (Molson and Taylor 1982, p. 446). The first Vickers Viking IV was completed in June of 1923 (Report on Civil Aviation 1923, p. 38).

The single engine amphibious flying boat, as shown on Figure App I.8 was utilized primarily for survey work and transport in Manitoba. To allow the flying boat to be amphibious it had an optional attachment of a wheeled undercarriage and tailskid. The Viking operated with a four-man crew: pilot, air engineer, photographer and navigator (Milne 1984, p. 3; Report on Civil Aviation 1924, p. 94).

Figure App I.8 Vickers Viking IV

	Imperial	Metric
Span	50 ft	15.2 m
Length	34 ft	10.4 m
Height	15 ft 1 in	4.6 m
Tare Weight	3,750 lb	1,704.5 kg
Gross Weight	5,600 lb	2,545.5 kg
Wing Area	594 sq ft	181 sq m
Cruising Speed	80 mph	128 kph
Maximum Speed	102 mph	163 kph
Rate of Climb	500 ft per min	152.4 m per min
Service Ceiling	9,000 ft	2,743.2 m
Engine	360 hp Rolls Royce Eagle VIII	

Sources: Molson, K. M. & Taylor, H. A., 1982, *Canadian Aircraft Since 1909*, Putnam, London, pp. 446-448.

The Viking had a slightly better range than the Curtiss HS-2L. Its major drawback was that it was under-powered and crews found that to maintain some margin of performance when fully loaded for survey trips, the wheels and tailskid needed to be removed to keep the weight to a minimum. A fully loaded Vickers Viking included fuel, the four man crew of 180 pounds each (82 kg), 206 pounds (93 kg) of photographic equipment, other gear and food weighing 227 pounds (103 kg) (Report on Civil Aviation 1924, p. 94). This was 700 pounds (318 kg) under the specification's maximum load. However the performance under real conditions demonstrated that fully loaded to the maximum weight with 2,000 pounds (909 kg) of fuel, crew and equipment, the Vickers Viking was a fine boat... but an extremely poor airplane.

The biggest drawback of the Vickers Viking was its take-off and landing capabilities, including poor water handling characteristics. In August 1924, Group Captain J.S. Scott wrote that the Viking:

“...requires too long a run and in rough seas it takes great skill to get the machine off the water. When taxi-ing in any kind of rough seas it is very difficult to control the direction, besides the difficulty of preventing the cockpit from filling up with water. So far we have been unable to find a way to land the Viking without porpising” (Molson and Taylor 1982, p.448).

The long take-off run meant that, like the Curtiss HS-2L, the Vickers Viking was restricted to the use of lakes and rivers that afforded enough room for the machine to become airborne.

Canadian Vickers Vedette

The year after the Vickers Viking IV was introduced, the Vickers company set up a division of the company in Montreal. There they began the first aircraft designed and built in Canada for bush flying, the Canadian Vickers Vedette. Tested in November of 1924, the Vedette was designed as a smaller flying boat, as shown on Figure App I.9, with particularly good take-off and climb to allow it access to smaller bodies of water (Molson and Taylor 1982, p. 175). The Vedette could become airborne in just six seconds according to specifications, compared to the Curtiss HS-2L's 38 seconds (Heathcote 1967, p. 5). The Vedette also had considerably more speed and climb, cruised at 87 mph (139 kph) and had a climb rate of 650 feet per minute (198 metres per minute) (See Figure 2) (Molson and Taylor 1982, p. 182). After 1926, the Vedette's original British built water-cooled Wolsely Viper engine was replaced by the American built J-4 Whirlwind air-cooled engine, the first American air-cooled engine to be used in a pusher configuration. By 1927, the number of Vedettes flown by private operators was greater than those flown by the Royal Canadian Air Force (refer to Table 3.1 and 3.2 in Chapter Three). As the first product of Canadian aviation design, the Vedette was seen as a great success.

"In 1925 the technical development of aircraft and equipment is also proceeding. The first products of Canadian design are now in use. The Vedette is the equal and for Canadian conditions, the superior, of any flying boat in the world today" (Report on Civil Aviation 1925, 1926 p.14).

Figure App I.9 Canadian Vickers Vedette

	Imperial	Metric
Span	42 ft	12.8 m
Length	32 ft 10 in	10 m
Height	11 ft 9 in	3.6 m
Tare Weight	2,140 lb	973 kg
Gross Weight	3,155 lb	1,434 kg
Wing Area	495.6 sq ft	151 sq m
Cruising Speed	87 mph	139 kph
Maximum Speed	98 mph	157 kph
Rate of Climb	650 ft per min	198 m per min
Service Ceiling	13,000	3,962 m
Engine	200 hp Wolsely Viper or J-4 Whirlwind	

Sources: Heathcote, A. P., 1967, "Wings Over the Wilderness", *The Canadian Aviation Historical Society Journal*, vol. 5, no. 1, pp. 4-7. Molson, K. M. & Taylor, H. A., 1982, *Canadian Aircraft Since 1909*, Putnam, London, pp. 175-182.

