FLYING THE NORTHERN FRONTIER: THE MACKENZIE RIVER DISTRICT AND THE EMERGENCE OF THE CANADIAN BUSH PLANE, 1929-1937

by

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ABSTRACT

This thesis examines the emergence of the Canadian bush plane in the context of Canadian Airways' operations in the Mackenzie River District during the years 1929-1937, focusing on the interaction between technology and its wider context. Using this 5-year history as its central focus, the dissertation explores the process of adaptation and modification that follows technology transfer, arguing that Canadian aircraft designers created the bush plane in response to users' experience with the aircraft in the context of local use conditions and practices. By focusing on the interaction between technology and use context, the thesis offers a glimpse into the process of technology transfer and adaptation, while also highlighting the importance of technology's users in injecting knowledge about the technology's interaction with its environment into the construction of new designs. It also brings into sharp relief geography's central role in shaping a technology, raising interesting questions about the nature of national styles of technology. Chapter 1 introduces the bush plane as a central figure in Canadian inter-war history, situating its emergence in relation to larger issues in the history of technology and history of aviation. Chapters 2 and 3 describe the development of Canadian bush flying in response to the conditions confronting the nation between 1919 and 1929, along with the

technical developments that allowed Canadians to acquire experience with northern aviation. Chapter 4 analyses Western Canada Airways' decision to establish its Mackenzie service, the conditions that influenced the selection of its fleet, the aircraft's response to this new environment, and the airline's role in adapting the aircraft to suit northern operating conditions. Chapter 5 explores the dialogue between technology and context, tracing the aircraft's impact on the north and the airline's response to those changes. Chapter 6 explains how these events culminated in the creation of indigenous Canadian bush planes that integrated user knowledge and responded to northern bush flying conditions. The final chapter offers a glimpse of the bush plane's development in the post-war era, providing an analysis of the relationship between technology and geography and the notion of national styles of technology.

ACKNOWLEDGEMENTS

As those who have undertaken such a project are well aware, while there is one name on the dissertation's title page, in reality the result is the product of the efforts of many and the strongest parts are often a reflection of these silent partners. The words that follow are but a small repayment of the debt of gratitude I owe to those named below. The reality of this thesis is due in large part to you and your support.

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Staff at the Archives of Manitoba, the Northwest Territories Archives, and the National Archives of Canada were both encouraging and immensely helpful in locating relevant materials. Other research took place at the Western Canada Aviation Museum and the Alberta Aviation Museum, where I discovered an unsuspected gem: a collection of dedicated volunteers and staff members. The preservation of this country's aviation history owes much to these individuals and they deserve our recognition for those efforts. On a personal note, I would like to thank them for welcoming me with open arms, for their willingness to give of their time and help, and for their trust in letting me loose amongst their collections.

Here at the Institute for the History and Philosophy of Science and Technology, I was fortunate to find a wonderful community of graduate students. I am convinced you would be hard pressed to find a more supportive and entertaining group of colleagues and I want especially to thank them for many common room lunch table conversations. Of this group, I am particularly grateful to Ian Slater and Ted Everson for their advice and guidance, and to Gillian Gass, Martha Harris, Keynyn Brysse, and Brigit Ramsingh for the laughter and support and for the conversations about everything that had nothing to do with school. Outside of my academics, the Master, officers, and junior fellows of Massey College provided me with a home as I began my studies in Toronto and many of my closest friends have come from its ranks.

Beyond the walls of academia there are those who merit my unending thanks. The first is Sabrina, whose abiding and unquestioning friendship is one of the joys of my life. And, before all others, there is my family: my husband, Nathan, my parents, Robert and Carolyn, my sister, Elicia, and my brother, Kevon. They have been my anchor and my safe harbour and without them, none of this would have been possible. To them, above all others, this work is dedicated. All that is best in it is theirs.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

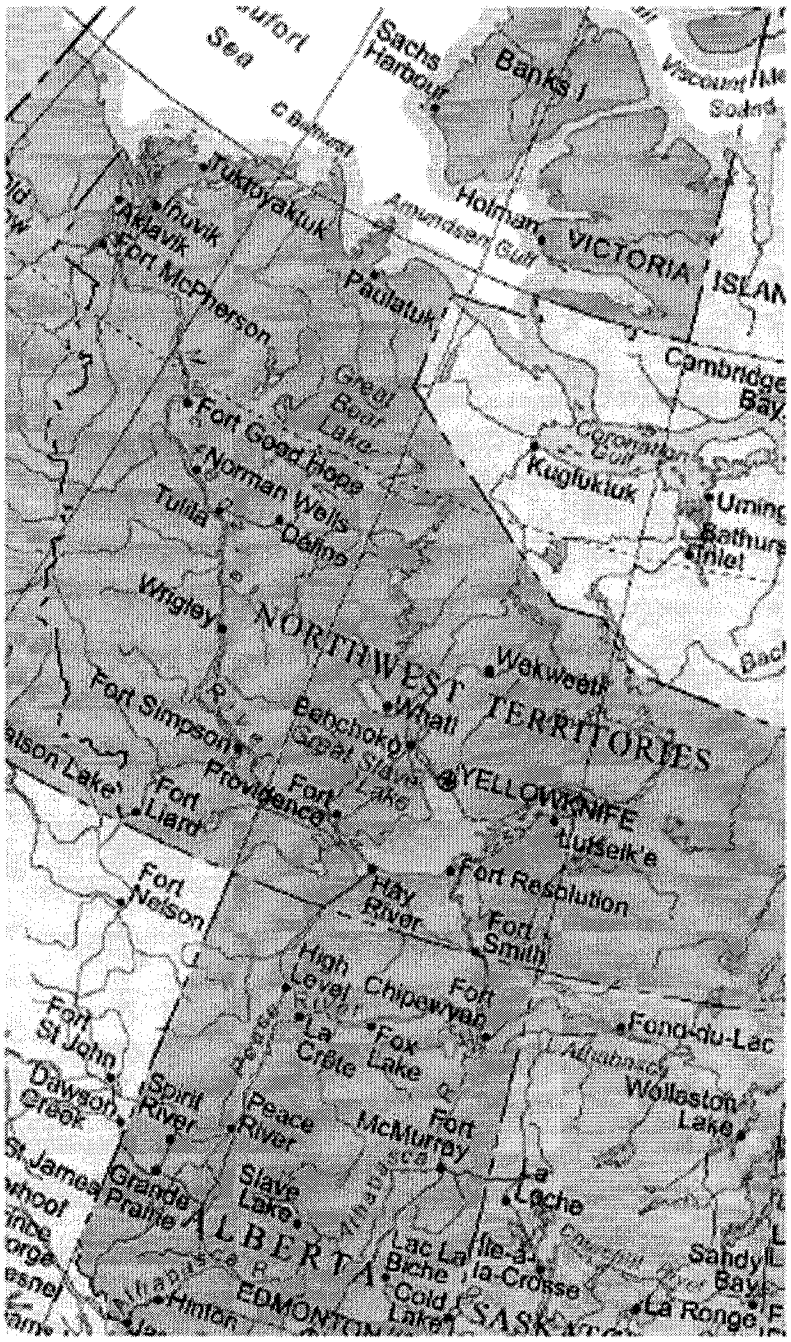

Figure 1.1: Map of the Mackenzie District.
Source: Atlas of Canada, General Reference Map (Detailed), 100th Anniversary Map Series, Natural Resources Canada, 2006, http://atlas.gc.ca.

1 – INTRODUCTION

Figure 1.2: CF-AAO, Fairchild FC-2W-2, 1934.
Left to right: Fred Joliffe, [unidentified] government inspector, pilot Matt Berry.
Source: AAM Photo Collection, 202382.

The image of the floatplane rising from a rock-bound northern lake is an iconic one in the Canadian imagination, bringing together as it does several of the cultural threads Canadians use to define themselves. Our theorists tell us that we are a northern people conditioned by our relationship with the spaces of the North, but that relationship is complicated, as most relationships are. On the one hand, we seem to cringe behind garrison walls, terrified of the vast, unfeeling power of the land. On the other hand, the North has ever lured us out from behind those walls to either become lost in its wastes or to rediscover ourselves. This is the imaginative North, alluring, dangerous, and ever present.[1]

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[1] Margaret Atwood, *Strange Things: The Malevolent North in Canadian Literature* (Oxford: Clarendon Press, 1995); Northrop Frye, *The Bush Garden: Essays on the*

In the physical world, the North's position in Canadian history is fraught with a similar tension. According to Northrop Frye, from its first discovery by European explorers the landmass that became Canada was considered an obstacle, lying as it did between Europe and the riches of the Orient.[2] This image of the land as a barrier persists through the writing of Canadian history. According to the Laurentian thesis, the St. Lawrence River began as the country's main axis, drawing one from the Atlantic into the continental interior, establishing an East-West orientation. However, the land's geography runs perpendicular to this axis, blocking East-West expansion. To this way of thinking, America offers a magnetic lure, pulling people, culture, and resources into its orbit, drawing them onto a more natural longitudinal, north-south axis and fragmenting the country.

For others, such as Harold A. Innis, Canada is not a human or technological triumph over geography. Rather, it is the organic outcome of trade routes created by the major river-systems in the northern half of the continent: the St. Lawrence – Great Lakes; the Hudson's Bay drainage basin; the Columbia River; and the Mackenzie River. To Innis, the separation of the United States and Canada is geographically natural. By comparison, the Laurentian hypothesis suggests that later national developments occurred as the country triumphed over its geography, knitting itself together with structures like

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Canadian Imagination (Toronto: House of Anansi Press, 1971); Sherrill E. Grace, *Canada and the Idea of North* (Montreal: McGill-Queen's University Press, 2001); Louis-Edmond Hamelin, *Canadian Nordicity: It's Your North, Too*, trans. William Barr (Montreal: Harvest House, 1978); Renée Hulan, *Northern Experience and the Myths of Canadian Culture* (Montreal: McGill-Queen's University Press, 2002); Brian S. Osborne, "The iconography of nationhood in Canadian art," in *The Iconography of Landscape*, eds. Denis Cosgrove and Stephen Daniels (Cambridge: Cambridge University Press, 1988), 162-178.

[2] Frye, *The Bush Garden*, 217.

the Canadian Pacific Railway. Nevertheless, both schools see geography as a decisive influence on Canadian history.[3] In Canadian culture and in national history, the North's geography is seen as both a threatening obstacle and as a genitive source of who we are. As part of our cultural imaginary and in our history, the droning floatplane is a powerful image precisely because it too participates in this tension.

Aircraft as a technology did not long predate the First World War and, indeed, many historians argue that it was the pressure of combat that forged the technology into a reliable machine capable of operating commercially.[4] When Canada emerged on the war's far side in 1918, the country found itself with a large number of young men trained as military pilots and flight engineers, many of whom sought civilian applications for aviation. In Canada, resource development presented one of the few opportunities for aviators and in this context, Canadians began using war surplus Curtiss HS-2L flying boats in support of the forest industry that operated along the Canadian Shield's southern edges. These aircraft provided fire spotting capabilities, aerial reconnaissance, and aerial photographs. Over the course of the decade, aviation operations in the bush expanded to

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[3] Carl Berger, *The Writing of Canadian History: Aspects of English-Canadian Historical Writing Since 1900*, 2nd Edition (Toronto: University of Toronto Press, 1986); Donald Creighton, *The Empire of the St. Lawrence: A Study in Commerce and Politics*, 2nd Edition (Toronto: University of Toronto Press, 2002); Harold A. Innis, *The Fur Trade in Canada: An Introduction to Canadian Economic History* (Toronto: University of Toronto Press, 1999). These two schools also share the common Canadian preoccupation with transportation and communication. Indeed, with such a vast country, how could it be otherwise, especially in a land where transportation has conditioned so much of our national development from the arrival of European explorers to the growth of the fur trade to the expansion of the wheat economy and finally the development of the middle North.

[4] John D. Anderson Jr., *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002); Tom D. Crouch, *Wings: A History of Aviation from Kites to the Space Age* (New York: W.W. Norton & Company, 2003).

include other types of aircraft and to encompass activities associated with the mining development occurring across the North. In doing so, Canadian operators would create a distinct type of aviation, bush flying, and would influence the creation of a new sort of aircraft, the Canadian bush plane.

As the aircraft became closely linked with the expansion of southern Canadian society and industry into the country's north, the bush plane's image became intertwined with the idea of the North and the country's developing perception of itself as a northern nation, which ran as an undercurrent through Canadian history in the first half of the twentieth century.[5] In stories of Canadian inter-war expansion, the airplane appears as a technology that allows us to literally transcend our geography, lifting us over difficult terrain and bringing the remote wilderness ever closer, shrinking distance and time. At the same time as it lifts us above geographical obstacles, the floatplane allows us to reach farther into the heart of the North, in some way bringing us into deeper contact with the land by giving us greater access to the interior. As part of the dramatic expansion into the North that occurred during the inter-war years, aircraft would aid in opening the Shield to the probing hands of prospectors and mining developers, forever altering both the land and life in the North.[6]

When treating this northward expansion, Canadian historians are quick to identify the aircraft's essential role in supporting this northern migration.[7] Unfortunately, these

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[5] For discussions of Canada's developing northern identity, see Grace, *Canada and the Idea of North*; Hulan, *Northern Experience and the Myths of Canadian Culture*; and Osborne, "The Iconography of nationhood".

[6] Morris Zaslow, *The Northward Expansion of Canada, 1914-1967* (Toronto: McClelland & Stewart, 1988).

[7] Michael Bliss, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto: McClelland & Stewart, 1987), chapter 15; Robert Bothwell, *Eldorado: Canada's*

same historians resist the temptation to examine the technological *deus ex machina* that entered at precisely the moment the resource industries moved into the North. In fact, as we will see, aircraft and mining were involved in a mutually dependent relationship in the Canadian North. Aircraft enabled mining development in the Shield and mining provided a market for aircraft, encouraging technical adaptation. This thesis gives in to the temptation to open the technological black box in order to investigate the evolution of the aircraft that enabled the changes occurring in the Canadian North during the years between the two World Wars.

In 1929, Western Canada Airways began offering a commercial service that reached north from its new base at Fort McMurray, Alberta, along the Slave River, across the 60th parallel and Great Slave Lake, and up the mighty Mackenzie River to the shores of the Arctic Ocean.[8] Although it followed existing river trade routes, this pioneering air service represented a complete break with the previous northern transportation system, which was built around dog sleds and riverboats. With the airplane's introduction, Western Canada Airways created a transportation system that shrank northern distances, opened the area to mineral development, and transformed the very character of life in the North. This dissertation charts the history of this route, uncovering the creation of a new

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National Uranium Company (Toronto: University of Toronto Press, 1984), chapters 1, 10; R. Douglas Francis, Richard Jones, Donald B. Smith, *Destinies: Canadian History Since Confederation*, 3rd Edition (Toronto: Harcourt Brace & Company, 1996), chapter 11; Zaslow, *Northward Expansion of Canada*, chapter 4; Morris Zaslow, *The Northwest Territories 1905-1980*, The Canadian Historical Association, Historical Booklet, no. 83 (Ottawa: The Canadian Historical Association, 1984), 10.

[8] See Figure 1.1. Note however, that throughout the dissertation I use the English names used for rivers, lakes, and communities. Recently, communities across the Northwest Territories have been reverting to their original Dene and Inuit names, however, I have chosen to use the names employed during the 1920s and 1930s. Despite the reversion, the communities that figure prominently in the dissertation have maintained their English names.

type of Canadian airplane conceived through the dialogue between technology and place. In the chapters that follow, I argue that the Canadian bush plane emerged through a process of technological modification and adaptation wherein the use context of the Canadian North, including operating conditions and practices, was incorporated into aircraft design, producing a new and distinct type of aircraft: the bush plane.

BUSH FLYING AND BUSH PLANES, AN INTRODUCTION

Pinning down the exact referent of the term bush plane can be a confusing process. In many ways the type could be defined by its use – that is, a bush plane could be any plane used in the practice of bush flying. As the name suggests, bush flying involves flying into the bush. In Canada, the bush refers primarily to the rocky area defined by the Canadian Shield, though other unsettled wilderness areas can also be referred to as bush. The Shield is a vast geological formation of ancient bedrock that girdles the country, beginning east of the Mackenzie Mountains and sweeping down from the Beaufort Sea to swing under Hudson Bay before turning north again into the Ungava Peninsula. Though generously sprinkled with mineral deposits, this area is also exceedingly difficult to traverse, being composed of rocky hills, muskeg bogs, lakes, and rivers. The region is not uninhabited but it is sparsely populated, leaving the wilderness largely intact. It being wilderness, the area has very few fixed landing fields. The few that do exist are associated with the larger communities that dot the space. Historically, however, there were no fixed runways in the area and no permanent landing fields along the Mackenzie River until World War Two. Instead, pilots used natural airfields. In the Canadian bush this meant water: lakes and rivers. Thus, bush flying involves the use of aircraft in unsettled wilderness areas without fixed landing strips, replacing these with natural runways, namely lakes and rivers.

In addition to geography, the variety of work carried out defines bush flying. For instance, bush planes have carried passengers, freight, mail, and even medical patients. As Con Farrell, an early bush pilot explained, they would fly anything as long as someone was willing to pay to have it flown.[9] In the early days, this meant that alongside more prosaic cargos, bush pilots had been known to carry oxen, pigs, and foxes, making for several humorous incidents. For instance, in 1933, Farrell himself hauled two small pigs from Edmonton, Alberta, to Cameron Bay, located on the shores of Great Bear Lake. Unfortunately, for both the pigs and the pilot, the animals did not take well to flying and became ill during the voyage. During a stop at Fort Rae, Farrell attempted to rinse the pigs' crate in an effort to eliminate some of the powerful odours emanating from the back of the cabin. In the middle of the process, the pilot lost his grip and dropped the crate into seven feet of water – with the pigs still inside. Farrell and his mechanic leapt into the lake and were able to rescue the sputtering pigs and eventually revive them by administering artificial respiration. Luckily, the pigs arrived at Great Bear Lake without further incident.[10] As this episode demonstrates, staff on northern bush runs could find themselves performing all sorts of tasks, depending on their cargo and, unlike modern passenger services, that cargo could be incredibly varied. Thus, bush flying is used as a catchall term to capture the variety of commercial aviation activity that takes place in the

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[9] Con Farrell, interview by Wes Matty, 20 August 1967, NWT Archives, G-1988-008-002.

[10] Margaret Mason Shaw, *Bush Pilots* (Toronto: Clarke, Irwin & Company Ltd, 1962), 173-175.

Canadian bush and, at the beginning of the practice, any aircraft that participated in these activities could legitimately be called a bush plane.

In the initial stages of Canadian bush flying during the 1920s and early 1930s, the pilots and organisations that developed the practice selected from pre-existing, available aircraft. Given that the Canadian aircraft manufacturing industry virtually disappeared at the end of World War One, the existing aircraft were all foreign-designed and at this point, any of the airplanes used in bush flying earned the moniker bush plane in virtue of the way they were used. Over time, as bush flying matured and the Canadian aircraft manufacturing industry expanded, Canadian users and designers collaborated to create first, Canadian-specific modifications of the foreign-designed aircraft used as bush planes, and later, Canadian-designed aircraft conceived especially for use in the bush. These special purpose bush planes shared a set of characteristics specifically adapted to their work in the Canadian North. It was this set of shared features and the intentionality of the designers that set the bush plane apart as a distinct type of aircraft.

The Noorduyn Norseman, the first successful aircraft designed specifically as a bush plane, appeared in 1935 and shares several characteristics with famous bush planes from the post-war era, namely the de Havilland Beaver and Otter, and the Fairchild Husky. To begin with, versatile resilience defined the bush plane. These mid-sized aircraft are all high-wing, cantilevered monoplanes, capable of being converted from floats to skis to wheels. While speed matters in terms of efficiency of operations, given the changing loads it carries, load capability is equally important in a bush plane. On modern bush planes, good sized cabin doors and squat bodies make freight loading simple and all are flexible enough to carry a variety of loads from passengers to mining equipment. All four classic designs listed above are also equipped with flaps that improve their take off and landing characteristics, enabling them to get into and out of smaller lakes. The Beaver, in particular, is cited as being an excellent Short Take Off and Landing (or STOL) craft.[11] While the later aircraft had more powerful engines, all four have solid performance characteristics, including good lift, which allows them to carry a substantial payload for their size. These mid-sized utility aircraft were rugged and reliable, able to withstand extreme bush conditions, and capable of carrying the necessary loads into difficult terrain. While several of the planes that existed in the 1920s and early 1930s possessed many of these characteristics, the Norseman was the first to successfully synthesise these qualities and the results of bush pilot experience into one machine, thereby producing a separate type of aircraft.

A Canadian Technology

This new sort of aircraft can legitimately be called the indigenous Canadian bush plane because the type developed out of the interaction between Canadian bush flying and the Canadian environment. In fact, bush flying appears to be a form of aviation unique to Canada. While aviation developed in other areas with remote wilderness interiors, including Alaska, Russia, Africa, Australia, and South America, differences in geography encouraged the use of different types of aircraft or a concentration on intercity services.[12]

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[11] Dick Hissocks, the de Havilland aerodynamicist who worked on the Beaver called it, “the first serious short take off and landing (STOL) airplane.” Quoted in Sean Rossiter, *The Immortal Beaver: The World’s Greatest Bush Plane* (Vancouver: Douglas & McIntyre, 1996), 10.

[12] For an overview of commercial aviation worldwide, see R.E.G. Davies, *A History of the World’s Airlines* (London: Oxford University Press, 1964).

In northern regions like Russia and Alaska, one would expect to see services similar to those in northern Canada. In Russia, for instance, the Siberian economy developed around furs and minerals, the two industries that provided the initial Mackenzie District air cargo, and like the Mackenzie, communities in the region were strung along rivers that could provide instant landing fields. Despite these similarities, commercial bush flying did not develop in the Soviet north, nor did northern aviation appear as early as in Canada. Instead, Russian aviators of the mid-1930s pushed the limits of their aircraft on daring long-distance flights and exciting Arctic rescue expeditions. Indeed, the differences are not surprising when one considers that Russia and the new Soviet Union spent the end of the war in the throes of a revolution and the establishment of a communist state. As John McCannon and Scott Palmer argue, this pattern of record-setting aviation reflected the state's, and particularly Stalin's interest in establishing the Soviet state's legitimacy.[13]

In Alaska, differences in the pattern of aviation were largely the result of geography. The bulk of Alaskan aviation during the 1920s and 1930s appears to be from fixed landing strips. This reliance on wheeled aircraft may partly reflect Alaska's mountainous geography and the lack of sufficient suitable natural landing fields. It may also reflect the Territory's willingness to finance the construction of permanent

[13] Scott W. Palmer, "Peasants into Pilots: Soviet Airmindedness as an Ideology of Dominance," *Technology and Culture* 41:1 (2000): 1-26; John McCannon, *Red Arctic: Polar Exploration and the Myth of the North in the Soviet Union, 1932-1939* (Oxford: Oxford University Press, 1998).

airfields.[14] This practice differed from northern Canadian bush flying as Canadians used floatplanes to reach out from established centres into the bush.

Australia and Africa also present similarities to the Canadian North, particularly in the large swaths of hostile wilderness that separate communities.[15] However, in both these locations aviation development seems to have concentrated on interurban, long distance passenger and airmail routes that were eventually linked to British imperial overseas airways. While Canada was separated from Britain by the wide Atlantic, routes that were largely over land meant the Empire could extend its air services to Africa and Australia sooner than it could offer regular transatlantic flights to Canada. Different geographies also meant neither Australia nor Africa possessed the network of lakes and rivers that could substitute for maintained airfields and so neither region depended on floatplanes. In Africa a lack of ready capital meant that local airlines came later than in Canada.[16] In Australia, a form of bush flying to outback sheep stations and a flying doctor service would eventually develop, but both would depend on wheeled aircraft because of geography and would develop later than Canadian bush flying.[17]

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[14] Robert W. Stevens, *Alaskan Aviation History*, vol. 1 and 2 (Des Moines, Washington: Polynyas Press, 1990). Stevens presents a detailed chronology, but claims based on his work are hampered by a lack of extensive footnotes or in-depth historical analysis. From the overview Stevens provides it seems apparent that the history of Alaskan aviation offers much the same scope for investigation as the history of northern Canadian aviation.
[15] *Australian Aeronautics, 1927-1977* (Parkville, Australia: Australian Division of the Royal Aeronautical Society, 1977); John Gunn, *The Defeat of Distance: Quantas 1919-1939* (New York: University of Queensland Press, 1988); Robert Lewis McCormack, "Aviation and Empire: the British African Experience, 1919-1939" (Ph.D. diss., Dalhousie University, 1974); B. Romain Ngamilu Awiry, *L'aviation civile et militaire zaïroise* (Braine-l'Alleud: J.-M. Collet, 1993); Neville Parnell and Trevor Boughton, *Flypast: A Record of Aviation in Australia* (Canberra: AGPS Press, 1988).
[16] McCormack, "Aviation and Empire," 53.
[17] Bob Norman, *Bush Pilot* (Cairns: Norman Enterprises, 1976).

Surprisingly, the pattern of aviation development in South America was most like that in northern Canada.[18] As in the North, South Americans used aircraft to overcome difficult geographies and to link the hinterland to the metropolis. Users employed aircraft in a similar range of activities, carrying airmail, passengers, cargo, and even supporting mineral development. In some cases, South American airlines exploited the physical geography by using rivers as natural runways. Strikingly, many of the early South American airlines used several of the same aircraft as Canadian companies: Bellancas, Fairchilds, Fokkers, Junkers, and Stinsons. In fact, R.E.G. Davies points to direct links between Fairchild and Mexican aviation as Sherman Fairchild purchased an interest in the Compañia Mexicana de Transportación in 1925.[19]

However, the bulk of these services depended on maintained landing fields. Nor do South American aircraft manufacturers appear to have developed South-America-specific variations of the designs, though Davies' work is not conclusive in this regard. Davies provides no analysis of South American aircraft design, but one might speculate that the lack of an indigenous South American bush plane was the result of a lack of indigenous aircraft manufacturing, an initial lack of technical expertise, a lack of necessary capital and markets, or a combination of the above. It seems that in Canada circumstances, geographic, economic, political, and otherwise, came together to produce, first, a distinct type of aviation and subsequently, a new type of aircraft.

[18] R.E.G. Davies, *Airlines of Latin America since 1919* (London: Putnam, 1984).
[19] Ibid, 3.

The Bush Plane's Significance

Technology Transfer

Examining the Canadian bush plane's history and its creation has important implications for our understanding of the history of technology, beginning with the history of technology transfer. The bush plane's emergence through a series of adaptations from imported and adopted to indigenous technology exhibits a pattern often seen in histories of technology transfer. Granted, historians interested in the movement of technology between different countries point out that technology transfer is a complicated process influenced by economic, cultural, legal, political, and social conditions. Because it depends on this complex network of circumstances, a situation that supports technology transfer in one instance may not enable transfer in another. That said, historians such as David Jeremy and Nathan Rosenberg identify a recurring pattern in which transplanted technologies undergo a process of modification that adapts them to their new environment.[20] In fact, Rosenberg argues that this process is key to successful technology transfer.[21] In their survey of the history of technology in Canada, Bruce Sinclair, N.R. Ball, and J.O. Peterson argue that Canada has a rich history of selecting foreign technologies and adapting them to suit local conditions. As Sinclair *et al.* point

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[20] David J. Jeremy, "Introduction: Some of the Larger Issues posed by Technology Transfer," in *International Technology Transfer: Europe, Japan and the USA, 1700-1914*, ed. David J. Jeremy (Brookfield, Vermont: Edward Elgar Publishing Company, 1991), 1-5; Nathan Rosenberg, *Inside the black box: Technology and economics* (Cambridge: Cambridge University Press, 1982). See also, Carroll Pursell, *The Machine in America: A Social History of Technology* (Baltimore: The Johns Hopkins University Press, 1995), chapters 1-3; Bruce Sinclair, "Canadian Technology: British Traditions and American Influences," *Technology and Culture* 20:1 (January, 1979): 108-123; B. Sinclair, N.R. Ball, and J.O. Peterson, eds., *Let Us Be Honest and Modest: Technology and Society in Canadian History* (Oxford: Oxford University Press, 1974), chapter 1.
[21] Rosenberg, *Inside the black box*, 249.

out, this has been a powerful, effective strategy for Canadians – in some cases powerful enough to produce distinctly Canadian variations on a foreign theme.[22] Harold Innis notes a similar process in the adaptation of water transport, specifically canoes, to different types of water systems.[23] Despite this recognition, studies of technology transfer tend to focus on the moment of transfer, concentrating on the conditions that enable and support the technology's movement.[24]

According to John Staudenmaier, technology transfer studies largely concentrate on four themes: the verification of transfer, analyses of processes by which technologies are carried from one location to another, the integration of transferred technologies into the recipient's technological network, and examinations of cultural tensions involved in technology transfer.[25] This study does not fall easily into one of these four categories. Instead, the thesis returns to Jeremy's argument, echoed by Bruce Sinclair, that recipients adapt transferred technologies to suit local conditions.[26]

Although technology transfer studies acknowledge the importance of local adaptation, these studies rarely probe the actual process by which local conditions are integrated into design modifications. This thesis, however, takes the transfer of aircraft to the North as its starting point, considering the process of modification that follows and its culmination in the appearance of a new sort of aircraft. Such an examination helps us to

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[22] Sinclair, *et al.*, *Let Us Be Honest and Modest.*
[23] Innis, *The Fur Trade in Canada.*
[24] David J. Jeremy, *Transatlantic Industrial Revolution: The Diffusion of Textile Technologies Between Britain and America, 1790-1830s* (Cambridge, Mass: The MIT Press, 1981); Rosenberg, *Inside the black box*; John M. Staudenmaier, *Technology's Storytellers: Reweaving the Human Fabric* (Cambridge, Mass: The MIT Press, 1985), 124-134.
[25] Staudenmaier, *Technology's Storytellers*, 123.
[26] Jeremy, *Transatlantic Industrial Revolution*; Sinclair, "Canadian Technology: British Traditions and American Influences".

penetrate the creation of indigenous technologies, providing a glimpse into the translation of environment and use experience into mechanical design.

Technological Styles: The Role of Geography

Examining the process of adaptation that led to the Canadian bush plane's emergence highlights the importance of local use context in the history of technology. The Canadian bush plane, which first appeared in the mid-1930s, was very different from the aircraft developing in the main stream of aviation. For instance, in American aviation, 1932 saw the first flight of the Boeing 247, followed shortly thereafter by the Douglas DC-1 in 1933. These all-metal, twin-engined, low-wing, cantilevered monoplanes with their elongated, smooth, ovular monocoque fuselages look much more like modern jet airliners than like their predecessors.[27] The history of this design breakthrough tends to dominate existing histories of inter-war aviation.[28]

Like most histories of European civil aviation, American aviation history concentrates on inter-urban passenger and business flights. These works recount the growth of the American industry as it moved from barnstorming to airmail flying to the important design revolution of the 1930s and the development of the passenger airliner. In the post-war era, aviation histories focus on the appearance of the aerospace industry.

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[27] Anderson, *The Airplane*, 201.

[28] Anderson, *The Airplane*; Roger E. Bilstein, *Flight in America: From the Wrights to the Astronauts*, 3rd ed. (Baltimore: Johns Hopkins University Press, 2001); Crouch, *Wings*; Davies, *A History of the World's Airlines*; Peter Galison & Alex Roland, eds. *Atmospheric Flight in the Twentieth Century* (Dordrecht: Kluwer Academic Publishers, 2000); Charles H. Gibbs-Smith, *Aviation: An historical survey from its Origins to the end of World War II* (London: Science Museum, 1985); Roger D. Launius, ed. *Innovation and the Development of Flight* (College Station: Texas A & M University Press, 1999); Ronald Miller and David Sawers, *The Technical Development of Modern Aviation* (London: Routledge & Kegan Paul, 1968); John Rae, *Climb to Greatness: The American Aircraft Industry, 1920-1960* (Cambridge, MA: The MIT Press, 1968).

While an interesting history, it is accurate only for a particular space and the focus on American and European aviation leaves out other patterns of development. For instance, these histories treat flying boats and other sorts of aircraft as aberrations or interesting diversions from the overall pattern of development and progress, but the bush plane is no aberration.[29] It developed in response to the needs of a particular place and type of operation and it has been so successful that the type remains in existence today. The bush plane reveals that parallel streams of technological development often reflect the influence of particular geographies and particular contexts. The Canadian perspective and the history this lens reveals balance American aviation history's focus on the evolution of the passenger airliners. The planes' designs are tied to place and the American or European story cannot be thought to hold for all conditions.

It is a point made powerfully by Thomas Hughes in his seminal work, *Networks of Power*. Seeking to move beyond internalist histories of technology, Hughes examines the relationship between technological systems and their contexts, and asks how context shapes decisions made by system builders about the inner workings of a particular technology. In outlining his project Hughes argues that, while national conditions, such as legislation, can influence developing systems, "local geographical factors, both natural and man-made" have more direct influence on the system's eventual shape.[30] Although

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[29] See for example, Bilstein, *Flight in America*, 93: "The era of the big flying boats represented an alluring interlude in airline travel."

[30] Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: The Johns Hopkins University Press, 1983), *x*. Hughes makes a similar argument in "The Evolution of Large Technical Systems," in *The Social Construction of Technological Systems*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch (Cambridge, Mass: The MIT Press, 1987): 51-82, and "Technological Momentum," in *Does Technology Drive History? The Dilemma of Technological Determinism*, eds. Merritt Roe Smith and Leo Marx (Cambridge, Mass: The MIT Press, 1994): 101-113.

natural geography disappears behind Hughes' argument for the importance of political culture in forming technological choices, he provides an important concept, technological style, which he defines as

> the technological characteristics that give a machine, process, device, or system a distinctive quality. Out of local conditions comes a technology influenced by time and place, a technology with a distinctive style. The local conditions external to the technology can be defined as cultural factors; the technology they shape, a cultural artefact. Among the cultural factors are geographical, economic, organizational, legislative, contingent historical, and entrepreneurial conditions.[31]

The story of aviation in the Canadian North demands just this sort of complex understanding and is especially important as it throws the role of geography into sharp relief, allowing us to emphasize the importance of physical place in the mix of historical conditions that shape technologies.

Alongside aviation historians, Canadian historians are also often guilty of overlooking the land's influence on our transportation technologies, focusing instead on political or cultural histories.[32] What Harold Innis notes so perceptively, and what seems strangely absent from histories of the Canadian railway, is that the land is not a passive bystander in these stories. What at first seems a triumph of technology over geography, on closer inspection, is profoundly conditioned by geography. In Innis' analysis, although canoes allow faster transit into fur-bearing regions, they must follow the water routes and go where the fur is, both of which are out of the canoe's control. Moreover,

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[31] Ibid, 405.

[32] See, for instance, A.W. Currie, *The Grand Trunk Railway of Canada* (Toronto: University of Toronto Press, 1957); John A. Eagle, *The Canadian-Pacific Railway and the Development of Western Canada, 1896-1914* (Kingston: McGill-Queen's Press, 1989); Sinclair, "Canadian Technology: British Traditions and American Influences".

their users must adapt them to the routes they follow.[33] The same is true of northern aviation. Initially sold as a means of speedily transcending the difficulties of land travel into the Shield, closer examination reveals that northern aircraft were just as conditioned by geography as other modes of travel. However much the aircraft might seem a creature of the skies, unhindered by earthly concerns, it could not escape the land. The land shaped its routes, determined its cargoes, and even moulded the very design of the machines themselves.

However, the relationship between technology and place is not unidirectional. Even as the North shaped the airplane, the planes were reshaping the North. The introduction of aviation to the Mackenzie brought previously inaccessible places within the reach of prospectors and mine developers, thereby opening the North to a series of economic and social changes. As Gabrielle Hecht demonstrates powerfully in *The Radiance of France*, the history of technology involves the mutual shaping of actors and objects.[34] The complex interactions between actors, context, and technology that she identifies, what Philip Scranton calls context as process, are key to understanding northern aviation.[35]

National Styles of Technology

Considering the role of local context and geography in the creation of new sorts of technology brings us into the realm of national styles of technology. The notion of a national style of technology seeks to account for the idea that the technological products

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[33] Innis, *The Fur Trade in Canada.*
[34] Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge, Mass.: The MIT Press, 1998).
[35] Philip Scranton, "Determinism and Indeterminacy in the History of Technology," in *Does Technology Drive History? The Dilemma of Technological Determinism*, eds. Merritt Roe Smith and Leo Marx (Cambridge, Mass.: The MIT Press, 1994): 143-168.

of a particular country somehow reflect or embody the national context that produces them. The idea connects Hughes' definition of technological style with a national context and is similar to the notion of national styles of science and engineering discussed by authors such as Mary Jo Nye, Jonathan Harwood, and Bruce Sinclair.[36]

The idea of a national style of technology remains contested. The debate in the history of technology concerns the question of whether or not a technology can be described, for instance, as particularly Canadian or particularly British. For example, Diane Menghetti argues that certain sets of technology are far too mobile and too international in their provenance to be usefully assigned national parentage.[37] Others, such as Hecht, argue that technologies are engaged in an ongoing, mutually constitutive dialogue with their national contexts.[38] Still others, such as Hughes, Jeremy, and Dianne Newell, convincingly argue that local use conditions have significant influence on the adoption, implementation, and evolution of technologies.[39] Although the concept of national technological styles remains contested, the Canadian bush plane's history provides evidence that reinforces the link between local use context and technological design to which the idea of national style points.

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[36] Jonathan Harwood, "National Styles in Science: Genetics in Germany and the United States between the World Wars," *Isis* 78:3 (September 1987): 390-414; Mary Jo Nye, "National Styles? French and English Chemistry in the Nineteenth and Early Twentieth Centuries," *Osiris* 8 (1993): 30-49; Bruce Sinclair, "Canadian Technology: British Traditions and American Influences".

[37] Diane Menghetti, "Invention and Innovation in the Australian Non-Ferrous Mining Industry: Whose Technology?" *Australian Economic History Review* 45:2 (July 2005): 204-219.

[38] Hecht, *The Radiance of France*.

[39] Hughes, *Networks of Power*; Dianne Newell, "All in a Day's Work: Local Invention on the Ontario Mining Frontier," *Technology and Culture* 26:4 (October, 1985): 799-814; Dianne Newell, *Technology on the Frontier: Mining in Old Ontario* (Vancouver: University of British Columbia Press, 1986).

My particular interest is the interaction between use context and technology and the way in which each is inscribed upon the other. One might choose to define the boundaries of the use context in different ways. For instance, one might select Canada as the context of analysis and examine the ways in which its conditions interacted with the aircraft to produce particular designs or adaptations. My own choice, however, has been to concentrate on the interaction between the Canadian North, and a particular portion of the Canadian North at that, and the aircraft. Admittedly, certain conditions that had significant effects on the bush plane's evolution are a product of the national context, for instance government decisions about airmail support or regulation. However, there are other conditions, particularly geography, that are specific to the Mackenzie region.

This sort of qualification raises the question of whether or not it is useful to talk about a broad national style of technology. My answer is an argument in favour of flexibility. With some technologies or with some questions, the national context might be the most fruitful unit of analysis. With the bush plane, it is more useful to consider its evolution in terms of a local or regional context. Even within the second sort of analysis, however, the concept of national style remains important because it reminds us that technologies come from a particular place and that place and technology are mutually shaping forces in history.

Separating the notion of technical style from national context allows one to consider similarities between different regions that exist in different countries. For instance, the parallels between the rugged versatility of the Canadian bush plane, its reliability, and ease of maintenance and repair and the Australian mining industry's interest in tough, portable, easily repaired technology suggests certain commonalities in the preoccupations of 'frontier' technology users.[40] While this project does not address these comparisons in any detail, the possibility remains an intriguing one worth further consideration.

STRATEGIES OF APPROACH

Exploring the interaction between place and technology affords important insights into the nature of technological change and the relationship between context, users, and technology, and the bush plane's history supplies a rich opportunity to consider these questions. However, the scope of Canadian aviation history is so broad that the subject must be refined to allow for a detailed analysis. Bush flying took place all across the Canadian Shield and into the wilderness of the Eastern Arctic and the Yukon interior, and was practiced by a number of firms. According to government reports, in 1929 "the greatest volume of flying was done in Canada by the fixed-base and itinerant operator."[41] Of 81 firms operating aircraft in Canada, 35 were engaged in air reconnaissance and exploration, a good indication of the number of firms operating in the country's wilderness areas. Of these, the most active was Western Canada Airways, which operated services in various regions. For instance, in northern Manitoba the company offered transport service from Cranberry Portage to the mining districts of the province. The airline provided similar services to the prospectors and mining developers of northwestern Ontario, southeastern Manitoba, northern Saskatchewan and, by the end of

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[40] Diane Menghetti, "Invention and Innovation".
[41] Canada, Department of National Defence, *Report on Civil Aviation for 1929* (Ottawa: 1930), 19.

1929, the Mackenzie District of the Northwest Territories.[42] The range of operators and the scale of operations make this a rich period in the history of Canadian aviation.

Focus: The Mackenzie District

Although I had originally intended to examine the history of bush flying throughout the Canadian North, research soon indicated that the scope of such a project would leave little room for more than a reiteration of the sorts of narrative chronologies that already exist. Moreover, it soon became clear that bush flying varied significantly from region to region, influenced as it was by local geography, environment, economic activity, airmail services, and traffic patterns. The extent of these variations suggested that the temptation to treat the Canadian North as a homogeneous region was misguided and that a sensitive examination of the relationship between local use context and technology must consider these differences. In fact, one might be pushed to suggest, along the lines of Louis-Edmund Hamelin's categories, that there are multiple Norths contained within the Shield.[43] The combination of this realization and the sheer scope of aviation history in the Canadian Shield made necessary the selection of a particular region on which to focus. Although Canadians practiced bush flying across the country and although these other pockets of activity did contribute to the genesis of the Canadian bush plane, the Mackenzie District provides the best opportunity to examine the interaction of place and technology.

The precise limits of the territory covered by the Mackenzie District are not strictly defined, and in fact, there are a number of regions covered by this term. To begin with, the area is often described in terms of the Mackenzie River. One of the largest

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[42] Ibid., 14-15, 22.
[43] Hamelin, *Canadian Nordicity*.

rivers in the country, the Mackenzie River is the outlet of an extensive watershed that begins in the Rocky Mountains and includes both Great Slave and Great Bear lakes. However, the areas of Alberta that eventually drain into the river are not generally included in the area referred to as the Mackenzie District. Instead, this term usually refers to the Mackenzie Valley, which includes the river and the lands that run alongside it, extending from the lower reaches of the Mackenzie Mountains in the west to the shores of Great Bear and Great Slave Lakes. To Western Canada Airways, the Mackenzie District referred to the regions that lay to the north and northwest of its base at Waterways, Alberta and were served by planes from this headquarters. The referents of these terms are not identical, but are relatively co-extensive and so the name Mackenzie District or region designates the area lying to the north of Fort McMurray, Alberta, running along the Slave and Mackenzie Rivers and including the region between the Mackenzie Mountains and the height of land east of Great Bear and Great Slave lakes.[44]

This region might seem isolated from the centres of Canadian aircraft design around Montreal, Quebec, but the Mackenzie offers a number of important features that make it an excellent location in which to ground an exploration of the relationship between use context and the Canadian bush plane's emergence. To begin with, a wide variety of influences that shaped the bush plane were at work within the Mackenzie District, unlike other regions of the country. For instance, there was no government mail run in the Eastern Arctic and no major mining boom in northern Manitoba during the 1930s. Instead, it was in the Mackenzie that the economic, political, cultural, environmental, and operational conditions that would eventually produced the bush plane

[44] See Figure 1.1.

came together in one location. This combination of circumstances offers the clearest illustration of the web of influences that would mould the new aircraft type.

Moreover, the extremes of climate and geography in the Mackenzie District make the historical interaction between aircraft and land particularly clear. This pioneering air route took Western Canada Airways and its aircraft deep into the Canadian North and exposed the fleet to geographic and climatic conditions so different in degree from the provincial norths as to be different in kind. For instance, aircraft in the Mackenzie District experienced colder winters and longer flight distances than aircraft on other bush runs in the provincial norths. This interaction, which was not as extreme in other northern regions, would have significant consequences for the bush plane's evolution. Placing this examination in the Mackenzie thus highlights the interaction between the aircraft and the land.

Finally, the Mackenzie District held a significant place in Canadian bush flying. Although government statistics for the period combine the Northwest Territories and the Yukon into one category, one can see the region becoming increasingly important during the early 1930s. In 1929, aircraft in the Northwest Territories carried a total of 20,410 lbs of freight, less than the amounts carried in Ontario, Manitoba, Quebec, and Saskatchewan.[45] By 1930, the combined freight total for the Northwest Territories and Yukon had risen to 310,119 lbs, ranking only behind Ontario and Quebec.[46] Within Canadian Airways Limited, Western Canada Airways' heir and the largest aviation

[45] Canada, *Report on Civil Aviation for 1929*, 16. I have chosen to use Imperial measurements throughout the dissertation because these are the units used by Canadian aviators during this period. Gas and oil are measured in Imperial gallons (1 Imperial gallon = 1.2 U.S. gallons), weight in pounds, and distances in miles.

[46] Canada, Department of National Defence, *Report on Civil Aviation for 1930* (Ottawa: 1931), 20.

company in Canada, the Mackenzie remained a significant district, especially after the Great Bear Lake rush in 1932, providing an important source of income during the doldrums of the Great Depression. Operations in the area pushed Western Canada Airways' and Canadian Airways' aircraft to their maximums with longer distances, greater operating speeds, and higher freight and passenger ton-miles. For instance, in the Mackenzie average flight distances were 135 miles, far above the company's average of 87 miles or the next longest distance on a bush run: 79 miles in Northern Manitoba.[47]

While the Mackenzie is undoubtedly significant in the bush plane's history, concentrating on one district may obscure the contributions made by pilots and engineers in other regions and the way in which experiences and conditions from across the country tended to either interact in the design process or reinforce one another in the bush plane's evolution. Indeed, such a comparative study presents opportunities for future work. However, because of a lack of analytical technical histories, the present scope of unstudied material requires a narrowing of focus and the Mackenzie region provides the clearest illustration of the web of conditions and events that would interact to produce the Canadian bush plane.

Focus: Western Canada Airways/Canadian Airways Limited

Within the Mackenzie there were a number of companies that operated aircraft commercially, including Commercial Airways, Mackenzie Air Service, and Western Canada Airways/Canadian Airways Limited. Western Canada Airways was formed in 1926 by James A. Richardson and Harold 'Doc' Oaks to serve the Red Lake gold fields

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[47] "Winter Season December 1, 1929 – April 30, 1930, Monthly Statistical Figures," CAL Collection, AOM, MG 11 A 34, Box 60: Statistics; "Summer and Winter 1929, Commercial," CAL Collection, AOM, MG 11 A 34, Box 60: Statistics.

of Northwestern Ontario. Over the next three years, the airline expanded to include services in Northern Manitoba and the Prairie Airmail system, established in 1927. The company eventually identified enough of a potential market in the Mackenzie District to send its planes north from Waterways, Alberta, to follow the old fur trade route down the Slave River to Great Slave Lake and from there down the Mackenzie River, across the Arctic Circle, to Aklavik on the shores of the Beaufort Sea. The company would go on to acquire and merge several other airlines, including Canadian Transcontinental, Canadian Airways (old), Internal Airways, and Interprovincial Airways.[48] The new airline, created in 1930, would be known as Canadian Airways Limited. Along the Mackenzie, the company would absorb its competitor, Commercial Airways, in 1931 and would maintain a brief monopoly in the area. However, Mackenzie Air Service's appearance in 1932 would shatter Canadian Airways' exclusive dominion and the two airlines would remain competitors into World War Two. Having pioneered commercial air service into the Mackenzie District, Canadian Airways would be an important force in the region and the airline's experience there would strongly influence the Canadian bush plane's development.

This thesis focuses on the activities of Western Canada and Canadian Airways for two reasons. First, Western Canada Airways, along with its offspring, Canadian Airways Limited, was the largest commercial airline in Canada during the 1920s and 1930s. For instance, of the 3,903,903 lbs of air freight carried in Canada during 1929, Western

[48] Since the result of these mergers would also be known as Canadian Airways, the first airline to bear the name is conventionally referred to as Canadian Airways (old) to distinguish it from the later, larger airline.

Canada Airways carried 1,661,585 lbs.[49] Using another measuring stick, Western Canada Airways had the largest fleet of aircraft. In 1929, of the 445 aircraft registered to Canadian commercial airline operators, Western Canada Airways had 34. The next largest company, Canadian Airways (old) had 29, while Commercial Airways had four.[50] After the 1930 mergers, the new Canadian Airways had 63 aircraft divided between its Eastern (35) and Western (28) Lines. The next largest transport company, Compagnie Aerienne Franco Canadienne, had only 11 aircraft, while Commercial Airways had increased its fleet to seven. The mining companies that used aircraft as part of their operations had moderate fleets, the largest being Consolidated Mining and Smelting's fleet of 15 aircraft. Northern Aerial Mineral Exploration (NAME) and Dominion Explorers had seven and six aircraft respectively.[51] In fact, Canadian Airways' national dominance would not be seriously challenged until Trans-Canada Airlines' appearance in 1937.[52] As the largest Canadian aviation company, Western Canada Airways/Canadian Airways Limited would have a significant influence on the shape of Canadian aviation as a whole and on those manufacturers interested in the Canadian aviation market.

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[49] *Report on Civil Aviation for 1929*, 16; "Summer and Winter 1929, Commercial," CAL Collection, AOM, MG 11 A 34, Box 60: Statistics.

[50] *Report on Civil Aviation for 1929*, 19-24.

[51] *Report on Civil Aviation for 1930*, 23-33.

[52] For the history of Trans-Canada Air Lines' formation, see: Robert Bothwell, William Kilbourn, *C.D. Howe, a Biography* (Toronto: McClelland and Stewart Ltd, 1979); Shirley Render, *Double Cross: The Inside Story of James A. Richardson and Canadian Airways* (Toronto: Douglas & McIntyre, 1999); and Philip Smith, *It Seems Like Only Yesterday: Air Canada, the First 50 Years* (Toronto: McClelland and Stewart Ltd, 1986). Bothwell, Kilbourn, Render, and Smith all offer explanations of why Richardson believed that he would be asked to form the new transcontinental airline and of why Howe subsequently decided to establish Trans-Canada Air Lines as a crown corporation, but their accounts are contradictory.

More prosaically, the airline left behind excellent archival records. Unlike its competitors in the Mackenzie, Commercial Airways and Mackenzie Air Service, Western Canada Airways/Canadian Airways Limited had a fully formed corporate structure that produced detailed aircraft logs, daily flight reports, technical reports, and extensive company correspondence. The majority of these documents are preserved in the Canadian Airways Collection located in the Archives of Manitoba. These documents provide a detailed picture of the airline's experience with its aircraft, employees' evaluation of aircraft performance, and the company's interaction with aircraft manufacturers. The competition along the Mackenzie, by contrast, did not produce strong corporate structures, nor do many of their records appear to have survived. Luckily, Canadian Airways' collection contains enough detail regarding their competitors' activities that one can reconstruct some of their influence on the bush plane's shape as well. The archive's extent and detail allow one to develop a clear understanding of the process by which operating experience with northern conditions translated into the bush plane's evolution.

Smaller collections in Canadian museums and the National Archives of Canada include personal recollections, some technical data, and the aircraft themselves. In fact, the aircraft preserved in Canadian aviation museums offer an interesting opportunity for industrial archaeology and an analysis of the actual aircraft could provide intriguing insights into the machines' functioning in use. That said, many of these aircraft have been meticulously restored by the museums and it is unclear what archaeological information, if any, may have been lost. While these materials buttress the story contained in the Canadian Airways collection, none provides the necessary mass to form the backbone of an analysis of the bush plane's emergence.

Unfortunately, Canadian Airways' archives begin to weaken during the mid-1930s. One possible explanation is that relevant documents passed to Canadian Airways' successors. Upon James A. Richardson's death in 1939, management of the airline passed to the President of the Canadian Pacific Railway. In an effort to bring order to an oversaturated market, the company added several other airlines to its possessions over the course of 1940 and 1941. Finally, in 1942, Canadian Pacific consolidated these companies as Canadian Pacific Air Lines, the forerunner of the modern Canadian Airways. This airline was eventually absorbed by Air Canada, the present-day descendant of Trans-Canada Air Lines.[53] While information inherited from Canadian Airways Limited via Canadian Airways may be contained in the Air Canada corporate archives, an evaluation of their relevance awaits their processing by the Canadian Aviation Museum. Fortunately, enough evidence remains in the Canadian Airways Limited collection to allow a detailed analysis of the bush plane's evolution between 1929 and 1937. Happily, the archives reach just far enough to include the emergence and adoption of the Noorduyn Norseman, the first successful Canadian bush plane.

A reliance on the Canadian Airways' collection also entails a focus on the experience of pilots, flight engineers, and managers. Passenger experience is accessible only indirectly as it is reflected in the corporate documents. Moreover, there are no women and no First Nations people as primary actors in the story contained in the airline's archives. It would be interesting to attempt a reconstruction of these people's

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[53] D.M. Bain, *Canadian Pacific Air Lines: Its History and Aircraft* (Calgary: Kishorn Publications, 1987).

experience of aviation's introduction to the North given that the aircraft seems to have had significant effects on life there. Despite these limitations, the Canadian Airways archives do have the technical data that, when placed in context, provides an excellent picture of the Canadian bush plane's evolution in response to operating conditions in the Mackenzie District.

Method

Given its complexity, the bush plane's history can be approached from a number of perspectives. The existing literature contains a number of narrative histories of Canadian aviation and first person recollections from those involved, both of which represent valuable sources of information that supply well-researched chronologies of events and important technical data. [54] In the academic world, the earliest histories of

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[54] The Canadian Aviation Historical Society's journal, the *CAHS Journal*, is the major organ for those interested in the history of Canadian aviation. It includes articles by museum volunteers, interested parties, and participants, but contains few academic works. That said, it is an excellent source for technical and chronological details and contains important first person recollections of significant events. Other sources include, Frank H. Ellis, *Canada's Flying Heritage* (Toronto: University of Toronto Press, 1962); J.R.K. Main, *Voyageurs of the Air: A History of Civil Aviation in Canada, 1858-1967* (Ottawa: Queen's Printer, 1967); Lorne Manchester, *Canada's Aviation Industry* (Toronto: McGraw-Hill, 1968); Shirlee Smith Matheson, *Flying the Frontiers: A Half-Million Hours of Aviation Adventures* (Calgary: Fifth House Ltd, 1994); John Melady, *Pilots: Canadian Stories from the Cockpit* (Toronto: McClelland & Stewart, 1989); Larry Milberry, *Aviation in Canada*, (Toronto: McGill-Hill Ryerson, 1979); Larry Milberry, *Air Transport in Canada*, vols. 1 and 2 (Toronto: CANAV Books, 1997); K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, Limited, 1975); K.M. Molson and H.A. Taylor, *Canadian Aircraft Since 1909* (London: Putnam, 1982); Patricia A. Myers, *Sky Riders: An Illustrated History of Aviation in Alberta, 1906-1945* (Saskatoon: Fifth House Ltd, 1995); Peter Pigott, *Flying Colours: A History of Commercial Aviation in Canada* (Toronto: Douglas & McIntyre, 1997); Bernard Shaw, *Photographing Canada from Flying Canoes* (Burnstown: General Store Publishing House, 2001); Shaw, *Bush Pilots*; Georgette Vachon, *Goggles, Helmets, and Airmail Stamps*, trans. Mary Downey (Toronto: Clarke, Irwin & Company, 1974); Max Ward, *The Max Ward Story: A Bush Pilot in a Bureaucratic Jungle* (Toronto: McClelland & Stewart, 1992).

Canadian aviation concentrate on reconstructing the chronology of events and explaining basic growth patterns using reliable archival materials. The first significant contributor in this respect was Margaret Solveig Mattson, with her groundbreaking work, "The Growth and Protection of Canadian Civil and Commercial Aviation, 1918-1919," which chronicles the growth of Canadian civil aviation and the government's role in enabling that growth.[55] More recently, scholars have begun to focus their attention on issues such as the government's role in Canadian aviation, corporate and regional histories, and Canadian aviation's cultural history.[56] By contrast, this thesis examines the machines themselves as they interacted with the northern environment in order to explain the evolution of the bush plane as a distinct type of aircraft and explore the relationship between place and technology.

The significance of the bush plane's history quickly becomes apparent when it is subject to a contextualist analysis that focuses on the aircraft users as the vectors that translated the interaction between technology and historical environment into a series of

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[55] Margaret Solveig Mattson, "The Growth and Protection of Canadian Civil and Commercial Aviation, 1918-1930" (Ph.D. diss., University of Western Ontario, 1978).

[56] Bain, *Canadian Pacific Air Lines*; Rénald Fortier, "Intervention gouvernementale et industrie aeronautique, L'exemple Canadien, 1920-1965," (Ph.D. diss., Université Laval, 1990); Rénald Fortier, "L'instrument privilégié d'Ottawa: Canadian Vickers et la fabrication d'aéronefs au Canada au cours des annés 1920," unpublished manuscript, 2005; William J. McAndrew, "The Evolution of Canadian Aviation Policy Following the First World War," *Journal of Canadian Studies* 16:3-4 (Fall-Winter, 1981): 86-99; Kyle McIntyre, "The Politics of Air Power: Mackenzie King and the Development of an Autonomous Canadian Air Force, 1935-1939," *CAHS Journal*, 26:3 (Fall 1988): 108-115; Render, *Double Cross*; Smith, *It Seems Like Only Yesterday*; Jonathan F. Vance, *High Flight: Aviation and the Canadian Imagination* (Toronto: Penguin Canada, 2002). Two works that predate Mattson's dissertation include, Russell H. Catomore, "The Civil Aviation Movement in Canada, 1919-1939" (M.A. thesis, Carleton University, 1971), and W.R. Finlayson, "Aviation and Its Place in Canada's Transportation System" (M.A. thesis, University of Toronto, 1933). However, neither has the scope of Mattson's later work.

incremental technical changes, that ultimately culminated in a design synthesis that produced the Canadian bush plane. As defined by Staudenmaier, the contextual method delves into the interaction between technology and its historical ambience, seeking to integrate the internal story of technical design with the technology's external context.[57] Within this broad method, scholars can choose to concentrate on particular ambient conditions, including but not limited to political, legal, economic, cultural, and social environments. As the bush plane interacted with the Mackenzie Valley, different conditions had more or less effect. For instance, during the Fokker Super Universal's initial adaptation, geography was most influential. However, as time went on economics and the consequences of political decisions acquired more significance. Thus, different sets of circumstances are more prominent in different parts of this story and the thesis chapters' emphasis will reflect this shift.

Of course, the aircraft of the 1920s and 1930s did not modify themselves. It was not a case of technical design naturally unfolding along some predetermined path of development. Instead, users and designers made technical choices in response to the ambient conditions they encountered, thereby translating use conditions into aircraft design. This analysis owes an intellectual debt to Ruth Schwartz Cowan's concept of the consumption junction, which brings consumer decision-making into the analysis of a technology's diffusion and ultimate success or failure.[58] However, the bush plane's

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[57] Staudenmaier, *Technology's Storytellers*, 167, 171.

[58] Ruth Schwartz Cowan, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in *The Social Construction of Technological Systems: New Directions in the Social History of Technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch (Cambridge, Mass.: The MIT Press, 1987), 261-280.

history pushes us to look beyond the moment of purchase for instances of interactions between user and producer.

With aircraft, purchase was not the only method of feedback. To begin with, the relationship between aircraft producer and consumer predates the moment of consumption as airlines and designers interact both during the design phase and after the aircraft are purchased. Moreover, the group of people that influence the design extends beyond the purchaser, in this case the airline. In Canadian Airways' archive, there is convincing evidence that pilots and engineers, although they did not directly purchase the aircraft, influenced the airline's purchasing decisions and had important input into the company's requests for modifications and design specifications. Based on the results of this interaction, it also appears that pilot and engineer suggestions were incorporated into aircraft designs. There is additional evidence that designers consulted pilots and mechanics directly when developing or evaluating aircraft models. Finally, though they may not have communicated directly with the manufacturers, passenger opinion, filtered through the pilots or airline, also influenced aircraft design. If one uses a strict interpretation of the consumption junction, however, this input is obscured. Thus, this thesis expands its focus to include not just the direct purchasers, but also the broad spectrum of aircraft users that influenced the evolution of the Canadian bush plane.

If users were the vectors, the information they were transmitting was knowledge developed through use of the artefact. Nathan Rosenberg distinguishes this type of knowledge, which he calls learning by using, from learning by doing, which develops during the production process. He argues that learning by using "grows out of actual experience in using" the technology.[59] Over time, the users (pilots, mechanics, airline managers, and passengers) acquired experience with northern flying, northern operating conditions, and the performance of different aircraft under these conditions. Through their interactions with aircraft manufacturers and their selection of particular aircraft in light of their experience, the users brought the northern use context to bear on the design of new airplanes. The users were the vectors that mediated between technology and use context and their choices shaped the emerging bush plane.

Initially, this process produced a series of small changes such as the Super Universal's modified undercarriage. It then led to the creation of design variations developed specifically for the Canadian North, such as the Fairchild 71C. Eventually, designers synthesized these modifications and variations with the body of northern aviation experience and existing aircraft design elements. The notion that small technical innovations can accumulate to produce dramatic technological change is not new to the history of technology. For example, David Landes' detailed analysis of the accumulation of innovations that made the Industrial Revolution a reality offered just such an argument as early as 1969.[60] In the history of aviation, scholars such as John D. Anderson and Ronald Miller and David Sawers argue that a synthesis of smaller technical developments produced the modern passenger airline, a dramatic breakthrough in aircraft design.[61] This thesis builds on these studies by combining an appreciation of small technical adaptations with a contextualist approach and a focus on the role of the user in technical change in

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[59] Nathan Rosenberg, *Inside the black box, ix.*
[60] David S. Landes, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present* (Cambridge: Cambridge University Press, 1969), especially chapter 2.
[61] Anderson, *The Airplane*; Miller and Sawers, *The Technical Development of Modern Aviation.*

order to achieve some insight into the process of adaptation and modification that moves a transferred technology from import to indigenous design, while highlighting the role of geography in the history of technology.

THE AIRCRAFT AND THE LAND: THE STRUCTURE OF THE DISSERTATION

Between 1919 and 1929, Canadians established bush flying alongside growing resource industries, first forestry, and then mining in the middle north. Chapter 2, "Foundations: The Aviation System to 1929," describes in detail the history of Canadian commercial aviation between 1919 and 1929, focusing on the emergence of bush flying as the dominant commercial activity in Canada. Chapter 3, "Technology, Experience, and Design: Laying the Foundations of Northern Aviation, 1919-1929," goes on to outline the significant technical developments and the accumulation of northern flying experience that laid the foundations for Western Canada Airways' 1929 expansion into the Mackenzie.

Figure 1.3: Fokker Super Universals G-CASK and G-CASL docked at Cameron Bay, 1932.
Source: AAM Photo Collection, 202354.

On their pioneering northern service, Western Canada Airways began flying the Mackenzie with a fleet of Fokker Super Universals. This aircraft, designed by a

Dutchman, Anthony Fokker, and manufactured in the United States, was originally conceived as a mid-sized transport for operation in Europe, not as a bush aircraft. Nevertheless, Western Canada Airways had had good experiences with the Super Universals and their predecessors, the Fokker Universals, on their more southerly bush routes and believed that the aircraft would continue to serve them well. Unfortunately, the interaction between plane and environment did not go entirely smoothly, forcing the pilots, mechanics, and airline to develop new operating procedures and encouraging the airline to work together with the manufacturer to develop modifications to the aircraft itself. As the company gained experience flying along the Mackenzie, it would modify the aircraft to suit these new, challenging conditions. Chapter 4, "A New North: Expanding into the Mackenzie, 1929-1932," chronicles Western Canada Airways' first experiences along the Mackenzie, exploring why the airline expanded north, why it selected Fokker aircraft, and how it adapted the aircraft to the northern environment, arguing that the Mackenzie's geography played a central role in the process of technical adaptation.

Even as the North reshaped the aircraft, the planes altered the North, changing the economy's base from fur to minerals and sparking the prospecting rush to Great Bear Lake. This new context would subsequently result in further changes to the aircraft used in the North. The shifting conditions would alter users' understandings of how they could use aircraft and of what they wanted in an aircraft. In an effort to meet these new needs, the airline would introduce new types of aircraft to the North, namely the Fairchild 71 and the Junkers W 33/34, and would eventually participate in the creation of the Canadian bush plane. Chapter 5, "A Fleet in Flux: Adapting to a Changing Environment, 1932-1934," focuses on the aircraft's impact on the North, particularly their role in creating the Great Bear Lake mineral rush of 1932. The chapter also charts the way in which these conditions altered the selection of aircraft designs used along the Mackenzie, reinforcing the connections between technical development and local use context.

The Fairchild 71 and Junkers W33/34 introduced in response to changing circumstances were still the products of foreign designers, but certain Canadian manufacturers were beginning to recognize the market for a bush plane. Initially, the response was quite small, consisting of producing variations on existing models that incorporated the experiences of Canadian bush plane operators. For instance, in 1932, Fairchild Aircraft's Canadian branch plant produced a variation on the popular Fairchild 71, the 71C. This aircraft incorporated changes which increased the plane's maximum licensed weight, widened cabin loading doors, offered a metal lined cabin, and improved cabin heating, amongst other alterations, all of which were added specifically with an eye to the needs of Canadian civilian operators.[62] Finally, in the mid-1930s Canadian aircraft manufacturers began producing indigenous designs, beginning with the spectacularly unsuccessful Fairchild Super 71. The iconic Noorduyn Norseman followed soon after.

The Norseman's 1935 appearance was both a beginning and an end. It was the first bush plane and the beginning of a Canadian design tradition. At the same time, it was the culmination of a process of modification and adaptation. Bush flying began with flying boats and open-cockpit biplanes, but as the activity moved out across the country into Northern Ontario, Northern Manitoba and finally down the Mackenzie River to the Arctic Ocean, the aircraft used for bush flying began to change. As Canadian Airways

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[62] Molson and Taylor, *Canadian Aircraft Since 1909*, 311-312.

struggled to adapt its fleet to the North, the pilots, mechanics, and managers acquired knowledge and experience that would eventually feed into Noorduyn's design and create a specialized bush aircraft.[63] As part of this process, users selected aircraft designs, adapted them to their new home and their new livelihood in the Canadian North, and eventually produced indigenous designs. The use of existing machines in a new environment produced a series of adaptations and modifications that would eventually produce a type of aircraft designed in Canada for a peculiarly Canadian activity in a Canadian environment. Chapter 6, "Indigenous Design and the Birth of the Canadian Bush Plane, 1934-1937," focuses on the development of these indigenous Canadian aircraft, demonstrating that these designs incorporated users' experiences of aviation in the North.

The Norseman and the Super 71 emerged just shortly before the Second World War and, with the lead up to the war, Canadian manufacturing focused more and more on military rearmament. During the conflict, production efforts focused almost exclusively on the military effort and the bush plane's development was interrupted until the end of hostilities in 1945. The concluding chapter offers a glimpse of the bush plane's post-war history, relating its emergence to the broader questions addressed throughout the dissertation, particularly the relationship between technology and geography, and the notion of national styles of technology.

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[63] This argument, which underpins much of this dissertation, echoes other theories of technological change, including Walter Vincenti's description of variation and selection patterns of development in engineering design and Andrew Pickering's mangle of practice in which scientific theories and instruments interact with the material in a "dialogue of resistance and accommodation." Andrew Pickering, *The Mangle of Practice: Time, Agency and Science* (Chicago: University of Chicago Press, 1995); Walter Vincenti, *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore: The Johns Hopkins University Press, 1990).

Asking the question, what happens when an existing technology is used in a new environment in the context of northern aviation reveals that historians of technology, very good at addressing the role of politics, economics, and social structures such as culture, could benefit from also considering the physical environment when examining the development of the bush plane. The need to literally ground explanations of technological development in geography and environment raises interesting questions about different types of technology. Many of the technologies studied by historians are urban: electrical systems, transport systems within and between cities, manufacturing processes, etc. In terms of geography, these urban centres are very much alike, especially in the twentieth century. However, when one steps outside these environments, geography becomes ever more prominent a reality, especially as one moves farther and farther from the homogenising influence of the urban. The bush plane is interesting in that it begins as an inter-urban form of transport technology that is transplanted into the bush. The aircraft itself is a highly refined machine requiring careful manufacturing and a great deal of skill to fly, and yet, in Canada, it is transplanted into the rugged environment of the Canadian North. The collision, in some cases literal, between aircraft and northern geography resulted in significant adaptations. This process reveals the often-overlooked role of place in shaping technology and the role of the user in mediating those influences, even as it prompts us to raise the idea of frontier as opposed to urban technologies.

Just as the history of bush flying reinforces the need to account for place in histories of technology, it also pushes us to remember the North's important place in Canada's history. However, in this story it is not the romantic or threatening imaginary

North; it is the real, physical North. By focusing on the actual geography and the material conditions of use, the bush plane's story reminds us that technology exists as both a cultural and a physical artefact, and that its material history cannot be understood independent of its context of use. Machines may be developed in the inventor's studio or on the engineer's drawing board, but they exist in the physical world, interact with that world and those interactions shape both the machine and the world. The physical environment of the Canadian North interacted with aircraft to produce new machines that enabled the North to be cultivated as a source of mineral resources. At the same time, non-physical features of the environment, including economic conditions and political attitudes shaped the context in which these aircraft developed. The changes created by the interaction between the aircraft and the multilayered conditions of the Mackenzie region rippled out from the North, shaping Canada's economic, political, and cultural development in the 1920s, 1930s and beyond.

Of course, as with any other historically causal factor, the land did not work alone in creating Canadian bush flying or bush aircraft. These machines were operated by specific people who lived and worked, not only in a physical geography, but in political, economic, social, and technological topographies as well. It was the layering of these geographies that produced the bush plane, a type of aircraft that would become an important part of Canadian mythology.

2 – Foundations: The Aviation System to 1929

The indigenous Canadian bush plane was not spontaneously created by designers at either Fairchild or Noorduyn. Rather, the bush plane's form evolved through a dialogue between the technology, aircraft, and its use-context, the North. Likewise, its very use in the North was an outgrowth of the Canadian aviation transportation system that began to develop in 1919. That system was itself a product of the interaction between technology and context and many of the forces that would shape the bush plane also shaped the overall form of Canadian aviation. Canada's geography, culture, economy, existing transportation networks, and the attitudes of its governmental policy makers all sculpted the national aviation system. Laid one on top of the other these multiple geographies would create the historical topography Western Canada Airways encountered in 1929 and would condition the bush plane's emergence as a technological form.

Laying the Foundations: World War One and the Canadian Air Board

Prior to World War One, aviation activity was largely experimental. In Europe, particularly in Paris, and in the United States there were lively aviation communities, complete with air meets, exhibitions, and prizes for accomplishments such as the first aerial crossing of the English Channel, which took place in 1909. In Canada, the first significant achievements were those of the Aerial Experiment Association. The society, founded in 1907 by Alexander Graham Bell, John Alexander Douglas McCurdy, Frederick (Casey) Baldwin, Thomas Selfridge, and Glenn Hammond Curtiss, was a collection of Canadians and Americans interested in aeronautics. Tapped into the American aviation community, the group conducted experiments at both Hammondsport, New York, where it had its first successful flight, and Baddeck, Nova Scotia, where on 23 February 1909, J.A.D. McCurdy made the first flights in Canada, and indeed, in the British Empire.[1]

Outside the Aerial Experiment Association, pre-war aviation in Canada was the pursuit of a small group of intensely air-minded individuals.[2] Canadians did host several air exhibits before the war, but these were sporadic. For instance, Edmonton had its first air exhibit in 1911 on the infield of a local racetrack, but it would be five years before another flight took place in Edmonton.[3] Americans dominated this pre-World War One exhibition flying and barnstorming, in part because of their access to flight schools. Canada would have no flight schools until World War One. Barnstorming and exhibition flying peaked in 1913 and the Canadian government's ban on private flying during World War One sharply reduced activity.[4]

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[1] Tom D. Crouch, *Wings: A History of Aviation from Kites to the Space Age* (New York: W.W. Norton & Company, 2003), 95-100, 103.
[2] Frank H. Ellis, *Canada's Flying Heritage* (Toronto: University of Toronto Press, 1962), chapters 1-5; Walter Henry, ed., *Uncharted Skies, Canadian Bush Pilot Stories* (Edmonton: Reidmore Books, 1983); John Melady, *Pilots: Canadian Stories from the Cockpit* (Toronto: McClelland & Stewart, 1989); Patricia A. Myers, *Sky Riders: An Illustrated History of Aviation in Alberta, 1906-1945* (Saskatoon: Fifth House, 1995); Jonathan F. Vance, *High Flight: Aviation and the Canadian Imagination* (Toronto: Penguin Canada, 2002).
[3] Tony Cashman, *Gateway to the North* (Edmonton: Duval House Publishing, 2002), 3, 5.
[4] Ellis, *Canada's Flying Heritage*, chapters 13 and14.

While World War One curtailed exhibition flying, it was, at the same time, a catalyst for aircraft manufacturing. Up until 1914, aircraft manufacturing in Europe and the United States remained small scale and somewhat experimental. The same was true in Canada, although some individuals sought to expand the industry's scope. In 1909, Frederick Baldwin and J.A.D. McCurdy formed the Canadian Aerodrome Company and approached the Canadian military about the possibility of acquiring aircraft.[5] Even before he had seen Baldwin's and McCurdy's aeroplane, the *Baddeck I,* Colonel Eugène Fiset, Deputy Minister of Militia, believed the aeroplane to be an expensive luxury that was still largely experimental and whose capabilities were undetermined. Fiset expected that when it came to aircraft, Canada, still being a young nation, would follow in the footsteps of larger, more powerful countries.[6] With attitudes like Fiset's, the military brass was reluctant to begin with and technical difficulties during the *Baddeck I*'s demonstration reinforced their suspicions of the new technology.

It was not an uncommon experience. The Wright brothers themselves encountered resistance and indifference when they first tried to sell their designs to the United States Army. The Wrights were hampered by their refusal to demonstrate their aircraft without a signed contract, a consequence of concerns about protecting their intellectual property. Although Britain and France expressed interest, their governments also proved unwilling to sign a contract without demonstration flights. However, in 1908, the United States government changed its mind, accepting the Wright brothers' bid

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[5] Rénald Fortier, "Intervention gouvernementale et industrie aeronautique, L'example Canadien, 1920-1965," (Ph.D. diss., Université Laval, 1990), 12-13.
[6] S.F. Wise, *Canadian Airmen and the First World War, The Official History of the Royal Canadian Air Force,* Volume I (Toronto: University of Toronto Press, 1980), 10-13.

on a military supply contract.[7] In fact, by the time war began in 1914, France had 141 aircraft, Britain's Royal Flying Corps had 63, and Germany had 230.[8] Canada, by contrast, had none.

During the war, Canadian contributions to aviation were made largely by individual Canadian citizens who served as members of the British Royal Flying Corps and Royal Air Force. As S.F. Wise explains, this was not purely the result of colonial-mindedness. Instead, it was the product of a "cautious and realistic assessment of the country's peacetime military needs."[9] The exact cost of military aviation was unknown, but the government assumed, correctly, that it would be high. Moreover, aviation's military usefulness was yet unproven. Within this context, Canada "seemed to have no more need for aeroplanes than she did for dreadnoughts."[10] The Government's decision would have important consequences. During the war, Canadian airmen would fight as individual members of the Royal Flying Corps. Moreover, there would be no institutional structure remaining from the war that could shape Canadian air policy.

Outside the Royal Flying Corps, there was a small amount of aviation activity in Canada. Early in the war, Canada did create the Canadian Aviation Corps, consisting of one Curtiss-Dunne biplane, its pilot, and a mechanic. By the time the Canadian Corps reached Britain, however, the plane was so damaged from being shipped across the Atlantic that it was never even unpacked. As the need for trained men increased, the British Corps established a Canadian division responsible for recruiting and training Canadians for service in the Royal Flying Corps. The training demanded aircraft and

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[7] Crouch, *Wings*, 82-84.
[8] Ibid., 152.
[9] Wise, *Canadian Airmen and the First World War*, 18.
[10] Ibid.

encouraged Curtiss to establish a factory in Toronto in 1914 to produce JN 4s as trainers. At the tail end of the war, the federal government created the Royal Canadian Naval Air Service (RCNAS) and the Canadian Air Force (CAF), both of which performed much more admirably than the stillborn Aviation Corps, but the government disbanded these air forces only shortly after their formation.[11]

Despite the prolonged lack of an official Canadian Air Force, upwards of 20,000 Canadians served with various air forces, including Britain's Royal Air Force, and Canada's own RCNAS and CAF.[12] At the end of the war this left the country with a large body of trained pilots and support staff, particularly flight engineers.[13] Canada's receipt of a substantial gift of surplus military aircraft from the United States and Britain supplemented the corps of available pilots and engineers.[14] The future seemed bright

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[11] The Royal Canadian Naval Air Service was formed to conduct anti-submarine patrols along Canada's east coast and came into existence 5 September 1918. The Canadian Air Force, really two squadrons composed of Canadians but operating under the Royal Air Force, was given British approval 5 June 1918, but was not mobilized until late November of that year. For a detailed discussion of the formation of the RCNAS and CAF, see Wise, *Canadian Airmen and the First World War*, 579-620.

[12] Wise points out that exact numbers of Canadian airmen are difficult to obtain. Because Canadians served primarily with the Royal Air Force, and because up until 1921 Canadians were classified as British citizens, the military records do not necessarily indicate which members of the Royal Air Force came from Canada. The records compiled by Canadians during and after the war were incomplete at the time and have become more so over the intervening years. Wise, *Canadian Airmen and the First World War, xi – xiv*. See also Appendix C: "Statistical Analysis of Canadians in the British Flying Services," Wise, *Canadian Airmen and the First World War*, 633-549 for a discussion of the records and methods Wise uses to arrive at the figure 20,000.

[13] Reviewing the biographies of the first generation of Canadian bush pilots and mechanics reveals that many served as air force pilots during World War One. For example, famous pilots like C.H. Dickins and W.R. May were both World War One pilots.

[14] The gift from Britain alone was worth well over $5,000,000. Canada, Air Board, *Report of the Air Board for the Year 1920* (Ottawa: 1920), 7.

indeed. With its supply of trained personnel and available aircraft, the country appeared to be in an excellent position to create a civilian aviation industry.

As the 1920s unfolded, however, that growth was much smaller and slower than conditions at the war's end promised. Much of the responsibility for this disappointment can be laid at the feet of the federal government. To begin with, Canada exited the war lacking any institutional framework for managing aviation. Although aviation was part of the mandate of the Reconstruction and Development Committee that Prime Minister Borden organised in 1917, and while the Naval Committee did in fact consider the state of aviation, at the end of 1918 Canada had little to no government policy concerning aviation.[15] The government's wartime approach to aviation had been piecemeal and at the end of May 1919, the cabinet decided to disband the Canadian Air Force and the Royal Canadian Naval Air Service.[16] This meant no one in the Canadian government had responsibility for aviation and, while there were a number of individuals interested in the area, there was neither an individual nor an institution through which to focus that

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[15] The following exchange was recorded during question period in April of 1919: Simon Fraser Tolmie (Victoria City): "1. What is the policy of the Government with regard to encouraging aviation? 2. What is being done to encourage our pilots and mechanics, who rendered such valuable service, to remain in Canada when they return? 3. Does the Government intend to take the initiative in this matter? If not, is it the intention of the Government to assist private enterprise organized by returning flyers?" The Honourable A.K. Maclean (Minister without portfolio) replied: "1. The policy of the Government with regard to the encouragement of aviation is at present under consideration and will be announced at a later date. 2 and 3. Answered by Number 1." Canada, *Parliamentary Debates*, House of Commons, 10 April 1919, 1340; See also W.A.B. Douglas, *The Creation of a National Air Force, The Official History of the Royal Canadian Air Force*, Volume II (Toronto: University of Toronto Press, 1986), 38; Fortier, "Intervention gouvernementale", 54.

[16] Douglas, *The Creation of a National Air Force*, 35; Wise, *Canadian Airmen and the First World War*, 619.

interest.[17] Moreover, the government was preoccupied. With the Armistice, Borden's Union government lost much of its credibility and was struggling to survive. Borden himself was preoccupied with Canada's involvement in the Paris peace negotiations and, in his absence, there was little support for aviation in the government or the cabinet.[18] The preoccupation, lack of structure, and the delay in creating appropriate administrative bodies meant that while Canada had stores of trained men and aircraft, the country could not immediately capitalize on those advantages.

In the meantime, a small group of middle-ranking civil servants were formulating the basis for Canada's aviation policy. For instance, John Armistead Wilson, who would go on to become Controller of Civilian Aviation and a major influence on Canadian aviation's development, and C.C. MacLaurin circulated memoranda that argued for strong civil aviation as the foundation of military air power.[19] Even as the cabinet determined to disband the Air Force, events prompted the government to take up the aviation question. Spurred by talks at the Paris Peace Conference and by rising safety concerns created by the surplus military Curtiss JN-4s now flooding the Canadian market, in March 1919 the Cabinet asked Wilson to prepare aviation legislation for it to consider. Wilson drafted a bill that created a board that would take responsibility for the regulation of Canadian aviation. After some modification, Cabinet presented the bill to the House in April 1919.[20]

In this context, the Canadian government chose to concentrate on regulation rather than on establishing government air services as the American government had

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[17] Douglas, *The Creation of a National Air Force*, 40-41.
[18] Ibid, 38.
[19] Ibid, 42-43.
[20] Ibid, 39-40, 44.

done.[21] Endemic caution, buttressed by the consequences of a deep post-war recession and growing political instability, reinforced the government's *laissez-faire* attitude. After all, as the Honourable Newton W. Rowell, President of the Privy Council, pointed out to the House, while government airmail would likely be of benefit to the country by bridging the gap between eastern and western Canada, there were serious questions about practicality, especially in regards to the distances to be travelled. While much more reliable than pre-war planes, during the 1920s aircraft still lacked the range necessary to cover Canadian distances, especially when there was no system of maintained emergency landing fields. Aircraft were expensive to purchase and operate, and the government wanted to be very careful before rushing into the field.[22] Thus, instead of implementing services in 1919, the government passed the Aeronautics Act, creating the Air Board to regulate Canadian aviation and to establish and operate government facilities and services.[23] The Board created by this bill met for the first time in June 1919.

While its initial activities focused on regulation, the largess of the Imperial war gift and similar gifts from the United States encouraged the government to create some sort of air force. In keeping with Canada's militia tradition, the Canadian Air Force began its second life as a non-permanent force under the Air Board's management.

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[21] See, for example, the comments of the Honourable Rodolphe Lemieux (Maisonneuve and Gaspé), Canada, *Parliamentary Debates*, House of Commons, 8 April 1919, 1264. To be fair, the question of aviation may have seemed rather specialized in the context of demilitarization and the political rifts beginning to appear in the Union government that had governed Canada at the end of the war. Robert Craig Brown and Ramsay Cook, *Canada 1896-1921: A Nation Transformed* (Toronto: McClelland & Stewart, 1974).
[22] Honourable Newton W. Rowell, Canada, Debates, House of Commons, 2 May 1919, 2036.
[23] Canada, Air Board, *Air Regulations, 1920* (Ottawa: 1920), 5-8. For a detailed history of the Air Board's formation see, Margaret Solveig Mattson, "The Growth and Protection of Canadian Civil and Commercial Aviation, 1918-1930," (Ph.D. diss., University of Western Ontario,1979), especially chapter 2.

Capable of expanding in the face of a military emergency, the force's functions in peacetime were designed to be almost exclusively instructional, carrying out government operations as a means of keeping its rotating crews in flying trim. There were no permanent establishments, no embodied units, and service formations existed only on paper. Officers and airmen were to undergo training for limited periods every two years. Meanwhile, the government created the Canadian Air Force Association to maintain contact with officers and airmen when they were not on duty or at the training facilities.[24] This second Canadian Air Force appeared in February 1920 and would concentrate on civilian activities until World War Two.

Although the Air Force began by conducting civilian operations, the Canadian government and the Air Board continued their hands-off approach to commercial aviation. The Board believed that "the most favourable fields for the commencement of operations were the less thickly settled and less thoroughly explored portions of Canada,"[25] but it offered no support for commercial aviation companies. This absence of a coordinated national development policy meant Canadian commercial aviation would develop on an *ad hoc* basis, responding to local needs.

Important members of the civil service originally saw civilian aviation as the foundation of military air power. The close association between military and civilian aviation reflected the views of J.A. Wilson, the chief aviation bureaucrat during the inter-war period. Wilson firmly believed that military air power could be built only on the

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[24] Canada, Air Board, *Report of the Air Board for the Year 1921*, (Ottawa: 1922), 11,12; J.A. Wilson to Sir Sefton Brancker, 13 March 1923, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.
[25] Canada, *Report of the Air Board ... 1921*, 6.

foundation of solid peacetime developments. Drawing on his experience with Canada's naval service during the First World War, Wilson argued,

> From every point of view, the policy best suited to the development of Air Power in this country, and elsewhere, is the encouragement of sound civil aviation. The work done along this line in Canada is attracting universal interest and attention. It has been on broader lines and has covered a wider range of services than has been attempted in any other part of the world. If Canada intends to develop its Air Power, this policy should be followed aggressively.[26]

Although Wilson expressed these views in 1923, he was already fighting against growing military dominance. In an effort to achieve financial economies and greater efficiency, the government decided on a policy of centralisation for the Dominion's defence.[27] As part of this centralisation, they created the Department of National Defence, which would assume responsibility for all aviation in Canada, both civilian and military. It was not exactly what Wilson had in mind. He argued,

> It seems to me a great misfortune that just as we were getting really well going, the soldiers were allowed to step in and take over the control. Before you can have an Air Force, which will have the sympathy and backing of the country, you must have some foundation. Without some useful development the whole business will be a burden instead of a pride, and an artificial operation without root. ... Therefore [I] started on the civil and useful as a foundation with a view to creating a superstructure, when we had made aviation part and parcel of the everyday routing of many useful and popular services throughout the country.[28]

Instead of a strong commercial sector providing trained pilots, support staff and manufacturing capabilities, the now-permanent air force was amalgamated with the Air

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[26] J.A. Wilson, "Air Policy," 1923, JA Wilson Papers, NAC, MG 30 E 243, vol. 6, Memoranda relating to air development in Canada, 1920-1926.
[27] Canada, Air Board, *Report of the Air Board for the Year 1922* (Ottawa: 1923), 9.
[28] J.A. Wilson to C.J. Grey, 12 June 1923, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.

Board's Civil Operations branch into a single military unit – a unit that continued to carry out mainly civilian activities.[29]

The close ties between military and civil aviation and the military's dominance of early Canadian aviation were products of an institutional structure that developed out of the First World War, the views of particular civil servants, the government's drive for efficiency, and the government's unwillingness to provide support for independent commercial companies. Thus, the military came to control much of the civilian aviation in Canada during the early 1920s. Given that the military dominated particular areas of aviation, commercial aviation's development would have to wait until entrepreneurs could identify niche markets not already occupied by the military. These openings would appear with the expansion of Canadian resource industries during the 1920s.

[29] Canada, Department of National Defence, *Report of the Department of National Defence for the Fiscal Year Ending March 1923* (Ottawa: 1923), 8, 37; Canada, Department of National Defence, *Report of the Department of National Defence for the Fiscal Year Ending March 1924* (Ottawa: 1924), 45. In fact, the amount of non-military activity increased after the creation of the permanent force. "The change in status from a civilian to a military organization does not interfere with the carrying out by the Force of duties of a civil character, and its activities in forest patrols, aerial survey and other operations on behalf of different Dominion and Provincial Government departments are being expanded rather than curtailed. It is the fortunate privilege of the Royal Canadian Air Force to be able to use its personnel and equipment to develop and serve the country and at the same time afford useful experience to pilots and observers." Canada, *Report of the Department of National Defence ... 1923*, 8. For specific figures, see Canada, *Report of the Department of National Defence ... 1923*, 42; Canada, *Report of the Department of National Defence ... 1924*, 53. The government did give away some of this work to commercial and provincial operators in Ontario and Quebec, but it continued to dominate in British Columbia, Alberta, Saskatchewan, and Manitoba, arguing that the commercial base in these areas was insufficient. Canada, *Report of the Department of National Defence ... 1923*, 43.

CONTEXT AT WORK: EUROPEAN AND AMERICAN DEVELOPMENTS, 1919-1924

As other nations emerged from the war, their aviation systems would develop differently in response to the particular circumstances they encountered. For instance, the French government quickly developed an elaborate state framework for aviation. The Under Secretariat of State for Aeronautics and Aerial Transport was responsible for technical services (research and development), manufactures, aerial navigation, and government subsidies for aviation. This willingness to commit government resources continued a pattern from the pre-war years.[30] By comparison, the British government offered little support for aviation until 1921. Expressing an attitude similar to the Canadian government's, Winston Churchill, then British Secretary of State for Air, told fledgling British companies that they must fly on their own and should not expect any government funding. Operating solely with revenue from fares proved too great a strain for most companies and they promptly closed. Finally, in 1921 the British government recognized that the new industry required support and began to subsidize cross-Channel flights. The industry's subsequent seasonal collapse in the winter of 1922 highlighted the difficulties of operating aircraft during the cloudy British winter in the era before instrument flying. The following year, the Civil Air Transport Subsidies Committee recommended the amalgamation of four operating companies and the result, Imperial Air Transport, appeared in 1924. Eventually coming round to the French view, the British government agreed that, on fulfilment of certain conditions, the company would be

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[30] Roger D. Launius, "The Wright Brothers, Government Support for Aeronautical Research, and the Evolution of Flight," in *Reconsidering a Century of Flight*, ed. Roger D. Launius & Janet R. Daly Bednarek, (Chapel Hill: The University of North Carolina Press, 2003), 50 – 69.

eligible for government subsidies.[31] Although they initially differed in their treatment of commercial aviation, both France and Britain continued to maintain substantial military air forces which they used to police their colonies.[32] On the other side of the Paris peace treaty, Germany, deprived of its military aviation sector by the Treaty of Versailles, focused on commercial development, particularly the creation of impressive aircraft from firms like Junkers.[33]

Across the Atlantic in the United States, aviation developed differently yet again, in large part because of the conditions present in the United States after World War One. Whereas Europe faced a seriously damaged transport system, which, at the best of times, had to contend with geographic barriers, such as mountains and large bodies of water, and national frontiers that complicated rail service, the United States' transport network remained intact. Unlike post-war Europe, large American cities were well served by rail and the train could offer more luxurious travel than the small, open-cockpit aircraft available at the time. These aircraft were also relatively slow and so offered little timesaving over short distances. Moreover, the Americans did not have access to the same large surplus of military aircraft, particularly the multi-engined planes that could be converted into passenger transports, which supported many of the early European airlines. Finally, the Americans did not have the incentive of national prestige or international competition to goad them into creating national, flag-carrier airlines, as in

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[31] R.E.G. Davies, *A History of the World's Airlines* (London: Oxford University Press, 1964), chapters 2 and 3.
[32] Crouch, *Wings*, 222-224.
[33] Ibid., 210-212.

Europe.[34] America's closest neighbours, Canada and Mexico, were even less aeronautically developed than the United States. Given these circumstances, the United States did not immediately develop an extensive aerial transport network like the one growing in Europe.[35] Instead, the first commercial aviation activities in the United States took the form of aerial entrepreneurship. The daredevil barnstormer fell into this category, as did air taxi and airfreight services, aerial surveying, and aerial mapping. These small-scale operations would take any commissions that came their way, but they remained small, local companies.

While circumstances in the United States did not encourage the development of an aerial transport network, airmail could offer an advantage over surface transport, particularly over long distances. Thus, the government initially concentrated on the creation of a long-distance, national airmail service. Between 1918 and 1921, the United States Post Office developed a 2600-mile transcontinental airmail route. The development began with an experimental service between New York, Philadelphia, and Washington in 1918. By May 1919, the route reached from New York to Cleveland and Chicago. It reached Sacramento by the fall of 1920 and on 22 February 1921, the first load of mail travelled from San Francisco to New York in 33 hours and 20 minutes.[36]

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[34] In Germany, this link took on important cultural dimensions as German nationalism embraced aviation as one of its means of expression. Peter Fritzsche, *A Nation of Fliers: German Aviation and the Popular Imagination* (Cambridge, Mass.: Harvard University Press, 1992).

[35] Roger E. Bilstein, *Flight in America: From the Wrights to the Astronauts*, 3rd ed. (Baltimore: The Johns Hopkins University Press, 2001), chapter 2; Crouch, *Wings*, chapter 6; Davies, *A History of the World's Airlines*, chapter 4; John Rae, *Climb to Greatness: The American Aircraft Industry, 1920-1960* (Cambridge, Mass.: The MIT Press, 1968), chapter 3.

[36] Along the way, the government established feeder links to Minneapolis and St. Louis. The government eventually abandoned these routes in favour of concentrating on the

This service meshed well with the decentralization occurring in American business during the first decades of the twentieth century. Aviation facilitated the process by accelerating business transactions. This quest for greater speed also spurred the next phase in American airmail development. Initially, the Post Office had transferred the mail from the aircraft to trains for the overnight portion of the transcontinental journey, resulting in an average travel time of 78 hours. Increasing the speed of transcontinental airmail would require round the clock air operations.

Given that pilots still flew their aircraft by sight because instruments were so basic, they could navigate only by visual reference or by dead reckoning. Since dead reckoning was so unreliable, the Post Office decided to establish a series of lighted beacons along the air route, allowing pilots to fly from one to the next without losing their way. Between 1922 and 1924, the government created a model night route between New York and San Antonio. In August of 1923, the Air Mail Service began night flying between Chicago and Cheyenne, Wyoming, and by 1926, the whole route was lit. By the time the service was fully operational, the trip from San Francisco to New York took an average of 29 hours 15 minutes.[37]

Beyond its contribution to hastening American business, the American airmail system provided important infrastructure for commercial aviation, including airfields, planes, hangars, and general knowledge about operating and maintaining aircraft. In addition, the airmail demonstrated the aircraft's potential utility. The service's high

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coast-to-coast service. Crouch, *Wings*, chapter 6; Davies, *A History of the World's Airlines*, chapter 4.

[37] Alfred D. Chandler, *The Visible Hand: The Managerial Revolution in American Business*, (Cambridge, Mass.: Harvard University Press, 1977); Bilstein, *Flight in America*; Crouch, *Wings*, chapter 6; Davies, *A History of the World's Airlines*, chapter 4.

profile also contributed to the popularization of aviation. In spite of this, the service and the government had not done much to support the development of private commercial air transport or the aircraft manufacturing industry. This would change during the decade's second half as the government began making legislative changes in order to address the American industry's moribund condition.[38]

THE INFLUENCE OF GOVERNMENT

Government willingness to support aviation's development, which was apparent in other parts of the world, was lacking in Canada. Although engaged in civilian activities such as forest fire patrols and aerial photography, the Canadian government made no effort to start or sustain passenger or freight transportation activities. Instead, the politicians saw aviation as a stopgap measure. According to the Air Board, rather than offering trunk-line connections between major centres, aircraft in Canada should operate in areas where the available means of transportation were arduous and slow.[39] Railways would be the backbone of the Canadian transportation system and aircraft would fill in the holes, especially in remote areas. The government's refusals to support commercial aviation as a central transportation system were not evidence of pure obstinacy. They reflected a recognition that Canadian conditions did not naturally lead to

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[38] Bilstein, *Flight in America*, chapter 2; Roger E. Bilstein, "The Technology of Flight: Three Sides of a Coin," in *Reconsidering a Century of Flight*, 15-49.
[39] "It was realized that aircraft could play a useful and important part in the development of the remoter parts of the country where the available means of transportation are slow, uncertain and laborious." Canada. *Report of the Air Board … 1922*, 5; Canada, Department of National Defence, *Report on Civil Aviation for 1923* (Ottawa, 1924), 7.

trunk line passenger and transportation services like those operating in Europe.[40] They also reflected the government's preoccupation with the state of Canadian railways.

Canada's expansion during the first decades of the century had demonstrated the limits of the existing transcontinental railway network, and the government supported the system's growth by financing the construction of new, more northerly routes. By the end of World War One, not only did the Canadian Pacific Railway (CPR) link the east and west coasts, Canada had a second transcontinental system, the Grand Trunk Pacific, and a third system on the prairies, the Canadian Northern. The CPR had also expanded in response to these new competitors. Unfortunately, the collaboration between government and business did not create a stable, well run enterprise. Rather, Canada's post-war recession highlighted the system's over-expansion, pressing the government to step in.

The government poured in money, but even then could not support the failing companies. Rather than continuing to empty money into a never-ending sinkhole, the government embarked on a process of nationalisation, eventually creating the Canadian National Railway in 1923. This process answered the government's needs to maintain an adequate transportation system, avoid the dislocation of credit, protect government investment in the companies, and ensure some permanence to the solution.[41]

The railways' over-expansion seems to have left a deep mark on the government's psyche. The rate of expansion had been remarkable for Canada. Between 1881 and 1900 Canada's railway mileage increased from 7,331 miles to 17,657 miles, while expansion by the Grand Trunk and Canadian Northern added approximately 11,160 miles of

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[40] Canada, *Report of the Air Board … 1922*, 8; Canada, *Report on Civil Aviation for 1923*, 7.

[41] Michael Bliss, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto: McClelland & Stewart, 1987). See especially chapter 14.

railway.[42] However, the system's collapse and eventual nationalization, not to mention the heavy debt placed on the government, reinforced the government's caution when it came to investing in the new aviation technology.

With its attention captured by attempts to prevent the disintegration of the nation's major transportation system, it is little wonder that aviation seemed a risky prospect to the government. Starting civilian aviation services would be costly and, given its recent experience with the railway, the government was unwilling to risk the money. Having just financed the war effort and rescued the railway from bankruptcy, the Canadian government was shouldering a substantial debt, much of it from the Railway Guarantee acts. As Margaret Solveig Mattson points out, Canada's national debt in March of 1919 was $1,584,000,000; almost four times what it had been in 1914.[43] Financial stringency prevented the government from embarking on a massive experiment, especially one that would merely duplicate the services already offered by Canada's extensive rail network.[44] Moreover, creating civilian air transport lines would produce competitors for the fragile railway. Thus, the government chose not to direct its limited financial resources towards commercial aviation, preferring to concentrate on developing a military force capable of providing the government with both military and civilian services. This meant commercial aviation was left to develop as best it could on its own.

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[42] G.P. de T. Glazebrook, *A History of Transportation in Canada, Volume II: National Economy, 1867-1936* (Toronto: McClelland & Stewart, 1964), 285; R. Douglas Francis, Richard Jones, Donald B. Smith, *Destinies: Canadian History Since Confederation*, 3rd Edition (Toronto: Harcourt Brace & Company, 1996), 58; In the original, the figure 11,160 miles is given as 18,000 kilometres.

[43] Mattson, "The Growth and Protection of Canadian Civil and Commercial Aviation," 112.

[44] J.A. Wilson to P.D. Acland, 5 December 1923, J.A. Wilson Papers, National Archives of Canada, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.

Outside the government, aviation would have to fill the niche markets open to it in the context of 1920s Canada.