While many of the problems with surplus First World War aircraft were addressed in the design and operating parameters of the Vedette, it was too small and lacked the capacity to do serious transport work in northern areas. However, the Vickers Viking IV and the Canadian Vickers Vedette were the first aircraft in the process of developing types of aircraft peculiar to Canada, to overcome the natural conditions existing in the country. As the end of the transitional phase neared there was a distinct shift from the adoption and adaptation of surplus machines to the construction of aircraft specifically designed for 'bush flying'.

"The requirement for new aircraft is not yet large but surplus war material is now obsolete and aviation is now more dependent on new construction than it was during the five years following the War (First World War)" (Report on Civil Aviation 1925, 1926, p.81).

Appendix II

Sources, References and Aviation Histories

In order to extract conclusions and analyze transitional phase aviation a variety of sources were consulted. The research draws on federal and provincial government reports tabled during the transitional phase. These documents provide information on both government civil flying and private commercial operations. However the author recognizes that these reports were tied to budget allocation decisions and that affected the presentation of the information. These reports were presented to shed the best possible light on transitional phase aviation in an effort to continue or increase the level of funding for their programs.

Another major research source was the *Canadian Aviation Historical Society Journal* that contained some articles by aviators of the transitional phase as well as articles written by aviation historians. These articles contained information on all aspects of aviation including aircraft and operations of the transitional phase. In addition to the journals, several flight log books and excerpts from flight logs of the transitional phase were examined. There are very few flight logs still existing or available to researchers. The useful information in the flight logs depended on the personality of the individual pilots. Many flight logs are no more than a list of flight designations akin to a cab drivers pick-ups and drop-offs. A very few flight logs contain route information and details about

refueling stops, mechanical difficulties and other conditions. For examples about the varied level of detail included in Flight Logs see Appendix III.

Photographic content analysis of transitional phase photographs was undertaken, this included photographs in journal articles and relevant books as well as examining some of the photographs held at the National Aviation Museum library. An example of the type of information the photographs could supply is from Shaw (2001, p. 9). The photograph is of J. A. Wilson in his Ottawa office in 1922. The entire background wall is taken up by a huge map of Canada. The title of the map is clearly visible and reads: "Railway Map of the Dominion of Canada". Interesting conclusions, such as the impact of railway location and launching points of aircraft operations, can be drawn from the prominence of this map in an office dedicated to aviation. Many of the photographs of the transitional phase tell a story or shed light on operational realities. That particular picture may indeed be worth a thousand words on the subject of transitional phase aviation.

The author also consulted many of the leading authorities in Canadian aviation history in Eastern Canada. The core area of interest of these historians is Canadian aviation prior to the Second World War. They were not interviewed or consulted on a regular basis, but through the authors association with the National Aviation Museum, the Canadian Aviation Historical Society and conferences such as "Celebration of Early Bush Flying" held in Grand-Mere, Quebec, on June 19, 1999, the 80th anniversary of the first bush flight in Canada.

These experts are all members of the Canadian Aviation Historical Society, and most are published authors. The provided advice, information, verification, direction and encouragement about the subject generally and specifically about individuals and aircraft associated with transitional phase aviation.

Ron Bell: Historian, Author.

Colin Caldwell: Son of Laurentide Air Service Pilot Jack Caldwell, Historian, Author.

Tim Dubé: Archivist and Historian at National Archives, President of Ottawa Chapter of Canadian Aviation Historical Society.

Dr. Rénaud Fortier: Curator of Aviation History at National Aviation Museum, Author.

Patricia Foss: Daughter of Laurentide Air Services Pilot Donald C. Foss.

George Fuller: Aviation Historian, Author.

Paddy Gardiner: Aviation Historian, Technical Aviation Consultant.

Bruce Gowans: Aviation Historian, Author.

Robert Graham: Son of St. Maurice Forest Protective Association Pilot Stewart Graham.

Brian Griffiths: Former Air Canada Operations Manager, Aviation Historian.

Hugh Haliday: Military Aviation Historian, Author.

Fred Hotson: Former de Havilland Canada Test Pilot and Engineer, Aviation Historian, Author.

Terry Judge: Aviation Historian, Computer Analyst.

Ralph Leonardo: Aviation Historian.

Dorothy Jean Lupien: Daughter of Laurentide Air Service mechanic.

Godfrey Passmore: Aviation Historian, son of pilot Hubert M. Passmore who flew for Laurentide Air Service, Jack Elliot Air Service and former General Manager of Fairchild Aerial Services Ltd. (Canada).

Dick Pickering: Aviation Historian.