First Steps: Canadian Commercial Aviation, 1919-1924

Many of the Canadians who served as airmen during the war were bitten by the aviation bug and wanted to keep flying. In Europe, they could have found employment in the developing aviation transport system. In the United States, the government maintained its air force and began to offer airmail services. In Canada, however, a man would not have these opportunities. Although optimism about the future of Canadian aviation accompanied the end of the war, the reality was not as rosy. Commercial aviation was growing, but only slowly, and even the creation of the Canadian Air Force produced only a handful of permanent positions.[45]

Progress was disappointing. European and American aviation companies faced situations in which there were large populations within reasonable distances of one another, in which traffic was heavy and demand for express service adequate, and in which the communities were able to bear the cost of these services. In contrast, Canada had a small population slung along its long southern border where large, sparsely populated expanses separated population centres.[46] Moreover, much of the terrain through which a Canadian transcontinental air route would run was difficult to build on, as railway engineers had discovered in the previous century. This made the construction of the necessary emergency and refuelling landing fields difficult and expensive. Reviewing aviation's Canadian development, Charles Edwards remembered,

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[45] Canada, *Report of the Department of National Defence ... 1923*, 8, 16.
[46] Canada, *Report of the Air Board ... 1922*, 5.

> For the first ten years after the war there was a great diversity in development between the United States and Canada. The United States had a population of 140,000,000 as compared with about 10,000,000 in Canada. Intercity services linking the large centres of population in the United States provided an immediate outlet and the organization of a nation-wide airway system was immediately feasible. In Canada there were few large cities and the cost of developing a nation-wide service of this kind was out of proportion to the population to be served.[47]

As Edwards noted, this "undoubtedly retarded the development of the Canadian airways system."[48] Exacerbating the situation was the relatively limited range of available aircraft – they could not cross Canada's expanses with a paying load. Faced with the railway crisis, the Canadian government was unwilling to offer financial support to a fledgling industry, especially to subsidize services in a difficult environment.

However discouraging they seemed, the expansive wilderness and lack of government support forced Canadians to invent a type of aviation suited to these conditions. Over the 1920s, Canadian aviators would turn this vast wilderness to their advantage by devising services that targeted the resource industries expanding into the Canadian Shield. Bush flying, which emerged over the first half of the decade, exploited the Shield's geography by making use of the natural landing sites available on its many lakes and rivers. By supporting the growing resource industries, it also pinpointed a source of income independent of government funding.

In the meantime, Canadian pilots turned to exhibition flying. After the war, surplus machines were inexpensive and easy to acquire, and the public was curious about this new form of transport. This encouraged many aviators to take up exhibition flying.

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[47] Charles P. Edwards, Chief of Air Service, Department of Transport, testimony on the development of commercial air services in Canada, ca. 1940, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 13, Specific memoranda, 1916-1949.
[48] Ibid.

These barnstormers would perform at local exhibitions and offer joy rides to an awestruck public. This interest quickly peaked, however, topping out in 1920, after which the novelty seems to have worn off. The drop in aviation activity also coincided with the post-war recession that gripped the Canadian economy beginning in 1921, and many of these small aviation companies failed.[49]

Luckily, another avenue existed, one that would characterise Canadian aviation through the inter-war years: the use of aviation in support of the growing resource industries. In Canada, this meant flying into the bush. These activities, which included aerial surveying, aerial photography, and forestry patrols, were the forerunners of the bush transport operations that would appear in the middle of the decade. From the very beginning, geography, economics, and politics conspired to create a form of aviation specially suited to Canada: bush flying.

The first commercial aviation company formed in Canada was an offshoot of the St. Maurice Forestry Protective Association. In 1919, the Laurentide Pulp and Paper Company, a member of the St. Maurice Association, began using two surplus HS-2L flying boats acquired from the United States' naval air service to conduct forest fire patrols and some basic forestry management, including aerial surveying and timber mapping. The company continued to employ aircraft for the 1920 and 1921 seasons, but in 1922, it decided to separate the air arm from the main company, creating Laurentide Air Services, Ltd. This company continued with the two HS-2L boats, offering aerial

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[49] Canada, *Report of the Air Board ... 1922*, 8; Canada, *Report on Civil Aviation for 1923*, 12. See also Bliss, *Northern Enterprise*, chapter 14.

surveying and forestry patrols, working for the Ontario government and private forest interests.[50]

That same year, 1922, Fairchild Aerial Surveys (of Canada) Limited also appeared. In 1921, Sherman Fairchild had founded the Fairchild Aerial Camera Corporation in New York state to develop, manufacture, and sell his aerial photography equipment. Created as an extension of Fairchild's American aerial photography activity, the Canadian company originally intended to contract out its flying operations. However, it found no one to offer this service and decided to purchase and fly its own machines, with the result that Fairchild Aerial Surveys (of Canada) began conducting surveying operations in 1922. It is interesting to note that this company appeared before its American counterpart, Fairchild Aerial Surveys, Incorporated, which was founded in 1924, suggesting a close relationship between aviation and Canadian resource industries. Fairchild would later become an important Canadian manufacturer, beginning by constructing photographic aircraft in the United States in 1925 and opening a Canadian subsidiary, Fairchild Aircraft Limited, in 1929. Fairchild Aircraft would go on producing aircraft until 1948.[51]

Fairchild's involvement reflected a pattern of American investment in Canadian aviation that would develop over the 1920s. In fact, in the early in 1930s, Western Canada Airways' founder and committed nationalist, James A. Richardson, would become so concerned about increasing American control over Canadian commercial aviation, especially in Eastern Canada, that he would move to create Canadian Airways

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[50] Canada, *Report on Civil Aviation for 1923*, 13.
[51] Dana Bell, *The Smithsonian National Air and Space Museum Directory of Airplanes: Their Designers and Manufacturers* (London: Greenhill Books, 2002).

Limited by purchasing smaller aviation companies and amalgamating them into a company large enough to resist the Americans. A similar pattern of American investment would appear in the aircraft manufacturing industry as American companies like Fairchild, Bellanca, and others established branch plants or subcontractors in Canada during the second half of the decade. In spite of American involvement, Canadian aviation developed in a very distinct way, influenced as it was by the government's attitudes and its close alliance with northern resource industries.

While Canadian commercial aviation began with the forest industry, the ability to use aerial reconnaissance, sketches, and photographs to gather information about a large area also appealed to Canadian surveyors.[52] Moreover, these surveyors recognised that aircraft could be used to transport work parties into the field, reducing travel time and expanding companies' spheres of operation. Over the 1920s, Canadian surveyors and the Canadian mining industry would adopt aerial surveying as an important element of their

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[52] Canada, *Report on Civil Aviation for 1923*, 5-6; "Aerial Transport in Mining Districts," *Canadian Mining Journal* (1919): 113; "The Air Force and Aerial Surveys," *Canadian Mining Journal* (1923): 448; "Air-line for Passengers and Freight," *Canadian Mining Journal* (1924): 548-549; "Air Service to Red Lake," *Canadian Mining Journal* (1926): 256; "The Modern Trend in Transportation," *Canadian Surveyor*, 3 (1930): 23; E.L. Bruce, "The Possibility of the Use of Seaplanes in Preliminary Mapping of Precambrian Areas," *Canadian Institute of Mining and Metallurgy Bulletin* 5 (1922): 224-229; W.B. Burchall, "Freighting by Air," *Canadian Institute of Mining and Metallurgy, Bulletin*, 26 (1933): 672-682; Canada, Department of National Defence, *Report on Civil Aviation for 1924* (1925): 49; John E. Hammel, et al. "Aerial Exploration," *Canadian Institute of Mining and Metallurgy, Bulletin*, 22 (1929): 454-469; W.G. Jewitt, "Aerial Exploration," *Canadian Institute of Mining and Metallurgy, Bulletin* 24 (1931): 456-465; C. MacLaurin, "Air Photography and the Aeroplane as Aids to the Prospector," *Canadian Institute of Mining and Metallurgy Bulletin* 15 (1922): 913-920; A.M. Narraway, "The Surveyor, The Aeroplane and Canada," *The Canadian Surveyor*, 4:1 (1933): 3-8; R.C. Rowe, "The Development of Travel in the Canadian North," *Canadian Mining Journal* (1929): 155-157, 194; R.C. Rowe, "A New Development in Freight Carrying Aeroplanes: Which Contains Some Account of JU 52, the New Addition to the Fleet of Western Canada Airways," *Canadian Mining Journal* (1931): 850.

tool kit. In fact, by the late 1920s, companies devoted to aerial mineral exploration began to appear (for example, Northern Aerial Mineral Exploration, 1928) and mining companies began to create their own air arms (for example, Consolidated Mining and Smelting, 1928).

While Canadian commercial aviation companies developed to serve the expanding resource industries, the Canadian government also recognised the potential of these services and responded accordingly. In the climate of fiscal restraint that characterised the inter-war years, the Canadian Air Force was under constant pressure to justify its existence and its funding. To do so the force sought out activities such as forest fire patrols that had demonstrable practical benefit.[53] In fact, between 1922 and 1925, forest fire patrols formed the largest portion of the Royal Canadian Air Force's (RCAF) activities.[54] Government services also concentrated on fire patrols, aerial sketching and photography, and mapping from those photographs. In addition, the government used aircraft to support field survey parties.[55]

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[53] Dwayne Lovegrove, "The RCAF, 1918-1939: A Political History," *CAHS Journal* 25:1 (Spring, 1985): 4-10, 19; Kyle McIntyre, "The Politics of Air Power: Mackenzie King and the British Commonwealth Air Training Plan," *CAHS Journal* 26:3 (Fall, 1988): 108-115; John Herd Thompson with Allen Seager, *Canada 1922-1939: Decades of Discord* (Toronto: McClelland & Stewart, 1985).

[54] The level of forestry activity decreased only with the creation of the directorate of Civil Government Air Operations in 1927. In 1924 the force flew 1356 hours on forestry protection and stayed steady at 1347 hours in 1925 and 1132 hours in 1926. The activity was transferred to the directorate of Civil Government Air Operations after its 1927 creation. Canada, *Report of the Department of National Defence ... 1924*, 53; Canada, Department of National Defence, *Report of the Department of National Defence for the Fiscal Year Ending March 1925* (Ottawa: 1926), 54; Canada, Department of National Defence, *Report of the Department of National Defence for the Fiscal Year Ending March 1926* (Ottawa: 1927), 46.

[55] Canada, *Report of the Air Board ... 1922*, 28.

Because resource development north of the rail line continued to be the most profitable area for aviation, both Canadian military and civilian operators concentrated their efforts in that zone. It sometimes placed them in competition. However, once the RCAF and Topographical Surveys Branch of the Department of the Interior had developed methods for plotting aerial photographs, civilian aerial photography expanded dramatically. Until then, however, the RCAF dominated aerial photography in Canada.

By 1924, Canadian aviation had weathered the boom of postwar exhibition flying and its subsequent bust. Recovering from the drop, aviators and government had identified a niche for aviation activities. While the focus in other countries had been on the use of aircraft for transport services, as the government noted, in Canada circumstances were not conducive to the development of air transport and the government saw airmail as an expensive luxury. Therefore, aviation followed the channels open to it: forestry and surveying. These outlets provided a means of developing self-sustaining aircraft operations, but the growth occurred very slowly. Post-war conditions in Canada, the United States, and Europe had produced distinct patterns of aircraft use by 1924. The Europeans focused on interurban transport, while the Americans had a transcontinental, government-operated airmail system. By contrast, Canadians began to develop the relationship between aviation and resource development that would profoundly shape Canadian aviation.

FINDING A NICHE: BUILDING CANADIAN COMMERCIAL AVIATION, 1924-1929

1924 was a significant year in Canadian transport history, marking as it did the beginning of sustained commercial air transport. Intriguingly, it was also an important date in European and American aviation. In the United States legislative changes established commercial aviation on a solid footing, while in Europe the aviation network began expanding to other parts of the world. As with the events that occurred between 1919 and 1924, the different paths that aviation followed in different regions during the second half of the decade were the result of conditions and forces particular to each territory.

According to a number of Canadian aviation historians, 1924 was the year Canadian aviation came of age. Symbolically, it had been 21 years since the Wright brothers' first flight in 1903. More practically, aviation saw some real changes in Canada starting in 1924. For instance, after reorganization in 1923, RCAF activity exploded in 1924 and military activity increased dramatically as the total number of flying hours almost doubled.[56] The total increased again in 1925, rising to 5,111 hours 47 minutes.[57] The level of overall activity remained relatively constant through 1926, but the amount of aerial photography jumped to 1,116 hours 17 minutes.[58] This was the last year that civilian activities would dominate the Air Force agenda as the newly created Civil Government Air Operations division took over this activity in 1927.

More importantly for this story, 1924 marked the beginning of sustained commercial air transport in Canada. While there had been previous attempts, including experimental airmail services between Toronto and Montreal in 1918, 1924 saw the

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[56] The total rose from 2090 hours 45 minutes to 3941 hours 45 minutes – of which forest fire patrols continued to be the largest segment: 1356 hours 17 minutes. Canada, *Report of the Department of National Defence … 1924*, 53; Canada, *Report of the Department of National Defence … 1925*, 54.
[57] Canada, *Report of the Department of National Defence … 1926*, 56.
[58] Canada, *Report of the Department of National Defence … 1927*, 47.

beginning of steady commercial aviation.[59] Building on the forestry management-aerial surveying pattern that marked the bush as a suitable space for aircraft operations and finally acting on ideas that had been present since before the war, Canadian aviators began to offer transport into the bush.[60]

In 1924, the number of firms chiefly operating aircraft dropped, but significant developments occurred nonetheless. That year, Laurentide Air Services announced plans to offer passenger, freight, and sticker airmail services into the Rouyn gold fields. It was the first regular air service of its kind to operate in Canada. In 1924 alone, the company carried 1,004 passengers and 78,000 lbs of freight.[61] Although improved road and water transport would cut into the firm's business so greatly that it would withdraw from the field in 1925, Laurentide's work marked a turning point in the history of Canadian aviation. For the first time aircraft had been used for regular transport. Even more significantly, the route was associated with mineral development.

During 1925, levels of activity remained roughly the same, barring Laurentide's withdrawal, but in 1926, the use of aircraft in the bush began to grow steadily.[62] The number of firms jumped from 8 to 14 and many of the new entrants offered services

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[59] The flights between Toronto and Montreal were part of a summer recruiting drive by the Royal Flying Corps, Canada. Honourable Newton W. Rowell, Canada, House of Commons, Debates, 2 May 1919, 2036.

[60] In fact, G.A. Thompson of Canadian Airways Limited would call this the birth year of commercial aviation in Canada on a sound basis. G.A. Thompson, memo, ca. 1930, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence post-1918-Jun 1929.

[61] Canada, Department of National Defence, *Report on Civil Aviation for 1924* (Ottawa: 1925), 34.

[62] Canada, Department of National Defence, *Report on Civil Aviation for 1925* (Ottawa: 1926), 22, 24; Canada, Department of National Defence, *Report on Civil Aviation for 1926* (Ottawa: 1927), 22.

similar to Laurentide's.[63] Part of this growth can be explained by the opening of the Red Lake gold fields in northwestern Ontario, where three of the new companies operated. One of these companies, Western Canada Airways, was born when its first machine left Hudson, Ontario, for Red Lake on Christmas Day, 1926. This new company followed the pattern of using aircraft to transport passengers and freight to areas off the railway in the Canadian Shield. By 1926, J.A. Wilson could write, "Aviation is no longer looked on as a freak or stunt, or as applicable to military uses only, but has come to be recognized as playing a very useful part in the development of our outlying country."[64] Aviation had established itself in a commercial niche.

The companies' functions were typical of the Canadian government's previously expressed view of aviation's place in the Canadian transport system. In the government's eyes, air services would not parallel the rail service. Rather, they would fill the gaps in the Canadian transportation system, and there were gaps. Although Canada had ample east-west rail service, the network had developed with agriculture in mind. As a result, it did not reach into the mineral-rich areas of the Canadian Shield. When the resource industries did begin their move northward, railway expansion was not a viable option.

Even without the railways' unfortunate economic position, constructing rail lines into the Shield would not have been an attractive proposition. Rail construction over and through bedrock was an expensive undertaking and the areas these lines would serve were as yet unproven – the mines might succeed, or they might fail within a short time, leaving the railway with an expensive spur line and no freight traffic. Overland or water

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[63] Canada, *Report on Civil Aviation for 1926*, 21.
[64] J.A. Wilson to Sir Sefton Brancker, 15 February 1926, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.

transport was also unappealing. Water transport was somewhat slow, and in undeveloped areas required canoes and portages. Overland motorized transport was not necessarily available in areas with no roads. In the winter months, when the water was frozen, dog teams and sleds offered the only method of transportation. It was a slow and expensive means of travel.

Thus, the difficulty of year-round transport in the region encouraged the use of aircraft. Aircraft offered substantial time savings and were competitive with prices for dog sled or overland travel. Moreover, because flying boats and floatplanes did not require a permanent infrastructure, they were flexible enough to accommodate the changing dynamics of mineral exploration.[65] Therefore, commercial companies sprang up in just such areas. The government had been right; these rugged, unsettled areas would be the main market for aviation, although it was, in some ways, a self-fulfilling prophecy. Inter-urban services would have required government subsidies, but because the government did not want to offer either direct or indirect financial support, these services did not appear. The only market for aviation was in the North, and that was where the services emerged.

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[65] Western Canada Airways used this argument in an unpublished manuscript, "The Business of Flying": "During the development of a mine between the discovery and the productive stage, while it is yet to be ascertained whether the mine is to turn out as a paying proposition and when the cost and delays entailed in road and railway construction would be prohibitive and not justified, it is during this stage that the mobility of air transportation so well suits the mining conditions of the North.

If, after thorough investigation, the property should prove non-productive, the plane could be withdrawn immediately to serve other fields. Should the mine on the other hand fulfil expectations, air transportation maintains a supply system for all immediate needs until such time as a permanent road or railways is taken in the area." "The Business of Flying," draft manuscript, December 1929, CAL Collection, AOM, MG 11 A 34, Box 64: Miscellaneous WCA Rates and Costs, 1927-1930.

While the Canadian government had initially been reluctant to support aviation, that attitude began to change in 1926. In that year, the subject of Empire air communications arose at the Imperial Conference and, as part of that meeting, Canada promised its support for the development of an inter-Empire airship service.[66] According to Charles P. Edwards, Chief of Air Service, Department of Transport, "the Canadian government then recognized that the time had come when a Canadian transcontinental service would play an important part in world communications."[67] Thus, the government pledged to support the Empire airship service, going so far as to develop an air harbour at St. Hubert, Quebec. While the plans came to naught and the service never materialized, the government's support reflected a growing willingness to encourage the growth of Canadian aviation.

In part, this additional involvement grew out of increasing concern that Canada was being left behind. The Department of National Defence had long maintained that because of its particular situation, Canada would naturally lag behind in the development of air transport services. However, in 1927, J.A. Wilson placed Canada alongside Australia and the United Sates and suggested that Canada should try to catch up.[68] In addition, Canadian politicians were becoming increasingly concerned with the expansion of American air routes across the border. American companies were applying for permits to enter major Canadian cities and travel by air was becoming increasingly

[66] Canada, Department of National Defence, *Report on Civil Aviation for 1927* (Ottawa: 1928), 59.
[67] Charles P. Edwards, Chief of Air Service, Department of Transport, testimony on the development of commercial air services in Canada, ca. 1940, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 13, Specific memoranda, 1916-1949.
[68] J.A. Wilson, "Air Mails," 26 July 1927, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 6, Memoranda relating to the development of civil aviation in Canada.

commonplace. In an effort to buttress Canadian air development, the government responded by establishing a government sponsored airmail service and beginning the Flying Club program, both in 1927.[69]

The government designed both these measures to support the growth of civilian aviation in Canada. For several years, the Post Office had allowed air services to sell special airmail stickers in return for conveying mails to Rouyn, Red Lake, and elsewhere. The success of these services encouraged the government to invest its own money. Unlike in the United States or Europe, the Canadian government wanted aviation to prove its sustainability and self-sufficiency before it would offer financial support.

Full government airmail service began in 1927 with contracts to carry mail to Anticosti Island, the Magdalen Islands, Pelee Island, and Red Lake. The government also operated an experimental service between Rimouski and ships in the St. Lawrence.[70] The following year, the government added Montreal, Ottawa, and Toronto, along with other locations. Later in 1928, Western Canada Airways began an experimental prairie service, linking Edmonton, Calgary, and Winnipeg.[71] The company expanded the route during 1929 and by 1930 would offer night service between Winnipeg and Edmonton, via Regina, Saskatoon, and North Battleford. The southern route also included stops at Moose Jaw, Medicine Hat, and Calgary. The establishment of these lighted air routes across the Prairies created an important element of Canadian aviation's infrastructure.

The second half of the government's measures, the Canadian Flying Club program, was designed to encourage the development of airports and pilots across the

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[69] Canada, *Report on Civil Aviation for 1927*, 33, 61.
[70] Ibid, 33-35.
[71] Canada, Department of National Defence, *Report on Civil Aviation for 1928* (Ottawa: 1929), 37-38.

country. Under this program, the government would issue two light planes, free, to any approved, incorporated flying club or association with a body of 10 licensed pilots plus 30 members seeking lessons. The government also guaranteed a grant of $100 for every pilot trained and licensed through the club. In order to qualify for the grant, the club had to provide an airport, complete with hangar and workshop, and hire a pilot instructor and a mechanic. Twenty-three clubs were formed in 1928 and 1929, with more than 5,000 members.[72] The government intended this initiative as a development tool. The clubs would provide trained Canadian pilots and would help to establish a chain of airports that could be part of a trans-Canada airway. However, the approach remained *ad hoc* and local. Clubs developed where there was local demand, not necessarily in locations where the government needed an airport.

While the Royal Canadian Air Force continued to use flying boats into the early 1930s, commercial bush operators shifted to float equipped aircraft in the mid-1920s.[73] This shift accompanied the rise of mineral development as the primary market for Canadian aviation. As the Canadian economy began to expand, aviators saw the development of a new market. In 1920, Canadian metal mining focused on the deposits around Cobalt and Kirkland Lake, Ontario, but in 1923, the Rouyn-Noranda district of Quebec took over as the major centre of mining activity. Whereas Kirkland Lake was just off the railway line, Rouyn was approximately 65 miles from the rails. This distance presented an opportunity for aviators who could transport prospectors and others over this distance, helping them avoid a difficult journey in a region with no roads. In the spring

[72] Canada, Department of National Defence, *Report on Civil Aviation for 1929* (Ottawa: 1930), 37.
[73] Bernard Shaw, *Photographing Canada from Flying Canoes* (Burnstown: General Store Publishing House, 2001), 141, 267, 269, 272, 274

of 1924, Laurentide Air announced its plans to introduce passenger and freight air services to the Rouyn district, leaving from Haileybury, Ontario. The airplane offered a faster, more comfortable, and sometimes less expensive method of reaching these newly discovered deposits, supplementing existing water transport. Although the company operated only until 1926, its activities reflected the pattern that would dominate bush flying for the next two decades: flying from a fixed base into the wilderness, and carrying people and freight in support of mineral development. However, the mining industry required greater payload capability than flying boats could provide and would also appreciate the year-round operating potential offered by ski-equipped aircraft.

During the 1920s and 1930s, Canadian mining moved farther and farther into the bush. The Red Lake gold field, opened in January of 1926, was even more remote than Rouyn had been. Red Lake was approximately 125 miles from the railway line, a distance that again encouraged the use of aircraft. By the time prospectors reached the Mackenzie River system in 1929, the distance between the railhead at Waterways and the first stop on the trip down river, Fort Chipewyan, was approximately 155 miles. Aviation allowed the mineral industry to exploit resources farther and farther from the roads or railways, even as interest in these deposits provided aircraft with an expanding market.

At the same time, commercial flying continued to expand. The growth of aviation during the latter half of the 1920s was remarkable. Between 1924 and 1927, the number of passengers carried rose from 4,314 to 16,664 and the amount of freight from 77,385 lbs to 380,433 lbs. Between 1927 and 1929, those numbers rose to 96,375 passengers and 2,489,189 lbs of freight.[74] In the meantime, the number of registered aircraft had risen from 67 in 1927 to 445 in 1929.[75] The Department of National Defence began releasing statistics broken down by province in 1926. These numbers indicated that although the majority of aviation activity was concentrated in Ontario, the highest rates of growth occurred in the Prairie provinces (Alberta, Saskatchewan, and Manitoba). The amount of freight, express, and mail carried in the three provinces increases almost 150-fold between 1926 and 1929. In 1926, the total amount of freight, express, and mail carried was 6,839 lbs; by 1929 that number rose to 1,018,483 lbs. It is important to note that these numbers include mail carried under the new government airmail contract. While one does see a jump in the total poundage in 1928, after the introduction of airmail, only in the Yukon and New Brunswick is mail the largest portion of air cargo. In every other locale, freight and express formed a larger proportion of the traffic.[76]

In 1929, the future of Canadian aviation seemed promising. In an effort to keep up with Europe and, more particularly, with America, the Canadian government had reversed its hands-off policy and was now prepared to offer financial support to the industry. The Flying Club program created a collection of airfields and organisations, *ad hoc* though they might have been, that trained new pilots.[77] Not only did these programs provide employment for pilot instructors, they also trained many of the next generation of

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[74] M.C. Urquhart, ed., *Historical Statistics of Canada* (Toronto: The MacMillan Company of Canada, 1965), 551.
[75] Lorne Manchester, *Canada's Aviation Industry* (Toronto: McGraw-Hill, 1968), 66.
[76] *Report on Civil Aviation for 1926*, 18-20; *Report on Civil Aviation for 1927*, 19-22; *Report on Civil Aviation for 1928*, 16-17; *Report on Civil Aviation for 1929*, 14-18. One should also note that the passenger figures include dual instruction flights and that the statistics do not distinguish between bush and interurban flights.
[77] Between 1927 and 1928 the number of licensed Canadian pilots rose from 72 to 328. *Report on Civil Aviation for 1928*, 14.

commercial pilots. In commercial aviation, airmail contracts encouraged the creation of inter-urban services and provided income stability to the companies that held them. Moreover, the industry had established a market serving the resource industries expanding into the Canadian Shield. Business was growing and airlines expanding. It was in this context that Western Canada Airways would inaugurate its Mackenzie River operations, riding a wave of optimism about aviation and the North.

Comparative Developments: European and American Growth, 1924-1929

Across the border in the United States, 1924 also marked a watershed, but in a different way. By 1924, the United States already had a well-developed transcontinental airmail service, but it was operated exclusively by the government. The Post Office's airmail system demonstrated the utility of aircraft but it provided no support to private operators, support that European countries had quickly perceived was necessary for the survival of commercial airlines. Noting the healthy level of aviation activity in Europe, members of the American government became concerned about how far the United States was beginning to lag behind the continent. For instance, by 1925, most European countries had civil ministries in charge of air commerce. The United States lacked this sort of structure. Two key pieces of legislation, the Air Mail Act, 1925, and the Air Commerce Act, 1926, would change this. These acts would create the conditions necessary to allow the growth of privately owned, commercial aviation in the United States.

The Air Mail Act, also known as the Kelly Act for one of the Members of Congress who introduced the bill, M. Clyde Kelly, opened airmail contracts to private operators. These contracts would provide guaranteed income to their holders and were a means of providing an indirect subsidy to commercial aviation.[78] The industry welcomed the support and the government received over 2000 enquiries about its initial offering of approximately one half-dozen regional feeder routes. Over the next decade, the United States Post Office would use these contracts to build up commercial aviation in America.[79]

While the Air Mail Act offered financial support, it did not address the lack of government structures for aviation. That was left to the Air Commerce Act of 1926. This legislation established the Bureau of Air Commerce in the federal Department of Commerce. The Bureau would be responsible for the development and enforcement of standards and regulations governing such things as pilot, aircraft, and air engineer licensing. These regulations made investors feel more confident about extending loans and providing capital to manufacturers and operators, in part because insurance companies now felt comfortable insuring aircraft that met government safety standards and were flown and maintained by certified personnel.[80] Because of the Air Mail contracts, there were opportunities to establish airline companies and the Air Commerce Act created a positive investment climate. It also did not hurt that the effects of this

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[78] According to David Lee, this approach reflected Herbert Hoover's views on the relationship between government and industry. David D. Lee, "Herbert Hoover and Commercial Aviation Policy, 1921-1933," in *Reconsidering a Century of Flight*, 89-117.
[79] In fact, Postmaster Walter Folger Brown would eventually get into trouble for using these contracts too vigorously in his quest to support the development of commercial aviation in the United States. Crouch, *Wings*, 271.
[80] Bilstein, "The Technology of Flight;" Crouch, *Wings*, chapter 6; As Mattson points out, American regulation followed Canadian developments. See Mattson, "The Growth and Protection of Canadian Civil and Commercial Aviation," 320-328.

legislation emerged in the context of the 1920s bull market. Capital was available to invest and aviation seemed a promising field.

The passage of these acts also had implications for aircraft manufacturers. The Air Mail Act and the newly available investment money provided airlines with the resources necessary to purchase new aircraft. As aviation grew, so too did the market for aircraft, and American manufacturers pursued that market. Changes in military procurement plans also contributed to the growing demand. The Morrow Board, chaired by Dwight Morrow, investigated the state of American military aviation and found that the United States lagged seriously behind European military air power. As a result, the Army and Navy developed five-year procurement plans that allowed them to purchase new aircraft and to fund or subsidize research into the development of new aircraft and engines. The entrance of new firms, such as Lockheed in 1926, indicates that these government initiatives, both civilian and military, created healthier conditions for the American aircraft industry. The willingness of big names in American manufacturing, such as Henry Ford, to enter the industry confirms that the situation must have looked bright in the mid-1920s.[81]

Unlike the situation in America, in Europe, the period between 1924 and 1929 was not one of spectacular internal expansion. By 1924, the outlines of the European air transport system were already established. Most of the routes operated year round and many of the airlines enjoyed the support of government subsidies. Given that the system

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[81] Crouch, *Wings*, 239-240; Dominick A. Pisano, "The *Spirit of St. Louis* -- Fact and Symbol: Misinterpreting a Historic Cultural Artifact," in *Reconsidering a Century of Flight*, 242-262; Rae, *Climb to Greatness*, chapter 3.

now reached across Europe, the next phase of European airline development centred on consolidation, as airlines improved their equipment, and inter-continental expansion.

Although extensive service beyond Europe would have to wait until the 1930s, European aircraft did establish routes to Africa, Asia, and the Middle East during the 1920s. For instance, the British began pioneering routes in the Middle East and India in 1918. Unfortunately, the technology remained unable to withstand the demands of such a trip. However, 3 years later, in 1921, the British did establish a Cairo-Baghdad route, in part to reinforce British control in Baghdad. By 1926, they would complete the route from Cairo to Karachi via Palestine, Iraq, and the Persian Gulf. This would be linked to London by 1929 and would support an extension from Cairo to South Africa by 1930.[82] Meanwhile, the French began airmail service to North Africa in 1919 and by 1925 had services reaching Morocco, Algeria, and equatorial Africa. Three years later, they were considering service to the Belgian Congo and had a weekly air and maritime service to South America.[83] The Dutch also contemplated extending overseas service to the Dutch East Indies.[84] The interest in overseas expansion was partly the result of European colonial empires, a circumstance not present in either Canada or the United States.

CONCLUSION

Just as European and American conditions formed their aviation networks, circumstances also sculpted the particular character of Canadian commercial aviation.

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[82] Canada, *Report on Civil Aviation for 1926*, 7; Canada, *Report on Civil Aviation for 1929*, 65.
[83] Canada, *Report on Civil Aviation for 1925*, 7; Canada, *Report on Civil Aviation for 1928*, 79.
[84] Canada, *Report on Civil Aviation for 1927*, 10; Canada, *Report on Civil Aviation for 1928*, 80.

Whereas European and American governments had seen fit to support aviation, the Canadian government was reluctant to finance the new technology's application. This attitude reflected the realities presented by a small population spread thinly along the long southern border, the difficulties of building and maintaining the necessary system of airfields, and the limits of existing aircraft range. It also mirrored the politicians' view of the Canadian transportation system, of which they believed the extensive rail network formed the backbone, in large part because of the government's heavy investment in the rail system. Given recent experiences with railway financing, the government was wary of providing money for an untried transport technology, especially one that would compete with the fragile railways. Instead, the government believed aviation's most appropriate role was as a supplement to rail transport, particularly in regions that had no rail service, such as the northern bush. Thus, the Canadian government allowed aviation to develop on its own and restricted itself to the regulation of commercial activity. This pattern continued until fears of falling behind other nations pushed the government to take action. In response to these concerns, the Canadian government began government-sponsored airmail service in 1927. That same year the government also established a national flying club program designed to train new pilots and create a network of maintained airfields. These programs represented the government's first steps towards the active support of commercial aviation.

In the meantime, Canadian commercial aviation had developed its own niche supporting the Shield's resource industries. In so doing, Canadian aviators constructed the practice of bush flying and 1924 marked the beginning of sustained commercial activity in Canada. It seemed that resource development in the Shield and aviation were well suited to one another. To begin with, the difficulty of travel in the rocky Shield created interest in alternate forms of transportation. It was a demand that aircraft could answer by offering faster, more comfortable travel. It was also one of the few opportunities that presented itself to Canadian commercial aviators in the 1920s, especially given the lack of government support. Moreover, geography provided natural landing fields that flying boats and ski or float equipped aircraft could exploit. The same geography that created the demand for other methods of transport meant that aircraft could exploit the lakes and rivers as natural landing sites. Because of the ability to make use of natural formations like lakes and rivers, the air services were flexible enough to respond to the resource industries' changing transportation needs. The expansion of these industries, particularly mining, into the Shield's favourable geography presented an opportunity that Canadian aviators seized upon. The pattern of flying into the bush in support of resource development would dominate Canadian aviation until the creation of a trans-Canadian passenger air service in 1937. It was the same pattern Western Canada Airways followed when it expanded to serve the Mackenzie District in 1929.

3 – Technology, Experience, and Design: Laying the Foundations of Northern Aviation, 1919-1929

The forms of Canadian, American, and European aviation in 1929 reflect the fact that ambient conditions encouraged aviation systems to develop in particular ways. While geography, economics, and politics were all important influences, aircraft technology itself was also a critical consideration, acting either as an accelerant or an impediment to particular types of activities. Moreover, as aviation continued to develop, the different types of systems also encouraged changes in aircraft design. This was as true in northern Canada as elsewhere. In fact, a number of technological changes that occurred during the 1920s materially contributed to Canadian aviation's northward expansion. These technological changes and subsequent changes in aircraft design enabled Canadian aviators to begin acquiring experience with northern aviation during the 1920s. These developments laid the foundations for Western Canada Airways' northern expansion in 1929.

Technology and Design

As in Canada, pre-war aviation in Europe had been primarily the domain of experimenters and inventors who exhibited their aircraft at international aero meets and competed against other aviators. Within a relatively short time, however, the military recognised aviation's strategic value. Aircraft began military service as observation platforms, offering information about enemy troop movements, encampments, supply lines and other important military details. However, enemy aircraft could collect the same facts about one's own troops and it thus became important to keep those airplanes out of one's own airspace. This aerial conflict began with hand-held guns and added aircraft-mounted guns only after Anthony Fokker developed the synchronized propeller that allowed bullets from a machine gun to be fired between the rotating blades. With this development, manoeuvrability became an important performance feature as pilots engaged in ever more dizzying dogfights. Although the war did not produce any revolutionary designs, it did push designers to turn remarkable performance characteristics into standard ones as aircraft routinely turned in performances that would have been record setting before the war.[1]

The nature of wartime production established a pattern of fluidity in aircraft design and solidified the close relationship between manufacturer and aircraft user. When aircraft manufacturing went from experimental to industrial during the war, it did so under conditions where aircraft design was in constant flux. As the combatants strove to maintain the upper hand technologically, designers and manufacturers had to keep up with users' battlefield experience and the technical advances of the other side.[2] This meant aircraft design was, by necessity, continuously fluid and a collaborative process between users and designers. The fact that post-war aircraft manufacturing, especially in the United States, was very dependent on military contracts cemented the industry's

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[1] Tom D. Crouch, *Wings: A History of Aviation from Kites to the Space Age* (New York: W.W. Norton & Company, 2003); R.E.G. Davies, *A History of the World's Airlines* (London: Oxford University Press, 1964); Peter Fritzsche, *A Nation of Fliers: German Aviation and the Popular Imagination* (Cambridge, Mass.: Harvard University Press, 1992); Charles H. Gibbs-Smith, *Aviation: An historical survey from its Origins to the end of World War II* (London: Science Museum, 1985).

[2] I.B. Holley Jr., *Ideas and Weapons: Exploitation of the Aerial Weapon by the United States During World War I; A Study in the Relationship of Technological Advance, Military Doctrine, and the Development of Weapons* (New Haven, Conn.: Yale University Press, 1953). See particularly, 61-63, 64, 90.

propensity to respond to user and purchaser design inputs as military requirements dictated the performance characteristics of many designs. This propensity may also reflect the complexity of the aircraft manufacturing process. Because of their technical intricacy and their high price, aircraft have never been mass-produced objects. Rather, the manufacturer's ability to turn a profit depended on securing a consumer base. Given that aircraft were so expensive to design and develop, it was imperative that the producer guarantee a market for the design. One way to achieve this was to work closely with the end user.

At the end of World War One, the vast majority of aircraft were still thin-winged biplanes powered by in-line, liquid cooled engines. The airframes were generally wooden structures covered in fabric. There were exceptions to this pattern, including Junkers and Fokker aircraft, or the flying boat, but most fell within this category. The type was an improvement over the birdcages of struts and wires with fuselage structures open to the air that had characterized pre-war aviation.

Despite these developments, the aircraft of 1918 would not have been able to function as transports in the Canadian North. To begin with, their cargo carrying capacity was limited and the aircraft that were able to land on the northern lakes, the flying boats, did not have an easy means of loading clumsy cargo. Moreover, the liquid-cooled aircraft engines would have frozen in the northern winter. Serious year-round activity would have to wait until the technology changed sufficiently to make it feasible.

Existing histories of aviation technology, particularly American histories, have a propensity to focus on the design revolution embodied in the birth of the modern passenger airliner as the pivotal event in inter-war aircraft design. Within this mindset, other technological changes acquire their significance insofar as they contribute to or enable this revolution.[3] Although undoubtedly a dramatic breakthrough in aircraft design, especially when considered in the context of post-war passenger jet developments, concentrating on the airliner revolution tends to obscure a cluster of technological changes that came together in the mid-1920s to produce the high-winged, mid-sized transport. John D. Anderson, in particular, treats the mid-sized utility transport as a sub-category of the strut and wire biplane. What Anderson does not recognise is that, taken together, the small evolutionary changes of the 1920s and 1930s formed the nucleus of a different type of aircraft. As Anderson points out, the individual elements were relatively small developments. However, their combination was enough to allow the development of the mid-sized transport. It was this type of aircraft that Canadian operators appropriated to use in the northern bush.

The mid-sized transport of the 1920s was generally a high-winged, single engined transport monoplane capable of carrying its pilot and between six and eight passengers, or the equivalent cargo. Typically, these aircraft had cruising speeds of 100 mph or slightly more and a range of 500 miles and up.[4] This type of aircraft would give birth to the Canadian bush plane. In fact, several of these designs would be amongst the first

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[3] See, for example, John D. Anderson Jr., *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002); Ronald Miller and David Sawers, *The Technical Development of Modern Aviation* (London: Routledge & Kegan Paul, 1968); and John Rae, *Climb to Greatness: The American Aircraft Industry, 1920-1960* (Cambridge, Mass: The MIT Press, 1968). All are excellent histories, but they all focus on the airliner revolution as the culmination of inter-war developments.

[4] Gibbs-Smith, *Aviation.* According to Miller and Sawers, the first major design change during the 1920s and 1930s occurred with the development of the tri-motor transports. However, these high-wing transports appear to be multi-engined modifications of the design type Gibbs-Smith identifies. Miller and Sawers, *The Technical Development of Modern Aviation.*

aircraft used as transports in the Canadian bush. Their carrying capacity, speed, range, and ability to exchange wheels for skis and floats, would make bush transport a possibility. The design changes that produced this new type can be grouped into three broad categories: airframes, wing design, and propulsion.[5]

Airframes

At the end of World War One, the bulk of planes used wood as their primary structural material. For instance, the HS-2L flying boats and Curtiss JN-4 biplanes used extensively in early Canadian aviation were both made of wood and fabric. In fact, the HS-2L's entire hull was wooden. While the body and many of their wings continued to be covered in fabric, the mid-sized transports that appeared mid-decade would use metal for their fuselage structural members.

One of the first to use metal as an important structural element, Hugo Junkers was a professor in the Department of Mechanical Engineering at the University of Aachen who became interested in aviation after the Wright brothers' public flights in 1908. Along with other unique design features, Junkers' first experimental aircraft, the J-1, 1915, had an all-iron skin. While at first glance iron seems far too heavy a metal for aircraft construction, Junkers used very thin sheets of the material so the J-1 was not overweight. That said, after the J-1, Junkers would switch to using duralumin, an aluminium alloy that would become important in the construction of many all-metal aircraft. Developed by Adolf Wilm, a metallurgist at the Zentralstelle für Wissenschaftliche-Technische Untersuchungen, in 1906, duralumin was an aluminium alloy containing copper, manganese, magnesium, iron, and silicon that was patented and

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[5] The following discussion draws heavily on John D. Anderson Jr.'s excellent technical history, *The Airplane: A History of Its Technology*, especially chapters 5 and 6.

ready for commercial use by 1909. By 1916, an American version, alloy 17S, was available in the United States. This very hard, very strong alloy was also light enough to be used in aircraft construction. Junkers would use this material in a line of all-metal aircraft that would include the J-13, developed in 1919. This aircraft was the ancestor of the W 33/34s and the Ju 52 that served so impressively in northern Canada during the 1930s.

Junkers believed metal construction could offer several advantages. Metal's durability, especially in the tropics, and ability to maintain its shape under different conditions made it suitable for different locations. It could be moulded into many shapes, which allowed significant design freedom for engineers. Bonding methods for metal, such as screwing, bolting, soldering, and welding, were more secure than wood glue, providing a greater safety margin. Moreover, the metal's properties remained constant over time, unlike those of wood and fabric. Finally, Junkers argued that because metal was more durable, repair and maintenance costs would be lower.

However, there were also some drawbacks to its use. Metal required tools that were more expensive than woodworking tools and wood offered a lower density, which made it lighter. More importantly, metal could be subject to corrosion.[6] Because of the worry about corrosion, the American and British governments were both initially resistant to use metal in aircraft construction. However, the development of non-corroding alloys reduced that anxiety. In the mid-1920s British researchers developed a technique for anodizing aluminium alloys, giving them a protective oxide coating, and, by 1927, E.H. Dix, an American, had developed a method of bonding pure, corrosion-

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[6] P.D. Acland to J.A. Wilson, 25 November 1925, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.

resistant aluminium to the surface of duralumin, creating Alclad, as it was known. In spite of these developments, Junkers' all-metal aircraft remained largely an anomaly until the 1930s.[7]

Nevertheless, airplanes were no longer the completely wooden structures of World War One. Although Junkers' all-metal machines remained anomalies amongst North American aircraft, aircraft designers did not entirely eschew the material. Instead, they used metal for the fuselage frame, nose and tail surfaces, and to line cabins, thereby protecting them from damage by the cargo. While some attribute this reluctance to build all-metal aircraft to an inherent, general conservatism amongst aircraft designers, there were several reasons to avoid all-metal construction.[8] All-metal aircraft were expensive to purchase and difficult, or expensive, to maintain, making them less attractive to operators.

In fact, the distinction between the wooden aircraft of the early 1920s and the all-metal aircraft of the 1930s was not as clearly defined as historians such as Eric Schatzberg and Anderson imply.[9] Schatzberg argues that the move to metal aircraft owes much to a set of symbolic values that tied metal to ideologies of progress. In advancing

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[7] Anderson, *The Airplane*, chapter 6; Miller and Sawers, *The Technical Development of Modern Aviation*, chapter 3. The monocoque metal fuselage would be an important component of the airliner revolution, but it was not a large part of mid-sized transport construction. While the Lockheed Vega, considered the pinnacle of the mid-sized, high-wing monoplanes of the 1920s, did use a plywood monocoque fuselage, this type of fuselage construction did not appear on any of the bush planes operating in the Canadian north between 1925 and 1935. In fact, most American and Canadian designs continued to be fabric covered.

[8] Anderson, *The Airplane*, 147; Miller and Sawers, *The Technical Development of Modern Aviation*, 50.

[9] Eric Schatzberg, *Wings of Wood, Wings of Metal: Cultural and Technical Choice in American Airplane Materials, 1914 – 1945* (Princeton, N.J.: Princeton University Press, 1999).

his argument that the symbolic meanings of aircraft materials shaped the technical history of aircraft design, Schatzberg chooses to call any aircraft in which a major part of the structure is wood, a wooden aircraft. He places this category against the all-metal or metal aircraft, one in which the internal structures are metal and only the covering is wood or fabric. This dualism tends to obscure the existence of hybrid aircraft that used metal for the fuselage or other components. Instead, in the latter half of the 1920s manufacturers constructed hybrid aircraft, using wood, fabric, and metal where they saw them as most appropriate. While the Junkers all-metal aircraft, the W 33/34 and the Ju 52, would be important northern workhorses, the trend would definitely be towards the mixed-material aircraft.

While Schatzberg does acknowledge that many aircraft of the 1920s were hybrids, his typology can obscure this fact for the reader. It also pushes Schatzberg away from the more complex story of why designers and engineers chose to use metal for certain parts of the aircraft and not others. The answer might very well lie in the cultural meanings Schatzberg identifies, but the picture is more complicated than his examination of the eventual replacement of wood with metal suggests. For instance, bush plane users would acknowledge metal's durability, but would balk at its cost and the difficulty of its maintenance. Schatzberg is right to consider attitudes as important components of technological decision making, but technical concerns also influenced users, manufacturers, and designers. In northern Canada, conditions of use dictated that flexibility and ease of repairs were important considerations. Thus, the mixed material construction of metal fuselage frame, wooden wing construction, and fabric skin was a sound option because it could be repaired more easily at the site of an accident, and because it was less costly.

Wings

While all-metal aircraft would remain exceptions until the airliner revolution, a number of mid-sized transports shared another characteristic: the monoplane resting atop the fuselage.[10] This high wing offered an important benefit to bush operators, namely ease of loading. It was much easier to load freight into the aircraft without the wing obstructing movement or hanging out over the loading dock at the water's edge. The feature also improved sightlines from the cabin, an important consideration for visual navigation and for the bush flier's main clients: resource developers interested in the land's geology. Thus, the high-wing monoplane would become synonymous with the image of the bush plane over the 1920s and 1930s.

At the end of World War One, the vast majority of aircraft were still biplanes, in large part because the thin airfoil mandated by contemporary aerodynamic theory could not withstand the forces exerted during aerial manoeuvres.[11] Two sets of wings braced by struts and wires, however, formed a large box capable of sustaining these forces. The external trusses were necessary because the thin wings were not substantial enough to contain the structural members that could replace the struts and wires.

German designs, however, were once again the exception. In defiance of accepted aerodynamic theory, Hugo Junkers developed the thick, cantilevered wing. He believed that the wings on an all-metal aircraft should be internally supported. However,

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[10] Here again, Junkers' aircraft were an exception. Both the W 33/34 and the Ju 52 were low-wing monoplanes.

[11] Early wind tunnel tests indicated that thin airfoils produced less drag. In actuality, these results were artefacts of the low airspeeds generated in early wind tunnels.

this would require a wing sufficiently thick to contain spars strong enough to support the wing in flight. Because contemporary aerodynamics indicated that thinner airfoils were aerodynamically superior, Junkers could find no data on thick wing performance. Therefore, he conducted his own tests. Junkers' results indicated that thick airfoils performed as well or better than the thinner wings and Junkers decided to use thick, cantilevered wings on his J-1.

The thick airfoils first appeared on a mass produced aircraft with the Fokker Dr. 1 triplane. Late in 1916, Anthony Fokker entered into a joint project with Hugo Junkers. In fact, there is some evidence that the German government forced the two to collaborate.[12] Junkers was developing an all-metal ground attack aircraft and needed a production facility, which Fokker provided. There is some debate over how much technical knowledge passed from Junkers to Fokker or between their employees during this period. According to Marc Dierikx, Fokker's biographer, Fokker essentially plundered the concept of fully cantilevered wings from Junkers, and then allowed the business deal to fall apart as he made off with the idea. Later in 1916, according to Dierikx, Fokker and one of his engineers, Möser, designed wooden cantilevered wings.[13] Unlike Dierikx, John D. Anderson attributes the wing's design to Reinhold Platz, Fokker's chief designer.[14] Regardless of how, or if, the idea migrated from Junkers to Fokker, the cantilevered wing would appear on both Fokker and Junkers designs through the 1920s and 1930s. Given that the two produced the most popular commercial designs

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[12] Miller and Sawers, *The Technical Development of Modern Aviation*, 55.
[13] Marc Dierikx, *Fokker: A Transatlantic Biography* (Washington: Smithsonian Institution Press, 1997), 40.
[14] Anderson, *The Airplane*, 146.

of the post-war period, it is surprising that more designers did not incorporate the feature.[15]

Instead, other designers continued to buttress their monoplanes with wing struts. Notwithstanding this extra bracing, use of the monoplane still required thick wings in order to enclose wing spars of the necessary thickness. The use of these airfoils relied on the results of aerodynamic research that indicated thick airfoils could perform well. As we have seen, Hugo Junkers' research was important in establishing the performance capabilities of thick airfoils. So too was work done by the American National Advisory Committee for Aeronautics (NACA), and the NACA first published results of its wind-tunnel experiments with thick airfoils in 1919. The report author, F.H. Norton, noted that the thick airfoil eliminated the resistance created by interplane bracing (i.e., the struts and wires running between the two wings of a biplane). He also pointed out that a monoplane simplified wing construction and assembly, and was able to generate a very high maximum lift.[16] Although NACA wind tunnel tests provided data about airfoil performance, the actual design process remained much more of an alchemical, intuitive art than a mathematized science. Virginius Clark, an American aircraft designer claimed, "The airfoil sections just seem to lay themselves out and, when good luck attends, fair results are obtained."[17] NACA would continue its data collection into the 1930s, producing a set of Technical Reports that would be invaluable for aircraft designers. From the perspective of the bush pilot, the thick monoplane allowed the designer to lift

[15] Gibbs-Smith, *Aviation*; Crouch, *Wings*, chapter 6.
[16] F.H. Norton, quoted in Anderson, *The Airplane*, 147.
[17] Virginius Clark, quoted in Anderson, *The Airplane*, 229.

the wing on top of the fuselage, improving ease of cargo loading and enhancing visibility from the cabin.

Although American and British designers were slow to incorporate the thick airfoil, by the mid-1920s changes were beginning to occur. One of the most popular was the introduction of an airfoil known as the Clark Y. Designed by Virginius Clark in 1922, initially as an airfoil section for propellers, it proved to have a relatively high maximum lift and low drag.[18] Indeed, many of the American aircraft employed as bush planes in the Canadian North used the Clark Y airfoil. In addition to good maximum lift, the airfoil produced stable aircraft that were also very manoeuvrable.[19] Good lift was important because it meant aircraft could lift large loads into the air and therefore, could carry goods for mining development. It also meant the aircraft could take off in a shorter distance, thereby increasing the number of potential take-off sites and expanding the aircraft's field of operations. These features made it attractive to customers, especially bush operators. Bush flying required a reliable aircraft that could perform in all sorts of conditions, not a temperamental race horse. Stability was important in achieving this goal because it meant aircraft were easier to control, could handle changing conditions, and could carry different sorts of cargo without being unreliable. Granted, bush planes did not need to perform breathtaking aerial manoeuvres, but they did sometimes need to get into or out of tight spots. With the manoeuvrability of the Clark Y airfoil, the pilot did not need to be as worried about where he had to put the aircraft down or take off. Again, the airfoil reinforced the plane's flexibility.

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[18] Anderson, *The Airplane*, 229.
[19] Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-0009.

The use of a monoplane, cantilevered or braced, substantially improved aerodynamic efficiency. However, lower drag meant that these streamlined planes had shallower gliding angles and thus could be difficult to land. Wing flaps helped to increase lift at slower speeds, reducing an aircraft's minimum take-off and landing speed and increasing the angles of ascent and descent. The simplest form of flap is a portion of the wing's trailing edge that can be dropped down, thereby increasing the wing's camber, or cross-sectional curve. The greater camber increases both the wing's lift and drag. This allows an aircraft to generate greater lift while travelling at slower speeds. By increasing the wing's lift, the flap reduces an aircraft's minimum take-off and landing speed, and, especially important for bush planes, the take-off and landing distance required. It also increases the glide angle for descent and possible take-off angle.[20] Increased angles of descent and ascent were important for bush flying because, like good lift, they enabled the aircraft to get into and out of more locations.

The Junkers Ju52 used a parallel development of the wing flap: the slotted wing. The slot developed as a means of smoothing airflow at high angles of incidence, thereby decreasing the chance of stalling. On the Ju 52, Junkers' engineer, O. Mader, developed a version that used an auxiliary winglet mounted behind the main wing and separated by a permanent space. This winglet could be operated like a flap: lowered to increase lift. This technology is visible on Canadian Airways' Ju 52, CF-ARM, and first appeared on the design in 1930. However, the trailing winglet generated a great deal of drag. As with Junkers' other designs, the Ju 52 remained an anomaly until the 1930s. Although flaps

[20] Miller and Sawers, *The Technical Development of Modern Aviation.* See particularly page 79.

increased an aircraft's versatility, the first bush plane to incorporate a wing flap would be the Noorduyn Norseman, which appeared in 1935.

These changes in wing design produced the high-wing monoplane, a silhouette that continues to typify bush planes in northern Canada. The high, thick-wing monoplane was more aerodynamic than the biplane, meaning the aircraft could go further on the same amount of gas. This longer range was attractive to customers interested in exploring and exploiting resources buried deep in the Shield. The Clark Y airfoil reinforced the monoplane's attractiveness by making it stable and manoeuvrable while providing good lift. Raising the wing above the fuselage made the aircraft easier to load and increased visibility for pilot and passengers, especially important when approaching new landing zones. These features were so attractive that even post-war bush planes such as the Husky, Beaver, Otter, and Twin Otter display this configuration.

Engines

Perhaps the most significant development in enabling year-round northern operations was the appearance of the air-cooled radial engine. If companies had been restricted to liquid-cooled engines, they would have had to contend with engines that froze during the winter. As it was, crews had to drain oil from the engine at the end of a winter day's flying to prevent it from congealing overnight and seizing the engine on starting. To restart the engine, the flight engineer would have to heat the oil on a stove while warming the engine using a blow pot and a nose hangar to trap the heat. When the engine was warm, the engineer would pour the oil back into the engine and the pilot would attempt to start it before the oil re-congealed.[21] To have added water-cooling would have increased the complications. Fortunately, air-cooled radial engines appeared in the 1920s.

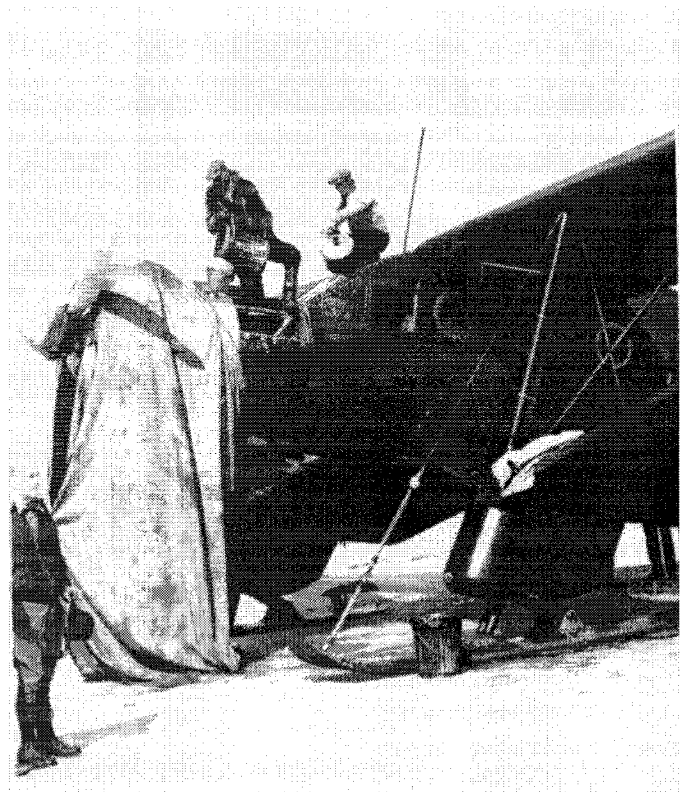

Figure 3.1: Refuelling Mackenzie Air Service Bellanca Air Cruiser.
The mechanic on the aircraft's nose is pouring reheated oil into the engine through a funnel. During heating the cover draped over the nose would have covered the engine from nose to windscreen with the blow pot placed on the snow under the engine.
Source: AAM Photo Collection, 202441.

As horsepower increased, World War One in-line water-cooled engines encountered weight to power ratio difficulties that limited their effectiveness.[22] However, air-cooled engines were not an option because World War One aircraft did not achieve

[21] Submission No. 127, re. funding for research by Associate Air Research Committee, 12 November 1920, NAC, RG-24 D-1-A, V 5588, file 7-21-7, Aviation and Aeronautics - Air Board; E.W. Steadman, "Operation of Aircraft and Aircraft Engines Under Winter Conditions in Canada," Appendix E, Canada, Department of National Defence, *Report on Civil Aviation for 1923* (Ottawa: 1924), 50 –56. This report also covers subjects such as ski design and flying with skis.
[22] Anderson, *The Airplane*, 152-154.

speeds high enough to produce sufficient airflow to cool the engine. Hence, the detour into rotary engines: spinning the engine itself could increase the rate of cooling. Unfortunately, the engine's power output was limited by its weight and the centrifugal forces produced by its rotation. Thus, water cooled engines regained their dominance once they had solved their weight to power ratio difficulties. By the end of the war, water-cooled engines powered most aircraft and the air-cooled engine appeared ready to fade away.

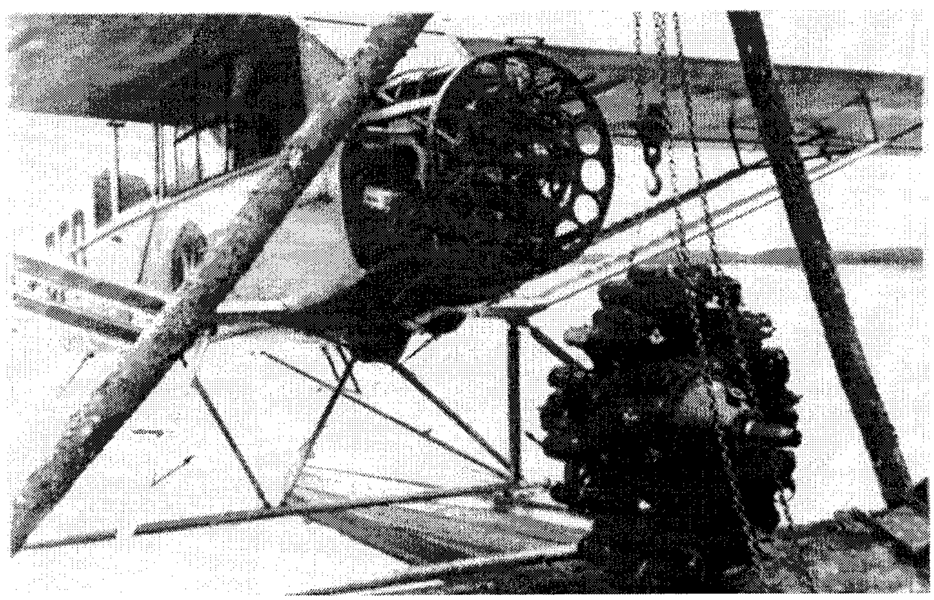

Figure 3.2: Canadian Airways Bellanca Pacemaker undergoing engine change in the bush, 1936. The engine has been removed from the front of the plane and is resting on the shore, *bottom right*. Note that the cylinders are splayed out circularly around the central crank shaft.
Source: AAM Photo Collection, 204152.

Fortunately, the air-cooled engine would experience a comeback in the mid-1920s. In 1917, Charles L. Lawrence created the Lawrence Aero-Engine Corporation, which designed air-cooled engines for the United States air forces, and in 1921, Lawrence's company produced the J-1, a nine cylinder, 200 hp, air-cooled radial engine. The United States Navy particularly liked this type of engine because it had fewer moving parts than a water-cooled engine and therefore required less maintenance.

Unfortunately, Lawrence did not have the production facilities to support the Navy's orders and the company was purchased by the Wright Aeronautical Corporation. Under this new arrangement, Lawrence and Wright produced improved versions of the J-1: the Wright J-3 and J-4. Samuel D. Heron, a British engine designer who had worked on air-cooled cylinders, joined Wright Aeronautical in 1926. With his involvement, the company produced the Wright J-5 Whirlwind, a 200 hp engine, that same year. This line of engines would eventually produce the 500 hp Cyclone engine.

Meanwhile, the Navy was looking for an additional supply source. They found it in Pratt & Whitney. A small group of Wright employees had left the company to form the new firm and would become Wright's main competition. The same year Wright produced the Whirlwind, 1926, Pratt & Whitney brought the 420 hp Wasp engine into production. It was twice as powerful as the J-5 Whirlwind. Originally designed to military specifications, the Wasp and Whirlwind became popular power plants for commercial aircraft. When marketing its engines for general aviation Pratt & Whitney highlighted the engine's reliability, durability, high safety level, and easy maintenance.[23] Competition between the two companies would lead to continual improvements in engine performance, especially as they vied for Navy contracts.

Close ties between the military and aircraft designers has been an ongoing feature of aircraft manufacturing, particularly in the United States. It was not so much that the

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[23] Bayla Singer, "Engineering Successful Innovation: Pratt & Whitney Aircraft Engines, 1925-1940" in *Innovation and the Development of Flight*, ed., Roger D. Launius, (College Station: Texas A & M University Press, 1999), 132-153. The company also pointed to the enclosed valves, clean nose that allowed good cowling lines, solid master rod and split crankshaft that produced high speed, the divided main crankcase that allowed maximum strength and minimum weight, the accessible and weather proof accessories, the mounting flange on the centre of gravity, supercharger, and lifting hooks on the centre of gravity. Singer, 141.

military developed the technical advancements themselves. Rather, military contracts underwrote manufacturers' research and development, enabling the private companies to achieve important technical developments.[24] The results, radial engines with increased power output, would power the aircraft that explored the Mackenzie Valley.

Ancillary developments also contributed to the jump in engine performance. Engines are made up of multiple pieces and improvements to these elements were essential for overall development. For instance, advances in valve, cylinder, and piston design contributed to increased power output.[25] Other important developments included improvements in fuels. Over the 1920s engine power output increased, but greater power could translate into greater heat, which resulted in burned out valves, cracked spark plugs, and engine knock. Engine knock occurs when the fuel in a cylinder ignites spontaneously, often because cylinder temperatures have risen too high. This spontaneous ignition can produce destructive vibrations, overheating, and a rise in oil pressure, followed by the loss of engine power and destruction of engine parts.[26] In the 1920s, researchers identified fuel composition as one means of controlling engine knock. By manipulating the fuel's chemistry one could reduce the heat generated inside the combustion chamber. In 1921, a General Motors employee identified the value of tetra-ethyl-lead as an anti-knock additive and the United States Navy adopted the additive in 1926, followed by the Army in 1927. One reason for the lag in adoption was the lack of

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[24] Rae, *Climb to Greatness*, 17, 22.
[25] Edward Constant and Miller and Sawers each provide interesting overviews of these critical developments. Edward W. Constant II, *The Origins of the Turbojet Revolution* (Baltimore: The Johns Hopkins University Press, 1980); Miller and Sawers, *The Technical Development of Modern Aviation.*
[26] Stephen L. McFarland, "Higher, Faster, and Farther: Fuelling the Aeronautical Revolution, 1919 – 1945" in *Innovation and the Development of Flight*, 100-131.

a means of measuring a fuel's anti-knock properties. The development of an octane scale answered this need. Another additive, iso-octane, a paraffin, was identified in 1926 by Graham Edgar, but it was rather expensive and so was not immediately adopted by commercial operators. Ronald Miller and David Sawers argue that these new fuels were responsible for the rise in engine power and drop in fuel consumption that occurred between 1928 and 1933.[27] Developments such as improved fuels and engine part design contributed to improved engine performances in the 1920s and 1930s.

While radial engines were important for northern aviation, the movement of air over the cylinders produced significant drag, reducing the aircraft's efficiency. The National Advisory Committee for Aeronautics in the United States would make substantial contributions to the solution of this problem by developing a cowling designed to smooth airflow over and around the exposed radial engine. A British researcher, H.L. Townend had investigated the issue separately, publishing research on what became known as the Townend ring in 1928. This eponymous ring of metal encircled the cylinders, leaving the engine's face exposed. That same year, NACA used its new Propeller Research Tunnel at Langley to conduct investigations into cowling design. Whereas Townend simply ringed the engine, the NACA cowlings covered much more of the power plant. However, because the radial engines depended on airflow to cool the cylinders, NACA concentrated on maintaining good airflow inside the engine. This feature made their design, which became available on production line aircraft in 1929, very popular. It reduced drag by streamlining the engine's external shape while maintaining effective cooling through internal ducting. The cowling resulted in

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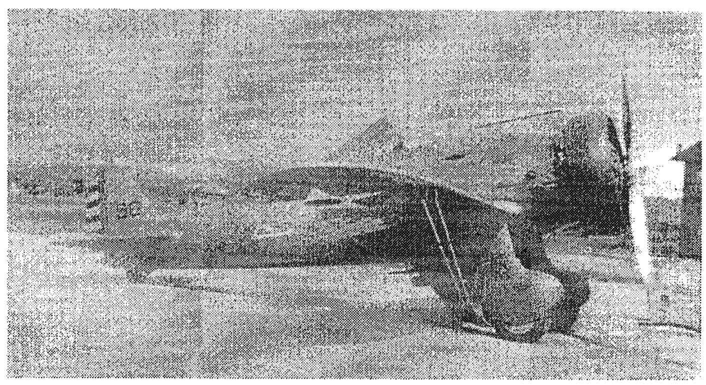
[27] Miller and Sawers, *The Technical Development of Modern Aviation*, chapter 3.

significant performance differences. For instance, the cruising speed of a Lockheed Vega fitted with NACA cowling increased from 135 mph to 155 mph.[28] For commercial companies reducing drag and increasing speed translated into fuel and time savings that both contributed to the company's bottom line and offered important competitive advantages.



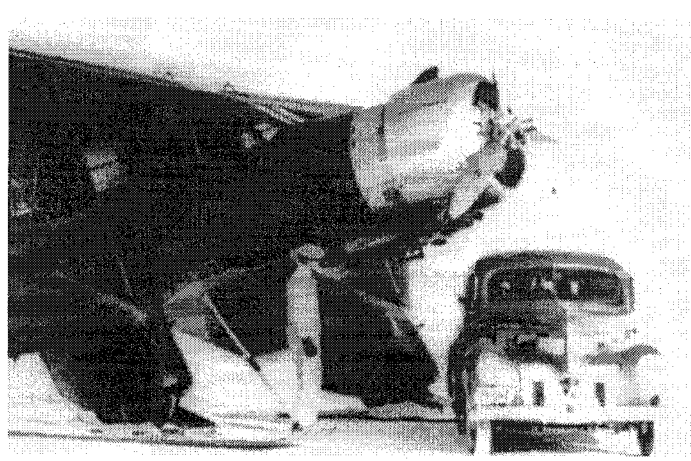


Figure 3.3: Comparison of Townend Ring, and NACA cowling.
As its name suggests, the Townend Ring, *top*, only rings the engine while the NACA cowling, *bottom*, extends back, joining the engine to the nose.
Source: Townend Ring, John D. Anderson Jr., *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002), 224; NACA Cowling, AAM Photo Collection, 202458.

[28] Ibid.

The NACA cowling research reflects the aviation community's growing interest in streamlining. The notion of streamlining or drag reduction had been available to designers since the turn of the century, but they had continued to design boxy, heavy-drag aircraft. Although cantilevered monoplanes helped to reduce drag, the Fokker and Junkers aircraft produced as monoplanes were poorly streamlined. During the 1920s, NACA became increasingly interested in streamlining, using their wind tunnel to conduct tests. However, the research remained largely unapplied. The first commercial aircraft to demonstrate streamlining's value was the Lockheed Vega, 1927. Its cruising speed of 135 mph outstripped the average cruising speed of its contemporaries, 100 mph, due largely to its sleek design.[29] Although bush planes did incorporate cowling and the Norseman would capitalize on its streamlined appearance, bush plane designers of the 1920s and 1930s still tended to produce rough and ready aircraft, rather than sleek airplanes.

In turn, the growing airline industry affected aircraft design. As the airline industry developed and businessmen became involved, aircraft operators developed increasing interest in efficiency of operation. A more efficient aircraft would give a company an advantage over its competitors and would allow it to reduce its costs. Thus, one sees increasing interest in engine development and aerodynamics. For instance, NACA made several important contributions to improved aircraft performance, including the development of a cowling designed to fit over radial engines, smoothing airflow and reducing the aircraft's drag. Important technological changes also came via the military,

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[29] Ibid.

in particular, the development of a new generation of more powerful radial, air-cooled engines.

Along with efficiency, reliability became a watchword in the aviation industry. If operators were to attract customers and keep their airmail and passenger schedules, they needed reliable aircraft. Ford capitalised on this concern with the Ford Reliability Tour, which began in 1926. Modelled on the reliability tours that helped establish the automobile as a trustworthy method of transport, the Ford Reliability Tour was a multi-stage race circling the United States that was designed to separate the aircraft that performed reliably and consistently from those that did not. Unlike other aerial competitions, which focused on remarkable one-time performances, the Ford Reliability Tour showcased aviation as a dependable means of transport. Manufacturers like Anthony Fokker saw it as such and used it as a publicity tour to demonstrate the reliability of their designs.[30]

Of all the spectacular flights that claimed public attention during the 1920s, none had quite the effect of the 1927 flight by a young, clean-cut blond who traversed the Atlantic alone in his plane. Followed by the public via radio and mobbed when he arrived in Paris, Charles Lindbergh became a cultural phenomenon, and some argue that the excitement surrounding his trans-Atlantic adventure sparked the growth of commercial aviation.[31] However, as Dominic Pisano points out, American aviation's growth spurt in the latter half of the 1920s depended on more than Lindbergh's

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[30] Dierikx, *Fokker*.
[31] Joseph J. Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950* (New York: Oxford University Press, 1983); John William Ward, "Charles A. Lindbergh: His Flight and the American Ideal," in *Technology in America: A History of Individuals and Ideals*, Carroll Pursell, ed., (Cambridge, Mass: The MIT Press, 1981).

popularity. Not only had government policies created a positive environment for the industry, military procurement resources contributed to a growing demand for aircraft. The patent suits brought by the Wright brothers had been settled and manufacturers could now produce planes without worrying about possible legal entanglements. The industry was well on its way to rationalization and had observed the manufacturing techniques of the automobile industry. Manufacturers formed an interest group to lobby for their concerns and were now able to draw on the skills of professional aeronautical engineers.[32] While Lindbergh might have made aviation popular, these other conditions were in place before his remarkable flight to Paris.[33] These conditions, in concert with the American government's decision to treat aviation as a business worth supporting, would lead to the development of the large passenger airline companies that would dominate American commercial aviation through the twentieth century.

Canadian Contributions

Canadians themselves made important technical contributions to the evolution of northern flying, primarily in undercarriage design. While the principle of equipping aircraft with skis was not new, during the War, through joint experiments by 44 Wing of the Royal Flying Corps and Canadian Aeroplanes Limited, Canadians developed a sturdy ski that would stand up to rough landings.[34] Later in the 1920s, the Elliot brothers of Sioux Lookout would become important ski manufacturers for Canadian bush planes.

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[32] Aeronautics emerged as a distinct engineering specialty during the 1920s. People had been studying aeronautics and fluid dynamics previously, but not as a distinct field. Bilstein, *Flight in America*, 70.

[33] Dominick A. Pisano, "The *Spirit of St. Louis* -- Fact and Symbol: Misinterpreting a Historic Cultural Artifact," in *Reconsidering a Century of Flight*, 242-262; Rae, *Climb to Greatness*, chapter 3.

[34] S.F. Wise, *Canadian Airmen and the First World War, The Official History of the Royal Canadian Air Force,* Volume I (Toronto: University of Toronto Press, 1980), 97.

When it came to summer-time flying, Canadians also improved on float design. Again, floats themselves were not a new idea, but Canadians would develop their own designs and local manufacturing base in which MacDonald Brothers of Winnipeg would be particularly prominent. These technical developments, in combination with the developments in airframes, engines and wings, would produce the aircraft that enabled northern aviation in Canada. It is not coincidental that Canadian bush transport became firmly established at the same time that the high-wing transport monoplane appeared.

Canadian bush flying had begun using surplus military Curtiss HS-2L flying boats. This type of aircraft was initially very successful in forestry and photographic work, and the Canadian government expressed a belief that the flying boat was best suited to Canadian conditions and work.[35] Given this belief, the government worked together with Canadian Vickers, a subsidiary of the British aeroplane manufacturer, to develop a series of flying boats designed specifically for work in Canada.[36] However well-suited to forestry patrols and aerial surveying, these aircraft with their in-line, water-cooled engines and need for open water, were poorly suited to year round northern operations.[37]

By mid-decade, Canadian aviators recognised they needed another sort of aircraft. The government's annual report on civil aviation for 1925 outlined the requirements:

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[35] Canada, Air Board, *Report of the Air Board for the Year 1922* (Ottawa: 1923), 23.
[36] See Appendix I.
[37] In fact, looking back from 1930, J.A. Wilson would comment, "The early winter services to Rouyn and the Red Lake district suffered from lack of proper equipment." J.A. Wilson, "The Use of the Aeroplane in Mineral Development," presented to the Third Empire Meeting and Metallurgical Congress, South Africa, 1930, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 17: Articles, speeches and paper by Wilson and others, 1926-1947.

> Aircraft with greater range of speed must be produced so that lower stalling and landing speed may be combined with a good cruising speed. A greater proportion of their gross weight must be paying load. Reliable engines must be produced, easy to maintain in operation; using less fuel per horse-power, and cheaper, and what is equally important, less dangerous forms of fuelling.[38]

Even as Canadian needs were changing, technological changes in aircraft manufacturing made a new sort of aircraft available. The high-wing monoplane, along with the air-cooled radial engine, appeared during the same period that Canadians articulated their new needs, and by 1926 Canadian aviators had access to air-cooled engine equipped aircraft with reasonable load capabilities and fair speeds, namely the Fokker Universal and the Fairchild FC-2. The appearance of these designs coincides with the first jump in aerial activity in Canada. These aircraft, with their air-cooled engines and float or ski capabilities, enabled airline companies to establish year-round transport operations into the Canadian Shield, just at the time when the mining industry was expanding into new territories and offering a market for their services.[39]

Although Canadians made several significant contributions to the adaptation of aircraft to Canadian operating conditions, the country's scientists had virtually no role to play in the process. This fact is somewhat surprising because so much of scientific research in Canada and so much of the National Research Council's early work focused on research with practical results.[40] However, there was little support for the Canadian

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[38] Canada, Department of National Defence, *Report on Civil Aviation for 1925* (Ottawa: 1926), 5.

[39] James A. Richardson to Frank Ross, Canadian Vickers, 15 February 1927, CAL Collection, AOM, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg. Feb 18/27 – Sept 23/37.

[40] Richard A. Jarrell and Yves Gingras, eds. *Building Canadian Science: The Role of the National Research Council*, special edition of *Scientia Canadensis* 15:2 (1991); Trevor Levere, *Research and Influence: A Century of Science in the Royal Society of Canada*

aviation industry, in part because scientists were limited by a lack of research facilities. The University of Toronto had the first wind tunnel, which opened in 1918, but it was quite small and could reach a top speed of only 60 mph. The National Research Council only obtained proper research facilities, namely a nine foot wind nozzle and water channel, with the formal opening of the Research Council's laboratories in 1932. With these limitations, until the mid-1930s Canadian scientists could make little contribution to the development of aircraft design in Canada.[41]

A second cluster of new, improved designs appeared by 1928 and supported a second round of aerial expansion. The improvements included more powerful engines, larger cabins, longer ranges, and better cruising speeds. C.H. Dickins, a prominent member of Western Canada Airways' Mackenzie staff, specifically identified the Fairchild 71 and Fokker Super Universal as key designs. With their new 400 horsepower air-cooled engines, the aircraft were more efficient and effective, giving bush pilots increased range and allowing further penetration of the North.[42] According to the government, year-round commercial flying was now possible because of the improved engines, cabins that protected pilots and passengers from the elements, and efficient ski undercarriages that allowed aircraft to exploit frozen waterways much as they used open

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(Ottawa: Royal Society of Canada, 1998); Morris Zaslow, *Reading the Rocks: The Story of the Geological Survey of Canada, 1842-1972* (Ottawa: Macmillan, Department of Energy, Mines and Resources, and Information Canada, 1975); Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto, 1987).

[41] Wilfrid Eggleston, *National Research in Canada: The NRC 1916-1966* (Toronto: Clarke, Irwin & Company Limited, 1978) 53-54; 60-61; Martin L. Friedland, *The University of Toronto: A History* (Toronto: University of Toronto Press, 2002) 262-263.

[42] C.H. Dickins, lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001.

water in the summer.[43] The technical developments in airframe, wing, engine, and accessory designs coalesced to produce the mid-sized transport aircraft that enabled the development of Canadian bush flying during the latter half of the 1920s.

Acquiring Experience

These technical changes were necessary preconditions for the expansion of northern aviation, but they were not sufficient to spark the successful opening of aviation into the farther North. For that to take place, aviators needed to develop a body of knowledge about northern operations, northern conditions, the need for infrastructure, the sorts of services aircraft could supply, and the scale of those potential contributions. Those involved, the pilots, engineers, and customers, also needed to develop the confidence that it could be done.

Canadians were not the only ones experimenting with northern aviation. For instance, Alaska had seen commercial aviation activities since 1922. However, as we have seen, it was different in character from Canadian activities. First, Alaskans most often used wheeled aircraft, with a very few flying boats. The different geographies help explain this divergence. Alaska did not have the same profusion of lakes and rivers as the Canadian Shield, but obviously had ground available on which to build airstrips. This meant that if a town wanted regular services it needed an airfield. This also meant that the pattern of activity was different. Alaskan aviation appears to have been primarily interurban. While aviators did serve mining areas, this happened only in the summer because of a reliance on liquid cooled engines. Winter aviation was put off until 1928

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[43] Canada, Department of National Defence, *Report on Civil Aviation for 1928* (Ottawa: 1929), 18.

when the Detroit News-Wilkins Arctic Expedition brought a Whirlwind equipped Vega to Alaska. The engine had to be adapted to the cold, but the aircraft was able to fly as a ski plane during the winter. By then, Canadian operators had several seasons of winter operations under their belts. In 1929, Alaska had a good set of airfields and was linked to the continental airmail service, but their activities were different from the pattern of aviation in the Canadian North.[44]

As we have seen, Canadian commercial aviation began with forestry operations in 1919. Over the course of the 1920s, the range of these activities expanded across the country, following the mining industry and unfurling into ever more remote regions and ever more demanding conditions. The commercial operations of the 1920s would create a body of experience with and knowledge about the day-to-day conditions of year-round bush operations in many areas of the country. A number of episodes from the 1920s illustrate this learning curve. The experience gained from these successes and failures fed into the growing body of knowledge about bush flying in Canada. This corpus of experience would enable Western Canada Airways to establish permanent, year-round operations along the Mackenzie in 1929.

The **Rene** *and the* **Vic**, *Imperial Oil, 1921*

In the winter of 1921, Imperial Oil wrote itself into Canadian aviation history by sending two Junkers-Larsen monoplanes north across the 60th parallel. Carrying men to Imperial's oil strike near Fort Norman on the Mackenzie River, their trip presaged Western Canada Airways' later development of a commercial air service running the length of the Mackenzie. This episode demonstrates that northern aviation did not

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[44] Robert W. Stevens, *Alaskan Aviation History*, Volumes 1 and 2 (Des Moines, Washington: Polynas Press, 1990).

immediately occur for good reason. It was not just a case of an unfavourable political or economic climate, though this would contribute to the project's ultimate failure. This story illustrates the gaps in knowledge about the technology's limitations, the extreme conditions of winter flying in the North, and the feasibility of using aircraft in those conditions. Though ultimately unsuccessful in using aircraft to support mineral development along the Mackenzie, Imperial Oil's attempt would provide important lessons about commercial operations in the Northwest Territories. The events would reveal crucial information about northern conditions, about the necessity of infrastructure, and the knowledge that ingenuity could help repair aircraft in the field.

As the end of the war and the post-war economic boom freed resources to support oil and gas exploration, Imperial Oil's interest returned to the oil find identified at Fort Norman in 1914. In the summer of 1919, the Northwest Company, an Imperial Oil subsidiary, followed up by sending a drill rig to the site. The crew struck oil on 24 August 1919, and by mid-October, T.A. Link, Imperial Oil geologist, carried news of the discovery south. While pleased with the discovery, the company noted that developing the well would remain uneconomical until the creation of a much better transportation system. As it was, Fort Norman was approximately eight weeks by dog sled from Peace River, Alberta, the nearest railhead. River transport was available, but the season was short.[45] In spite of Imperial's tempered response to the find, rumours began to grow.[46] These rumours incited a small but active and highly public staking rush during the winter

[45] K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, 1975), 42.
[46] *Globe*, Toronto, October 19, 1920.

of 1920-1921, beginning with local trappers and traders, and followed by outside travellers.[47]

Imperial found itself unsettled by the onrushing excitement. Nervous about maintaining control over its northern find and eager to consolidate its operations in the region, it was looking for a means of speedily reaching north. Imperial needed a transportation method that would allow it to bypass the difficulties and time involved in northern travel, and to reach the area before the bulk of its competitors.

A number of individuals outside Imperial Oil speculated that aircraft could serve the area's transportation needs.[48] While none of these schemes ever left the ground, Imperial also identified aviation as a potential solution to its problems. Aircraft promised to leapfrog both the water route and overland trip. Moreover, aircraft equipped with skis would allow an exploration party to reach Fort Norman before the spring thaw that would bring Imperial's competitors north.

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[47] See Morris Zaslow, *The Northward Expansion of Canada, 1914-1967* (Toronto: McClelland & Stewart, 1988), 22 for a description of the staking boom.

[48] For instance, E.L. Janney, Canada's first military aviator, had a fanciful scheme to use dirigibles to navigate the northern gap. More realistically, F.R. McCall, ex-fighter ace, headed a firm that advertised a service that would use two six-passenger flying boats to fly from the railhead at Peace River to Fort Norman beginning 1 May 1921. Wilfred 'Wop' May and associates planned to open the Great Northern Service flying boat operation beginning June 1921, flying from Lesser Slave Lake to Fort Norman.

Unlike other oil companies, Imperial had the resources to support such an endeavour. In 1921 Mackenzie River Oil Ltd. commissioned R.H. Mulock, WWI flying ace, to produce a detailed report on the feasibility of northern aviation. Along with recommending an organizational structure and the use of F.3 flying boats, Mulock produced a cost estimate for the expedition. He reckoned that the use of five aircraft (3 in operation, 2 spare), eight pilots, and eight mechanics would cost a total of $500,000. If one removed Mulock's reserve cushion, one could reduce the cost to $375,000. It was too rich a price for the speculative company, which chose to conduct its 1921 operations using traditional methods of transportation. Imperial Oil, however, had the financial resources to contemplate such a scheme, though theirs developed on a much smaller scale.

Larry Milberry, *Aviation in Canada* (Toronto: McGraw-Hill Ryerson, 1979), 27.

To realise their aim of reaching the field before their competitors, Imperial Oil needed a mid-sized transport that could function as a ski-plane. They also needed an aircraft with good range and good cargo capacity. With these requirements in mind, they chose the Junkers-Larsen JL-6, the designation for the North American version of the Junkers F.13. These German-designed, all-metal, corrugated-skin monoplanes were powered by one 185 horse powered engine, could seat 5 passengers or carry the equivalent weight, approximately 1 ton, and had a non-stop flight radius of 1,000 miles.[49] The model seemed ideal for northern operations, as it could be converted from wheels to skis or to pontoons, making it possible to operate the craft in all seasons and from a variety of bases. Its range, carrying capacity, and winter capabilities all made the JL-6 seem well suited to the environment and task at hand.

During March of 1921, Imperial Oil began preparations, moving two aircraft to the company's base at Peace River, Alberta, and converting them to skis. On 22 March 1921, the planes made the first flight across the 60th parallel during a trip to establish a fuel cache at the Upper Hay River Hudson's Bay post, 190 miles north of Peace River. The group did not make extensive arrangements for fuel caches because they planned to use motorboat gas and oil purchased at the trading posts along the way. However, they were unsure about fuel availability at Hay River. As a result, the company had to establish its own fuel supply by hauling 200 gallons of fuel to Hay River.[50]

The exploration party that left Peace River two days later on 24 March 1921, consisted of Elmer Fullerton, the captain of G-CADP, christened the *Vic*, George W.

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[49] "The Flying Man in Industry," *Imperial Oil Review* (1921): 7, 15.
[50] Elmer G. Fullerton, "Pioneer Flying in the Canadian Sub-Arctic," *Imperial Oil Review* (1921): 26-30.

Gorman, piloting G-CADQ, also known as the *Rene*, William Hill and Pete Derbyshire as mechanics, H.W. Waddell, surveyor, and Sergeant Hubert Thorne, Royal Canadian Mounted Police (RCMP), who acted as a guide while returning to his post at Fort Norman.[51] Between 24 and 27 March, a fierce blizzard forced the company to remain at Fort Vermillion, only 40 miles from Peace River. Departing after the storm, the group decided to refuel at Vermillion, using regular gas and bypassing the cache of aviation fuel at Hay River. This decision would later cause serious problems, demonstrating the importance of infrastructure for successful northern aviation.

On 28 March 1921, the expedition continued on to Fort Simpson, located at the junction of the Mackenzie and the Liard Rivers. There, the serious difficulties began. On reaching the post, the pilots discovered that the ice on the Mackenzie was a jumble of contorted hummocks utterly unsuitable for landing an aircraft. Instead, the pilots decided to land on a field near the post. While landing, the *Rene* broke through the heavy snow crust and nosed over, breaking a ski and its propeller. The *Vic*, which had landed safely, was then flown to a near-by inlet that offered a safer, smoother landing area. As he was flying to the inlet, Fullerton noticed that the plane's engine was producing a knocking sound, most likely because of the build up of excessive carbon deposits from the low-grade fuel acquired at Vermillion. This discovery meant the *Vic* was also unserviceable.[52]

Thus, the party found themselves stranded at Fort Simpson with two partially damaged planes, 500 miles from their supplies and 300 miles from their objective. They

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[51] According to Larry Milberry, Thorne was the first member of the RCMP to use an aircraft in the line of duty. Milberry, *Aviation in Canada*, 28.

[52] At this point, the story becomes more difficult to trace. The recollections of the participants conflict, and those involved are now deceased. K.M. Molson's discussion of the flight in *Pioneering* provides good coverage of those differences. What follows covers the agreed-on essentials.

made the decision to fit the *Vic*'s skis and propeller to the *Rene* and to continue their journey. Although the transfer was successful, the take-off was not and the plane came down hard while attempting to lift off, resulting in a broken propeller, damaged wing, and wrecked undercarriage.[53] Now both planes were damaged and, as Fullerton pointed out, it would have been five months before replacement parts could be shipped in on the summer steamboats.

The problem seemed insurmountable until Walter Johnson, a Hudson Bay employee at the fort, suggested that he could make a new propeller to replace the damaged one.[54] Using sleigh boards from the Hudson Bay Company's stores and moose-glue, William Hill and Walter Johnson used the Roman Catholic mission's workshop to construct a new propeller. This process was extremely difficult and time consuming, as Hill and Johnson worked long hours for eight days.[55]

On 22 April, the propeller was fitted to the *Rene*, tested for 'track', and found to be less than a quarter of an inch out, reducing concerns about excessive vibration.[56] The propeller withstood the forces from full engine revolutions with no signs of splitting, cracking, or strain. These positive signs were confirmed with a satisfactory air test. Expecting the spring break-up any day, the group decided it was inadvisable to continue

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[53] Elmer Fullerton to Frank Ellis, 14 November 1957, Frank Henry Ellis Collection, WCAM.

[54] Philip H. Godsell to [the Manager, Public Relations, The Imperial Oil Company] Toronto, 5 February 1955, Frank Henry Ellis Collection, WCAM.

[55] William Hill, quoted in Milberry, *Aviation in Canada*: 29; Fullerton to Ellis, 17 March 1958, Frank Henry Ellis Collection, WCAM; Fullerton, "Pioneer Flying"; There is confusion amongst the recollections and secondary accounts regarding the precise dates of the trip, the date on which the propeller was completed, and what happened to the *Rene* during this period.

[56] Track refers to the path the propeller follows as it rotates. Each blade tip should follow the same path. If the paths do not match, the propeller will vibrate, often causing structural damage to the airframe.

on to Fort Norman with the ski equipped plane and instead decided to return to Peace River, leaving Derbyshire behind with the *Rene*.

On 25 April 1921 the four men flew straight from Fort Simpson to Peace River, a distance of 510 miles, in 6 hours of non-stop flying. It was a trip that ordinarily would take between 4 and 6 weeks of hard overland travel by dog team.[57] As the *Imperial Oil Review* noted,

> one continuous flight south, following the straight line the wild goose takes, jumping five hundred and ten miles between breakfast and lunch, and landing safely and in perfect order, shows that air travel into the north is feasible. Between the points the aeroplane spanned in its six-hour homeward flight, the fastest time by dog team is forty-five days.[58]

In spite of the difficulties, delays, and ultimate failure of the team to reach Fort Norman, Imperial Oil remained positive about the potential contribution of northern aviation. In fact, the company was sufficiently convinced to authorize a second aerial expedition later that spring.

The second Fort Norman expedition left Peace River on 27 May 1921, including Fullerton, Hill, Waddell the surveyor, and Theo Link, Imperial Oil geologist. Aside from minor delays at the beginning, the trip from Peace River to the fort proceeded relatively smoothly. When the group reached Fort Norman, landing on the Mackenzie caused grave complications. As Link described it:

> Fullerton had the machine up about 3500 ft when we sighted Ft. Norman, (thus showing we were well under the Maximum load), and after a few banks, tried a landing on the Mackenzie River which was about as smooth as glass… We hit the water in the same fashion in which all other landings were made, but on the second jump the machine came to a sudden stop. For a minute Bill and I wondered what had happened. Immediately I climbed out and to my great astonishment saw the right

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[57] Fullerton, "Pioneer Flying".
[58] "Flying Across the Edge of the Great Unknown," *Imperial Oil Review* (1921): 4-6, 6.

> pontoon smashed almost beyond recognition floating some yards behind us. Almost simultaneously the right wing began to fill with water and sink. For a few moments it looked as if the whole machine would sink straight to the bottom. However as luck would have it, the left pontoon was without a scratch and held that part of the machine up, while the right wing dragged by the current on the bottom of the river, which was at a depth of about 10 feet. After the machine had settled the lower part of the cabin had filled with water, and about half of our baggage had become water soaked.[59]

Fort Norman's inhabitants rescued the plane and its passengers, sending out two canoes to collect the baggage and passengers and to attach a rope to the aircraft. The plane was then pulled ashore with the bottom wing scraping over the river's rocky bottom, badly damaging the right wing tip. The right pontoon was smashed, but the struts were still in perfect condition. Once on shore, the Imperial Oil party, with the aid of nearly all the people at the post, managed to raise the right wing high enough to slip a scow under the undercarriage, replacing the damaged pontoon. 3 June saw the plane humiliatingly towed down river to the oil well at Fort Norman.

With both planes out of commission, repairs had to wait until replacement parts could be shipped north by boat. In early August, almost two months later, Hill and Derbyshire repaired the *Vic*. The air test was successful, carrying A.W. Harris, Imperial Oil's superintendent of Arctic operations, Link, and Waddell on a flight over the entire area Link's exploration party had covered in the 1921 season. With the *Vic* restored to health, Hill went south to work on the *Rene*. On 6 August, Fullerton, Gorman, Derbyshire, Mr. McKinnon from Imperial Oil, and Chester A. Bloom from the Calgary Herald, all flew to Fort Simpson. By 21 August, both the *Vic* and *Rene* left Fort

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[59] Theo A. Link, Fort Norman, to Tronson Draper, 7 June 1921, Frank Henry Ellis Collection, WCAM.

Simpson. Arriving at Peace River, the *Vic* landed safely, but *Rene* hit a submerged log and capsized.

After this anti-climax, Imperial Oil decided to abandon its northern air wing. Surprisingly, it was not because of the technical difficulties. Despite these technical mishaps, Imperial Oil remained positive about aviation. After the spring flight, Link concluded, "the aeroplane could be used to a great advantage in geological work, and in the stretch from Simpson down to here I saw many important things which would require months of hard labour to reach by the old way."[60] Link noted that the aircraft had covered the distance between Peace River and Fort Vermillion in only 2 hours and 35 minutes, a trip that had taken Link 33 hours running time by boat. The next leg, between Vermillion and Fort Smith, a day trip for the aircraft, had taken Link a month the previous year, with eight days spent navigating the Vermillion Chutes.[61] These experiences led Link to believe that aircraft offered speedy and easy travel, important advantages when considering northern mineral development.

However, Imperial had ventured much by sending these two lone aircraft into a northern winter, and perhaps their experiment could have continued longer if the well had proved economical to develop. The Mackenzie River oil rush that provided the justification for these flights had taken place within the context of Canada's post-war economic boom. However, the boom turned to bust at almost the same time that Imperial's planes took off for the North. Inflation during the late war and immediate post-war period led to a situation in 1920 wherein people abruptly stopped buying. This sent the Canadian economy into dramatic collapse and began the severe economic

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[60] Ibid.
[61] Theo A. Link, "Fort Norman or Bust," *The Imperial Oil Review* (September 1921): 3-6.

depression of the early 1920s, a depression that would continue until at least 1926.[62] Under these circumstances, mineral exploration was essentially on hold. The oil at Fort Norman was incredibly far from any market and therefore uneconomic to develop. Thus, the Mackenzie oil rush never materialized. In the end, only 360 oil and gas claims were staked and only four drilling outfits imported in 1921, three by Imperial and one by the Fort Norman Oil Company of Toronto.

Imperial Oil's 1921 flights demonstrated that a serious gap existed in knowledge about northern flying operations. While aircraft had been successfully used in forestry since 1919, these flying boats operated only in the summer and were therefore subject to less arduous conditions. In fact, Canadian aviation historian Lorne Manchester argues, "winter flying in the far north was avoided in the 1920's [sic] when at all possible. The extremely low temperatures, high winds, storms and low visibility created extremely hazardous flying conditions."[63] The pilots and operators had no experience with northern winter flying and were unaware, for instance, of the ice conditions on the Mackenzie River. Moreover, the lack of appropriate infrastructure meant the party was ill-equipped to deal with mechanical malfunctions on route. On the other hand, the events demonstrated the ingenuity and resourcefulness that would continue to characterise northern aviation. They were all experiences subsequent operators would learn from. When it began its operations, Western Canada Airways would carry materials for field repairs and would establish its own fuel caches along the route, but it would continue to

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[62] Michael Bliss, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto: McClelland & Stewart, 1987), chapter 14.
[63] Lorne Manchester, *Canada's Aviation Industry* (Toronto: McGraw-Hill, 1968).

rely on the ingenuity of its pilots and engineers to ensure the airline's smooth functioning.

Arctic Expedition, 1922

While aircraft would not penetrate the Mackenzie region again until 1926, aviation was an important component of the Canadian government's Arctic Expedition of 1922. R.A. Logan's fact-finding mission on behalf of the Canadian Air Board and the optimism of his subsequent report reflect the Air Board's interest in finding uses for aircraft in the remote areas of the Dominion. It also reflects a recognition of the need for greater knowledge about the North before the government undertook any flying in the area.

During the early 1920s the Eastern Arctic fur trade recovered from a wartime slump and, as it expanded, drew more white trappers to the region. With these men came guns and an increased number of reported violent crimes. At the same time, the government was becoming concerned about arctic sovereignty, as Denmark appeared to ignore Canadian claims to Ellesmere Island. Although the sovereignty crisis eased in 1921, the Canadians decided to send an expedition to the Arctic archipelago in the summer of 1922. This patrol would reinforce Canadian sovereignty claims by touring the Eastern Arctic and address the growing levels of violence by establishing two RCMP posts.[64]

Under the Northwest Territories Branch of the Department of the Interior's administration and led by J.D. Craig, Dominion Land Surveyor, the 43-man expedition

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[64] Zaslow, *Northward Expansion of Canada*, chapter 1. See also Nancy Fogelson, *Arctic Exploration and International Relations, 1900-1932*, (Fairbanks: University of Alaska Press, 1992).

left Quebec City on 18 July 1922 aboard a Canadian Government steamship, appropriately christened the *Arctic*. Included in the expedition was Squadron Leader R.A. Logan, an instructor with the Canadian Air Force.[65] Logan was there to collect information about northern flying conditions, a subject about which little was known.[66] The Department of the Interior had originally requested the Air Board's assistance in providing aerial surveying support for the expedition, but a lack of financial resources combined with a dearth of knowledge about local flying conditions scuttled that plan. Instead, the Air Board sent Logan, a man with experience in surveying, meteorology, aerial navigation, and wireless work, on a fact-finding mission.[67]

After the voyage, which visited Baffin, Bylot, Ellesmere, and North Devon Islands, and established RCMP posts at Craig Harbour and Pond Inlet, Logan seemed optimistic about the use of aircraft in the far North. The Canadian Air Force pilot identified several possible contributions from aircraft, not least of which was the development of northern and arctic flying bases to defend Canada from a northern attack. Other uses included linking northern government outposts, resource exploration and management, topographical and geological surveys, collection of navigation information for marine shipping, and support for the RCMP. Logan recognised that it would be some time before commercial development would reach the far North, but he believed that the government should take a pioneering role. He also identified several promising sites for northern aerodromes, although, as he admitted, the expedition's schedule prevented him

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[65] Canada, *Report of the Air Board … 1922*, 50-52; Bernard Shaw, *Photographing Canada from Flying Canoes* (Burnstown: General Store Publishing House, 2001), 41-43.
[66] R. A. Logan, "Report of Investigations on Aviation in the Arctic Archipelago carried out during the summer of 1922," Robert Archibald Logan Fonds, NAC, MG 30 B 68, vol.s 1 and 2.
[67] Canada, *Report of the Air Board … 1922*; Shaw, *Photographing Canada*.

from conducting detailed investigations of most of the sites. In fact, Logan had to make many of his observations from the ship's deck using field glasses. Based on the observations that he could make, Logan believed that aircraft equipped with wheels and skis could find many places to land in the Arctic and could make significant contributions.[68]

In spite of his optimism, Logan did recognize that Arctic flying would encounter several obstacles. While the ice and land provided suitable winter landing spaces, during much of the winter flying would be limited because of a lack of daylight. However, the availability of 24-hour daylight during the summer would offer compensation. The cost of northern operations was of greater concern. Logan was keen to identify locations close to local fuel supplies, in part because he recognised that shipping supplies for a base, including a year's supply of aviation fuel, would be extremely expensive. Nevertheless, Logan believed that the right sort of aircraft, namely a wheeled or ski-equipped plane capable of carrying approximately 1000 lbs over distances of 300 miles or more, and powered by an air-cooled, radial engine, could operate well in the Arctic. Most strikingly, Logan did not believe that the cold would be an impediment to northern operations.[69] It was an overly optimistic conclusion, as Western Canada Airways' experience along the Mackenzie would later show.