Alastair Reeves: Aviation Historian, Author, President of Montreal Chapter of Canadian Aviation Historical Society.

Ross Richardson: Former Aviation Design Engineer, Historian, Author.

Christopher Terry: Director General of the National Aviation Museum, Aviation Historian, Author.

The available secondary sources addressing the transitional phase were also utilized. Unfortunately, despite the transitional phase's significance in Canadian aviation history, there are limited sources of research, and those

resources available are not explicitly geographical or scholarly in nature, nor are there any comprehensive works detailing flight routes, objectives or operations. There is no source that provides a global vision of data, so it must be gathered piecemeal and reconstructed from multiple sources with varying degrees of detail and reliability.

It is through this reconstruction process derived from a survey of the literature that the flight route information was amassed and compiled. The process incorporated written, pictorial and map analysis and simple logic as well as drawing upon information not strictly confined to the field of aviation. This included the location and verification of where aircraft during the transitional phase were operating and if these operations were associated with particular features either natural or manmade. From these conclusions any patterns or process underlying flying during the transitional phase can be extracted.

Appendix III

Flight Logs of Stuart Graham and Madge Graham

This is one of the only examples of flight logs where cross reference is possible. The different levels of description for the same flight gives a more complete picture of not only the routes flown but also conditions and other details. Madge Graham did not accompany her husband on all flights, the flights on July 1, 1919 and August 5, 1919 illustrate the difference in detail between the two logs.

Stuart Graham provided interesting details about the problems associated with the Curtiss HS-2L taking on water (Figure App III.1), while Madge just refers to how the aircraft flew (Figure App III.2). Conversely on the August 5th flight it is Madge who provides the details of the route, and Stuart who only notes the destination and purpose.

The value of the having the two flight logs is immeasurable. With only a single flight log or a single perspective of a flight, the amount of detail and accuracy is entirely dependent on the author.

	Machine No.	Duration of flight	Landings	Height	Pilot	CHARACTER OF FLIGHT
1	1876	3-50				Test. Machine will not climb. Fins full of water and machine generally sodden.
2	1876	3-10	3.10 pm.			La Tuque Up Croche to Lake Shee.
3						Fire sighted and reported near Lake Culotte.
4						Unable to fly owing to lubricating oil not arriving.
5	1876					Oil shipment received.
6	1876		1. pm			Endeavoured to make flight. Machine too waterlogged to fly. Must complete launching equipment and haul out machine to drain and dry.
7	1876					Launching track finished. Machine hauled out. 1000 lbs water removed from hull.
8	1876	3-45	4.30 pm			Five patrol to Lake Clair and return.

Figure App III.1 Stuart Graham's Flight Log Excerpt

							CHARACTER OF FLIGHT
No.	Type of Machine	No. of Machine	Duration of Flight	Landings	Height	Pilot	
Aug 5	HS2L	1876	3-30	2:45 pm			Fire patrol. L. W. Yagameach and return west of St. Maurice River.
12		1876	3-0	8:40 am			North over Mekinac along Transcontinental to Lake Shee. Several small fires up. Bostonais noted and reported. Recent burn noted east side of L. Concomash. Landed Lake Shee. Return over southern limits. To Lake St. John. Rain storms whole journey. Moored in Roberval Harbour. Filled with gas and oil. Awaiting arrival of Woods Superintendent. Left Lake St. John NNE following River Mistassini to Grand Rapids changed course to SSE crossing country to Grand Peribonka River. WSW to Lake St. John and Roberval.
28		1876	2-20	1:25 pm			Roberval to Lac des Piles. After 4 hrs 10 mins in air en route Lac des Piles obliged to land Lac des Piles owing short of fuel. Phoned -
29		1876					
30		1876	2-10	6:50 am			
30		1876	4-10	1:30 pm			

Figure App III.1 Continued

Date	Type Machine	No. Machine	Duration of Flight	Landings	Height	Pilot	CHARACTER OF FLIGHT
Aug 25	HSR	1976	50 min	1	1000	S. Graham	Test Flight. Machine flew very heavy. Loe La Tortue.
Aug 25			1 hr 35 min	1	5000		Left water Loe La Tortue 2 45 pm. Machine not climbing well. Circled to gain altitude 30 min. Struck course NNE at 3 15 with 2000 ft altitude. Landed Lake Wayagamac 4 20 pm.
Aug 26			1 55	1	5000		Left water Lake Wayagamac 6 5 pm. Crossed St Maurice River above La Tuque. Turned south at Junction of Creek à Noel and St Maurice. Passed over Lakes Ciconcine and Sassa maskin. Struck St Maurice at Junction of Matlaum River. Landed Loe La Tortue 8 15 pm.
Aug 26			15 min	1	1000		Left water Loe La Tortue 1 15 pm. Landed Loe La Tortue 1 15 pm.

Figure App III.2 Madge Graham's Flight Log Excerpt

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