The Canadian Arctic Expedition of 1922 took place against the backdrop of international relations made increasingly complex by a parade of polar expeditions by men from countries other than Canada. While the public hailed these men as romantic heroes, the Canadian government was concerned about the implications for national

[68] Logan, "Report of Investigations."
[69] Logan, "Report of Investigations"; Canada, *Report of the Air Board ... 1922.*

sovereignty. Aviation contributed to this complexity. With the technical developments of World War One, especially in aircraft design, the Arctic acquired new strategic and economic importance as the territory now lay open to economic development and to potential aerial attack. Interest in the area encouraged the Americans to collect more information about Arctic flying, specifically through the United States Army Air Force's expedition from New York to Nome, Alaska, in 1920. Plans for a follow up expedition using the dirigible *Shenandoah* were shelved in 1924. Arctic expeditions by others, and the fear that new landmasses might be discovered in the polar regions exacerbated Canadian concerns.[70] Against this canvas, Logan's urgent calls for the government to establish arctic airbases appears as a strategic response to the international tensions brewing in the 1920s.

Despite Logan's optimism, aside from a cluster of exploratory flights in the mid-1920s, there was little Arctic aviation, either governmental or commercial, until much later. Although polar flights appeared to be quite fashionable between 1925 and 1930, Arctic aviation remained a chancy, unreliable business. In the mid-1920s aircraft technology was not sufficiently developed to allow it to perform reliably under harsh arctic conditions and many of the polar aerial expeditions suffered accordingly. For instance, in 1923, Roald Amundsen, who had been interested in Arctic aviation since before the war, made an unsuccessful attempt to use aircraft on an Arctic expedition. His endeavour to use Curtiss and Junkers planes ended in forced landings and necessitated the expedition's cancellation.[71] Two years later, in 1925, Donald MacMillan and Richard Byrd undertook an expedition to explore Baffin, Axel Heiberg, and Ellesmere Islands,

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[70] Fogelson, *Arctic Exploration.*
[71] Ibid., 129.

and the North Greenland ice cap. Persistent bad weather and engine trouble plagued their efforts to use aircraft to speed surveying of these areas and, when all of the spare parts had been used, MacMillan was forced to curtail the use of his aircraft.[72] That same spring, Amundsen and Lincoln Ellsworth used two Dornier flying boats as part of their Arctic explorations. Unfortunately, the engine of one aircraft failed, forcing it to land in an open lead. When the second plane attempted to land, it bellied out on the ice. Amundsen, Ellsworth, and their party spent three weeks repairing the least damaged plane with spare parts cannibalized from the other aircraft and chopping a runway out of the ice using only small hand tools.[73] In 1926, flying from Spitsbergen, Norway, Byrd made the first successful flight to the North Pole, using a Fokker tri-motor aircraft.[74] Right behind him, Amundsen and Ellsworth made the first transit of the polar sea on the dirigible *Norge*, captained by Umberto Nobile, flying from Spitsbergen, Norway, to Point Barrow, Alaska.[75] Two years later in 1928, Eielson also reached the Pole using a Lockheed Vega.[76]

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72 Ibid., 90-96.

73 Beekman H. Pool, *Polar Extremes: The World of Lincoln Ellsworth* (Fairbanks: University of Alaska Press, 2002), 39-73.

74 It should be noted that the legitimacy of Byrd's claim is now strongly questioned.

75 Pool, *Polar Extremes*, 99-123; Fogelson, *Arctic Exploration*, 135; Two years later, in 1928, Nobile would attempt to retrace the *Norge* voyage. During the expedition his airship crashed and Amundsen disappeared during the search and rescue efforts. For a first-hand description of Amundsen's trans-polar flight see Roald Amundsen and Lincoln Ellsworth, *The First Flight Across the Polar Sea* (London: Hutchinson and Co., 1927). This memoir also contains chapters written by H.J. Riiser-Larsen, First Lieutenant in the Norwegian Navy, second in command of the *Norge* and the expedition navigator, describing air navigation near the pole (chapter 10) and the expedition's reasons for selecting an airship over an aeroplane. These arguments derived largely from the fact that, unlike an aircraft, an airship will remain airborne even if its motor ceases to operate: see chapter 12. In his autobiography, Lincoln Ellsworth describes both the team's ill-fated attempt to reach the Pole by aircraft in 1925 and the *Norge*'s successful trans-polar flight. Lincoln Ellsworth, *Beyond Horizons* (New York: Doubleday, Doran and

Though these expeditions tended to highlight the technology's fragility, they provided valuable information about Arctic conditions. For instance, Amundsen and Ellsworth first experience with Arctic flying revealed the treacherous nature of polar sea ice, which was a pile of ridges and blocks, not the smooth surface it appeared from the air. Aerial expeditions also revealed that there were no unknown landmasses that would complicate Arctic sovereignty issues.[77] As aircraft design developed, interested parties would be able to prosecute aviation in the far North with increasing regularity. One need only consider the later success of the Hudson Strait expedition for evidence of this development.

While a lack of economic activity restricted commercial aviation in the Arctic, the information Logan obtained would prove important. Not only did his report promote the use of aircraft in the North and contribute to a general optimism about this possibility, it also materially contributed to the government's aviation activities along the Hudson Strait in 1927-1928. A body of knowledge about aviation in northern conditions was growing steadily.

Company Inc., 1938). Roland Huntford's excellent study of Robert Scott and Roald Amundsen gives only a brief treatment of Amundsen's polar flights, placing them in the context of the explorer's need to revive his reputation after Scott's death in Antarctica. Huntford also argues that Amundsen's need to maintain that reputation drove him to set out to rescue Umberto Nobile, the expedition that ultimately led to his death. Roland Huntford, *Scott and Amundsen* (London: Hodder and Stoughton, 1979), 569-579; this book is now published under the title, *The Last Place on Earth.*

[76] Molson, *Pioneering*, 5; T.M. Reid, "Search for Carl Ben Eielson," *CAHS Journal* 3:2 (Summer 1968): 36-41.

[77] In fact, as the focus shifted to trans-Arctic flights and as aircraft acquired longer ranges, Canadian concerns about their arctic sovereignty lessened. See Fogelson, *Arctic Exploration.*

Northwest Territories Surveys, 1926

During the second half of the 1920s, the Canadian mining industry extended its interest farther and farther into the Shield. As part of this expansion, the Northern Syndicate sent a party into the Northwest Territories in 1926.[78] It would be an example of a successful northern operation. Piloted by C.S. "Jack" Caldwell and crewed by Irenée Vachon, G-CAEB crossed the territories' border on 30 June 1926 at 8 pm. As Vachon remembered, "The object of this expedition was no doubt mining. The idea was good, but due to lack of organisation, it was a failure."[79] While the expedition, which used a Vickers Viking Mark IV, an amphibious version of the flying boat powered with a Napier Lion Aero engine, did not produce significant mineral finds, it was technically successful. After having been sent from Sault Ste. Marie to Edmonton for overhaul, the airplane was shipped to Lac la Biche for final assembly. On the 22 June, Caldwell and Vachon flew to Fort McMurray and on to Fort Fitzgerald on the 23rd. There they met their passengers, Mr. Dunn, Mr. Pollan, and Mr. Meakel, land surveyor, who had travelled to Fitzgerald by Hudson Bay riverboat along with their supplies.

The operation began by establishing gasoline caches on 30th June. Vachon noted,

> Most of our flying was done in evening with return flight before midnight. The reason of this was having no maps (this place [the area south east of Great Slave Lake] was called the blind spot of Canada), the evening being good and quiet, no wind, we could make a fair and accurate estimate (depending on our Air Speed Indicator) how far we had travelled in and out on each flight.[80]

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[78] Canada, Department of National Defence, *Report on Civil Aviation for 1926* (Ottawa: 1927), 27-29.
[79] Irenée Vachon to Frank Ellis, 7 May [no year], Frank Henry Ellis Collection, WCAM.
[80] Ibid.

Surveying and exploration continued until 15 August when operations ceased because "the weather was getting bad and nights were fairly cold especially in the Barren Land."[81] Unfortunately, the activities yielded no mineral discoveries. On returning to Fitzgerald, the company instructed Vachon and Caldwell to take the airplane to Edmonton and then to the High River RCAF station, where the aircraft landed on 4 September 1926, ending the expedition.[82] While the operation did not identify worthwhile mineral deposits and would remain an isolated event, these activities showed that, in contrast to Imperial Oil's experience, well-supported aircraft could operate successfully in the far North and provide useful services to mineral developers.

Activity Around Hudson Bay, 1927

In 1927, Northern Manitoba became a centre of extensive aviation activity. The federal government had decided to open a port at Churchill on the shores of Hudson Bay. This project had two components: the construction of a seaway and port and the building of a railway to carry grain to the port. Aviation would make significant contributions to both of these projects and in the process Canadians would gain important experience flying in extreme weather conditions. The activities in connection with the railway construction would reveal the extent of aviation's usefulness.

Use of the port at Churchill would depend on the ability of ships to navigate the Hudson Strait between the Ungava Peninsula and Baffin Island. The main purpose of the 1927 Hudson Strait expedition organized by the Canadian government was to assist in establishing this navigation route. The expedition was to ascertain the length of the

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[81] Ibid.
[82] Irenée Vachon to Frank Ellis, 25 February 1946, Frank Henry Ellis Collection, WCAM.

navigation season into the bay and patterns of ice movement in the area. Leaving Halifax in July 1927, the crews spent a year conducting over 200 daily aerial patrols in six open-cockpit Fokker Universals.[83] The fact that these men conducted these flights during the winter in open-cockpit planes is a testament to their fortitude and their operations during this period built up experience with flying in the North during the winter.

Back in Manitoba, aviation would play a significant role in building a railway that would carry freight to the port at Churchill, transporting workers and supplies for the railway's construction. It was a large job, and, somewhat surprisingly, Western Canada Airways was the only company to tender for the contract.[84] Using two Fokker Universals, over a period of three weeks the company carried 12 men and 15,000 lbs of material to Churchill from Split Lake on the Hudson Bay railroad.[85] Not only did the airlift advance the terminus' construction by approximately nine months, the project also demonstrated that aircraft could be used to transport large quantities of supplies safely and effectively in the Canadian North. It provided insight into the scale of contributions that aircraft could make to northern development, piquing the interest of mining developers.

Barren Lands Flying, 1928

Another jump in general knowledge of northern aviation came with C.H. "Punch" Dickins' pioneering Barren Lands flight of 1928. That summer, Colonel C.D.H. MacAlpine, the President of Dominion Explorers Limited, chartered a plane from

[83] Frank H. Ellis, *Canada's Flying Heritage* (Toronto: University of Toronto Press, 1962); Shaw, *Photographing Canada.*
[84] Molson, *Pioneering*, 23.
[85] G.A. Thompson, memo, ca. 1930, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence post-1918-June 1929.

Western Canada Airways. Piloted by Dickins and crewed by W.B. Nadin, flight engineer, the new Fokker Super Universal, G-CASK, carried MacAlpine and Richard Pearse, the editor of the *Northern Miner*, on a flight of just less than 4,000 miles. While Pearse was looking for first-hand news of the country for his paper, MacAlpine was inspecting Dominion Explorers parties prospecting along the western shore of Hudson Bay. The group left Winnipeg on 28 August 1928, flew through northern Manitoba to Churchill, and from there, north along the shore of the bay, stopping at prospecting camps. At Baker Inlet, Northwest Territories, they turned inland, flying across the Barren Lands, aiming for Fort Fitzgerald on the Slave River.

The plane had performed well throughout the flight, but during the morning they were flying to Fitzgerald, the engine suddenly went silent. Dickins glided the plane onto the Slave River and drifted up to the muddy bank. It turned out that the gas gauge had frozen in the night and had incorrectly indicated a full gas tank that morning. Instead, they had run out of gas in the middle of the bush. Like a good bush pilot, Dickins made a fire and brewed some tea. While the group sipped their tea and pondered their next move, one of the serendipitous twists of northern fate occurred.

Heralded by the chugging sound of its motor, one of the Mackenzie River steamers appeared around a bend in the river, pushing a barge of freight. Seeing the party waving on the bank, the Captain pulled the boat into shore and asked if they were all right. Dickins replied that they were all fine, but asked, did the Captain happen to have any aviation fuel on board? The Captain answered that he had several drums, all for some fellow, Dickins, who thought he would fly an airplane into the North. After laughing at their good fortune, the crew refuelled the plane and continued on their way to

Fort Smith, located just north of the rapids from Fort Fitzgerald. From there, they flew across northern Saskatchewan and on to Winnipeg, completing their counter-clockwise circuit.[86]

The expedition made a number of contributions to the development of northern flying. The trip had covered 3,960 miles of largely unmapped country in 37 hours flying time spread over 12 days. The ability to do so relatively unscathed helped build confidence in the aircraft's ability to operate in the North. The flight also demonstrated aviation's usefulness for mining and mining development companies. MacAlpine reckoned that a similar trip would have taken two years travelling by boat, canoe, dog team and on foot and would have cost twice what it cost to charter an aircraft. According to Dickins, the experience of operating the aircraft in the area and its cost effectiveness convinced him that the idea of opening air service into the North was not so crazy after all.[87] While all of these northern activities provided more information about flying north of 60° latitude, they did not provide enough information about winter flying – a fact Western Canada Airways would discover when it initiated its northern operations in 1929.

CONCLUSION

The sort of aviation Dickins and other pilots were pursuing in the Canadian North was very different form aviation in Europe and the United States, largely as the result of

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[86] C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001; C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-002.

[87] C.H. Dickins, "Across the Barrens", *CAHS Journal*, 8:1 (Spring 1970): 22-24; C.H. Dickins, "The Barren Lands Flight Fifty Years Later," *CAHS Journal*, 21:2, (Summer 1983): 56-63; C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001; Fred W. Hotson, "Punch," *CAHS Journal*, 32:2 (Summer 1994): 40-48.

local conditions. Unlike the United States and European governments, in Canada the government's unwillingness to offer financial support to commercial aviation, which grew out of its previous experience with railway development and its acknowledgement of the realities of the Canadian condition, had encouraged commercial aviation to develop a close relationship with the niche markets that could support its development, namely the resource industries.

The ability to pursue this relationship depended on the development of aircraft technology that enabled northern aviation, such as air-cooled engines. As aviation supported forestry and then mining development, aviators developed a knowledge-base regarding northern flying. These conditions, in combination with other circumstances, including economic conditions and further technical developments, would lead to Western Canada Airways' decision to open regular commercial service down the Mackenzie River in 1929.

Developments between 1919 and 1929 established the pattern of Canadian bush flying practice. At the same time, technical modifications and growing experience with northern aviation laid the foundations for Western Canada Airways' Mackenzie expansion and produced the forerunners of the Canadian bush plane. Increased knowledge and better adapted technology encouraged Western Canada Airways to move north into the Mackenzie where the interaction between northern use conditions and the aircraft would catalyse a series of technical changes that would ultimately lead to the creation of the indigenous Canadian bush plane.

4 – A New North: Expanding into the Mackenzie, 1929-1932

In the morning cold of 23 January 1929, C.H. "Punch" Dickins, Western Canada Airways pilot, and Louis "Lew" Parmenter, aircraft engineer, lifted off from Waterways, Alberta in their Fokker Super Universal, G-CASN. Their one passenger was T.J. Reilly, Postal Inspector. Over four days the crew flew from Waterways to Fort Smith, Fort Fitzgerald, Fort Resolution, where they left Reilly, Hay River, Fort Providence, and Fort Simpson where the crew collected their second passenger, "Rags" Wilson, and a load of furs. After a successful trip down the Mackenzie, on 27 January Dickins turned the plane for home, heading to Fort Resolution to collect Reilly. It had been a smooth journey, confirming Dickins' belief that aircraft service along the Mackenzie had a bright future.

Despite the success of its northbound trip, when the plane reached Fort Resolution on its return journey, the legs gave way on landing and as the aircraft collapsed to the ground, the propeller blades were bent. Demonstrating the resourcefulness of many bush plane crews, Dickins and Parmenter spent four days repairing their craft. They "fixed [the legs] by straightening [them] as much as possible then cut off the cracked parts and inserted water pipes inside and riveted [them] into place."[1] Unfortunately, the propeller could not be straightened and the blades had to be cut off above the damage, approximately 18 inches from the tips. After effecting these repairs, the plane and crew

[1] C.H. Dickins to W.L. Brintnell, 2 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – Mar 1929.

arrived back in Waterways on 2 February 1929.[2] In spite of the unfortunate technical difficulties, these flights marked a watershed in Mackenzie District transportation. While there had been other flights in the region prior to 1929, Western Canada Airways was the first company to offer regular, commercial air transport in the region. Others would soon follow, but Dickins' January flight was a decisive moment.

Establishing the service was a gamble, but one the airline felt justified in taking. Not only had company executives identified a series of business opportunities in the North, given the fleet's successful performance on southern bush routes, they had also acquired solid confidence in their aircraft. However, the company and its staff would quickly discover that the Mackenzie environment was harsher than the provincial norths of Western Canada Airways' previous experience. In fact, winter conditions were so extreme that the undercarriages of the Fokker Super Universals used along the river could not withstand them and failed repeatedly. This encouraged the company to work closely with the aircraft's manufacturer to develop a set of adaptations that would allow aircraft to function in northern conditions. Despite these efforts, the Super Universals' limitations would become especially clear when compared to the competition's operational experience with its fleet of Bellanca Pacemakers. Throughout this period, the Mackenzie's geography was a strong influence on both the technology and on Western Canada Airways' transportation system. Reviewing the history provides insight into how users transplant technologies into new environments and subsequently adapt them to local conditions.

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[2] K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, 1975), 62.

Moving Into a New North

When C.H. Dickins returned from his Barren Lands flight in 1928 he felt convinced that aircraft could successfully provide transportation services into the Mackenzie, an idea that had interested him for some time.[3] Clennell Haggerston "Punch" Dickins was born in 1899 in Portage la Prairie, Manitoba. The family moved to Edmonton when "Punch" was still in elementary school, and after graduating from high school, he enrolled in mechanical engineering at the University of Alberta in 1915. During his second year, the young Dickins withdrew from school to join the Canadian Expeditionary Force. By April 1918, he had transferred to the Royal Air Force where, at 19, he earned a Distinguished Flying Cross for the gunnery skills that helped him bring down seven enemy aircraft. After the war, Dickins briefly returned to civilian life before joining the Canadian Air Force in 1921. Working in northern Alberta, Dickins did aerial photographic work out of High River and participated in the winter testing of Siskin aircraft. In 1927, he left the Air Force and at the beginning of 1928 joined the staff of Western Canada Airways, moving to Gold Pines, Ontario with his young wife, Connie. As part of the staff, Dickins piloted the famous Barren Lands flight in 1928, an experience that reinforced his long-standing desire to establish air service into the North. As Dickins put it, "I had grown up in Edmonton and gone to school there, and this Mackenzie River and the north country did have an attraction to me."[4]

After starting the Mackenzie River service Dickins would go on to become an important manager in Canadian Airways Limited and other Canadian aviation companies.

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[3] C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001.
[4] C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-002.

Following the creation of Canadian Airways, Dickins became Superintendent of the Mackenzie District and in 1935 became General Superintendent, Northern Operations. Later, he would become General Manager and Vice President of Canadian Airways' progeny, Canadian Pacific Air Lines. In the late 1940s, he joined the staff of de Havilland Canada and was instrumental in collecting and responding to bush pilots' requests for the design of the famous de Havilland Beaver. In 1964, he became Executive Vice President of de Havilland Canada and Assistant to the President. He retired in 1965 and died in 1995 at the age of 96.[5] A later review of Dickins' life claims that before leaving the Royal Canadian Air Force he wrote to the Canadian Pacific Railway suggesting that they start an airline to serve the North. This letter was then forwarded to James A. Richardson, Western Canada Airways' president and founder.[6] While the extent of his influence is unclear, Dickins' attitude to the North was likely a catalyst for the company's northern expansion.

While Dickins' impetus was important, the ultimate decision lay with Western Canada Airways' executives and before the company could expand into the Mackenzie, they had to see it as an attractive option. Though the company kept copious notes on many subjects, the record of why the executives authorized the airline's northern expansion, if it ever existed, has been lost. That said, some of the corporation's reasoning can be pieced together from the records that remain. Examining the decision offers suggestive insights into the process of technological transplantation.

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[5] Jim Farrell, "Punch and Connie," *Edmonton Journal*, 14 January 2001, AAM, Newspaper clippings; Fred W. Hotson, "Punch," *CAHS Journal*, 32:12 (Summer, 1994): 40-48.

[6] Farrell, "Punch and Connie".

Although it is unclear exactly when Western Canada Airways made the final determination to begin northern operations, their decision to establish gas caches in the area during the summer of 1928 indicates they were considering the service at least as early as that spring. The least expensive way to move fuel north was by boat, but the northern shipping season was terribly short, so one had to plan ahead. The company had to order a year's worth of gasoline and oil in the spring so that it would be ready to be carried north during the truncated navigation period. As Dickins points out, the gasoline that saved him on the Barren Lands flight was part of a shipment Western Canada Airways had made to create gas caches along the river for his work in the area the following winter, evidence that the company had decided to establish a Mackenzie air service.[7]

Some indication of the airline's overall motives can be discerned in the annual corporate reports from the late 1920s. The government of the time liked to portray commercial aviation companies as disinterested contributors to Canada's growth and prosperity, and Richardson himself would write, "My own interest in Airways was inspired entirely by a desire to accomplish the earlier opening up, in a large way, of the mineral wealth of Canada".[8] The reality, however, was that no matter what the owner's

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[7] C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-002.

[8] James A. Richardson, "Canadian Airways Limited, Memorandum," 7 April 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, April 1934. The government reports of the period each contain comments similar to that found in the *Report on Civil Aviation*, 1928: "Some very remarkable flying records have been set by a number of commercial pilots during the year which, if they had been made in the full glare of publicity which accompanies such flights in most parts of the world, would have made them famous. In northern Canada the work is done, not for its publicity value, but because it is urgently required in the development of the country and for a really useful purpose. It seems to pass unrecognised. Its value to the state and to those interests which

personal feelings, these airlines were businesses and could not continue to operate if they could not at least pay their expenses. Western Canada Airways' annual report for 1930 remarked,

> It does not require a great vision or imagination to find aerial activities in which the Company's capital might be employed – we receive almost daily proposals to enter into operations and to purchase equipment which, if adopted, would effect a precipitous downward revision of the current ratio [of assets to liabilities] and probably result in disaster. But what does call for clear vision, imagination, and sound judgement, is the finding of those classes of work from which the revenue will not only cover all costs but also provide a reasonable return on invested capital considering the risk involved.[9]

Though the comments do not directly refer to the Mackenzie District, they do indicate that the airline sought markets that would provide a reasonable return on investment. Given this commitment, the decision to establish a northern division suggests the executives saw the Mackenzie as a region that would enable the company to produce such a return.

Again, direct evidence of the circumstances that formed this conviction is difficult to obtain. However, there are several conditions that likely contributed to the company's belief. The first was a widespread sense, which developed in the late nineteenth and early twentieth centuries, that the Canadian North, hitherto considered a barren wasteland, was actually a source of great riches.[10] As the nineteenth century drew to a

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have organized it is none the less great." Canada, Department on National Defence, *Report on Civil Aviation for 1928* (Ottawa: 1929), 6.

[9] Canadian Airways Limited, "First Annual Report of the Directors", 9 March 1930, CAL Collection, AOM, MG 11 A 34, Box 23: Annual Reports.

[10] The following discussion draws on Michael Bliss, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto: McClelland & Stewart, 1987), chapters 12, 13, 14; John Herd Thompson with Alan Seager, *Canada 1922-1939: Decades of Discord* (Toronto: McClelland & Stewart, 1985), chapter 5; and Morris Zaslow, *The Northward Expansion of Canada, 1914 – 1967* (Toronto: McClelland & Stewart, 1988), chapters 1, 3, 4.

close and the twentieth began, natural resources seemed to hold the key to Canadian wealth. While agriculture had become an important staple product at the end of the 1800s, minerals, hydro-electricity, and forest products became increasingly important in the early years of the 1900s. As railways opened up new areas and foreign capital flooded in, Canada experienced extensive growth in these areas. This development altered perceptions of the North, transforming a forbidding wasteland into a vast storehouse of wealth just waiting to be utilized.

Although the war brought some industries, like fur, to a standstill, it was good for the businesses of the middle North. The demand for resources from the Allied war machine led to a sharp increase in natural resource production, particularly in agriculture, forestry, and metal. Unfortunately, this wartime boom collapsed when Canada slipped into an economic recession in 1920. Price inflation had accompanied the boom, squeezing wage earners, and in 1920, consumers simply stopped buying. As a result, the boom quickly deflated, producing very difficult economic times in Canada during the first half of the post-war decade.

Luckily, the United States' economy was roaring away below the border and there was plenty of American capital available to invest in Canadian resource industries. It was this investment that, beginning in 1924, helped to pull Canada out of the recession, creating prosperity that would last until 1929. This growth was rooted in the exploitation of natural resources and marked a shift from western-fuelled growth to northward economic expansion. While manufacturing and agriculture remained the largest Canadian industries through the 1920s and forestry and mineral development remained lesser contributors, during the first half of the decade the latter grew significantly.

Between 1921 and 1926, forestry's net domestic income grew from 37 million to 64 million dollars, an increase of 73%. Over the same period, mineral development's income grew from 92 million to 139 million dollars, an increase of 51%. By contrast, agriculture grew 41% from 561 million to 795 million dollars while the total net domestic income grew from 3,454 to 4,337 million dollars: 26%.[11] During the second half of the decade, agriculture's rate of growth continued to be lower than the Shield's industries' and between 1926 and 1929, mineral development grew even faster than forestry.[12] Agriculture would continue to be a larger component of the economy, but during the 1920s, the North was the area that was growing.

Although economically less significant than agriculture, of the new resources industries, mining held the most significance for the national imagination.[13] With mining expansion, the Shield became a new North, full of potential wealth. Tied to this dream was the romantic image of the lone prospector gliding over northern lakes in his canoe, an image that did not match the hard, slogging reality of muskeg, mosquitoes, and black flies.

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[11] F.H. Leacy, ed. *Historical Statistics of Canada,* 2nd Edition (Ottawa: Statistics Canada and Social Science Federation of Canada, 1983), Series F 153 – 165. See Table 4.1.
[12] See Table 4.1.
[13] Thompson, *Canada 1922-1939*, chapter 5.

Table 4.1: Economic Growth in Canada, 1919-1930

Net domestic income, by industry, 1919 – 1926
(*millions of dollars*)

Year	Total net domestic income	Agriculture	Forestry	Fishing, Hunting and Trapping	Minerals	Manufacturing
1919	3958	783	53	35	99	1032
1920	4541	924	69	38	135	1142
1921	3454	561	37	22	92	723
1922	3589	643	48	32	108	725
1923	3829	699	57	30	109	821
1924	3641	574	64	29	104	769
1925	4139	896	59	31	122	829
1926	4337	795	64	33	139	929

Source: F.H. Leacy, ed. *Historical Statistics of Canada, Second Edition* (Ottawa: Statistics Canada and Social Science Federation of Canada, 1983), Series F 153 – 158.

Gross domestic product at factor cost, by industry, 1926 – 1930
(*millions of dollars*)

Year	Agriculture	Forestry	Fishing and Trapping	Minerals	Manufacturing	Transportation, Communication, and Public Utilities
1926	884	66	41	154	1050	626
1927	883	69	39	168	1135	660
1928	929	72	41	189	1241	733
1929	699	78	39	218	1328	725
1930	629	61	30	183	1231	662

Source: F.H. Leacy, ed. *Historical Statistics of Canada, Second Edition* (Ottawa: Statistics Canada and Social Science Federation of Canada, 1983), Series F 56 – 75.

As with forestry, mining's northward expansion had ties to the United States. First, American demand provided a market for Canadian minerals as they flowed across the border to supply growing American manufacturers, particularly in the automobile, electrical, and radio industries. This increased demand meant higher prices for base metals. Unfortunately, it also meant the base metal sector would collapse when

American manufacturing demand disappeared during the Depression. Until then, however, the field continued to grow and, like pulp and paper production, required heavy capital investment. Again, Canadian growth depended on American investment and by 1930, almost 40% of Canadian mineral production was American controlled, a state of affairs that does not seem to have bothered Canadians.

By the late 1920s, the Canadian economy was booming again and mining expansion, aided by aircraft, was pushing back the economic frontiers. As prospectors sought new sources of minerals, mining "extended Canada's horizons far beyond the limits of the farming and forestry frontiers."[14] For instance, the *Northern Miner*, a trade weekly, began the decade "devoted to the interest of the mining industry of northern Ontario," according to its masthead. By the end of the decade it had become "a weekly newspaper devoted to the interests of the mining industry of northern and central Canada." It was one small indication of the country's northward expansion.

This state of affairs also reinforced the idea that Canada could look to its wilderness as a source of wealth and prosperity. For instance, in 1928 one headline in the *Northern Miner* described the Canadian North, by which it meant Manitoba, Saskatchewan and Ontario, as the world's metal pot.[15] Dickins and Western Canada Airways seemed to have shared this optimism and were willing to see the North as a place of opportunity. The general optimism would have supported the company's decision to go north.

Aviation played an important part in this optimism. While people saw the Shield as a source of wealth, the difficulty was, as always, access. Aircraft seemed to offer the

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[14] Zaslow, *Northward Expansion*, 117.
[15] "New North World's Metal Pot," *Northern Miner*, 16 February 1928.

perfect solution to the paradox presented by a land that was, on the one hand, a source of potential wealth and, simultaneously, an obstacle to exploiting that wealth. The aircraft could turn the obstacle to advantage and allow southern Canada to conquer the North and extract its resources.[16]

As Jonathan Vance points out, aviation's boosters were quick to exploit this connection to support Canadian aviation.[17] Using aircraft, they argued, could realize the dream of opening the North. The subtext was, "look, aircraft can be useful." For boosters and government alike, the North was the place for aviation and each reinforced the optimism about the other's potential. The North could be a source for wealth because the airplane could take people there and bring resources out. At the same time, the North could provide a field of application for aviation.

The aviation branch of the Department of National Defence also promoted this view, emphasising aviation's usefulness for foresters, prospectors, and surveyors.[18] J.A. Wilson, now Controller of Civil Aviation, made just such an argument in a paper presented to the Third Empire Mining and Metallurgical Congress, South Africa, in 1930. He claimed,

> there is no doubt that the mining areas in northern Canada have been developed many years ahead of expectation, because of this increased ease of transport throughout territory hitherto practically inaccessible. Mining

[16] Jonathan F. Vance is right to point out the imperialist overtones of this view as it characterises the North as an uninhabited domain of vast wealth just waiting to be conquered by the technologically advanced South. Jonathan F. Vance, *High Flight: Aviation and the Canadian Imagination* (Toronto: Penguin Canada, 2002), 153.
[17] Vance, *High Flight*, 133-134.
[18] See repeated references to the link between aviation and natural resource development in the Department's annual reports. For example, Canada, Department of National Defence, *Report on Civil Aviation for 1926* (Ottawa: 1927), 11; Canada, *Report on Civil Aviation for 1928*, 6; Canada, Department of National Defence, *Report on Civil Aviation for 1929* (Ottawa: 1930), 5.

> engineers and executives have been able to inspect areas hundreds of miles from civilization. Exploration companies are able to place prospectors in the field without loss of valuable time in travelling and can maintain them there, move them from location to location, receive regular reports on the progress of their work, prompt news of any important discoveries and, in fact, control their operations in a way which would be impossible without air transport.[19]

The successes of aircraft in the North were also credited with encouraging development in other areas of aviation. According to the Department of National Defence, "the successful use of aircraft in the north awakened public opinion to the possibilities of rapid transportation by air."[20] The view seems to have spread into general circulation as articles enumerating aviation's success appeared in a variety of publications.[21]

In particular, the mining community appeared very keen on aviation. Articles in mining industry publications had advocated the use of aircraft in support of mining development as early as 1919, arguing the technology could allow the development of currently inaccessible deposits.[22] However, the serious use of aircraft in mining had to wait until 1924 and the establishment of Laurentide Air's service to Rouyn.[23] The

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[19] J.A. Wilson, "The Use of the Aeroplane in Mineral Development," Third Empire Mining and Metallurgical Congress, South Africa, 1930, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 17, 5-7.
[20] Canada, *Report on Civil Aviation for 1929*, 5.
[21] Western Canada Airways' scrapbooks contain clippings from sources as varied as the *Royal Bank Newsletter* and the *Mining and Industrial News*. "Aviation," *Royal Bank of Canada Newsletter*, March 1927, and "Commercial Aviation," *Mining and Industrial News*, 15 March 1927, in Canadian Airways Scrapbook, WCAM, Collection # 193, 82-5; See also Russell H. Catomore, "The Civil Aviation Movement in Canada: 1919-1939' (M.A. Thesis, Carleton University, 1970).
[22] R.E. Hore, "Aerial Transport in Mining Districts," *Canadian Mining Journal* (1919), 113.
[23] While the idea was put into practice in 1920 by a prospecting party in Northern Ontario, the application appears to have remained relatively isolated as one continues to see publications calling for the extensive use of aircraft in mining development. See, for example, C. MacLaurin, "Air Photography and the Aeroplane as Aids to the Prospector," *Bulletin of the Canadian Institute of Mining and Metallurgy* 15 (1922): 913-920.

reaction to Laurentide's service and the others that followed in Red Lake and elsewhere appears to have been overwhelmingly positive amongst members of the hard-rock mining community. Articles in the *Northern Miner* and the more scholarly *Canadian Mining Journal* emphasised the positive contributions that such services made in the development of northern deposits. According to these authors, aviation conquered distance and geography, making the remote accessible and allowing mining development to occur independent of the railway.[24] These capabilities attracted the mining industry and its enthusiasm encouraged airline expansion because it promised a market for the service.

With the hard-nosed focus on performance indicated in the airline's Annual Report for 1930, this generalised belief in the North's potential likely would not have been sufficient to convince Western Canada Airways' executives that they should invest in a Mackenzie District service. They would have wanted clear indications that the area offered a good opportunity for their company. With this objective in mind, late in 1928, the airline sent Dickins to Edmonton to canvas business and investigate the potential success of a service from Fort McMurray to Fort Simpson. Dickins' resulting reports argued that just such an opportunity existed.

For Western Canada Airways, the North was a general source of opportunity, and the Mackenzie Valley in particular had several potential sources of revenue to offer. Compared to other areas where commercial air transport generally followed mineral finds, in late 1928 and early 1929 the Mackenzie's economy still depended primarily on

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[24] "Air-line for Passengers and Freight," *Canadian Mining Journal*, (1924): 548-549; H.D. Wiltshire, [Managing Director, Laurentide Air Service Ltd,] "Air Route to Rouyn," *Canadian Mining Journal*, (1925): 174-176; "Northern Air Service in Operation," *Canadian Mining Journal*, (1925): 516; "Air Service to Red Lake," *Canadian Mining Journal*, (1926): 256; "Editorial," *Northern Miner*, 2 June 1927.

fur trading and in his preliminary reports, Dickins identified this industry as the region's major market for air service.[25] While the fur market had crashed in 1920, along with the rest of the Canadian economy, it had begun to recover in 1924.[26] Moreover, fur made good air cargo, being high in value while low in weight. Furthermore, as W.E. Gilbert, Western Canada Airways pilot, later pointed out, the most valuable furs were located farthest from civilization. They were also available only in the winter when the animal's fur would be thickest.[27] Because of these conditions, it was impossible to get the furs to the international fur markets held in Winnipeg in April during the same season in which they had been trapped. This might not seem to be a problem, as furs do not initially appear to be a time-sensitive commodity. However, the first time furs were transported out of the Mackenzie by aircraft and sold that same season in Winnipeg, they brought premium prices because of their excellent condition.[28] These prices made the cost of flying furs worthwhile, especially when shipping by air with Western Canada Airways saved the trader about 20¢ per pound on transport.[29] According to Dickins, the fur industry offered at least one source of business along the Mackenzie.

It was a good market for air service, but was seasonal, offering two peak periods of activity around Christmas and Easter and these two isolated spikes could not sustain

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[25] C.H. Dickins to W.L. Brintnell, 5 January 1929, 7 January 1929, and 2 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan-March 1929; C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District,' 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan - March 1929.
[26] Zaslow, *Northward Expansion of Canada*, chapter 5; See also Table 4.1.
[27] W.E. Gilbert, "Flying Fur," [ca. 1935], CAL Collection, MG 11 A 34, Box 33: Fur (Air transport of raw furs), Oct 5/29 – Sept 20/37.
[28] W.L. Brintnell to T. Wilkins, 5 October 1929, CAL Collection, AOM, MG 11 A 34, Box 33: Fur (Air transport of raw furs) 5 Oct/29 – Sept 20/37; C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001.
[29] C.H. Dickins to W.L. Brintnell, 5 January 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

year round operations for the company. Luckily, Dickins identified other opportunities. Aside from the fur traders, Dickins reported general interest in passenger transport and growing enthusiasm about the service.[30] In fact, Dickins suspected that aircraft would quickly replace travel by dog team entirely.[31] The Royal Canadian Mounted Police (RCMP) and Roman Catholic Church offered other sources of traffic, transporting their staff to and from their northern posts.[32] Furthermore, Dickins pointed out that aircraft could provide valuable services to northern communities by carrying perishable goods like fruit and eggs north in winter.[33] All of these activities would help to fill the planes on in-bound trips to collect furs or during periods of low freight activity. However, the district had a small permanent population so the company would have to identify yet other sources of income.[34]

Alongside these smaller markets, there was evidence that mineral interest in the area was building and this mining development would provide the sort of ongoing income the company would need to make a northern run worthwhile. There had been some previous mineral interest in the area at the turn of the century and in the pre-war years. Men travelling through on their way to the Klondike had staked claims in the

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[30] C.H. Dickins to W.L. Brintnell, 7 January 1929, 2 February 1929, 13 February 1929, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[31] C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District,' 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan-Mar 1929.
[32] Ibid.
[33] Ibid.
[34] C.H. Dickins to W.L. Brintnell, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929; Over the course of the inter-war years Western Canada Airways would carry all these types of cargo. Mail would be a staple once the company acquired its competitor Commercial Airways and mining transport would eventually be the largest share of the company's freight and passenger transport. However, the institutional contracts never amounted to much, in large part because the RCAF began operating in the area in 1930, taking government business.

Great Slave Lake District, generating interest in the area around Fort Resolution in particular. Several discoveries of gold and silver deposits had sparked a small mineral rush at the end of the 1800s. The Geological Survey of Canada responded by sending James Mackintosh Bell and Dr. Robert Bell to survey the south shore of Great Slave Lake in 1899, expanding the field of operations to include Great Bear Lake in 1900.[35] The Survey continued to work in the area, sending parties to the Mackenzie watershed in 1914.[36] However, the work provided no immediate results. Interest in the district flared again in 1921 with Imperial Oil's activity around Fort Norman, but in light of the economic recession, that too came to naught.

As the economy recovered in the mid-1920s, the area once again began to attract attention, beginning in 1926. Not only did the Northern Syndicate, a mining development company, carry out aerial surveys of the area north east of Great Slave Lake during 1926, Consolidated Mining and Smelting was also active in the region.[37] That summer, the company launched a systematic attempt to discover the rich mineral deposits rumoured to be lurking in the Mackenzie District. Consolidated's party ventured into the country north of Edmonton, guided by government maps that were "just outlines of the

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[35] James Macintosh Bell, *Report on the Topography and Geology of Great Bear Lake and of a Chain of Lakes and Streams Thence to Great Slave Lake*, Ottawa: Geological Survey of Canada, 1901.

[36] For a history of the Geological Survey of Canada see Morris Zaslow's mighty work, *Reading the Rocks: The Story of the Geological Survey of Canada, 1842-1972* (Ottawa: Macmillan, Department of Energy, Mines and Resources, and Information Canada, 1975). For a history of work in the Northwest Territories up to and including World War Two, see chapters 8, 11, 15, 16, 17 (this chapter also discusses the Survey's relationship to aircraft), and 18.

[37] The following discussion draws upon the memoirs of Ted Nagle, a surveyor for Consolidated Mining and Smelting during the 1920s and 1930s, who worked in the Mackenzie region during the late 20s and early 30s. Ted Nagle and Jordan Zinovich, *The Prospector North of Sixty* (Edmonton: Lone Pine Publishing, 1989). See particularly chapters 1-8.

major lakes and rivers."[38] Working without sextant or transit, instruments Consolidated believed were too heavy and fragile to withstand northern travel, the party had to estimate their position and do their best to fill in the gaps on the maps. In spite of their hard work, the group made no significant mineral discoveries.

However, by the fall of 1927 Consolidated knew that, beginning in 1929, it would use aircraft to carry prospectors into the North. Thus, during the summer of 1928 the company used its northern survey crews to examine sites and identify deposits for the airborne parties to explore. Partway through May, Consolidated decided it should investigate galena deposits on the south shore of Great Slave Lake. These would later be developed into the Pine Point Mine, though at the time the area was known as Dawson's Landing. The traffic to the region would be an important source of business for Western Canada Airways during its first year of operation.

Other companies were also active along the Mackenzie, including Atlas Exploration and Northern Aerial Mineral Exploration.[39] In addition, Colonel MacAlpine of Dominion Explorers toured the area at the end of his flight through the Barrens with 'Punch' Dickins. Prospecting activity was increasing and towards the end of 1928, the *Edmonton Journal* predicted that Athabasca, Great Slave Lake, and the Nahanni were all on the cusp of mining development.[40] Although there was no prospecting rush in progress, Dickins reported that pressure seemed to be building towards the summer of

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[38] Nagle, *The Prospector North of Sixty*, 36.
[39] Canada, *Report on Civil Aviation for 1928*, 26; "Prospectors Going Down Mackenzie," *Northern Miner*, 23 May 1929.
[40] "Thirty Years of Mining Progress Shows Canada on Threshold of Wealth," *Edmonton Journal*, 29 November 1928.

1929.[41] While others were successfully using aircraft in the region, none of these companies was offering commercial air transport. Thus, the traffic from mineral development would offer a source of year-round business for Western Canada Airways' new operations and aviation's pattern of growth established between 1926 and 1928 grounded Dickins' optimism about the route's potential.

Finally, there were indications that government airmail along the Mackenzie was a real possibility. An airmail contract would be a welcome, stable source of income for the company.[42] Early in 1929, Western Canada Airways was able to carry backlogged second-class mail that had been piling up at Fort McMurray waiting for the beginning of summer navigation in June or July, as the dog team mail service could not handle it.[43] Although the mail was cleared in one trip, there were signs that the arrangement could become permanent.[44] There had been murmurs about beginning a Mackenzie District airmail service as early as 1918 and again in 1921 and 1925, but nothing had happened, largely because northern aviation remained unproven and the local population was too small to warrant the expense.[45] However, discussions had resumed in 1927 and action appeared forthcoming.

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[41] C.H. Dickins to W.L. Brintnell, 13 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[42] C.H. Dickins to W.L. Brintnell, 7 January 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[43] C.H. Dickins to W.L. Brintnell, 5 January 1929, 13 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[44] C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District,' 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan-March 1929.
[45] "Memorandum for Deputy Postmaster General: Aerial Mail Service, 14 December 1918, NAC, RG 3 E 6 V 991, f. 10-1-12; E.L. Jenny to Postmaster General, 12 February 1921, NAC, RG 3 E 6 V 2673, f. 10-4-185, vol. 1, 1920-1930; "In and Out of North," *Edmonton Journal*, ca. 1921, NAC, RG 3 E 6 V 2673, f. 10-4-185, vol. 1, 1920-1930; B.W. Broatch, Northern Air Service Ltd. to A. Webster, Secretary, Post Office

These discussions began with rumours and correspondence between the Post Office and parties interested in providing the service. For instance, during the summer of 1927 Canadian Vickers made enquiries of the Post Office concerning the costs of operating an airmail service along the Mackenzie.[46] The subject was also discussed at the Inter-Departmental Committee on Air Mails in February of 1928, and though the minutes reflect a generally positive view of the matter, they do not indicate what, if any, final decision was reached.[47] That said, by the end of the year the government was ready to go public with the news, as Edmonton M.P., K.A. Blatchford, announced that Postmaster P.J. Veniot had agreed to the route.[48] Although the announcement was made, the service would not be established on a permanent basis until the fall of 1929. In the meantime, Western Canada Airways obtained permission to issue its own airmail stickers to carry mail along the Mackenzie and was licensed to charge a fee of 10¢ per ounce, in addition to the ordinary postage.[49]

Western Canada Airways sought to obtain the permanent Post Office airmail contract for the region because such an arrangement would offer a steady, guaranteed,

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Department, 15 June 1925, NAC, RG 3 E 6 V 2673, f. 10-4-185, vol. 1, 1920-1930; J.A. Wilson to Charles G. Grey, 21 June 1925, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920 – 1942; J.A. Wilson, "Practical Flying in Canada," 14 February 1926, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 6, Memoranda relating to air development in Canada, 1920-1926.

[46] R.H. Mulock, Canadian Vickers, to Arthur Webster, Secretary, Post Office Department, 10 August 1927, 15 August 1927, and Arthur Webster to R.H. Mulock, 17 August 1927 and 8 September 1927, NAC, RG 3 E-6 V 2673, f. 10-4-185, vol. 1, 1920-1930.

[47] Minutes of Inter-Departmental Committee on Air Mails, 7 February 1928, NAC, RG 3 E 6 V 2673, f. 10-4-185, vol. 1, 1920-1930.

[48] "Air Mail Service to Far Northern Points Promised This Winter," *Edmonton Journal*, 14 November 1928.

[49] Western Canada Airways to Arthur Webster, 20 March 1929; Arthur Webster to Western Canada Airways, 20 March 1929; Arthur Webster to E. Westman, 23 April 1929, NAC, RG 3 E 6 V 2673, f. 10-4-185, vol. 1, 1920-1930.

year-round income that could subsidize the airline's other activities. By stabilizing the service, an airmail contract would help the run provide a good return on investment. Political willingness to expand airmail into the area offered yet one more income opportunity and contributed to the collection of circumstances that encouraged Western Canada Airways' northern expansion.

According to Dickins, the Mackenzie District offered a number of potential sources of income. In addition to general passenger and freight traffic, there were cargoes of fur, prospecting and mining business, and the promise of a coveted airmail contract. The Mackenzie offered not just one source of income, but several, making it an attractive area in which to open a new air service. Moreover, bush flying appeared to be a growth industry at the end of the 1920s. While it had suffered from the post-war economic recession like other industries, commercial aviation had begun to recover in 1924 and by 1926 seemed to have turned the corner. Serious activity had begun with Laurentide Air Service's route to Rouyn in 1924 and during 1925 levels of activity held steady. However, in 1926 the field began to grow steadily. By 1928, commercial aviation appeared to be in the middle of a full-scale boom.[50] Aviation in Canada seemed to have hit its stride. The situation would have given Western Canada Airways confidence in aviation's potential for growth and may have made it willing to risk a new service along the Mackenzie, especially when the potential traffic appeared to be available.

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[50] Canada, Department of National Defence, *Report on Civil Aviation for 1925* (Ottawa: 1926), 22; C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001; See Table 4.2.

Table 4.2: The Growth of Canadian Aviation, 1926-1928

	1926	1927	1928
Number of Manufactures	2	2	4
Firms Operating Aircraft	14	20	53
Total Number of Flights	4 755	16 748	75 285
Total Number of Flying Hours	5 860	12 070	43 071
Total Mileage Flown (Miles)	393 103	829 010	2 728 414
Total Number of Passengers Carried	6 436	18 932	74 669
Total Freight/Express Carried (lbs)	724 721	1 098 348	2 404 682
Total Mail Carried (lbs)	3 960	14 684	316 631
Total Number of Licensed Aircraft (All types)	44	67	264
Total Number of Licensed Personnel	103	148	458
Number of Licensed Pilots	20	43	258
Number of Licensed Pilot-Air Engineers	18	29	70
Number of Licensed Air Engineers	65	74	130

Source: Canada, *Report on Civil Aviation for the Year 1928*,14
Note: These numbers include all civil operations, not just commercial activity (i.e. including all Flying Club activity). However, they do not include private aircraft.

Not only were there several potential markets along the Mackenzie, the company had good reason to believe it could capitalize on those sources of traffic. Dickins' early experience in the region suggested that Western Canada Airways could compete with existing transport services and capture these markets. In winter, northerners travelled overland primarily by dog team. While the method made travel possible and was easier than travelling on one's own feet, it was still difficult, slow, and expensive. During the winter, aircraft could easily compete in the fields of comfort, speed, and cost.[51] For

[51] Although he does not provide exact costs, Dickins makes this argument in C.H. Dickins to W.L. Brintnell, 5 January 1929, and 13 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

instance, in a letter of thanks to Western Canada Airways dated March 1929, Dr. C. Bourget, the Indian Agent at Fort Resolution, points out that by using Western Canada Airways' services he was able to make his tour of the Mackenzie quickly and for a cost of only $135, versus the $400 it had cost him to make the same journey by dog team in the previous year.[52] Because dog travel was so slow by comparison, services that used it, like the mail, could make only a small number of trips per season. The speed of aircraft allowed an increase in frequency of service, reducing feelings of isolation and making the planes an attractive option.

The situation in the summer was, however, different. During that season, the Hudson's Bay Company offered steamship service between Waterways and the rapids at Fort Fitzgerald and between Fort Smith, above the rapids, and Aklavik. These ships were faster than a dog team and less expensive. They could also carry bulky freight efficiently and at a lower cost. However, aircraft could still compete when it came to travel time, especially with high value, low weight items like furs, or time-sensitive materials like perishable food and mail.[53] In light of these comparisons, Western Canada Airways likely believed it could compete with the existing sources of transport and capture the markets it identified in the Mackenzie District north of Edmonton. These beliefs would have encouraged the company to approve the expansion of air service into the Mackenzie.

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[52] C. Bourget to Western Canada Airways, 2 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[53] C.H. Dickins to W.L. Brintnell, 5 January 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

Table 4.3: Rate Schedule, Western Canada Airways Mackenzie District, 1929

From Waterways to:	Distance	Express/lb	Mail/lb	Passenger
Fort Chipewyan	140 Miles	.25¢	.25¢	$40.00
Fort Fitzgerald	250	.40	.35	75.00
Fort Smith	265	.40	.35	75.00
Fort Resolution	400	.75	.70	120.00
Hay River	475	.85	.80	142.00
Fort Providence	550	.95	.90	165.00
Fort Simpson	700	$1.15	$1.10	210.00

Passenger rates include 20 lbs baggage free, provided total weight of passenger and baggage does not exceed 200 lbs
Fare between posts difference between rates quoted above
Special Charter Trips at rate of $2.00/mile, plus $75.00/day

Source: "Schedule of Rates Waterways to Simpson (Mackenzie District)," 4 March 1929, CAL Collection, AOM, MG 11 A 34, Box 64: Miscellaneous WCA Rates and Costs, 1927-1930.

Selecting the Fleet: the Fokker Super Universal

The potential opportunities in the Mackenzie District made expansion into the region an attractive proposition for Western Canada Airways. However, it was not enough to identify these opportunities. In order to justify service expansion, the company needed to believe that it could successfully operate aircraft under northern conditions. After all, the Mackenzie was a harsh, largely unmapped, and unknown area – not the first choice for expensive pieces of equipment like aircraft. Again, direct evidence of any kind regarding the airline's decision to go north in 1929 is difficult to find. However, a number of circumstances likely contributed to their confidence. Prevailing views of aviation, the company's experience with bush flying, and the design of the planes themselves contributed to Western Canada Airways' belief that such an operation was possible.

Experience with bush flying across the country suggested that aircraft could operate very successfully in the Canadian wilderness and, moreover, could operate profitably. The forestry work, especially that performed by the Royal Canadian Air Force, and the commercial activities of firms such as Laurentide Air illustrated bush flying's potential. Since Laurentide's first flights in 1924, the practice had spread across the country and these activities consistently demonstrated that aircraft could perform useful work in the Canadian North. Western Canada Airways itself had been an important agent in bush flying's expansion. The airline began its life in the Red Lake gold fields, late in 1926, with one aircraft, offering air travel to prospectors and mining developers. By the end of 1927, it had grown from a fleet of one Fokker Universal to a fleet of three Fokker Universals, two Fairchild monoplanes, and two de Havilland Moths, all operating chiefly into Northern Ontario and Manitoba mining areas, with some work in Northern Saskatchewan.[54] Western Canada Airways' expansion continued in 1928 as the company added a flight training school, operations in British Columbia, and the Prairie Airmail service to its activities.[55] Outside the company, experience accumulated over the 1920s showed that northern aviation was possible year-round as activities like the Hudson Strait expedition demonstrated that properly supported and maintained aircraft could perform successfully in extreme winter conditions.

Unfortunately for the company, it was about to discover that the Mackenzie was not merely an extension of these provincial norths. This region would prove to be a particularly demanding environment, so demanding that it provoked changes in aircraft

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[54] Canada, Department of National Defence, *Report on Civil Aviation for 1927* (Ottawa: 1928), 27-28.
[55] Canada, *Report on Civil Aviation for 1928*, 25-26.

design. However, that knowledge would come only with operating experience and before the service was launched, Western Canada Airways had good reason to be optimistic about the aircraft's northern performance. Western Canada Airways' regular winter activities supported this belief, as did its operations along the western shores of Hudson's bay and the eastern coast of the Northwest Territories. These experiences proved to the company that aircraft could be useful in the North and find a market for their services. They also demonstrated that aircraft could operate under northern conditions. Taken together, these experiences and attitudes gave Western Canada Airways confidence that it could take aircraft north into the Mackenzie valley.

Western Canada Airways' experience with bush flying operations also made the company confident it could avoid the problems that had faced Imperial Oil in 1921. The failure of Imperial Oil's Fort Norman expedition had highlighted infrastructure's importance when operating aircraft in remote locations, a requirement Western Canada Airways was well equipped to meet. In contrast to many bush airlines, Western Canada Airways had a corporate organization that enabled the long term planning that could ensure supplies, like gasoline and oil, were ordered and delivered to supply depots along the route. It also had an established maintenance organisation that included flight engineers, base supplies, and a central maintenance department.[56] As a result, it had a solid foundation from which to extend its experience and structures into the Mackenzie District.

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[56] Maintenance operations began with S.A. 'Al' Cheesman, a former Ontario Provincial Air Service mechanic, who joined Western Canada Airways' initial staff with H.A. Oaks. As the fleet grew, the company recruited more mechanics, and by November of 1927 completed the construction of maintenance workshops on Brandon Avenue in Winnipeg. These workshops served as the central repair and overhaul depot for Western Canada Airways. Molson, *Pioneering*, 21-27.

Western Canada Airways' own experience with bush flying, primarily in Northern Ontario and Manitoba, indicated that aircraft could be used successfully in the Canadian Shield and its support organisation suggested it could avoid Imperial Oil's pitfalls. While these conditions were important, perhaps the most important component in the company's belief that it could operate aircraft along the Mackenzie was its confidence in the specific aircraft it used. After two full years of business in demanding conditions and on demanding undertakings, the company had aircraft that it trusted and that it believed could perform in the Northwest Territories.

The airline had begun with a Fokker Universal and while the airline had added other aircraft, including specialised airmail planes like the Fokker F.14 A, the Universal continued to form the backbone of its bush fleet.[57] A product of the high-wing monoplane era that began in the mid-1920s, this aircraft would prove itself a hardy, versatile bush aircraft during its service with Western Canada Airways. At first glance, the Super Universal might seem an unlikely candidate for use as a Canadian bush plane. The progeny of Dutch aircraft designer Anthony Fokker and very similar to the aircraft Fokker produced during World War One, the Super Universal would be Western Canada Airways' first choice for use along the Mackenzie.

According to James A. Richardson's recollection, when he first decided to begin serving the mining areas of Northern Ontario in 1926, the company sought a plane that would be able to take off from and land on small lakes with a maximum disposable load. It also wanted a monoplane for ease of loading and unloading. Additionally, because of the rapid evolution of aircraft design during the 1920s, it was important that the company

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[57] Ibid., 266.

be able to use the aircraft year-round in order to obtain maximum service from it before the design became obsolete. Richardson himself discussed the matter with Anthony Fokker and consulted Imperial Airways, who assured him that the Fokker Universal was the only plane available that would be suitable for the company's work.[58]

The Super Universal was the direct descendent of the Fokker Universal. Both planes were the products of the famous Dutch aircraft designer. Anthony Fokker was born on 6 April 1890 on his father's coffee plantation in Java. Four years later, the family returned to Holland for the children's education. Unfortunately, Fokker, by his own admission, did not do well in school. Luckily for him, he was able to convince his father to fund his training in aircraft construction. When the school he attended reorganized, Fokker withdrew and began constructing aircraft of his own design in Germany, launching Fokker Aviatik in 1912. When the war broke out two years later, the German military became interested in his designs and his business expanded.[59]

During the war Fokker developed the feature that would become characteristic of his later products, namely the plywood covered, fully cantilevered wing. Drawing on the expertise of other individuals, including Villehaad Forsman, the Swedish engineer who developed the plywood wing covering, and Hugo Junkers, the German aircraft designer who initially developed the fully cantilevered wing, Fokker and his engineers developed their wing structure through a process of trial and error, rather than scientific

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[58] James A. Richardson, "Canadian Airways Limited, Memorandum," 7 April 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, April 1934.
[59] This brief biography of Anthony Fokker draws on the excellent work by Marc Dierikx, *Fokker: A Transatlantic Biography* (Washington: Smithsonian Institution Press, 1997), and Anthony H.G. Fokker and Bruce Gold, *Flying Dutchman: The Life of Anthony Fokker* (New York: Arno Press, Inc. 1972). Originally published 1931.

investigation.[60] As German society fell apart at the end of World War One, Fokker returned to the Netherlands, smuggling planes and factory equipment out of Germany. By 1919, he had opened an office in Amsterdam, and by 1926 had disposed of most of his German assets. In spite of this, Fokker's name would long be synonymous with German military aircraft.

In 1923, Fokker incorporated the Atlantic Aircraft Corporation (New Jersey) as an American outlet for his designs. It was this company, with Robert Noorduyn as the central designer, that produced the Fokker Universal in 1926. Very similar to Fokker's first commercial airliner, the F.II, the Universal was intended specifically for the American airline market. It was a single engined monoplane with a steel tube and fabric fuselage, an open cockpit, closed passenger cabin and Fokker's characteristic thick plywood-covered wing. Two years later, the Super Universal appeared with its more powerful engine, enclosed cockpit, and stronger performance. Both models developed in the United States, but depended heavily on Dutch research, although most of the design work involved modifying existing models. Marc Dierikx argues that the development of Fokker's aircraft suffered from their designer's intellectual limitations. Dierikx contends that Fokker's refusal to invest heavily in research and development restricted the designs to Fokker's own hands-on experience and understanding. This obstinacy would also

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[60] Dierikx argues that Fokker relied on trial and error and rule-of-thumb methods for aircraft design and that this eventually pushed him out of the field. It might have been the case that Fokker was not equipped to deal with the mathematization of aeronautical engineering, but the process of variation and selection that came to characterize aircraft design, according to Walter Vincenti, is much like Fokker's own process of trial and error. Walter G. Vincenti, "The Retractable Landing Gear and the Northrop 'Anomaly': Variation-Selection and the Shaping of Technology," *Technology and Culture*, 35:1 (January, 1994): 1-33; Walter G. Vincenti, *What Engineers Know and How They Know It: Analytical Studies from Aeronautical History* (Baltimore: The Johns Hopkins University Press, 1990).

appear in the company's reluctance to introduce modifications that would help adapt the Super Universal to northern conditions.[61]

Following Richardson's initial investigations, Western Canada Airways began its bush services with a Fokker Universal, G-CAFU. By the end of 1927, the fleet included 3 Universals and, over the company's life, it owned 12 of the 45 Universals produced. As mentioned above, the Fokker Universal was a high-wing monoplane with the thick, all wood, plywood covered wing characteristic of Fokker designs. Unlike other Fokker aircraft, however, the Universal's wing was not fully cantilevered, being braced with a small strut connected to the aircraft's body. Equipped with a Wright J-4B or J-5 engine, the aircraft was capable of achieving a maximum speed of 118 mph and of cruising at 98 mph. On a full tank of gas, it had a range of 535 miles. The aircraft accommodated 4 passengers in an enclosed cabin, but left the pilot seated in an exposed cockpit located in front of the wing.[62]

Given that the aircraft had been designed elsewhere, the airline did have to make several changes to adapt the design to Canadian conditions. For instance, Western Canada Airways had to design skis for the Fokker and put in "a lot of new boiler pipes" in order to be able to use it in the winter. The company also had concerns about the

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[61] While the Universal and Super Universal were successful aircraft, particularly in the emerging bush markets, Fokker's American company disappeared during the spate of mergers that reshaped the American aircraft industry in the late 1920s. Absorbed by General Motors, Fokker Aircraft disappeared into the aircraft division of General Motors: General Aviation. In contrast to Eric Schatzberg, Dierikx argues that "the demise of the wooden airplane in the 1930s had more to do with the failures of the Fokker factories than with any ultimate victory of one technology over the other." According to Dierikx, the decline occurred because Fokker would not invest in research and development and because it was he who directed the course of the company. Dierikx, 147.

[62] Molson, *Pioneering*, Appendix XI, 290.

aircraft's ability to endure work in the far North.[63] Anticipating the problems the airline would encounter with the Universal's younger sibling, Harold Oaks, Western Canada Airways' first pilot, noted, "The rubber shock absorbers on our first Fokker were useless in cold weather, but shock absorber cord which replaced the rubber was more satisfactory.... [Moreover,] the original ski pedestals were replaced by cedar blocks ..."[64] Although Oaks noted that the Universal suffered as a floatplane, the airline believed the problem could be remedied with better float design.[65] Oaks' severest complaint was that it was difficult to deal with Fokker and his company and that service support was lacking.[66] Despite these criticisms, the planes performed impressively, conducting the Hudson's Bay airfreight contract for Western Canada Airways and the Hudson Strait expedition for the Canadian government.

Although Oaks had expressed dissatisfaction with the Universals, when the time came to select aircraft for the new Mackenzie service, Western Canada Airways turned to another Fokker aircraft as the mainstay of its new fleet. This decision may have reflected a change in the company's management. Oaks had left Western Canada Airways in 1928 to establish Northern Aerial Mineral Exploration with Jack Hammel and had been replaced as Operating Manager by W.L. Brintnell.[67] Brintnell, along with several of the pilots, had a positive opinion of the Fokker Universal. It had the sizable disposable load,

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[63] James A Richardson to Frank Ross, 25 April 1927, CAL Collection, AOM, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg. Feb 18/27 – Sept 23/27.
[64] Harold Oaks to Cowley, 4 May 1927, CAL Collection, AOM, MG 11 A 34, Box 55: Skis.
[65] Harold Oaks to J.A. Wilson, 17 August 1927, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, July – Dec 1927.
[66] Ibid.; James A. Richardson to F.M. Ross, 25 April 1927, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, July – Dec 1927.
[67] R.K. Malott, "In Memoriam: Harold A. (Doc) Oaks," *CAHS Journal*, 6:2 (Summer, 1968): 53.

a high monoplane wing that enabled ease of loading and unloading, and the possibility of year-round service that reflected the company's essential requirements.[68] As Brintnell wrote to the manufacture,

> We are now commencing our third year using Fokker aircraft and wish to take this opportunity of expressing our appreciation of the service your machines have given under our conditions. We operate six months of the year on floats and six months on skis and the machines are only inside during periods of overhaul. Our conditions are probably as exacting as those to be found anywhere and in spite of this we find our overhaul and service charges are very slight.[69]

The new attitude might also have been the result of the Super Universal's improved design. In the opinion of Western Canada Airways pilots, the Super Universal represented a distinct improvement over its predecessor. One of the changes that stood out most for the pilots was the enclosure of the cockpit, offering a warmer space for the pilot and crew during winter flying.[70] It was also a bigger aircraft and could now accommodate up to 6 passengers. In addition, the Super had double the Universal's power. Equipped with a Pratt & Whitney Wasp engine, depending on the engine model, the plane could produce between 400 and 410 hp. This increased power translated into better performance with a cruising speed of 118 mph, although, on floats the plane's speed was more like 95 mph.[71] The Super Universal's range was now approximately 700 miles as a float plane and between 725 and 760 miles on skis. Given that the company wanted to offer both passenger and freight service, payload was another important

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[68] James A. Richardson, "Canadian Airways Limited, Memorandum," 7 April 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, April 1934.
[69] W.L. Brintnell to Fokker Aircraft Corporation of America, 30 November 1928, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Nov – Dec 1928.
[70] C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001.
[71] C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-0002.

consideration. According to sales figures, the Super's total payload was 1200 lbs, but with a full complement of operating equipment, the disposable load was closer to 760 or 780 lbs.[72] Nevertheless, the Fokker's specifications compared well with other mid-sized transports of the period.[73]

One visually minor change was the removal of the wing strut. The wing was now fully cantilevered with the struts for the undercarriage extending straight down from the wing. While this was a seemingly minor alteration, it would have serious implications for the plane's suitability in the North. This was the aircraft that pioneered commercial air transport along the Mackenzie.[74]

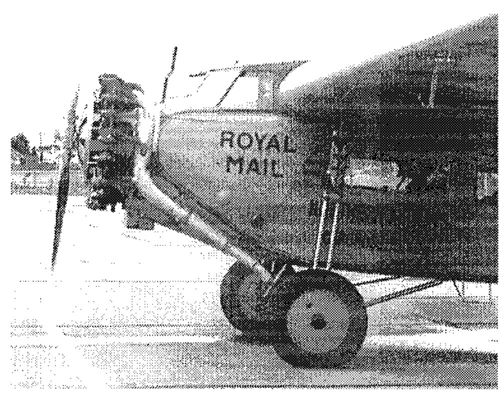

Figure 4.1: Detail of Fokker Super Universal undercarriage.
Source: CF-AAM, Fokker Super Universal, Restored by Alberta Aviation Museum, Bob Busse, Alberta Aviation Museum, Personal Collection.

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[72] CF-AJC, Aircraft Initial Analysis, [no date]; CF-AJC, Certificate of Registration of Aircraft, 25 June 1930; CF-AJF, Aircraft Initial Analysis [no date]; CF-AJF, Certificate of Registration of Aircraft, 7 January 1930; G-CASN, Certificate of Registration, 17 December 1928; G-CASQ, Certificate of Registration, 16 January 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft; "Sales Specifications," Atlantic Aircraft Corporation to Western Canada Airways, 16 January 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft; "Standard Specifications, Fokker Super-Universal Monoplane – Pratt & Whitney 'Wasp' engine," Atlantic Aircraft Corporation, 12 June 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft.
[73] See Appendix I. CF-AJC Logs, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJC Logs, Jan 31/33 to July 16/34.
[74] See Appendix I for technical details.

Bush flying in general required particular features in an aircraft, namely versatility, manoeuvrability, range, reliability, convenience, and year-round performance. Although designed as an American transport, the Fokker Super Universal had a number of features very useful for bush flying. To begin with, the aircraft met the condition of versatility. Because Western Canada Airways began and would continue by carrying a assortment of traffic over its route, ranging from fur bales to prospecting supplies to emergency medical cases and passengers, the aircraft it used needed to be able to accommodate a variety of loads, including both freight and passengers. The Fokker Universal and Super Universal had been designed with just such versatility in mind. Not only could seats be removed to accommodate large cargo, the designers thoughtfully included an additional cargo hold for passenger baggage. The plane was therefore well able to carry both the different types of cargo and the necessary loads to make it well suited to Western Canada Airways' projected activities.

When it came to manoeuvrability, bush operators required a plane that could get into and out of inaccessible locations and that could do so with substantial loads. This was essential in order to be able to offer charter services to prospectors and other field parties. Good lift was key component of manoeuvrability because it allowed aircraft to get into and out of small lakes, even when fully loaded. The Super's rate of climb, 850 feet/minute at sea level, reflected the aircraft's solid lift capabilities.[75] Finally, the ability to load cargo and passengers from awkward shorelines was important and the Super's high wing aided with this.

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[75] Fokker Super Universal Manual, AAM. By comparison the Fairchild 2 had a rate of 580 feet/minute and the Fokker Universal could make 800 feet/minute. The Bellanca Pacemaker could achieve 900 feet/minute. Molson, *Pioneering*, 276, 285, 290.

In the North, range was also essential. Aside from being able to carry a substantial load, the aircraft had to be able to reach across the northern distances. In reality, this meant being able to fly from fuel depot to fuel depot. Since these were associated with the settlements, they were an average of 150 miles apart in the Mackenzie District. The longest stretch between posts along the river was the 200 miles between Fort Good Hope and Arctic Red River. While the company undertook several charter contracts, even the flights to Yellowknife Bay, or Great Bear Lake did not require extremely long operations, adding legs of less than 200 miles to existing routes.[76] These were all distances well within the Super Universal's maximum range of approximately 700 miles or 4 hours flying time. By contrast, the Fairchild FC-2, with a payload of approximately 700 lbs, had a range of 520 miles and the Fairchild 71C, introduced in 1928, had a range of 625 miles.[77] Because Western Canada Airways began its service with no competition, the Super's ability to reach from point to point along the river was enough when Western Canada Airways first began its activities.

The major selling point for all of the company's services was the speed and ease airplane travel offered over other forms of transportation in the North. When it came to speed, any aircraft was faster than either dog team or steamship travel and, since when the company began its service it had no competitors, the Fokker's speed does not appear

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[76] To reach Yellowknife Bay the plane travelled from Fort Resolution, a distance of 110 miles. G-CASQ Flight Reports, 11 April 1929, CAL Collection, AOM, MG 11 A 34, Box 86: G-CASQ Flight Reports, Jan – Apr 1929. On the first flight to Great Bear Lake, G-CASM travelled from Fort Simpson to Fort Norman, 300 miles, and then to Borland's Post, 80 miles, and Deer Pass Bay, another 80 miles. On the return trip, with no cargo, the plane flew direct from Great Bear Lake to Fort Simpson, 460 miles. G-CASM Flight Reports, 29 July 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec. 1930.

[77] Donald Morrison Bain, *Canadian Pacific Airlines: Its History and Aircraft* (Calgary: Kishorn Publications, 1987), 57.

to have been an important consideration. Aircraft transport was also much easier than overland travel and much more comfortable. That said, because it offered much greater speed than the other forms of travel, passenger comfort was not as central an issue on the early bush runs. However, as additional competition appeared, both of these factors would become increasingly important.

To promote their services, especially in an environment where the travelling public was still sceptical of air travel, air service operators needed to offer safe, reliable service.[78] In the North, there was the added concern that equipment failure could leave the pilot, passengers, and crew stranded far from a repair shop and perhaps marooned in an unfriendly environment. Effecting repairs under these conditions was even more expensive than usual, as parts often needed to be carried to the downed aircraft by plane, not to mention the costs associated with the business lost because the fleet was short an aircraft. Thus, it was important that Western Canada Airways' planes be reliable aircraft. Happily, the company's experience with the Fokker aircraft indicated they could withstand demanding flying, as demonstrated by their operation on the Hudson Bay airlift and Barren Lands flight.[79]

Finally, the aircraft needed to be able to operate year round. This meant it needed to be able to function as both a floatplane and a ski plane. While Western Canada

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[78] Vance points out that one of the air lobby's most significant challenges was convincing a population suffering from a war-influenced perception of aviation that flying was in fact safe and reliable. This was key to aviation's success. Vance, *High Flight*, 109, 119-126. Joseph Corn echoes this argument in Joseph J. Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950* (Oxford: Oxford University Press, 1983).
[79] Looking back, W.J. McDonough recalled the Super Universal as "reliable and steady but slow". W.J. McDonough, "Canada's Aircraft Industry," Address to Canadian Section, Society of Automotive Engineers, Toronto, 15 November 1944, Arthur George Sims Fonds, NAC, R 2383-0-5-E.

Airways had to carry out some of its own modifications to improve the planes' performance in these guises, the Fokker Super Universal could operate as a float or ski plane. Year round operations also required winter performance and experience with the Fokker Universal suggested that the Super Universal could function well in the winter.

In general, the Fokker Super Universal had the technical capabilities to serve as a northern workhorse. It had a large payload, good speed and range, and versatility. It had also demonstrated its reliability during the Hudson Bay freighting contract and C.H. Dickins' Barren Lands flight, as well as on less spectacular daily operations in northern Manitoba and Ontario. With bush flying requirements in mind and with evidence of the Super's northern performance, it seemed a reasonable choice to use the aircraft to establish Western Canada Airways' northern service.

To Western Canada Airways' own experience with the Fokkers was added the knowledge that others had successfully used the aircraft in the Northwest Territories. For instance, during 1928 Northern Aerial Mineral Exploration Ltd. used one Fokker Universal and one Fairchild monoplane on a prospecting mission in the area south east of Great Slave Lake.[80] This confidence in the aircraft's ability to perform the tasks required of it supported Western Canada Airways' decision to move north into the Mackenzie District in 1929. Between the new design features and the company's successful experience with the earlier Universal, Western Canada Airways believed it had an aircraft that would enable it to expand down the Mackenzie River and into the Northwest Territories.

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[80] Canada, *Report on Civil Aviation for 1928*, 26.

The history of Western Canada Airways' decision to extend air transport services down the Mackenzie using Fokker Super Universals reminds us that technologies do not migrate on their own. The decision to expand the use of aircraft into other contexts, be they geographical or operational, is taken by one or more users who operate within a context that includes both physical conditions such as environment and geography and intangible conditions such as economics and users' beliefs about those situations, their values, and their beliefs about technologies. The decision is also influenced by the technologies' parameters and limitations, which may enable or may obstruct certain activities or uses. In 1929, Western Canada Airways, a company that valued return on investment along with the development of Canadian commercial aviation, saw an opportunity in the Mackenzie District and had confidence that its machines would allow it to pursue that opportunity. Once that decision was taken, technology and context would interact to produce a transport system particular to the area.

Building the System

The same conditions that encouraged Western Canada Airways' northern expansion also shaped the result, as aircraft interacted with the Mackenzie region's particular characteristics, influencing the airline's transportation system. Where the airline wanted to go in the Mackenzie was largely determined by the available traffic and the market for air service, specifically the location of important cargo sources like fur, mineral development, and airmail, a condition closely tied to geography. The physical geography also influenced the routes taken between cargo pick up points. Finally, seasonal patterns of activity were linked to environment and climate. Through each element, the land remained an important influence on the eventual shape of Western Canada Airways' Mackenzie routes.

While aircraft represented an important break from the existing northern transportation network, one that theoretically could operate independent of geography, in reality Western Canada Airways developed a main trunk route that duplicated existing water routes. As the service established itself over the first year, the path from Waterways to Fort Chipewyan, Fort Fitzgerald, Fort Smith, Fort Resolution, Hay River, Fort Providence, and Fort Simpson, became the company's regular course. The route north followed the major waterways, tracing the Athabasca River to Fort Chipewyan at the mouth of Lake Athabasca, turning north with the Slave River, jumping the falls between Fort Fitzgerald and Fort Smith, and ending at Fort Resolution on the south side of Great Slave Lake. From there, the route turned west, skirting the lake's southern shore to Hay River at the mouth of the Hay River, and on to Fort Providence where Great Slave emptied into the Mackenzie River. Fort Simpson was a short journey up the Mackenzie to the forks of the Liard and Mackenzie Rivers.[81] A close examination of the trunk line reveals that while the aircraft flew above the land, its route was profoundly shaped by the region's geography.

The sources of business and their locations helped to define Western Canada Airways' Mackenzie District service. The choice of Waterways, Alberta, as the company's southern base presented some obvious advantages. First, the Alberta and Great Waterways Railroad, completed in 1925, ended at Waterways and provided both a source of northbound traffic and a destination for southbound cargo. After all, the

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[81] See Figure 1.1.

airline's objective in expanding into the Mackenzie was to access new markets. To capitalize on the potential opportunities available with fur transport, mineral development, and airmail, the airline needed to access the sources of that traffic. The railroad also allowed the airline access to rail transport for staff and parts shipments. Secondly, the snye at Waterways offered a sheltered harbour for the aircraft, though it did occasionally flood during the spring.[82] These two considerations provided excellent justifications for establishing a regional base at Waterways.

Farther up the flight path, the major source of traffic was the fur industry. According to C.H. Dickins' correspondence, Fort Simpson and Fort Resolution were the major sources of fur traffic.[83] Other spots were also collection points for fur, including Fort Norman, Fort Reliance, Fort Rae, Fort Good Hope, and Aklavik, but the traffic generated north of Fort Simpson was minor.[84] The majority of these posts were located along the major rivers or the shores of the lakes, largely because these locations had offered access to water transportation. Seeking to capture this traffic, the company would need to visit the posts, thereby replicating both the water transport routes and the winter

[82] A snye is a secondary river channel, separated from the main river by a piece of land.
[83] C.H. Dickins to W.L. Brintnell, 5 January 1929, 7 January 1929, 2 February 1929, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[84] C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929; L.R. Mattern to W.L. Brintnell, 5 December 1929, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #1: Feb 9/29 – Dec 31/29; G-CASM Flight Reports, 25 May 1929 – 31 December 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec. 1930; G-CASP Flight Reports, 2 April 1929 – 10 April 1929, CAL Collection, AOM, MG 11 A 34, Box 86: G-CASP Flight Reports, Jan – Apr 1929; G-CASQ Flight Reports, 16 January 1929 – 12 April 1929, CAL Collection, AOM, MG 11 A 34, Box 86: G-CASQ Flight Reports, Jan – Apr 1929; CF-AFL Flight Reports, 8 December 1929 – 31 December 1929, CAL Collection, AOM, MG 11 A 34, Box 94: CF-AFL Flight Reports, Dec 1929 – Apr 1930.

dog team trail. The cargo, furs, placed certain requirements on the company and, given existing fur trade patterns, pressed Western Canada Airways to replicate those trade routes.

Nevertheless, fur did prompt a minor amount of route expansion. For instance, the first flight to Fort Good Hope on 6 March 1929 had left Waterways on 2 March 1929 carrying mail and some express bound for Good Hope. According to Dickins' later recollections, the flight carried 6 bales of fur from the trading post at Fort Good Hope for transport to Edmonton, where they were shipped to the Winnipeg auctions. He believed this was the first time that furs taken along the Mackenzie had reached the fur markets the same year they had been trapped.[85] As part of this trip, when he took off from Good Hope on 7 March 1929, Dickins took a detour north to become the "first commercial flight in Canada over [the Arctic] circle."[86]

The airline had identified other sources of business in addition to fur and these also influenced the service's development. The general passenger and express service depended on traffic generated by the population centres in the area. These were primarily associated with the forts and trading posts along the major waterways.[87] Perishable goods for restaurants and storekeepers formed a significant part of this business, and demand came mostly from Forts Chipewyan, Fitzgerald, Smith, and Resolution.[88] This portion of

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[85] C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-0002.
[86] G-CASQ Flight Reports, 7 March 1929, CAL Collection, AOM, MG 11 A 34, Box 86: G-CASQ Flight Reports, Jan – Apr 1929.
[87] C.H. Dickins to W.L. Brintnell, 13 February 1929, and C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[88] C.H. Dickins to W.L. Brintnell, 23 October 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Oct – Dec 1929.

the river system also appears to have generated the bulk of general passenger and express services.[89] Flying for large organisations like the RCMP, Roman Catholic Church, or federal government offered another source of income for the company.[90] Again, the RCMP posts, religious missions, and government offices tended to be associated with trading posts, reinforcing existing travel routes. Since its business was connected to the forts, Western Canada Airways chose to fly along the transport routes linked to the forts. Again, the nature of the traffic cast the mould for the pattern of travel and the geography that originally influenced the posts' location also shaped the airway.

Aside from its semi-regular trunk-line route, Western Canada Airways offered charter service and some of this work would pull the company off the trunk line into unexplored areas.[91] That said, although charter work deviated from the main route, it too would be influenced by geography. The consumers tended to be mining developers and prospectors and their activities took the company out beyond the regular river route.[92] For example, in 1929 Western Canada Airways took passengers to Great Bear Lake, Fort Reliance on the northeast arm of Great Slave Lake, and Yellowknife Bay. This charter activity also motivated some of the company's route expansion. For example, the later

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[89] C.H. Dickins to W.L. Brintnell, 10 March 1929, and C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

[90] C.H. Dickins to W.L. Brintnell, 5 January 1929, and C.H. Dickins, "Some Notes on Summer Operation in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

[91] While Western Canada Airways service was fairly regular, it was not a completely scheduled service. Activity depended on the level of business and if there was no traffic, the planes did not fly. C.H. Dickins to W.L. Brintnell, 2 February 1929 and 13 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

[92] C.H. Dickins, "Some Notes on Summer Operation in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

development of the Great Bear Lake radium deposits would pull the company to develop a spur line into the area, reaching from the main trunk line. While mineral development broke away from the river, the flight patterns were still conditioned by the land. Prospectors were very interested in geology and in charter services, promising mineral areas determined flight destinations. Thus geography continued to shape aircraft routes.

A third type of cargo, mail, influenced the route's pattern, and it too would reinforce existing transportation routes. Western Canada Airways began its Mackenzie District service by carrying second-class mail that had accumulated at Waterways during the winter of 1928-1929.[93] Later that winter, the company obtained permission to operate an airmail sticker service into the Mackenzie District, reaching all the way to Aklavik.[94] The service necessitated stopping at post offices along the way. Again, the post offices were associated with the existing fur trading posts and forts and, therefore, Western Canada Airways' route followed the existing water transport routes.[95]

Airmail influenced Western Canada Airways' services in another way. Beyond the privilege of issuing its own airmail stickers, the company wanted to obtain the government airmail contract that appeared to be on the way. Dickins believed that if the

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[93] The mail accumulated at the railhead during the winter because the limited cargo capacity of the dog sled meant the second class mail had to wait until the summer shipping season. C.H. Dickins to W.L. Brintnell, 5 January 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

[94] Arthur Webster, Secretary Post Office Department, to Western Canada Airways, 20 March 1929, NAC, RG 3 E-6 V 2673, f. 10-4-185, vol. 1: 1920-1930.

[95] Arthur Webster to Acting Chief Superintendent, Air Mail Service, Post Office Department [no name given], 21 March 1929, NAC, RG 3 E-6 V 2673, f. 10-4-185, vol. 1: 1920-1930. When Commercial Airways signed their formal airmail contract, the list also included Fort Fitzgerald, Hay River, Fort Providence, Wrigley, Fort Norman, Fort Good Hope, Arctic Red River, and Fort McPherson. "Contract for Conveyance by Air of His Majesty's Mails," 29 October 1929, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways Limited #1, Jan 7/31 – April 30/31.

company could show it was already operating along the airmail route it would have a better chance of obtaining the permanent contract.[96] This may have contributed to Western Canada Airways' decision to obtain the previously mentioned sticker service reaching all the way to Aklavik.

Nevertheless, the motivations behind the first flight to Aklavik, situated on the shores of the Beaufort Sea, are not clear. Dickins left Fort McMurray on 30 June 1929. While the plane carried passengers as far as Wrigley, above this stop the only cargo was 31 lbs of freight and 18 lbs of mail. Dickins did pick up a passenger at Arctic Red River and carried him to Aklavik, becoming the "first aeroplane to Aklavik and all points below Good Hope."[97] Arriving at Aklavik, Dickins found a community of "about three hundred Eskimos who had never seen a plane, and together with about three hundred dogs tied up, the din when [Dickins] shut off the engine and got out was astounding."[98] However, it does not appear that there was a large amount of traffic waiting at Aklavik. The plane delivered only 11 lbs of freight and 8 lbs of mail. Instead, Dickins spent three hours providing joy rides to the locals. Between 7:00 and 10:00 p.m. on that hot summer evening, the Fokker Super Universal carried 42 people aloft on their first flights.[99] The

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[96] "The Commercial Airways of Edmonton have bought a Lockedd [sic] Vega which is now on its way up here, and will be in the field next year. They are also after the mail contract strongly and that is why I think that if we can just make an even break on this service now we will eventually make good out of it as the mail will come our way…" C.H. Dickins to W.L. Brintnell, 2 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

[97] G-CASM Flight Reports, 1 July 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec. 1930.

[98] C.H. Dickins to Western Canada Airways, 5 July 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, July – Sep 1929.

[99] G-CASM Flight Reports, 1 July 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec. 1930; Dickins' recollection of the moment is amusing, though his remembrance of the time differs from the time recorded in the

next morning dawned fair and the plane was away by 8:15 a.m., back to Arctic Red River via Fort McPherson, carrying 1 passenger, 2 lbs freight, and 12 lbs mail. Dickins deposited his passenger in Arctic Red River before proceeding back down the river.[100] There is no indication in the flight reports of why the flight extended beyond Good Hope, nor does existing company correspondence offer insight. The small amount of traffic does not appear to be enough of an explanation. One suspects that the motivation may have been associated with ongoing government deliberations about extending an airmail contract for the Mackenzie District. If so, this flight could have been made to demonstrate that the company was capable of flying to Aklavik and indeed, had already done so.

In spite of this successful flight, Western Canada Airways did not get the airmail contract. It went instead to their competitor, Commercial Airways of Edmonton, likely because of political considerations. This meant that their competition would be maintaining a regular, scheduled service along the river. In order not to lose business to

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aircraft flight reports. "It was the first airplane ever there and it created a bit of excitement. The Eskimos were very curious, and they came and touched it and felt it and looked at it and wondered what made it go and so on and through the RC [Roman Catholic] interpreter I found out that several of the men wanted to go for a ride, so I said, alright, and six at a time they climbed in. Well, it was very interesting. They had no fear at all, but some of them, I guess none of them had ever seen the delta of the Mackenzie River from the air before, and they didn't realize the thousands of ponds, and sloughs and little channels and the variations that there were. They'd look at it always from the ground level and they could travel with a dog team and they knew where the portages were, and all this, but they hadn't seen what was beyond that fringe of scrub brush over there. So, they'd shriek and shout when I'd circle the settlement, and they could see it down there and then they knew where they were. So I took seven trips that night, and it was now after midnight by quite a bit, though the sun was still on the northern horizon. I was done for, so I tied up – called it a day." C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1979, NWT Archives, G-1992-041-0002.

[100] G-CASM Flight Reports, 2 July 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec. 1930.

Commercial, Western Canada Airways would have to offer a similar service. Thus, even though they did not hold the airmail contract, airmail still influenced the route Western Canada Airways chose to follow. This consideration fed into the combination of economic and geographic conditions that shaped the route. The desire to acquire the airmail contract pushed Western Canada Airways to extend their service to Aklavik. Though they did not achieve their goal, Commercial's schedule forced Western Canada Airways to keep pace so as not to lose any business and likely contributed to their decision to offer ongoing service to Aklavik.

Geography influenced not only the company's choices about stops along its route; it was also an important consideration in establishing the flight paths between stops. The routes taken between cargo-rich points were partly a matter of efficiency, following the most direct path, but were also informed by safety considerations. As with other dimensions of northern aviation, geography was a central influence. The major rivers and the lakes' shorelines provided well-defined routes to follow. This was especially important in a period when the Northwest Territories remained largely unmapped, the maps that were available were little more than outlines of the major water systems, and instrument flying was rather rudimentary. The major lakes and rivers provided well-defined landmarks for pilots navigating in these conditions. Moreover, the river offered constant access to an emergency landing field. Although the river ice was often rough, it was a sure bet in the event of technical difficulties. If the plane were forced down, the river had the added advantage of being a major transportation route for the area. While the level of traffic was never heavy, a plane that made a forced landing along the river was more likely to encounter aid. According to W.L. Brintnell, "you have a certain amount of dog team travel up and down the river, with occasional cabins and a post every 150 miles or so. Conditions are really much worse north of Gold Pines or north of The Pas, as there are no definite routes of travel and no one is in the country."[101] Thus, the region's geography again encouraged Western Canada Airways to replicate existing travel patterns.

Western Canada Airways' Mackenzie service developed a pattern influenced by the location of traffic sources and physical geography. It also developed seasonal rhythms. For instance, Dickins began operating during a seasonal low. There was little economic activity during the period between January and March and levels of traffic mirrored this.[102] The business available came mostly from fur traders who wanted to bring out furs collecting at their posts. The best furs were available only during the winter and were brought to the posts around Christmas and Easter time.[103] This resulted in increased business during these periods.[104]

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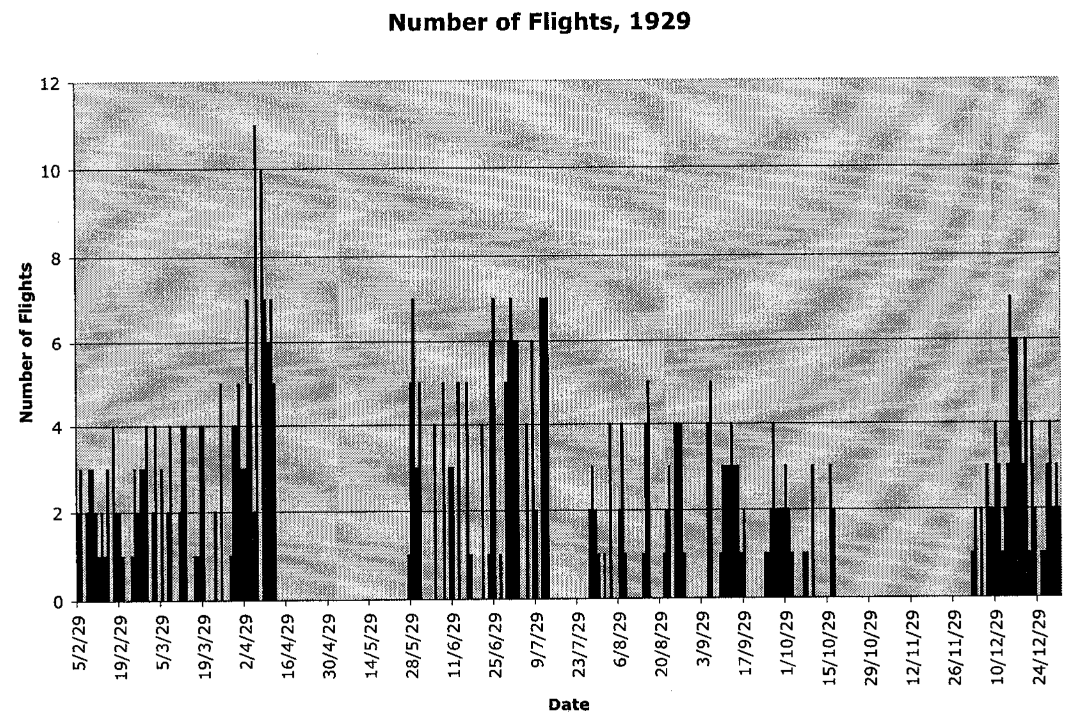
[101] W.L. Brintnell to C.H. Dickins, 22 February 1929, AOM, CAL Collection, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[102] C.H. Dickins to W.L. Brintnell, 7 January 1929, 13 February 1929, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[103] C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[104] C.H. Dickins to W.L. Brintnell, 13 February 1929, and 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.



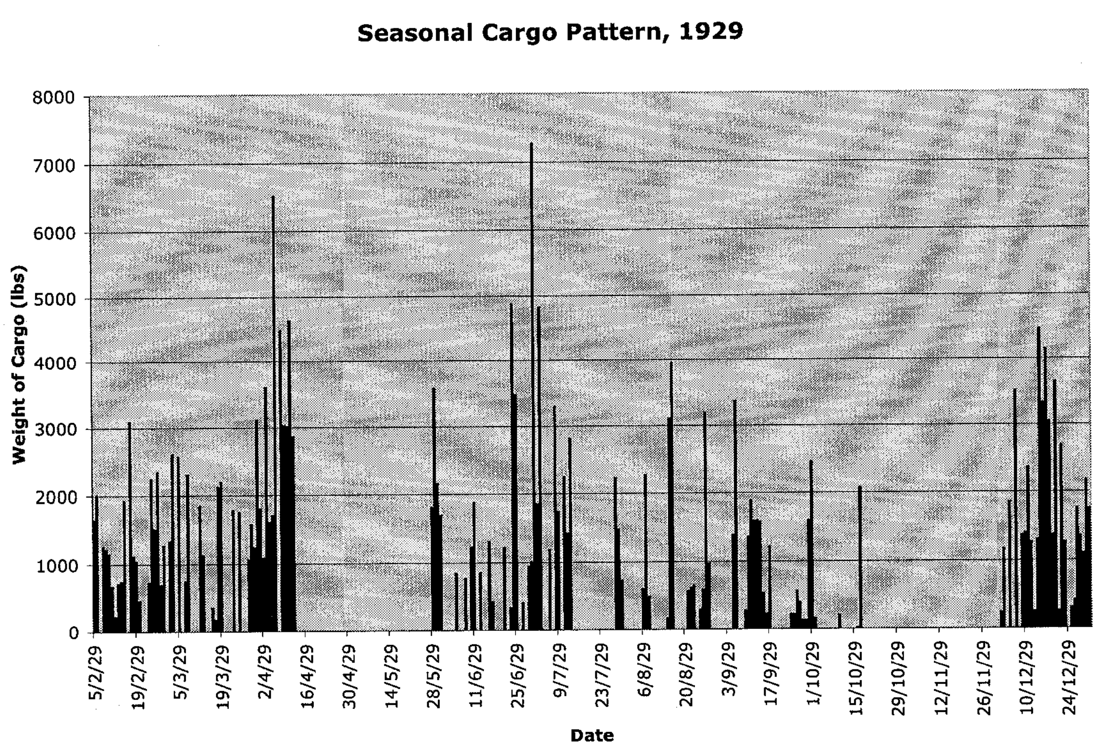


Figure 4.2: Graph of Canadian Airways' traffic patterns over 1929.
Source: Flight Reports and Logs for CF-AFL, G-CASM, G-CASP, G-CASQ, CAL Collection, AOM.

The spike in fur traffic in the spring combined with another jump in traffic that occurred around spring break-up. Break-up in the spring and freeze-up in the fall marked aircraft activity in the North. Because aircraft depended on waterways for their landing areas, they required either open water for float aircraft or solid ice for ski-equipped planes. The transition period while the ice was melting or forming meant that those landing fields were unavailable. Break-up usually extended from mid-April to late May and freeze-up from mid-October to early December. Because transportation by water, land, or air, was unavailable during the period, people would try to get in or out of the area before it became cut off. Correspondingly, traffic would build up during the off period and there would be a spike once service resumed.[105]

Traffic associated with mining development also contributed to the seasonal spikes. For instance, during the first year of operations, charter flights to Dawson's Landing around spring break-up contributed to a dramatic spike in activity. Since prospecting depended on being able to see the ground, it needed to take place after an area was relatively snow-free. This was often the case by early spring but, since the snow receded before the ice disappeared, many mining concerns sent in prospecting parties before the spring break-up so they could have a longer season of activity. In fact, mining traffic would be a greater and greater contributor to these spikes as mining activity in the Territories increased.

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[105] C.H. Dickins to W.L. Brintnell, 13 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929 C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929; L.R. Mattern to W.L. Brintnell, 5 December 1929, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #1: Feb 9/29 – Dec 31/29.

The summer season after the post-break-up rush was sometimes slow. Unlike the winter, however, it was not because there was no economic activity during this period. Instead, during the summer aircraft faced competition from boats operating along the Mackenzie and associated rivers. These boats were slower than aircraft, but much less expensive for large freight.[106] Because of this, the boats took much of the freight traffic during the summer.[107] However, during the summer of 1929, activity picked up because of greater mining activity. This produced an increased number of charter trips, and made Dickins optimistic about prospects for the summer of 1930.[108] Again, at the end of the season there was a spike of activity surrounding freeze-up, bringing the company back to the point at which it began its service twelve months previously.

Considering the influence of economic circumstances, geography, and environment, it becomes clear that rather than rising above the land, Western Canada Airways' northern service was closely tied to it. This connection to the land illustrates the connection between geography and technological development, revealing that the development of technological systems is not only the result of non-tangible features like economics, politics, and culture. Along the Mackenzie, it was also the product of

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[106] The trip between Fort Smith, above the rapids, and Aklavik took 9 days. Hudson's Bay Company Mackenzie River Transport Schedule, 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways #3, Oct 31/31 – Nov 1/32.

[107] C.H. Dickins to W.L. Brintnell, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929; C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929; C.H. Dickins to W.L. Brintnell, "Report on Summer Operations – Mackenzie River District – 1929," 22 October 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Oct – Dec 1929.

[108] C.H. Dickins to W.L. Brintnell, "Report on Summer Operations – Mackenzie River District – 1929," 22 October 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Oct – Dec 1929.

geography. Interactions between land and aircraft moulded the system. They would also sculpt aircraft use practices and, ultimately, the very shape of the aircraft themselves.

Operating in the Mackenzie's Geography

Although the company had operated in Northern Ontario and Northern Manitoba since 1926, rather than being an extension of these provincial norths, the Mackenzie District would prove to be a new environment, one that, at least in the winter, was sufficiently different in degree as to be almost different in kind. While the two areas were both located in the Canadian Shield, there were a number of important distinctions between operations in Northern Ontario and Manitoba and operations into the Mackenzie. To begin with, flying in the Red Lake area and in Northern Manitoba took place to and from small to mid-sized lakes and rivers. By contrast, the Mackenzie Valley flight route followed the great Mackenzie River and branched out across Great Slave and Great Bear Lakes, two of the largest fresh-water lakes in the world. This created treacherous landing conditions, in both summer and winter, with bigger swells on the lake and a stronger current in the river. In winter, these circumstances translated into much rougher ice conditions, placing stress on the aircraft during takeoff and landing. The area was also much further north, subjecting planes, pilots, and flight engineers to much colder temperatures. Moreover, distances between settlements and points of call were longer in the Northwest Territories than in the provinces. These differences in scale and temperature meant that operating conditions along the Mackenzie would be significantly different from Western Canada Airways' previous experiences.

The differences would also mean that the company's initial confidence in its machines would be shaken by the aircraft's response to the northern environment. The undercarriage would prove to be the Fokker Super Universal's Achilles heel. The shock absorbers were weak and would fail repeatedly under the Mackenzie's winter conditions. However, the company would not discover this until it had established the Mackenzie District service. The region's qualitatively different environment would challenge the technology and require Western Canada Airways to work with the aircraft manufacturer to produce modifications that would enable the machines to operate successfully in the region.

To be fair, the region offered an environment very conducive to aviation. The Mackenzie River presented a natural highway, providing a landing facility along which the area's major settlements were strung. It also supplied a landmark, a path visible from the air in a mostly unmapped and otherwise trackless land.[109] On the other hand, the North's extreme environment and the operators' lack of knowledge about conditions there created serious obstacles. As Western Canada Airways operators discovered, the Mackenzie's winter environment presented one of the sharpest points of difference. Not only was it colder, it was colder for longer.[110] Unfortunately for the operators, they had to be outside in it in order to maintain the aircraft. As Dickins described it:

> The chief difficulties of the winter operations that we are carrying on is the fact that we are out in the open all the time ... The winds are the hardest things to contend with, forty below doesn't worry me but when it's

[109] C.H. Dickins, "Report on Conditions McKenzie [sic] River District," 20 February 1931, CAL Collection, AOM, MG 11 A 34, Box 42, Edmonton and McMurray Base Correspondence: Jan 1/31 – March 31/31; Harold Kemp, "The Old-Time Bush-Pilot," unpublished manuscript, Elmer G. Fullerton Fonds, National Archives of Canada, R 1469-0-1-E.
[110] James A. Richardson to G.C. Drury, 5 February 1931, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil.

> forty below and a twenty to forty mile wind, it's tough, and the wind blows every day one way or the other.[111]

Compared to Northwestern Ontario, the distances between settlements were much greater and so any discomfort, whether from cold or otherwise, lasted longer as the plane flew from one stop to the next.[112]

While the landing conditions south of Fort Simpson were comparable to those in Northwestern Ontario, the cold made the stress on the aircraft more extreme.[113] Moreover, landing conditions deteriorated rapidly north of Fort Simpson. Describing the first flight across the Arctic Circle, Dickins noted,

> There were no outstanding difficulties except the abominable weather, and the poor landing conditions on the river below Simpson. From Simpson to Wrigley is not too bad, but could land only in the mouth of a small creek about two miles above Wrigley. From Wrigley to Norman there is no place that we could land on the main river, and few lakes inland, as the valley lies between two mountain ranges here. At Norman there is a mountain that stands at the head of the Bear River, and the wind currents coming around that rock are scandalous. The river is nothing but a jumble of ice and snow, and there is a lake back of the fort about three miles but it was so drifted that I did not want to take chances on it. ... However, from there to Good Hope is not quite so bad, but hardly any landings on the main river, mostly in lakes back from the river and in the smaller streams that run into it.[114]

Between the cold and the rough winter landings, the conditions put a great deal of stress on the aircraft.[115] This combination made the standard comparisons to Northern Ontario

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[111] C.H. Dickins to W.L. Brintnell, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[112] W.E. Gilbert to G.A. Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Jan 1933.
[113] C.H. Dickins to W.L. Brintnell, 2 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[114] C.H. Dickins to W.L. Brintnell, 10 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[115] T.W. Siers to G.A. Thompson, 23 December 1932, CAL Collection, AOM, MG 11 A 34, Box 38: Maintenance.

or Northern Manitoba irrelevant, and pushed the airline to adapt both practice and machine to this new North.[116]

Adapting Practice

Given that Western Canada Airways undertook the first winter service along the Mackenzie River, its pilots and mechanics had to learn about northern operations on the job. Standard maintenance routines obtained in the North, with daily inspections of the aircraft, periodic airframe overhauls, and regular engine care. Minor repairs were effected as required, for example tightening or loosening the controls, installing a new battery, or oiling moving parts. Major overhauling occurred during break-up or freeze-up and was done at the main shops in Winnipeg.[117]

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[116] W.E. Gilbert to G.A. Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Jan 1933.

[117] For instance, CF-AJC underwent a complete overhaul in October of 1930: "Machine taken in shops for repair. Main Plane: Cleaned seams scraped and panels sand papered. Panels refaired at port top 2nd and 3rd from tank at s-carf [sic]. 1st and 2nd from tip at aileron spar. Centre section, starboard panel at s-carf [sic] and new biscuits fitted at lifting eyes. Starboard. Trailing edge panel at fuselage cut out. All tapes removed and new ones fitted. All bare wood coated two lionoil. Top side coated 1 silver lionoil and two Valentines enamel lower side one enamel. Thanks removed tested and re-fitted. Fuselage. Cover cleaned and small patches fitted. New tail end inspection door fitted. Cabin heater removed from rear of cabin and new one fitted at forward end. Beading at door frame repaired.
Empanage [sic]. Tail surfaces cleaned and small patches fitted. Side play taken up in actuating gear, and new inter stabilizer tube fitted.
Controls. Controls checked and new ones fitted to upper and lower starboard elevator and upper port elevator.
Undercarriage. New type undercarriage fitted with Gruss air struts.
Machine assembled and rigged.
Compass swung and compensated.
New controls fitted and inspected" CF-AJC, Logs, 8 October 1930, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJC Logs, June 24/30 to Jan 29/33. The empennage refers to the aircraft's tail assembly, consisting of the stabilizer, elevators, fin, and rudder.

In the winter, however, daily maintenance was more complicated because of the cold weather. In order to prevent the engine oil from congealing in the cold, when the plane stopped its engine,

> you had to drain it out and you had to get it out as soon as you stopped because, at 40 and 50 below zero, didn't take very damn long to get hard. That was the first thing – the mechanic got down and got the engine cover on, oil plugs out and down it came.[118]

After draining the oil there was refuelling, running poles under the skis so they would not freeze to the snow overnight, and tying down the plane in case the wind came up.[119] In the morning, the oil had to be heated over a stove while the engine was reheated using a blow pot placed under the nose cover. When the engine was heated and the oil liquid, it was poured in and the engine started, hopefully before the oil re-congealed. If the engine did not catch, the oil had to be drained immediately and the whole process repeated. Because much of the maintenance involved fine manual work, the engineers were often reduced to working in freezing temperatures with bare hands.[120] None of this differed from winter procedures in other districts.

Nonetheless, conditions in the Mackenzie were more extreme than the provincial norths and the crews had to learn techniques specific to flying this far north. The details might seem small, but they were key to successful operation. During that first winter, C.H. Dickins and Louis Parmenter learned a great deal. Later Dickins recalled, "We avoided complete disaster, and we found, however, that oil lines would freeze-up, a carburettor would ice up and that, occasionally, on rough ice, the undercarriage would be

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[118] Con Farrell, Interview, 20 August 1967, NWT Archives, G-1988-008-0002.
[119] C.H. Dickins, Lecture, Ontario Science Centre, 1978, NWT Archives, N-1992-120-0001.
[120] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.

damaged."[121] The pilots also acquired knowledge about managing winter conditions. For instance, W.E. Gilbert remembers learning that "in the winter time, for instance, snow is always softest and least drifted in the lee of a northern shore – northern or northwestern because the big winds come from the north and the northwest – and so the general procedure is to land along the northerly shore even in spite of the wind and in there there is a regular pillow of soft snow – the wind never gets at it."[122] They also had to learn how to handle summer conditions:

> you had to understand ground swells and take a big lake like this [Great Slave Lake], and if there's a wind blowing, you don't go in and land on that like, you'd buck yourself all to pieces. ...There's lots of bays like this [Yellowknife Bay] you could get in or you damn well go back to Rocky River and wait. If you had to get into Resolution, you'd go back to the river, Slave River, sit down at what we called the Saw Mill, have a cup of tea or talk to people round there and come in.[123]

Once acquired, pilots passed on that knowledge informally when they would meet. There was no training school, "it was passed on from one to the other."[124] The new pilots would learn from the experienced ones when they were lucky enough to get into a settlement overnight.[125] It was a classic example of craft knowledge gained, not through scientific investigation or formal education, but through accumulated experience. This experiential knowledge then passed down through an informal system of apprenticeship and conversations amongst pilots.

Mechanics had a similar sort of education. While the basics of engine or aircraft maintenance might be acquired through formal training, the real education took place on

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[121] C.H. Dickins, Lecture, Prince of Wales Northern Heritage Centre, Yellowknife, NWT, September 1978, NWT Archives, G-1992-041-002.
[122] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.
[123] Con Farrell, Interview ,20 August 1967, NWT Archives, G-1988-008-0002.
[124] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.
[125] Ibid.

the job. For example, John J. Bowan, mechanic with Western Canada Airways' competitor, Commercial Airways, recalls having some training at technical school but had to learn aircraft maintenance, let alone winter maintenance, after he was hired.[126] Louis Parmenter, the first Western Canada Airways mechanic in the Mackenzie District, did have wartime experience with aircraft maintenance, but coming from Britain had a lot to learn about Canadian winters, let alone flying in them.[127] For instance, Parmenter had to contend with the first Fokker undercarriage failure and improvise repairs in the bush. Nevertheless, Dickins was particularly impressed with his performance and ingenuity.[128] While there was some training at the company's main shops during overhaul periods, most of the mechanics' knowledge had to be developed in the field, learning from others or through experience.[129] Later, Canadian aircraft manufacturers would translate this knowledge, along with the pilots' experience, into the design of indigenous Canadian bush planes.

Adapting the Machines

Not only did the pilots and engineers have to learn how to function in this new environment, the aircraft themselves had to be adapted in order to operate smoothly north of Fort McMurray. The dialogue between technology and its context of operations demonstrates the impact that place can have on the success or failure of a particular

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[126] John J. Bowan, interviewed by Evelyn Rowand, 1 May 1972, NWT Archives, G-1988-008-0007.
[127] C.H. Dickins to W.L. Brintnell, 20 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[128] "In connection with this trip [to Good Hope] and the work in general all winter I wish to bring to your attention the good work of Parmenter who has stuck through the cold and various handicaps of working in the open under very adverse conditions even when the natives have quit." C.H. Dickins to W.L. Brintnell, 10 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.
[129] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.

design. This interaction becomes especially apparent when one considers the Fokker Super Universal's Mackenzie career alongside that of the Bellanca Pacemaker, but before making that comparison, one must first explore the impact of northern operations on the Super Universal's construction.

To begin with, it is important to recall that the Fokker Super Universal was originally designed as a wheeled aircraft, but the aircraft required skis in order to operate in the Mackenzie during the winter. However, equipping the aircraft with skis would compromise the Fokker's shock absorbing capabilities in such a way that when the Super Universals began flying in the Mackenzie winters, it would produce serious consequences. On the original design, a rubber wheel absorbed much of the shock of landing. The rest travelled up

> vertical struts fitted with shock absorbers between axles and front wing spar, taking the bulk of wing weight directly instead of through fuselage. Shock absorbers formed of elastic cord over pins, with practically no initial tension, permitting easy replacement and long stroke under shock, with exceptionally soft action in taxiing.[130]

When a wooden ski mounted below a wooden pedestal replaced the rubber wheel, the wheel's shock absorbing qualities would be lost. Despite this, the aircraft performed well in other areas during the winter of 1928-1929, the first season of its winter operations in Canada.

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[130] Atlantic Aircraft Corporation, "Standard Specification, Fokker Super-Universal Monoplane – Pratt & Whitney "Wasp" engine," 12 June 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft; The *CAHS Journal* describes the arrangement as an "undercarriage slider bungee shock assembly … rubber bungees for springs – 14 feet of 1/2" rubber cords wound around pins." "Anatomy and Oddities: An Inside Look at a Pioneering Canadian Bushplane 1929 – 1937," *CAHS Journal* 35:1 (Spring 1997): 20 – 21, 20.

Figure 4.3: Detail of Fokker Super Universal shock absorber arrangement.
Stress would have travelled up the struts to the rubber bungee cord assembly, *centre*.
Source: CF-AAM, Fokker Super Universal, Restored by Alberta Aviation Museum, Bob Busse, Alberta Aviation Museum, Personal Collection.

Although the shock assembly initially appeared able to withstand the force originally absorbed by the rubber wheel, when used along the Mackenzie the shock cords lost their elasticity in the cold, forcing the .095 inch walled chrome molybdenum steel struts to absorb much more of the landing force than their designers intended.[131] Not surprisingly, given the cold temperatures and rough ice conditions of the northern winters, the struts began to give way under the additional stress. However, it was not an eventuality anticipated by the operators.

The company experienced its first undercarriage failure in January 1929, when C.H. Dickins made the first flight along the Mackenzie. On the plane's return trip, Dickins reported that he had,

> Quite a tough trip as you may imagine from reading the flight reports. Experienced one of the worst spells of weather in 18 years, and had temperatures down to 62 below zero and 54 below with a 50 mile wind. Had a few troubles the chief one being frost and ice in the carburettor at

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[131] Charles Froesch, Fokker to W.L. Brintnell ,16 January 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.

> temperatures below 30 below zero. This is due to not having enough heat from the exhaust to warm the air being taken into the carburettor and I would think that a heater of the Wright pattern with also a cowling or jacket around the air intake would eliminate this trouble. [132]

Dickins also noted,

> The rubber shock absorbers on the undercarriage are not much good at extreme temperatures, freezing solid and makes landing just the same as tho solid tubes were in the legs. In general the landing conditions are not bad, and compare favourably with any in Ontario, but the super loaded at temperatures below 30 below certainly takes even little ripples very hard. I would like to have a ship with hydraulic or air shock absorbers, for this run in winter. Can you inform me if there has been any trouble with supers in other districts this winter. [133]

Dickins' interest in a different set of shock absorbers was the result of the events following his landing at Fort Resolution:

> At Resolution I landed in a heavy snow storm and made a good landing but ran over a drift which I could not see and the right leg folded then the left, there was no jar of any kind, and the passenger thought that it was the normal way for the machine to land. … The legs we fixed by straightening as much as possible then cut off the cracked parts and inserted water pipes inside and riveted in place. We also removed one shock absorber ring to give more resiliency. I flew the ship out this way.
>
> I have been over the ground now, and know my landings so that I do not anticipate any other trouble from this source only in the event of forced landings.[134]

Later that spring, Dickins would repeat his request for new shock arrangements, noting he had had good experiences flying air force aircraft equipped with oleo landing gear on operations during the winter of 1926.[135] In spite of Dickins' optimism, this would be only

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[132] C.H. Dickins to W.L. Brintnell ,2 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence: Jan – March 1929.
[133] Ibid.
[134] Ibid.
[135] C.H. Dickins, "Some Notes on Winter Work in McKenzie [sic] District," 17 March 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan-Mar 1929.

the beginning of a four-year struggle to adapt the technology to the rigorous northern environment.

The airline had also experienced another undercarriage failure on a Super Universal at Regina. W.L. Brintnell, Western Canada Airways' Operating Manager, was in contact with Fokker, and he and the manufacturer assumed that the failure was the result of a strut too weak to sustain the force of landing. However, Brintnell did ask the company to confirm that the undercarriage struts were strong enough to withstand regular ski flying as the company had already taken the measure of increasing the shock cord length to increase the unit's shock absorbing capacity.[136] When the Fokker engineers replied they concluded,

> With reference to the failure of the landing gear, we interpret it to be a collapse of the vertical tubes underneath the shock strut and if such is the case, there is no doubt that the actual failure did not occur while taxiing, but the damage must have been done during a previous hard landing, which resulted in either a cracked or bent tube, not noticed by routine inspection. Furthermore, the probability is that taxiing on frozen ground quickly accelerated the failure of these members and fortunately so while the plane was still on the ground.
>
> … there is no question that these tubes [vertical struts] should be of heavier wall thickness when used with skiis. The mere fact that you find it necessary to either increase the number of shock cords or their size, is an indication of the greater severity of skii flying.
>
> The present tube size on your Super Universal is 1-1/2" x .095 wall chrome molybdenum steel and we would recommend not less than .120 wall thickness when used in conjunction with skiis. This recommendation depends to a certain extent on the type of skii used.[137]

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[136] W.L. Brintnell to A.A. Gassner, Fokker Aircraft Corp, 10 January 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
[137] Charles Froesch to W.L. Brintnell, 16 January 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.

Although Brintnell recognized the effect of northern conditions on Super Universals flying in the Mackenzie, he deferred the manufacturer's suggested modification until the purchase of any new Super Universals.[138]

By late February, however, Brintnell was becoming more concerned. Writing to Charles Froesch, he somewhat unfairly complained,

> On several occasions we discussed the matter and were assured that the undercarriage was sufficiently strong to withstand ski flying. However, we think that your engineering staff do not appreciate the conditions under which these machines have to operate, namely, drifted snow on the big lakes makes very rough landing ground, and also the fact that in temperatures around 30° below zero the elastic shock cord on the vertical struts does not give nearly as much resiliency as it should, so that the majority of the shock is taken solidly right at the wing.[139]

Brintnell's criticisms were unfair because Froesch's letter of just over a month previous had recommended thickening the strut walls to increase their ability to absorb the shock of ski flying and Brintnell had deferred the modification.

Even as he blamed the conditions and the manufacturers, Brintnell also insinuated that the failures were partly the result of Dickins' flying. Writing to Dickins he complained, "We are not having any trouble with Super-Universal undercarriages anywhere else, and they are standing up very well under all conditions. These two accidents, namely the one at Regina and the one at Resolution are costing us about $2000 a piece, and we certainly cannot afford to have any more."[140]

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[138] W.L. Brintnell to Charles Froesch, 29 January 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
[139] W.L. Brintnell to Charles Froesch, 21 February 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
[140] W.L. Brintnell to C.H. Dickins, 22 February 1929, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence, Jan – March 1929.

Six months later maintenance costs must have begun to worry Brintnell appreciably, as he wrote that summer requesting information on the new, stronger vertical struts that Fokker had promised for the Super Universals and details about when they would be shipped.[141] Only twelve days later Brintnell wrote again to Fokker to enquire about the possibility of incorporating aerol struts into the strengthened undercarriage.[142] In the Mackenzie's exacting winter conditions, the rubber shocks froze solid, and a new aerol shock struck him as a great improvement. Brintnell noted that he had discussed with Anthony Fokker the possibility of working the aerol strut into the pedestal of Super Universal skiis along the lines of a Fairchild ski pedestal design that used aerol shocks. He wondered if Fokker was looking into this modification.[143]

Apparently, the manufacturer was doing just that. Twelve days later, A.A. Gassner, Fokker's chief engineer, replied with a drawing of the Super Universal gear incorporating the aerol struts. He noted, "the changes required besides the aerol strut are different lengths of vertical tubes and a casting for the bottom of the aerol strut in joining it with the vertical tubes."[144] While the company did not yet have the aerol struts in production, if Western Canada Airways were interested, Fokker would submit the design

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[141] W.L. Brintnell to A.A. Gassner, 4 July 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, July – Sep 1929.
[142] Aerol struts use a cylinder filled with air to absorb the shock of landing and taxiing, replacing the rubber cords of the original design.
[143] W.L. Brintnell to A.A. Gassner, 16 July 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
[144] A.A. Gassner to W.L. Brintnell, 24 July 1929, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Aircraft.

to the American Department of Commerce for approval. Brintnell replied that the design looked interesting and requested two sets to test.[145]

Despite this correspondence, the aerol strut modification was not immediately adopted, evidenced by Dickins' ongoing requests to have it incorporated into some sort of modification. When the company began full winter operations in 1929-1930, the Fokker Super Universal still used the same undercarriages and Dickins feared that,

> under real forced landing conditions around the Lakes, the machine will be damaged due to the drifts and with absolutely no sheltered places, the landings at Resolution and Fitzgerald are also very bad this year, and there is considerable strain on the machines. The Commercial [Commercial Airways, Western Canada Airways' competitor in the region] are using the rubber shock in the pedestals [of their skis] and find it very good so far. This oildraulic should be better with a non freezing solution in it, and

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[145] W.L. Brintnell to A.A. Gassner, 1 August 1929, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, July – Sep 1929. Rather than issuing airworthiness certificates for different aircraft types based on Canadian evaluations of the designs, the Canadian government chose to rely on the reviews conducted and certificates issued by the governments of the country in which the aircraft was manufactured. As a signatory of the International Convention for Air Navigation, which Canada ratified in 1921, Canada had reciprocal agreements with the other signatories that recognized one another's airworthiness certificates. The United States, however, had not ratified the Convention. Thus Canada reached a separate agreement with that country in 1923. Under this agreement, "the same validity shall be conferred by the competent Canadian authorities on certificates of airworthiness for export issued by the competent United States authorities for aircraft subsequently to be registered in Canada as if they had been issued under the regulations in force on the subject in Canada, provided that such aircraft have been constructed in continental United States or Alaska in accordance with the airworthiness requirements of the United States." "Arrangement Between Canada and the United States of America Relating to Certificates of Airworthiness for Export," J.A. Wilson Papers, NAC, MG 30 E 243, vol. 11, Specific Memoranda, 1919–1946. According to the Canadian government, this "simplified the situation materially and relieves this department [the Department of National Defence] of undertaking the detailed examination of the design of machines produced by aircraft constructors in the United States." Canada, Department of National Defence, *Report on Civil Aviation for 1923* (Ottawa: 1924), 9.

> will replace the shock absorbing property lost when the tire and wheel is replaced with a ski.[146]

Dickins' concern reflected the serious undercarriage failure the Fokker Super Universal, G-CASO, experienced in November 1929. To begin with, G-CASO left Fort Reliance on 16 November 1929, piloted by Roy Brown. The plane later landed at the north end of Aylmer Lake because of fog. Brown reported,

> I made a normal landing on good surface and waited fifty yards from shore for fog to clear. At 12.10 the fog began to lift and visibility appeared fit to proceed. Proceeding to taxi out for the take-off I had only taxied fifty yards at approximately six miles per hour when right vertical undercarriage strut collapsed allowing the right wing-tip to strike the ice breaking off eight feet of the wing and the right aileron. ... We were forced to leave the machine in its present location owing to its bulk weight and the obvious inability of three men to move it.[147]

Failure to incorporate the strut modifications had resulted in serious damage to the aircraft and a resultant loss of potential business.

All over the Mackenzie, the landings were extremely rough during the winter of 1929-1930 and two other aircraft developed serious undercarriage problems in March 1930. On 16 March, pilot W.E. Gilbert and mechanic Stan Knight found a broken fitting on the port shock-absorber plunger of their Super Universal, CF-AFL.[148] More seriously, less than a week later G-CASM, a third Super, damaged its port strut landing on the Whitefish River.[149] The Fokker Super Universal increasingly seemed poorly adapted to northern winters.

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[146] C.H. Dickins to W.L. Brintnell, 29 January 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Jan – Mar 1930.
[147] Roy Brown to W.L. Brintnell, 9 March 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Jan – Mar 1930.
[148] Flight Report, CF-AFL, 16 March 1930, CAL Collection, AOM, MG 11 A 34, Box 94: CF-AFL Flight Reports, Dec 1929 – April 1930.
[149] According to the flight report, the aircraft "damaged top of port vertical u/c [sic] strut landing #88 [i.e. at Whitefish River] – cut off and re-bolted. Landing conditions fair but

Over the course of March, Western Canada Airways' managers became progressively more concerned with the situation, prompting Brintnell to contact Fokker's service division again:

> We are again having trouble with the collapse of the shock struts on Super-Universals, and as in each case where a wing is damaged in a remote area it means considerable expense for us to salvage the machine. We have just had another failure. A machine started to taxi and had not gone 30 feet from its starting point when this strut collapsed.
>
> We must have some other arrangement, and would like you to let us know if you can build us struts for this machine in which are incorporated Gruss air spring similar to the F.14, but the whole arrangement about 100% stronger than you would figure for operations in the States.
>
> This is getting to be such a costly thing and running our maintenance up so high that we have to have some action right away.[150]

The company found this expense particularly troubling. R.H. Mulock noted that the maintenance on the Super Universal had been more expensive and costly than other types of equipment.[151] Reviewing the winter of 1930, Dickins came to the same conclusion, largely because the failures along the Mackenzie had cost the company "nearly three thousand dollars not counting loss of time."[152]

Brintnell's demands of Fokker in the spring of 1930 were, in some ways, a reiteration of his correspondence of the previous winter. Charles Froesch responded with drawings

> showing the changes which we have made on the construction of the lower strut in order to provide greater rigidity and render this type of strut

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ran into ridges at end of run." Flight Report, G-CASM, 22 March 1930, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec 1930.

150 W.L. Brintnell to Charles Froesch, 5 March 1930, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.

151 R.H. Mulock to George S. Burrows, 15 December 1929, CAL Collection, AOM, MG 11 A 34, Box 23: Canadian Vickers Correspondence, 20 May 1929 – 19 July 1934.

152 C.H. Dickins to W.L. Brintnell, 15 April 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence, Jan 2/30 – June 30/30.

> adaptable for ski work. This alteration or deviation from our standard specification consists of substituting the lower part of the 1 1/2 inch tubes with a 2 inch tube section properly braced by spacer strips, and fish mouthed at the top to the regular outer tubes, a sleeve being inserted to properly distribute the column load.[153]

It was a solution similar to the previous response of thickening the strut walls, improving the material strength to resist the force of hard landings.

The company's efforts did not end there. Only four days later Froesch wrote to say that he had spoken with A.A. Gassner, another member of the Fokker design team, and that they had "arrived at the conclusion that the only way to satisfactorily solve this problem for you and adapt Gruss air struts to the Super-Universal is to work out a design similar to that laid out for your F-14s." The language is almost a recitation of Brintnell's letter of 5 March.[154] Describing the new arrangement Froesch continued,

> You will note that the air bottle is directly connected to the axle and swivelled at the top to a V strut connected to the front and rear landing gear fittings at the fuselage. A vertical streamlining strut connects this assembly to the old shock strut fitting on the front spar.

However, Fokker would have to obtain United States Department of Commerce approval before the modification could be incorporated into the aircraft and so, "the best course for the time being is to increase the size of the vertical tubes, inserting a sleeve at the point where these portions join the standard tube size, in order to obtain strength at that point as well as column rigidity." Froesch offered to send these reinforcements and to discuss the

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[153] Charles Froesch to W.L. Brintnell, 8 March 1930, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.

[154] Charles Froesch to W.L. Brintnell, 12 March 1930, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft; W.L. Brintnell to Charles Froesch, 5 March 1930, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft.

new arrangements when he visited Western Canada Airways' head offices in early June.[155]

In response to the situation, the pilots continued to advocate for aerol struts.[156] Although the company recognized the need for a solution and the manufacturer had developed a modification that responded to the company and its pilots, the winter season was coming to an end and the changes required government approval. As a result, installation of the new shock absorbers would have to wait until the machines changed back from floats to skis. When the fall freeze-up came around that October, Gruss aerol struts began appearing on the Fokker Super Universals of Western Canada Airways' Mackenzie fleet.[157]

The Gruss shock absorbers performed well through the winter of 1930 – 1931 and the pilots were very impressed. W.E. Gilbert, flying G-CASK, seemed particularly pleased with their performance. As he put it, "New landing gear is a tremendous improvement – (makes pilot think he is "learning to land," at last)."[158] Gilbert's pleasure lasted through that winter, and he commented, "Steerable tail-ski combined with new

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[155] Charles Froesch to W.L. Brintnell, 12 March 1930, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.

[156] D.S. Atkinson to W.L. Brintnell, 2 May 1930, CAL Collection, AOM, MG 11 A 34, Box 55: Skis; Strikingly, it is the pilots who communicate with company management, not the flight engineers. As the company's structure became more bureaucratic, even the pilots lost this direct contact, funnelling information through district superintendents. That said, it was the pilot that filled out the flight report, which were a major source of technical information for the company, not the flight engineer. This process suggests that the pilots' knowledge had greater authority than the engineers.

[157] CF-AJC, Logs, 8 October 1930, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJC logs, June 24/30–June 29/30.

[158] Flight Report, G-CASK, 9 December 1930, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASK, Flight Reports, Jan – Dec 1930.

undercarriage makes down wind taxying on hard drifts remarkably easy,"[159] and, after landing at Fort Rae, Great Bear Lake, and Coppermine, "Unbelievably hard rough drifts, following last week's blizzard. Without new type undercarriage operating under these conditions would have been impossible."[160] The problem appeared to be solved.

Unfortunately, the benefits were short lived. By the middle of the following winter, 1931-1932, the northern environment was again exacting a price from the technology.[161] January of 1932 was an especially cold month and by the end, the struts were failing again. G-CASK, the redoubtable northern workhorse, was laid low on 15 January 1932.[162] As Gilbert described it, he was proceeding from Fort Smith to Fort Resolution to rendezvous with CF-AJC and CF-AKI, piloted by C.H. Dickins and W.R. May respectively. He noted that the best landing area at Resolution had been constantly shifting due to a series of high winds over the winter. However, the landing was no rougher than average at that time of year. "Just as the pilot was about to open the throttle to commence taxiing in to the settlement, the upper struts on the undercarriage began to

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[159] Flight Report, G-CASK, 12 January 1931, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASK, Flight Reports, Jan – Dec 1931.
[160] Flight Report, G-CASK, 22 March 1931, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASK, Flight Reports, Jan – Dec 1931.
[161] As an interesting sidelight, CF-AJC lost its undercarriage in early December 1931, but as a result of poor workmanship – poor welding on a wing fitting. Flight Report, CF-AJC, 19 December 1931, CAL Collection, AOM, MG 11 A 34, Box 97: CF-AJC, Flight Reports, Jan – Dec 1931; Log entry, CF-AJC, 19 December 1931, CAL Collection, AOM, MG 11 A 34, Box 75: AJC logs, June 24/30 to Jan 29/33.
[162] "Undercarriage buckled in landing but – (thank God!), aircraft little damaged." Flight Report, G-CASK, 15 January 1932, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASK, Flight Reports, Jan – Dec 1932.

buckle, dropping the aircraft to the snow on practically an even keel."[163] Gilbert was at a loss to explain the cause of the accident,

> since this type of undercarriage (the GRUSS design) has given such remarkably efficient service on this aircraft for the past two winter seasons. The undercarriage is carefully inspected by the pilot as well as the engineer at the end of each run and no sign of any weakness had at any time been noted. It may be possible that, when the old undercarriage has been removed some cause for failure will be noted.[164]

CF-AJC was close behind, splintering a pedestal and bending its right undercarriage strut on 22 January 1932.[165]

Then G-CASK's shocks failed again. On 27 January the plane's "shock legs froze in contracted position owing extreme cold [-62° F[166]], but later expanded again (no apparent damage in landing this way)."[167] Later Gilbert wrote, "We landed at Echo Bay in the softest spot available and found to our surprise that the undercarriage was again normal, and that no amount of taxying slowly around caused it to show any faulty operation."[168] However, Gilbert was not so lucky the next day.

> On the following day, 810 lbs of baled fur was loaded [at Coppermine], and, fearing that trouble might well occur again, we lashed two small, light bales against the cabin wall, outside, and upon the top drift struts of the undercarriage, realizing that thus far all the struts have buckled upward allowing the vertical strut to fold inward through the cabin wall and the wing to be damaged.

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163 W.E. Gilbert to G.A. Thompson, 15 January 1932, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft.
164 Ibid.
165 Flight Report, CF-AJC, 22 January 1932, CAL Collection, AOM, MG 11 A 34, Box 97: CF-AJC, Flight Reports, Jan – Dec 1932; Logs, CF-AJC, 22 January 1932, CAL Collection, AOM, MG 11 A 34, Box 75: AJC Logs, June 24/30 to Jan 29/33.
166 W.E. Gilbert to G.A. Thompson, 4 February 1932, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
167 Flight Report, G-CASK, 27 January 1932, CAL Collection, AOM, MG 11 A 34, Box 85: Flight Reports, G-CASK, Jan – Dec 1932.
168 W.E. Gilbert to G.A. Thompson, 4 February 1932, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft.

> A landing was effected on a fairly smooth portion of Echo Bay, but, after contracting on the first drift the undercarriage refused to extend and the second shock, metal to metal, buckled the port side of the undercarriage. Fortunately, our fur shock absorber prevented the vertical strut from coming closer than one foot from the cabin wall, and though we were still travelling at 25 mph when the failure occurred, the aircraft's wing was kept clear and little damage was done.
>
> … Pursuant to your instructions, conveyed to us here by Mr. Dickins we shall continue to use every possible precaution against a recurrence of this trouble, but landing conditions are worse than the usual this Winter, and carrying big loads, makes even the best of landings very hard on an undercarriage. … [169]

The same day, G-CASQ ran into serious difficulty. Though its undercarriage seemed to have performed beautifully up until then, the strut eventually buckled under the pressure. On 4 February 1932, Andy Cruickshank wrote, "Undercarriage and skiis also tail skid wonderful – didn't think it possible undercarriage could stand such pounding."[170] After the next flight, he was forced to write, "Axel on port side bent up like a fish hook by rough landings – had to take off undercarriage and heat axel to straighten. Strengthened up with wood block. Think it will hold to McMurray. Snow getting rougher every day."[171] CF-AJC, now repaired, ran into more problems because the oil lubricating the shock absorbers was too heavy for the northern cold. In an effort to compensate, H. King, Western Canada Airways mechanic, replaced the lubricating oil with a mixture of transformer and coal oil.[172] Nine days previously, 30 minutes after

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[169] Ibid.; See also, Flight Report, G-CASK, 28 January 1932, CAL Collection, AOM, MG 11 A 34, Box 85: Flight Reports, G-CASK, Jan – Dec 1932.
[170] Flight Report, G-CASQ, 4 February 1932, CAL Collection, AOM, MG 11 A 34, Box 86: Flight Reports, G-CASQ, Jan – Apr 1932.
[171] Flight Report, G-CASQ, 6 February 1932, CAL Collection, AOM, MG 11 A 34, Box 86: Flight Reports, G-CASQ, Jan – Apr 1932.
[172] Logs, CF-AJC, 7 February 1932, CAL Collection, AOM, MG 11 A 34, Box 75: AJC Logs, June 24/30 – Jan 29/33.

landing at Fort Resolution, G-CASL lost pressure in its leg because of a faulty valve.[173] G-CASK continued to experience problems after rough landings at Echo Bay on Great Bear Lake.[174] Undercarriage failures were becoming routine along the Mackenzie.

According to Archie McMullen's recollection, seven different aircraft experienced these failures that winter.[175] The cause of these problems was repeatedly identified as the result of lubricating oil in the struts congealing in the cold temperatures. G-CASK's original collapse was attributed to the fact that the cylinders "were filled with heavy instead of non-freezing oil, which at the very low temperatures now prevalent here, had a consistency resembling sludgy treacle. Doubtless this was the direct cause of the failure of the undercarriage to perform, as both failures have occurred in the only period of intense cold yet experienced."[176] McMullen, pilot of G-CASL, attributed the failures to the fact that the struts had been designed in Detroit and had never been through real cold weather testing. Thus, the oil in the shock would freeze.[177] The company easily addressed these problems by ensuring lighter oils were used in the struts, although the engineers had to wait for head office approval before implementing the procedure.[178]

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[173] Flight Report, G-CASL, 25 February 1932, CAL Collection, AOM, MG 11 A 34, Box 85: Flight Reports, G-CASL, Feb – May 1932.
[174] Flight Reports, G-CASL, 14 February 1932, 5 March 1932, CAL Collection, AOM, MG 11 A 34, Box 85: Flight Reports, G-CASK, Jan – Dec 1932.
[175] Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-0009.
[176] One assumes that the oil referred to is a lubricating oil, as the shocks fitted to G-CASK were Gruss aerol struts. If the lubrication was lost when the oil congealed and the parts seized, the shock from the landing could conceivably compromise the legs. W.E. Gilbert to G.A. Thompson, 4 February 1932, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft, Individual Fokker Aircraft.
[177] Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-0009.
[178] Logs, CF-AJC, Fall overhaul report, November 1932, CAL Collection, AOM, MG 11 A 34, Box 75: AJC Logs, June 24/30 to Jan 29/33; Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-0009.

The company also decided to use Fairchild ski pedestals that incorporated shock absorbers into the pedestals on some of the aircraft, a course recommended by C.H. Dickins who commented, "I am firmly convinced that the undercarriage as supplied by the manufacturers are [sic] not designed with sufficient shock absorbing property to allow solid pedestals to be used in the Mackenzie River District as landing conditions are extremely rough."[179]

Figure 4.4: Fairchild ski pedestals. Fairchild at Fort McMurray, 1934.
Source: AAM Photo Collection, 204128.

The airline had now worked through three Mackenzie winters and yet had not completely solved the problem. The process of adaptation was frustrating for the both pilots and the company. After the initial failure in 1929, Dickins had to convince company management that there was indeed a problem with the design and Brintnell was

[179] Logs, CF- AJF, 14 February 1933, CAL Collection, AOM, MG 11 A 34, Box 75: Log, CF-AJF, Sept 5, 1932 – March 16, 1934; C.H. Dickins to G.A. Thompson, 14 March 1932, CAL Collection, AOM, MG 11 A 34, Box 55: Skis.

unwilling to immediately accept that the new environment was too stressful for the undercarriage. However, when the maintenance costs mounted higher and higher, management took notice and began to ask the manufacturer to make changes. Initially, the manufacturer thought thickening the struts would be sufficient. However, they too eventually came around to the idea that the struts needed to be redesigned. The situation was complicated as Fokker was going through its own reorganization during the same period that the Supers needed updating.[180] Finally, Western Canada Airways obtained the modifications it requested. Even then, however, it was not enough: even the grade of oil used had to be fine-tuned for the North. Strangely, just as the company seemed to have adapted the Super Universals to the Mackenzie's environment, management began talking about replacing the aircraft. Although the company had adapted the aircraft to the physical conditions along the Mackenzie Valley, by the time they had achieved this feat other conditions had changed significantly enough to seriously undermine the Fokker Super Universals' suitability for Mackenzie operations. To begin with, they were now part of a fleet with two aircraft types.

ABSORBING THE COMPETITION: BELLANCA PACEMAKERS IN THE NORTH

After Western Canada Airways initiated its Mackenzie run in 1929, one other company also began operations along the river. Commercial Airways' Red Armada, so called because of their orangey-red colour scheme, provided Western Canada Airways' only direct competition in the area, though several mining and exploration companies such as Dominion Exploration, Consolidated Mining and Smelting, and Northern Aerial

[180] During this period General Motors absorbed Fokker's American operation, and the company became GM's aircraft division, General Aviation. Dierikx, *Fokker*, chapter 7.

Minerals Exploration, all had their own air arms. Commercial Airways, founded by 'Wop' May, Vic Horner, and Cy Becker, all of Edmonton, began operations in August of 1928 with a single Avro Avian.

Figure 4.5: Wilfrid Reid May.
Source: AAM Photo Collection, 202668.

Born in 1896, Wilfrid Reid May, who had earned his nickname 'Wop' from a young, tongue-tied cousin, was a well known Canadian war pilot who had gained fame because of his role in bringing down the German war ace Baron von Richtofen. Although sometimes identified as a war hero because of the event, May was not responsible for shooting down the Red Baron. Rather, as an inexperienced Royal Flying Corps pilot, May had been the Baron's prey during his last aerial battle. In 1952, May described it to the 12th Calgary Boy Scout Troop:

> The day came when I was to go over with the Squadron. Roy [Brown] was the Squadron Leader that day. He gave me instructions that I was not to get in any dog fights and that I was to sit up on top and watch to see what happened. …

> Just underneath me I noticed this machine, but again obeyed instructions not to get into any trouble. This guy turned out to be the nephew of Baron Richtofen. He had been given the same instructions as I had been given. … The second time he got up I could not resist the temptation and took a crack at him, but I missed him. He was underneath me and in the circuit for protection. I woke up in the middle of the circuit. The machines were coming from all directions. They were firing at me, I was firing at them. Finally, I got so frustrated, so many of them coming at me, I had never seen any Germans before. Anyway, I went into a steep turn and then gave them Hell and opened up my guns. That was where I made a mistake because my guns jammed, first one, then the other, and then I was caught and had to come out of it. In those days, we had to spin out of it into the sun for home – west – we were going East and needed to remember to turn and get going that way to go home. I did that and was patting myself on the back. At this time, there had not been a bullet put in my machine.
>
> … I looked around and saw a red triplane on my tail, I did not know that this was Richtofen, nor that everyone went over to France hoping that they would not meet him. Anyway, this is the peculiar thing about this particular flight – I did not know what I was doing, I was a very poor flyer, and he did not know what I was doing and could not figure out what I was going to do next. I didn't know myself. That is what saved me and he never hit me. He chased me for all that distance and I started to spin again to get out of his way. I hedge hopped for 15 miles, he just did not hit me because I was slipping and sliding all over the sky and he was so mad that he was not hitting me that he followed me over our lines – he never used to do this. … I was down on the Somme River and could not get down any further. I was going around the bend of the Somme, he beat me to it and came across the top. I looked around and saw that he had me. I could not turn back and felt that I had "had it". …I looked around again when I was expecting to get it and saw him spinning. I looked further up and saw one of my machines. Our machine, of course, was Roy Brown. …That was one time that inexperience saved me. … The fact that I flew so badly is undoubtedly what saved me. He was shot down by Roy Brown with one bullet. Roy happened to have been chased out by two machines, Richtofen happened to be in his sight and he opened his guns in one burst and that was it. I would have been the 81st victim of Richtofen.[181]

Who could have guessed that this inexperienced young man would go on to become one of the most respected pilots along the Mackenzie River?

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181 W.R. May, 19 February 1952, 12th Calgary Boy Scout Troop, Wilfrid Reid May Fonds, NAC, R 5258-0-8-E.

After demobilizing in 1919, May returned to Edmonton eager to remain in the aviation game. He and his brother, Court, founded May Aeroplanes that same year, chartering an airplane from the city of Edmonton. Unfortunately, the company quickly folded and Wop went to work for the National Cash Register Company.[182] In 1926, May rejoined the world of commercial aviation as a pilot for a passenger service in the Peace River district of Alberta. Two years later, he went to work as an instructor for the Edmonton Flying Club, and later in the same year formed Commercial Airways.[183] Although equipped only with a tiny open-cockpit Avian, May and Horner gained national attention with their dramatic mid-winter dash to bring badly needed supplies of diphtheria anti-toxin to Little Red River in 1929.

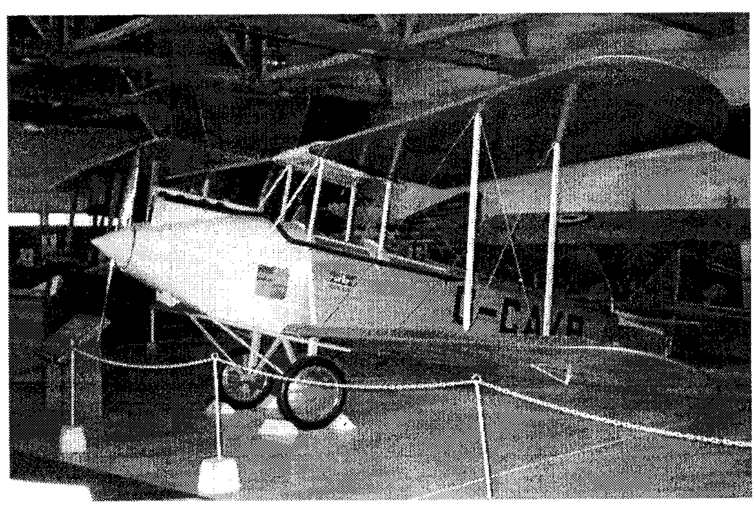

Figure 4.6: Avro Avian.
Source: Alberta Aviation Museum, Personal Collection.

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[182] It was here that he sustained the eye injury that would force him to withdraw from active flying in 1936. Denny May, Interview, [No Date], NWT Archives, G-1999-095-0013. See also, Iris Allan, *Wop May, Bush Pilot* (Toronto: Clarke, Irwin, 1966) and Sheila Reid, *Wings of a Hero: Canadian Pioneer Flying Ace Wilfrid Wop May* (St. Catharines: Vanwell Publishing, 1997).

[183] "Commercial Airways Sold to Western Canada Lines," *Edmonton Journal* (2 May 1931), CAL Collection, AOM, MG 11 A 34, Box 110: Newspaper Clippings, 1931-33; J.P. de Wet, "Wings of the North: A Series of Biographical Sketches of Northern Air Pilots, No. 2. Wilfred Reid May," *Canadian Mining Journal* (1932): 13 – 15.

On 1 January 1929, word arrived from Little Red River that the community, located 600 miles north of Edmonton, had been stricken by diphtheria. The news came via a messenger who had travelled by dog sled from Little Red River to Fort Vermillion, a distance of 50 miles, and, on finding the supply of anti-toxin inadequate, travelled another 300 miles to the railhead at Peace River to telegraph a message to Edmonton. The journey had taken two weeks, from 18 December 1928 to 1 January 1929. On receiving the request, the Board of Health contacted May and Horner, and asked them to fly diphtheria serum to the small community. The crew left Edmonton on 2 January 1929. Flying in their open-cockpit Avro Avian with the serum wrapped in blankets and kept over small heater so that it would not freeze, the pair flew 265 miles to McLennan Junction where they were forced to overnight because of bad weather. The following day they flew to Peace River in the morning and on to Fort Vermillion that afternoon. There they transferred the package to the RCMP, who carried the serum overnight to Little Red River by dog team.

The public followed the story avidly and when May and Horner arrived back in Edmonton, they were greeted by a crowd of 10,000. The two had flown through poor weather in an open cockpit plane without instruments over poorly mapped terrain. Limited by their inability to fly at night, because they had no instruments, no lit airways, and no emergency fields, and hampered by bad weather, they had still managed to deliver the medicine in only 2 days, as compared to the two week journey from Little Red River to Peace River. It was a heroic accomplishment.

Later in 1929, with financial backing from the investment firm of Solloway Mills, Commercial Airways was able to purchase two new Bellanca CH-300s.[184] These aircraft, along with a Lockheed Vega, were the nucleus of the Red Armada and the company would use them to capitalize on the same traffic drawing Western Canada Airways north.

Figure 4.7: Commercial Airways' first airmail flight.
Left to right, back row: Idris Glyn Roberts, Cy Becker, [unidentified] fur trapper, Superintendent Walter Hale, Post Office, Moss Burbidge, Ted Watt, reporter; *front row*: Don Robinson, Reg Jackson, Boom Lumsden, Archie McMullen, Stan Green.
Source: AAM Photo Collection, 202499.

Commercial Airways had an added advantage. Although Western Canada Airways was already operating along the Mackenzie and had been granted airmail sticker privileges by the Post Office, on 29 October 1929 the federal government awarded

[184] C.H. Dickins to W.L. Brintnell, 20 January 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #2, Jan 2/30 – June 30/30; C.H. Dickins, "Report on Conditions McKenzie [sic] River District," 20 February 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #4: Jan 1/31 – March 31/31.

Commercial Airways the new airmail contract for the Mackenzie River run.[185] On 10 December 1929, May and the Red Armada lifted off from Fort McMurray with a cargo of airmail bound for points north along the Mackenzie.[186]

As mentioned above, Commercial Airways had not been alone in seeking the Mackenzie River contract. Western Canada Airways also desired the steady income an airmail contract represented and had submitted a bid. On several counts the larger company seemed more deserving: they had an established airmail service along the route, experience with and a good record of maintaining timely service on the prairie intercity airmail run, and a larger fleet that meant they could more easily replace a damaged plane in order to maintain scheduled airmail flights. However, political considerations were against them – or so Western Canada Airways believed. To begin with, the M.P. for East Edmonton, K.A. Blatchford, was firmly committed to seeing the contract awarded to a local company.[187] Moreover, the government as a whole was concerned with Western Canada Airways' developing monopoly. This turn of events made Commercial Airways a serious competitor – not because of superior aircraft or service but because of the regular income supplied by the airmail contract. The contract gave them stability and a staying power they might not otherwise have had.

Western Canada Airways believed it could hold out despite Commercial's advantage, but Commercial Airways quickly began cutting into Western Canada

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[185] Arthur Webster to Western Canada Airways, 20 March 1929, 21 March 1929, NAC, RG 3 E-6 V 2673, file 10-4-185, vol. 1; "Contract for the Conveyance by Air of His Majesty's Mail," 29 October 1929, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways Limited #1, Jan 7/31 – April 30/31.
[186] A good deal of this cargo also made the return trip from Aklavik, being first flight covers. Denny May, Interview, [No Date], NWT Archives, G-1999-095-0013.
[187] "Air Mail Service to Far Northern Points Promised This Winter," *Edmonton Journal*, 14 November 1928, NAC, RG 3 E-6 V 2673, vol. 1.

Airways' northern business.[188] The regular airmail service helped to publicize their existence and to develop their reputation. Their political connections and lower rates also helped draw customers away from Western Canada Airways.[189] Not only did Commercial have the advantages of an airmail contract and political connections, Western Canada Airways' own mechanical troubles with the Super Universals' undercarriages contributed to the state of affairs by increasing the airline's maintenance costs. These failures also represented an opportunity cost because the loss of aircraft to repairs meant the company could not accommodate all of the available business.[190] What the airline could not take went instead to Commercial, resulting in a loss of income for Western Canada Airways and a gain for their competition. When placed alongside the Bellancas' success, the Super's failures were costly indeed.

Over the next year, Commercial plied the Mackenzie with the Red Armada, adding a third Bellanca in May 1930 and experiencing many fewer technical problems than its larger competitor's fleet of Fokker Super Universals.[191] While Western Canada Airways struggled to adapt its larger, more powerful aircraft to the demands of northern operations, the plucky Bellancas proved well suited to the North.

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[188] "They [Commercial Airways] will be too busy with their mail contract for a while to seriously cut in on our business..." L.R. Mattern to W.L. Brintnell, 2 December 1929, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #1: Feb 9/29 – Dec 31/29.

[189] C.H. Dickins to W.L. Brintnell, 29 January 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931; The company responded by lowering its own rates: "I am not afraid of their competition in our own territory now that we are on an even basis of rates." C.H. Dickins to W.L. Brintnell, 27 March 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931.

[190] "Traffic is fair, although I have been disappointed in the missing of some work through trouble..." C.H. Dickins to W.L. Brintnell, 29 January 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931.

[191] "Canadian Civil Aircraft Register,' compiled by J.R. Ellis, *CAHS*, 2:1 (Spring 1964) – 7:3 (Summer 1969).

These aircraft were part of the same generation of aircraft as the Fokker Universals and Fairchild series, the single-engined high-wing monoplanes that were all part of the design shift that occurred in the mid-1920s.[192] Designed by Giuseppe Mario Bellanca, a Sicilian-born American aircraft designer, the Pacemaker first appeared in 1928. A direct descendent of the famous Bellanca *Columbia* that flew the Atlantic just after Lindbergh, the six-seat high-wing monoplane was smaller and less powerful than its contemporaries, having a 300 hp Wright J-6 engines to the 400 hp of the Super Universals, but it still managed to compete with, and in some cases outperform, these larger aircraft.[193]

The Pacemaker began its existence in 1925 as the WB-1, an aircraft Bellanca designed for the Wright Aeronautical Corporation, which wanted a plane designed to use its new Whirlwind engine. Wright subsequently sold the aircraft manufacturing portion of its business to the Columbia Aircraft Corporation, and under this new direction the WB-2 was renamed the *Columbia.* Under this name, it traversed the Atlantic in 1927. Shortly thereafter, control of the Columbia Aircraft Corporation passed to Dupont. This new company, Bellanca Aircraft, produced the Pacemaker, a variation of the original WB/Columbia design.[194] Despite an apparent lack of Canadian input into the design, the Pacemaker would go on to become one of the most successful aircraft to operate along the Mackenzie in the early 1930s.

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[192] John D. Anderson Jr., *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2004).
[193] Note, the exact horsepower of the Fokker Super Universals ranged between 410 and 425 hp. Certificates of Registration for CF-AIA, CF-AJQ, CF-AKI, CAL Collection, AOM, MG 11 A 34, Box 24: Bellanca; E.P. Gardiner, "Bellanca's Flying 'W' in Canada," *CAHS Journal*, 9:1 (Spring 1971) 7-18; Molson, *Pioneering*.
[194] Gardiner, "Bellanca's Flying 'W' in Canada".

One of the Bellanca's unique features was the lifting shape of its wing struts. Unlike Fokker Super Universals and Fairchild aircraft whose struts functioned solely as structural supports, Bellanca turned them into an aeronautical asset, shaping and arranging them in such a way that they enhanced the aircraft's lift.[195] The additional lift provided by the struts contributed to the aircraft's ability to carry loads that belied its size and power plant.[196]

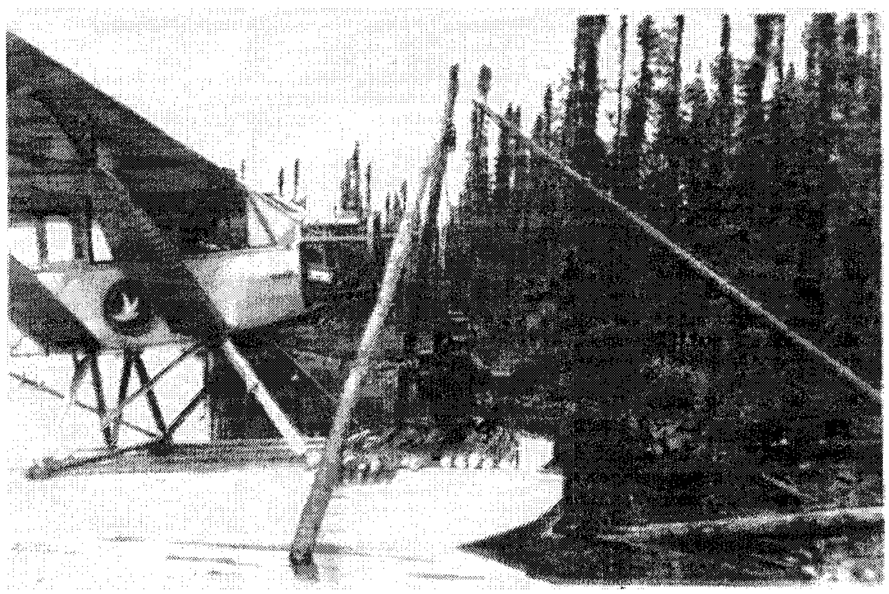

Figure 4.8: Bellanca Pacemaker Wing Struts.
Canadian Airways Pacemaker undergoing engine change in the bush. Note the struts' airfoil shape.
Source: AAM Photo Collection, 204139.

In the air, the Pacemaker was a solid plane and pilot Archie McMullen described it as a very stable aircraft. Along with the Fairchilds and Fokkers, it had a thick airfoil,

[195] Bain, *Canadian Pacific Airlines*; Gardiner, "Bellanca's Flying 'W' in Canada".
[196] According to Canadian Airways' analysis, a Pacemaker on floats could carry approximately 1140 lbs while one on wheels or skis could carry 1225 lbs, a larger load in a plane much smaller than the Super Universal. It also had a climb rate of 900 feet/minute. CF-AIA Initial Analysis [no date]; CF-AJQ Initial Analysis [no date]; CF-AKI Initial Analysis [no date], CAL Collection, AOM, MG 11 A 34, Box 24: Bellanca; Molson, *Pioneering*, 276.

which contributed to its lifting capabilities.[197] While aileron control became worse at slower speeds, the aircraft was stable even in bad weather. It was also designed in such a way that the aircraft did not exhibit any odd or cantankerous characteristics if it did stall. McMullen did note that because the Bellanca had a slightly different airfoil, if it had a tail-heavy load the wings would cup the air and create a vacuum on the trailing edge, which reduced its speed. A pilot could compensate by keeping the leading edge level with the trailing edge. In spite of this quirk, McMullen felt very confident in the aircraft.[198]

Looking in from the outside, C.H. Dickins saw the Pacemaker as a good passenger plane, somewhat hampered by a small cabin with no extra storage space, but with good lift characteristics and good performance on skis.[199] Compared to the Fokker Super Universal, on paper the Bellanca appeared to be no threat. Even in the summer of 1931, when the Supers had already experienced some difficulty with their undercarriages, Dickins still believed that the Fokker Super Universals were the best equipment available for the kind of work the company was performing in the Mackenzie District.[200] However,

[197] Anderson, *The Airplane*, 144.
[198] Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-0009; See also, Squadron Leader R.S. Grandy, "Report on the Belle Isle Experimental Air Mail Service," 1932, NAC, RG 24 E-1-A V 5097, file no. 1021-3-302.
[199] "The equipment [of Commercial Airways] is working pretty well, and is useful for passengers more than freight, but the passenger business is certainly picking up and constitutes a fairly large amount of our business in this district." C.H. Dickins to W.L. Brintnell, 19 June 1930, 20 January 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #2, Jan 2/30 – June 30/30.
[200] C.H. Dickins, "Report on Conditions McKenzie [sic] River District," 20 February 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #4, Jan 1/31 – Mar 31/31.

the planes' actual working experience showed the Bellanca to be more rugged and more reliable than the Super Universal.[201]

The major problem with the Super Universal was the series of undercarriage failures that plagued Western Canada Airways through the winters of 1929-1932. The Bellancas, by contrast, suffered no such affliction. The fact that the Bellancas were equipped with oleo struts materially contributed to this difference.[202] Additionally, Commercial Airways equipped its aircraft with shock absorbing ski pedestals that helped to absorb the pounding of a winter landing.[203] These differences enabled the Bellancas to better weather the North's extreme winter conditions.

Though possessed of an excellent service record, the Bellancas were not indestructible. For instance, Commercial Airways did experience one major crack up in their first winter of northern operations. Late in the morning of 18 March 1930, I. Glynne Roberts brought his plane, CF-AJQ, down at Fort Norman. As he landed, the port ski broke and the plane tipped over onto its side, damaging the port wing tip and bending the propeller. Over the course of the next 10 days, Roberts effected temporary

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[201] For a technical comparison, see Appendix I.

[202] Where the aerol struts were filled with air, the oleo struts used oil to cushion the shock, forcing oil through a small valve into a hollow piston when the strut was compressed. An inventory of Commercial Airways' stocks taken when Canadian Airways Limited purchased the company lists 8 oleo strut springs for Bellancas and 3 Oil Draulic strut wrenches. "Inventory of Commercial Airways Ltd. Stores and Equipment, Taken over May 1st 1931," CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways #2, May 1/31 – Oct 31/31.

[203] "The Commercial are using the rubber shock in the pedestals and find it very good so far. This oildraulic [ski shock absorber, of which Dickins enclosed a drawing,] should be better with a non freezing solution in it, and will replace the shock absorbing property lost when the tire and wheel is replaced with a ski." C.H. Dickins to W.L. Brintnell, 29 January 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, Jan – Mar 1930.

repairs on site, making the plane airworthy enough to ferry out.[204] That said, there were no repeated structural failures as on the Super Universals.

Overall, the problems Commercial Airways encountered were relatively minor. In addition to the above accident, CF-AJQ needed its throttle wires replaced in December of 1929 and suffered another set of ski breakages in February 1930. During the summer, the floats Commercial used required frequent pumping, but the bulk of maintenance focused on general repairs: patching tears in the fuselage fabric and general upkeep. For instance, during a summer overhaul, CF-AML underwent the following procedures:

> Floats taken off to be repaired. Cabin and Locker doors covered with fabric + redoped. Control cables and pulleys inspected and oiled. Former rib on Starboard front strut repaired. Fuselage internal brace wires checked. Rudder patched on Starboard side. Stabiliser control cables checked and screw hack cleaned + lubricated. Joyce Stick taken out + welded up + refitted to guide. Ship put in Flying position and re-rigged. Oil [unclear] put on Cabin floor. Cabin heater coupled + blank plate put in Cabin.
>
> Floats installed. Machine worked down + Lionel Oil rubbed on top of Main plane. Fuselage Lionel oiled all over + empennage + struts.[205]

CF-AJQ, along with the RCAF's Bellancas, did have trouble with its celluloid windows and they had to be replaced.[206] The aircraft's heating systems were also less than optimal.[207] However, the magnitude of the difficulties was certainly not as significant as

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[204] I. Glynne Roberts, CF-AJQ Log entry, 18 March 1930, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJQ Logs, Sept 27/29 to Mar 30/32; C.H. Dickins to W.L. Brintnell, 27 March 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931.
[205] Whitaker, CF-AML Log entry, 13 August 1930, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AML Logs, June 2, 1930 – Sept 1, 1932.
[206] A. McMullen, CF-AJQ Log entry, 17 November 1930, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJQ Logs, Sept 27/29 to Mar 30/32.
[207] Denny May, Interview, [no date], NWT Archives, G-1999-095-0013. Other operators found the same: "The exhaust heater on the Bellanca C.H. 300, used last year on winter operations, was found to be too small to keep the cabin comfortably warm." F.C.

the Super Universal's collapse habit. Nor did these minor repairs significantly affect the company's ability to provide passenger and freight services. Overall, these aircraft remained in very good condition when examined by T.W. Siers early in 1931.[208]

After only slightly more than two years of independent operation, in spite of its excellent fleet and the government airmail contract, Commercial Airways fell victim to Western Canada Airways' expansion and in the spring of 1931, Western Canada Airways, now known as Canadian Airways Limited, absorbed the smaller firm in order to rid itself of damaging competition and to obtain the government airmail contract it coveted.[209] Although Western Canada Airways never saw the Bellancas as a threat, Commercial Airways' business competition soon concerned the company. Not only did Commercial have income from the airmail contract, it also created competition for other government contracts, which C.H. Dickins attributed to their close relationship with the sitting M.P. from Edmonton East.[210] When the prospecting and northern flying business collapsed in 1930 because of the economic depression gripping the country, Commercial lowered its rates in order to corner a larger share of the diminishing market.[211] Members

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Higgins, Flight Lieutenant, Acting C.O., Ottawa Air Station to Director, Civil Government Air Operations, NAC, RG 24 E-1-A V 5084, file 1021-2-59.

[208] T.W. Siers to W.L. Brintnell, 14 January 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways Ltd #1, Jan 7/31 – April 30/31.

[209] See also Margaret Solveig Mattson, "The Growth and Protection of Canadian Civil and Commercial Aviation, 1918-1930," (Ph.D. diss., University of Western Ontario, 1979), chapter 10.

[210] C.H. Dickins to W.L. Brintnell, 29 January 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 –1931; C.H. Dickins to W.L. Brintnell, 19 June 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #2, Jan 2/30 – June 30/30.

[211] C.H. Dickins to W.L. Brintnell, 18 April 1930, and 19 June 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #2, Jan 2/30 – June 30/30; C.H. Dickins to W.L. Brintnell, 10 July 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931.

of Western Canada Airways/Canadian Airways believed Commercial could not sustain these rates and would quickly go out of business. C.H. Dickins wrote, "My main objective now is to keep working to prevent competition getting any of the outside business, and if we can do that we can eliminate them sooner or later, as I cannot see that they are making any money out of the mail."[212] However, the decline in available business affected both Canadian Airways and Commercial, "the only difference being that they [Commercial] adopted a policy of "Bargaining" to the extent of carrying passengers at whatever rates they can or will pay."[213] By the following winter, Canadian Airways began considering purchasing the competition in order to eliminate the irritant. In addition, such a purchase would bring Canadian useful aircraft as well as the coveted airmail contract.[214] In fact, James A. Richardson was only interested in Commercial if the airmail contract came with it.[215] Therefore, in the early winter of 1931 Canadian Airways opened negotiations with the unwilling Commercial Airways.

Fortuitously, at least for the expanding Canadian Airways, just as the airline decided to make its move, Commercial found itself in financial difficulties. Commercial Airways' major shareholder, Solloway Mills, was implicated in stock fraud and the airline lost its financial backing. It meant the company could not keep the business afloat

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[212] C.H. Dickins to W.L. Brintnell, 15 April 1930, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #2, Jan 2/30 – June 30/30.
[213] C.H. Dickins to W.L. Brintnell, 10 July 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929-1931.
[214] C.H. Dickins, "Report on Operations," [ca. Feb 1931], CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929-1931; C.H. Dickins, "Report on Conditions McKenzie [sic] River District," 20 February 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #4, Jan 1/31 – March 31/31.
[215] James A. Richardson to W.G. Sigerson, 7 January 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways Ltd. Jan 7/31 – April 30/31; Mr. Bennest to Messrs. Brownlee, Porter, Goodall & Rankine, 20 April 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways Ltd. Jan 7/31 – April 30/31.

and was open to purchase offers.[216] After a series of negotiations, many of which hinged on the airmail contract, on 13 May 1931 Canadian Airways took over Commercial Airways and, for the moment, controlled aviation in the Mackenzie Valley.[217]

As with the other companies it purchased, Canadian Airways acquired Commercial's staff and aircraft. It absorbed pilots May and McMullen and mechanics Torrie, Stalpert, and Bowen into its staff. Three of Commercial's Bellancas joined two Super Universals on the Mackenzie run, while the remaining Bellanca and the Vega joined the Edmonton-North Battleford section of the prairie airmail service.[218]

Although they continued to be very serviceable, useful aircraft, the Pacemakers did begin to show some signs of wear after several years of use. Apparently, the ball joints connecting the undercarriage axle to the fuselage eventually began to break down. The Canadian Department of National Defence first noticed this phenomenon and Bellanca's replacement solution in December 1932.[219] A month later Bellanca Aircraft of Canada contacted Canadian Airways to inform them of their 'desire to have the ball joints replaced at the connection between the diagonal axle brace tube and the fuselage' and to report that they were sending replacement parts for CF-AML and CF-AKI.[220] These parts were duly installed that same month.[221] Interestingly, in contrast to Fokker, here the

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[216] C.H. Dickins, "Report on Conditions McKenzie [sic] River District," 20 February 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #4, Jan 1/31 – March 31/31.
[217] W.L. Brintnell to W.B. Burchall, 22 May 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways #2, May 1/31 – Oct 31/31.
[218] Ibid.
[219] E.W. Steadman, 5 December 1932, NAC, RG 24 E-1-A V 5097, file no. 1021-3-302.
[220] O. Yossem to Canadian Airways Ltd. 3 January 1933, CAL Collection, AOM, MG 11 A 34, Box 24: Bellanca.
[221] G.A. Thompson to Bellanca Aircraft Ltd, 16 January 1933, CAL Collection, AOM, MG 11 A 34, Box 24: Bellanca.

manufacturer contacted the company pre-emptively. Canadian Airways did not have to wait until the part failed before seeing action.

The second set of major difficulties came, not from the airframe, but from its power plant, the 300 hp Wright J-6 Whirlwind. During the autumn of 1931, these engines began experiencing serious problems: engine valves were failing. In September 1931, CF-AJQ and CF-AKI both encountered this malfunction. On 1 September, May noted that CF-AKI's motor was running weak and rough and that its gas consumption was elevated. On the 3rd he and Harry King, the air engineer, remarked, "motor using too much oil 1 gal per hour." On the 10th King serviced the motor and changed the oil. Things were quiet until the 17th: "Exhaust Valve #6. Cylinder Broke. Returned to McMurray via RCAF secured cylinder from RCAF and returned by them to Boat Yard. Replaced cylinder and piston. Not necessary to work motor out as rings or piston were not broken. No dirt going in motor."[222] CF-AJQ experienced a similar set of events. On 14th September, "Aircraft forced landed at Amick L [ake] #6 exhaust valve broken. New piston + cylinder coupled assembled engine cleaned them out found ok."[223]

These problems were part of a series of engine failures that plagued the company that winter. T.W. Siers, chief mechanic, believed that sediment left by ethyl gasoline, which the company had switched to recently, was making the exhaust valves sticky and causing the problem.[224] Despite the fact that other companies had experienced problems

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222 Flight Reports, CF-AJQ, 1, 3, 10 & 17 September 1931, CAL Collection, AOM, MG 11 A 34, Box 99: CF-AKI Flight Reports, May-Dec 1931.
223 Log entry, CF-AKI, 14 and 15 September 1931, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AJQ, Log, Sept 27/29 to Mar. 30/32.
224 T.N. Clayton to J.H. Doolittle, 10 September 1930, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil; G.C. Drury to J.A. Macdougal, 2 February 1931, CAL

with ethyl gasoline, the airline continued to use gasoline with the additive.[225] In fact, the company eventually traced the valve problems to engine overheating caused by air leaking into the induction system. This produced a weak gas mixture and overheated the engines, damaging the valves.[226] In the end, it had nothing to do with the gas and everything to do with proper maintenance, demonstrating the essential role that engineers played in the smooth functioning of these northern services.

However grating, these difficulties appear to have been much less disruptive than the Fokker Super Universals'. More startling, given that they were smaller, less powerful aircraft, the actual cost of operating the Bellancas was significantly lower than operating Super Universal's operating costs.[227] Most tellingly, while all but one of the Super Universals retired from active northern service by the autumn of 1933, the Pacemakers remained active on into 1935. Because of their design, the Bellancas were better suited to the North and were more durable as a result. The dissimilarity between the histories of Bellanca and Fokker aircraft in the Mackenzie highlights the interactions between technology and local use context that can affect the success or failure of technological

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Collection, AOM, MG 11 A 34, Box 33: Gas and Oil; T.W. Siers to W.L. Brintnell, 31 July 1931, CAL Collection, AOM, MG 11 A 34, Box 38: Maintenance.

[225] G.A. Thompson to Mamer Air Transport, Spokane, Washington, 22 April 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil; N.B. Mamer, to G.A. Thompson, 26 April 1932, 26 April 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil; W.E. Sigerson to G.A. Thompson, 4 November 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil.

[226] T.W. Siers to G.A. Thompson, 15 April 1932; James Young, President Canadian Pratt & Whitney, to W.C. Sigerson, 3 August 1932; T.W. Siers to G.A. Thompson, 14 July 1933; W.C. Sigerson to James Young, 27 March 1934, CAL Collection, AOM, MG 11 A 34, Box 38: Maintenance.

[227] 84¢/mile for a Bellanca with a load of 1000 lbs as compared to $1.01/mile for a Super Universal with a load of 1200 lbs. G.A. Thompson to C.H. Dickins, 25 November 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #7, Oct 5/31 – Dec 29/32.

transplantation. Western Canada Airways' subsequent efforts to adapt the Super Universals to the Mackenzie provide a glimpse into the development of modifications that adapt existing technologies to new environments. Since aircraft are complex technologies governed by regulations, local mechanics could not make significant adaptations themselves, but their experiences, coupled with those of the pilots, informed the changes made to adapt the Fokker Super Universals to the Mackenzie's environment.

CONCLUSION

The contrasting experience of Western Canada Airways and Commercial and their two fleets highlights the role that environment can play in determining the success of a technology. Initially, the Super Universal might have seemed like a better bush plane given that it was larger and had a more powerful engine, enabling it to carry substantial loads. On the other hand, the Bellanca had a higher cruising speed and longer range. However, what truly set the two designs apart was their reaction to the northern environment. Where the Bellanca was well adapted and performed well, the seemingly minor difference in the Fokker's undercarriage seriously undermined its ability to operate in the northern environment. In response, the user, Western Canada Airways, worked diligently to adapt the aircraft's design to suit these use conditions.

The process of modification that engaged Western Canada Airways during this period raises several interesting issues. When placed alongside the history of Bellanca Pacemakers operating in the Mackenzie District at the same time, the comparison between the Super Universal and the Pacemaker highlights the design conservatism of Fokker and his company. Unlike Bellanca, Fokker seemed reluctant to incorporate new features that could easily address the problems the Supers encountered in the Mackenzie.

In addition, Bellanca took the initiative to respond to the few difficulties that did appear. Moreover, the comparison demonstrates that technical designs can be well or maladapted to not only particular tasks or uses, but also to particular environments. In this case, the machine's difficulty functioning in a specific context pushed the users to develop modifications that adapted the aircraft to the environment. These modifications represented some of the first steps towards the creation of an indigenous Canadian bush plane. Despite the protracted process, the reworking of the Super Universal undercarriage highlights the malleability of aircraft design and the close relationship that could develop between aircraft users and manufacturers. Feedback on in-use performance could be incorporated into aircraft design, helping to produce aircraft that reflected particular use-conditions.

Western Canada Airways' activities sowed the seeds for changes that would dramatically transform the North. The most obvious or striking event was Dickins' momentous flight to Great Bear Lake, picking up Gilbert LaBine from McTavish Bay on 26 August 1929. LaBine's discovery of a radium deposit at the east end of Great Bear Lake on this outbound flight would spark the Territories' first major mineral rush, create a new crown corporation, and eventually contribute to the development of nuclear research in Canada.[228] This discovery would change the shape of the northern economy, northern development, and the pattern of northern aircraft operations. In turn, this would result in changes to the type of aircraft at work along the Mackenzie, changes that contributed to the bush plane's evolution.

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[228] Robert Bothwell, *Eldorado: Canada's National Uranium Company* (Toronto: University of Toronto Press, 1984).

5 - A Fleet in Flux: Adapting to a Changing Environment, 1932-1934

Even as Canadian Airways Limited struggled to adapt its fleet of Fokker Super Universals to the North's harsh conditions, the world in which they operated began to change. Outside the Mackenzie Valley, the Great Depression plunged the world into a deep and prolonged economic recession. The Depression's effects penetrated even the rocky fastness of the North as men sought hope and jobs in mineral development. Even without these tribulations, northern life was changing as a consequence of the aircraft's presence. The North was opening up. Residents now had better access to mail from the outside, emergency medical care, and fresh produce. Mining companies could now reach remote mineral deposits and, because of this, the northern economy was transforming. With the establishment of mines, northern society also changed. Now mining camps filled with men from the south replaced fur trading posts as centres of activity.[1] It was a new social and economic pattern, one that would continue to dominate the region through the twentieth century, and it was the direct result of aircraft use.

While interactions between machine and environment produced changes in the aircraft, at the same time, aircraft were changing the North. Most significantly, they contributed to the Great Bear Lake rush that began in 1932. Late in the summer of 1929, Gilbert LaBine spotted evidence of pitchblende from the window of a Western Canada

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[1] For a detailed history of the social and political consequences of these changes see Morris Zaslow, *The Northward Expansion of Canada, 1914-1967* (Toronto: McClelland & Stewart, 1988), chapters 4, 6, 7, 13.

Airways plane.[2] In the dark economic times that followed, LaBine's discovery shone especially bright, prompting a large scale prospecting rush in the spring of 1932.

Canadian Airways was not the only airline to capitalize on this growth. By 1932, the company once again had competition. Their former employee, W.L. Brintnell, left the company late in 1931 and almost immediately established Mackenzie Air Service. The new airline plied the same territory as Canadian Airways, presenting opposition in one of the few districts that remained profitable for the airline during the depression. Rate cutting soon set in, exacerbated by Mackenzie Air Service's willingness to overload their aircraft and Canadian Airways' inability to have weight regulations enforced. Under these circumstances, Canadian Airways began to seriously re-evaluate the fleet that only two years earlier, in 1931, had seemed state of the art.

Canadian Airways would respond to these conditions by adjusting its Mackenzie District fleet composition. Between 1932 and 1934, the Bellanca Pacemakers acquired from Commercial Airways became more important to Canadian Airway's Mackenzie operations. The airline also introduced Fairchild and Junkers aircraft to the region, including the first aircraft intended specifically for bush flying in the Canadian North, the Fairchild 71C. A variation on the popular 71, the 71C signalled the beginning of significant changes in Canadian aircraft design. At the same time as these aircraft appeared, the Fokker Super Universals, formerly the fleet's backbone, began to fade away, being phased out of Mackenzie District service. These changes each reflected users' shifting understandings of what made a good bush plane, and can be seen most clearly in the Fokker Super Universal's emerging obsolescence. Events in the Mackenzie

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[2] Note, Western Canada Airways became Canadian Airways Limited in 1930.

between 1932 and 1934 serve to remind one that geography, while a significant component of technological history, was not the only condition that influenced the emergence of the Canadian bush plane. Moreover, these incidents highlight the dialogue between technology and context, illustrating their engagement in a process of mutual shaping mediated by the technology's users.

ECONOMIC BREAK-DOWN

Far away from the North, events occurred that would reshape the wider context of northern aviation. This redefinition of operating conditions would eventually cause Canadian Airways to redefine its technical needs, to re-evaluate its existing fleet, and to introduce new aircraft to the North. The prosperity that fuelled Canadian aviation's growth during the 1920s came to a crashing halt in 1929. While the causes of the Great Depression that followed the American stock market crash of October 1929 were complex, tied to international markets and monetary policy, the results were impossible to ignore. Dependent as it was on export markets, Canada was hit particularly hard. For instance, after the crash the American capital investment that had sustained Canadian mining and forestry, disappeared. On the prairies, Canadian farmers grappled first with declining wheat prices, the result of a worldwide glut fuelled by bumper crops, and then with a prolonged drought that turned rich prairie soil into dust.[3] Political responses

[3] Robert Bothwell and J.L. Granatstein, *Our Century: The Canadian Journey*, (Toronto: McArthur & Company, 2000), chapters 4 and 5; R. Douglas Francis, Richard Jones, Donald B. Smith, *Destinies: Canadian History Since Confederation*, 3rd Edition (Toronto: Harcourt Brace & Company, 1996), chapter 12; J.L. Granatstein, Irving M. Abella, T.W. Acheson, David J. Bercuson, R. Craig Brown, H. Blair Neatby, *Nation: Canada Since Confederation*, 3rd Edition (Toronto: McGraw-Hill Ryerson Ltd, 1990), chapter 7; Desmond Morton, *A Short History of Canada*, 5th edition (Toronto: McClelland & Stewart, 2001), chapters 3 and 5; Kenneth Norrie, and Douglas Owram, *A History of the*

would translate these economic conditions into circumstances that affected northern aviation.

On the whole, Canadian politicians were at a loss. William Lyon Mackenzie King, Prime Minister when the Depression first hit, did little other than balance the budget by tightening the government's belt. R.B. Bennett, who ousted King in 1930, saw only one solution: raise tariffs to protect Canadian goods. Given that other, larger economies did the same, this policy was ineffective. At home, the government faced growing demands on its purse as it strove to keep drowning provinces afloat. Unfortunately, these demands came even as its sources of revenue dried up. Keynesian debt financing had not yet taken hold and the Canadian government reacted to the deepening economic crisis by cutting back ever further.

In the face of failing farms and soup kitchen lines, the government-sponsored airmail services began to seem unnecessary luxuries. As the Depression persisted, Prime Minister Bennett and his government considered cancelling them. What, in 1928, was deemed necessary for Canada to keep up with its neighbours was now a "somewhat spectacular but absolutely unnecessary thrill."[4] Beginning in May 1931, the Eastern intercity services were incrementally suspended until completely eliminated by 30 April 1932. On the prairies, the government reduced the intercity airmail from two branches to

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Canadian Economy (Toronto: Harcourt Brace Jovanovich Canada Inc, 1991), chapter 18; John Herd Thompson with Alan Seager, *Canada 1922-1939: Decades of Discord* (Toronto: McClelland & Stewart, 1985); Jonathan F. Vance, *High Flight: Aviation and the Canadian Imagination* (Toronto: Penguin Canada, 2002), chapters 5, 9, 11,12.

[4] Peter J. Veniot (Postmaster General), Canada, Debates, House of Commons, 26 May 1928, 3432; Alfred Speakman (M.P., Red Deer), Canada, Debates, House of Commons, 26 June 1931, 3115.

one, finally suspending the contract entirely on 1 March 1932.[5] The only routes that remained were those serving isolated areas not reached by rail, including the Mackenzie District.[6]

These cancellations were harsh blows to Canadian Airways. Over the previous three years, the airline had spent a great deal of money establishing and providing the prairie airmail. Cancellation of the contract left the company with surplus staff, surplus aircraft that had been purchased specifically to carry the mail and were not yet paid for, and a substantially reduced income. In 1931 mail formed 65% of Canadian Airways' operating revenues – this would drop to 34.7% after the 1932 cancellations.[7]

The shockwave from this dramatic change in circumstances rippled north through the Mackenzie Valley. As airmail cancellations squeezed Canadian Airways financially, the still-intact Mackenzie airmail contract, worth $45,000 per year, became more important than ever to the company's bottom line.[8] With airmail earnings vanishing, the company actively promoted passenger and freight traffic, especially on the bush runs.[9] As J.A. Wilson, Controller of Civilian Aviation, commented,

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[5] "Report of the Deputy Postmaster General, 1931-1932," Canada, Post Office, *Report of the Postmaster General for the Year Ended March 31, 1932* (Ottawa: 1932), 6.
[6] For a discussion of the politics surrounding Canadian Airways Limited and its airmail contracts, see Shirley Render, *Double Cross: The Inside Story of James A. Richardson and Canadian Airways* (Vancouver: Douglas & McIntyre, 1999).
[7] W.C. Sigerson to R.W. Finlayson, 13 February 1933, CAL Collection, AOM, MG 11 A 34, Box 64: Statistics: CAL Statistics 1931-1933, 1934 (Accounting and Statistical Data, All Lines). Between 1931 and 1932, the total poundage of mail carried by Canadian Airways Limited dropped from 459,458 lbs to 299,066 lbs. Appendix V, "Operating Statistics," in K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, 1975), 255.
[8] "Transfer of Contract," 24 September 1931, CAL Collection, AOM, MG 11 A 34, Box 28: Commercial Airways #2, May 1/31 – Oct 31/31.
[9] "Annual Report, Canadian Airways Limited, For the Year Ended December 31, 1932," CAL Collection, AOM, MG 11 A 34, Box 23: Annual Reports.

> Canadian Airways, of course, are very hard hit by the cancellation of so many air mail routes. However, their cash position is sound and due to generous allowances in past years for depreciation they can carry on for a while yet. There is a lot of work in the North which should help them. They are continuing to run several small passenger lines to maintain their organisation in different parts of the country, though I am afraid they cannot expect to make much money out of these without mail contracts to help.[10]

The cancellations also meant that pilots and engineers scurried north as Canadian Airways redeployed its senior staff to the only region of the country where there were regular flying jobs.[11] Fortunately for the airline, there was a rising tide of prospectors flowing north to the recently scouted mineral deposits on the rocky, inhospitable shores of Great Bear Lake. This flood offered some recompense for the income lost to the contract cancellations and within the economic climate created by the Depression it was terribly important to Canadian Airways.

GREAT BEAR LAKE: A CHANGING LANDSCAPE

The mineral discoveries alongside Great Bear Lake provided much needed income for the airline by encouraging increased levels of traffic into the Mackenzie District. They also reconfigured the route's structure. Now planes branched off from the main river run, reaching either from Fort Norman east along the Bear River to Great Bear Lake or north from Great Slave Lake, through Fort Rae, to approach Great Bear from the south. Although the Mackenzie River and the Mackenzie airmail route remained an important trunk line, the spurs into Great Bear Lake changed the aircraft's context of operations. Because Great Bear extended the system, aircraft range, speed, efficiency,

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[10] J.A. Wilson to Charles G. Grey, 20 May 1932, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.
[11] Archie McMullen, Interview, 16 September 1978, NWT Archives, G-1988-008-009.

and comfort became important points of evaluation. In addition, increased levels of traffic and competition from Mackenzie Air Service meant aircraft payload acquired greater significance. Given the ties between mineral development and air transport, namely that it provided bush fliers with a substantial portion of their business, the Great Bear Lake discoveries changed the Mackenzie context sufficiently that Canadian Airways had to re-evaluate its fleet composition, adding new aircraft to the district and eventually replacing the existing group of airplanes.

Located between Great Slave Lake and the Arctic coast, Great Bear Lake is the second largest lake in the Northwest Territories. Perched on the edge of the tree line, the shores presented a rough, but dramatic vista to the few white explorers who had seen it before the 1930s. James Macintosh Bell, working for the Geological Survey of Canada in 1901, described swampy low lands and dramatic cliffs of granite and greenstone rising from the lake to reach heights of 600 and 700 feet.[12] Charles Camsell, also a geologist, reported that

> The shores of the lake are in general low. Ranges of hills approaching 1,000 feet in height, however, occupy the peninsula between McVicar and Keith bays and that between Richardson bay and Smith bay. The shores of McTavish bay too are bold and rocky, often rising sheer out of the water for hundreds of feet. The southern and western shores are well wooded, while its northern and eastern borders are more thinly forested. The immediate shores are mainly of sand and gravel and are usually devoid of trees, but are well clothed with willows and various ericaceous shrubs and herbaceous plants. In most places along the south shore this treeless stretch is only a few hundred yards in width, and in the bays the forest extends to the water's edge.[13]

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[12] James Macintosh Bell, *Report on the Topography and Geology of Great Bear Lake and of a Chain of Lakes and Streams Thence to Great Slave Lake*, (Ottawa: Geological Survey of Canada, 1901), 17.
[13] Charles Camsell and Wyatt Malcolm, *The Mackenzie River Basin*, Memoir 108, No, 92, Geological Series, Geological Survey Ottawa, 1919, 40.

Camsell's description sketches the contours of a lake that, even when he summarized its geological history in 1919, had not been completely mapped.[14] Frederick Watt, who prospected Great Bear in the 1930s, described it in his memoirs as

> a giant among the world's freshwater seas. ... It stretches in burnished beauty under the unsleeping summer sun, 12,000 square miles of liquid ice moving restlessly between its low western shore and the craggy heights that contain it to the east. With autumn comes twilight and grey turbulence. The huge swells have 150 miles in which to gather strength before they shatter against the eastern mountains. Even after winter's shield has crushed the life from them, the fury of the waves can be seen chiselled in crystal, high on the naked shore.
>
> This is Great Bear Lake, long shrouded in mystery and superstition, as cold and pitiless as the treeless Barren Ground which lies to the north.[15]

Ice began to form along the lake's shores in late October, but the centre often remained ice-free until December. Once it did freeze, however, the lake would be locked in ice until June. Even then, large ice floes would often remain until mid-July[16]. These conditions made travel and transportation difficult. The shipping season was short and, because the lake froze and thawed at different times than more southerly lakes and rivers, it was difficult for planes to access it from the south because of landing gear issues: while it might be time for floats south of Great Bear, on the lake the ice might still be in. This was the mysterious, difficult lake, with its promise of riches that drew men north in the early thirties, desperate to strike it rich and escape the Depression's hardship.

This episode in Canadian Airways' northern history owed much to the luck of two brothers, Gilbert and Charles LaBine. Mining developers, the two had just closed their

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[14] Camsell and Malcolm, *The Mackenzie River Basin*, 39.
[15] Frederick B. Watt, *Great Bear: A Journey Remembered* (Yellowknife: Outcrop Limited, 1980), 1.
[16] Camsell and Malcolm, *The Mackenzie River Basin*, 40.

unsuccessful Long Lake, Manitoba operation when they began looking for a new mine along the shores of Great Bear Lake. According to Gilbert LaBine, reports from other mining professionals of copper finds in the Northwest Territories initially piqued his interest. Given that copper prices were rising, it seemed a way to save his company. Thus, LaBine headed north with W.L. Brintnell, Operating Manager with Western Canada Airways. As part of his 1929 inspection tour through Great Bear Lake, Aklavik, and Dawson, Yukon Territory, Brintnell would drop LaBine at Great Bear Lake.[17] While LaBine did find copper, the deposit was not rich enough to justify the cost of extraction and transportation and would never make any money. It was after this depressing realization that LaBine made his remarkable discovery.[18]

Retrieving Gilbert LaBine from his late season prospecting on the McTavish Arm of Great Bear Lake, Western Canada Airways pilot C.H. Dickins flew along the eastern shore of the arm.[19] Out the plane's window, LaBine noted red streaks on the rocks, which were just barely visible in the late afternoon sun. These streaks told LaBine that cobalt and its companions, silver and pitchblende, the home of lucrative radium, likely lurked along the shores of the great northern lake.

Discovered by the Curies in 1898, until the Second World War radium was valued primarily for its place in medical radiation treatments. Unfortunately for the medical community, the production of radium required large amounts of pitchblende and an intensive refining process. It was, therefore, very expensive. This situation was

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[17] Molson, *Pioneering*, 62-63.
[18] Robert Bothwell, *Eldorado: Canada's National Uranium Company* (Toronto: University of Toronto Press, 1984), 1- 21.
[19] Flight Report, G-CASM, 26 August 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec 1930.

exacerbated in the 1920s by the virtual monopoly of the Belgian company, Union Minière.[20] The discovery of pitchblende on the eastern shore of Great Bear Lake thus promised fantastic riches as it would provide a supply of precious minerals that could break the Belgian monopoly. Given pitchblende's value, LaBine's accidental discovery would spark the largest inter-war prospecting rush down the Mackenzie River.

LaBine was not the only prospector active in the region in 1929. Nor was he the first to remark on the striking geological features of Echo Bay. In his 1901 report, Bell noted, "The high rocky walls were stained and weathered to beautiful shades of purple, red and brown, and gave, with the reflection of their precipitous cliffs in the clear northern waters, a singularly rich effect."[21] Charles Sloan had gone so far as to stake the area for Dominion Explorers in 1922. However, the copper finds he identified were left to lapse because of a lack of transportation to the lake.[22] In the summer of 1929, however, Canadian mineral developers, assisted by aircraft, began to explore the swath of country between the two great northern lakes, Great Slave and Great Bear.

While most prospecting activity in 1929 centred on the areas north of Lake Athabasca and at the Pine Point zinc deposits, prospectors were active as far north as the Coppermine River.[23] In fact, Dickins had dropped a party of three at Dease Bay on Great Bear Lake in late July.[24] Later that fall Dickins would also be part of the search for a

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[20] Bothwell, *Eldorado*, 4-9.
[21] Bell, *Report on … Great Bear Lake…*, 17.
[22] Leslie McFarlane, "It Wasn't All Luck," *Maclean's Magazine*, 1 January 1932, CAL Collection, AOM, MG 11 A 34, Box 110: Newspaper Clippings, 1931-33.
[23] "Prospectors Going Down Mackenzie," *The Northern Miner*, 23 May 1929, 21.
[24] Flight Reports, G-CASM, 28 and 29 July 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec 1930.

missing Dominion Explorers party north of Great Bear near Coppermine.[25] However, LaBine was the first to identify the pitchblende deposits. He would return the following spring with E.C. St. Paul to conduct geological surveys and stake claims on the eastern shore of McTavish Arm.[26] That season he would be joined by Consolidated Mining and Smelting, Dominion Explorers, and Northern Aerial Mining Exploration, as well as others working the area for copper.[27] As *Maclean's Magazine* later remarked, while the field looked promising, exploration so far from the end of steel required experience and deep financial pockets. At the earliest stage of development, alongside the LaBines, themselves owners of a mining company with experience in northern Manitoba, the field parties all represented large, well-financed mining and development companies.[28]

Working on McTavish Arm, LaBine identified the pitchblende deposit that would be Eldorado's foundation. The company sent samples of this ore to the government's Mines Branch in October 1930, which, along with visits by government officials, confirmed the presence of high-grade radium-bearing ore at LaBine Point.[29] Over the course of 1931, Eldorado consolidated its holdings at Great Bear. As stories about its find leaked out, activity increased, and though in 1931 the rush was not yet in full swing,

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[25] Flight Reports, G-CASM, 26 – 30 September 1929, CAL Collection, AOM, MG 11 A 34, Box 85: G-CASM Flight Reports, May 1929 – Dec 1930.
[26] W.L. Brintnell to Gilbert LaBine, 4 February 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931; C.H. Dickins to W.L. Brintnell, 20 February 1930, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence 1929 – 1931.
[27] "Copper Rush on to Great Bear Lake," *The Northern Miner*, 3 July 1930: 1; "Staking Starts in Coppermine Area," *The Northern Miner*, 3 July 1930: 3; Bothwell, *Eldorado*, 24; Nagle and Zinovich, *The Prospector North of Sixty*, 231.
[28] Leslie McFarlane, "It Wasn't All Luck," *Maclean's Magazine*, 1 January 1932, CAL Collection, AOM, MG 11 A 34, Box 110: Newspaper Clippings, 1931-33.
[29] Bothwell, *Eldorado*, 23-34.

Canadian Airways foresaw a substantial growth in traffic to the area.[30] The news of rich radium ores at Great Bear Lake stoked the prospecting rush that began during the spring of 1932.

The swelling rush pressed Canadian Airways to re-evaluate its northern fleet. Given the route's enhanced significance because of the broader economic context, it was especially important to Canadian Airways that the Mackenzie be a profitable district and they were eager to capture as much of the intensifying Great Bear Lake traffic as possible. However, the growing traffic and route extension would place increased demands on the company's aircraft. This prompted management, especially C.H. Dickins, now the Mackenzie District Superintendent, to re-evaluate the company's existing fleet in order to ensure the greatest possible carrying capacity and efficiency of operations. Canadian Airways was about to change its fleet composition in response to the operating conditions created by the Great Bear Lake discoveries.

Hints of management dissatisfaction with the aircraft had first appeared in 1931. With its takeover of Commercial Airways, Canadian Airways acquired its competitor's fleet of four Bellanca Pacemakers. Over the summer of 1931, Canadian Airways operated the Bellancas alongside its fleet of Super Universals. That fall, the company began to compare the two types of aircraft. This comparison revealed that the Bellancas

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30 "Prospectors Start Rush Into Rich Great Bear Lake Find," *The Northern Miner*, 27 August 1931: 1, 5, 7; "High Radium Values at Great Bear Lake Are Detailed," *The Northern Miner*, 3 December 1931: 9; "Abundant Silver, Rich Radium Ores Found in Great Bear Area," *The Northern Miner*, 14 January 1932: 9,11; L.R. Mattern to G.A. Thompson, 24 February 1931; C.H. Dickins to G.A. Thompson, 5 March 1931; and C.H. Dickins to G.A. Thompson, 15 September 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #4, Jan 1/31 – March 31/31; "Annual Report, Canadian Airways Limited, for the Year Ended December 31, 1931," CAL Collection, AOM, MG 11 A 34, Box 23: Annual Reports.

were actually more efficient, costing less per mile than the larger Supers did.[31] At this stage, the discrepancy caused the company no distress, but by the end of 1932, it would be grounds for concern and one reason for eventually removing the Supers from northern service. As fall turned to winter and 1931 turned to 1932, the Great Bear Lake rush continued to build. When it broke upon the North in the spring of 1932, the flood destabilized northern aviation in such a way that Canadian Airways would alter its Mackenzie fleet to compensate.[32]

At first, it was simply a question of volume. As more people sought to come north, G.A. Thompson, the company's new Assistant General Manager, became concerned about Canadian Airways' ability to handle the traffic. Writing to other Canadian Airways executives, he pleaded for more planes and pilots on the Mackenzie, noting,

> at the present time we have enough work signed up to keep all these machines busy under the most favourable conditions until break-up. … In the meantime, we will be getting seriously behind in our work which will cause considerable dissatisfaction amongst our clients. This we cannot afford, particularly at the present time with opposition on the Mackenzie River and further opposition in the shape of Mr. Brintnell in the offing.[33]

The appearance of this new competition added urgency to his concern. Where Canadian Airways had briefly been the only game in town, there was now another airline waiting to pounce on any business the former monopoly could not handle.

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[31] G.A. Thompson to C.H. Dickins, 25 November 1931, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #7, Oct 5/31 – Dec 29/32.
[32] Watt, *Great Bear*, 82, 83; J.A. Wilson to Charles G. Grey, 6 April 1932, JA Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942.
[33] G.A. Thompson to C.M. Forrest and J.A. Macdougall, 12 February 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932.

COMPETITION: MACKENZIE AIR SERVICE APPEARS

Wilfred Leigh Brintnell, founder of this new company, Mackenzie Air Service, and known by his middle name, Leigh, has already appeared as Western Canada Airways' Operating Manager and Canadian Airways' Assistant General Manager responsible for Western Lines. Born in Belleville, Ontario, in 1895, like many of the other early bush pilots, Brintnell learned to fly with the Royal Flying Corps. He enlisted in 1916, but never served in combat, becoming an air force instructor after completing his training in 1917. After the war, Brintnell worked in real estate and insurance in Florida, though he kept his hand in private flying. When the Ontario Provincial Air Service formed in 1924, Brintnell joined, spending summers flying in Ontario and winters working in Florida. With the creation of Western Canada Airways, Brintnell joined its staff as a pilot and 1928 saw him appointed as superintendent at Hudson in northern Ontario. When Harold 'Doc' Oaks resigned from the company that same year, Brintnell succeeded him as Operating Manager, a position below only the Secretary Treasurer and the President. In that capacity, he was instrumental in developing the prairie airmail service and made a number of significant flights, including his 1929 inspection tour from Winnipeg to Great Bear Lake, Aklavik, Dawson and back to Winnipeg. This tour included dropping Gilbert LaBine on the shores of Great Bear Lake and the first aerial crossing of the Rockies. During the Second World War, Brintnell ran Aircraft Repair Limited and would later join United Air Services when it absorbed his company. After working for United Air Services, Brintnell retired from aviation in 1965 and died in January 1971 at the age of 75. Although an important contributor to the company's growth, Brintnell would shortly become one of its most irritating competitors.

The explanations for Brintnell's departure from Canadian Airways are confusing. While profiles based on interviews with Brintnell himself point to the prairie airmail's cancellation as the catalyst for his resignation, comments by Canadian Airways officials hint at a more acrimonious split.[34] According to James A. Richardson, he let Brintnell go because, while a first class pilot, "he is very slow on figures and we had to finally give up the job of attempting to make an executive of him and let him out."[35] Whatever the reasons, Brintnell left Canadian Airways in December 1931 and in early 1932 formed Mackenzie Air Service.[36] This new company, staffed by Brintnell, Matt Berry, and Stan McMillan, flew the Mackenzie basin and into Great Bear Lake, placing themselves in direct competition with Canadian Airways' Mackenzie operations.

The economic conditions created by the Great Depression magnified Mackenzie Air Service's effects. As G.A. Thompson had pointed out, in the bleak depression Canadian Airways needed as much of the Mackenzie District income as it could get. Mackenzie Air Service threatened this revenue. To secure the business Great Bear Lake generated, Canadian needed to ensure it had adequate carrying capacity, as any excess would go to support its new competitor. In response, Canadian Airways increased its Mackenzie fleet, though only slightly.

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[34] J.P. de Wet, "Wings of the North: A Series of Biographical Sketches of Northern Air Pilots, No. 8: Wilfred Leigh Brintnell," *Canadian Mining Journal* (August 1933): 317 – 319; K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, Limited, 1975), 40, 62-63; D.F. Parrott and R.K. Malott, "In Memoriam: W. Leigh Brintnell," *CAHS Journal* 10:1 (Spring 1972): 15.
[35] Wilfred C. Sigerson to G.A. Thompson, quoting James A. Richardson, 10 April 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities #1, April 1/30 – Dec 18/33.
[36] Ibid.

Planning for 1932 operations, Thompson forecast a busy year with the bulk of business concentrated into the two weeks before the April break-up, June, September, and the first half of October. He calculated that eight machines would be necessary to carry the traffic.[37] Thus, Canadian Airways added aircraft to its Mackenzie fleet: G-CASL, a Fokker Super Universal, and G-CARH, a Fairchild FC-2. The Fairchild's introduction marked a turning point. With its arrival, northern aviation's technical composition began to change as other aircraft began displacing the Super Universals.

RESPONDING TO COMPETITION: FAIRCHILD AIRCRAFT

G-CARH, a Fairchild FC-2, was the product of a company with longstanding Canadian connections. Sherman Mills Fairchild, born 7 April 1896 in Oneonta, New York, first gained prominence with his 1918 design of a between-lens shuttered camera for the U.S. Military. In 1920, Fairchild formed the Fairchild Aerial Camera Corporation to manufacture and sell his camera. Following this he created Fairchild Aerial Surveys (of Canada) Limited, 1922, and Fairchild Aerial Surveys, Incorporated, 1923, to conduct aerial surveys, partly in an effort to create a market for his invention.[38]

At that time, aerial surveying was performed primarily from open-cockpit flying boats that left the pilot and camera operator, along with the camera, exposed to the elements. After visiting Fairchild Aerial Surveying's Grand'Mère base and observing Canadian operations, the pilots' and crews' discomfort struck Fairchild. He solicited

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[37] G.A. Thompson to C.M. Forrest and J.A. Macdougal, 23 February 1932, CAL Collection, AM, Box 4: Correspondence, Jan 32 – Sept 32.
[38] Dana Bell, *The Smithsonian National Air and Space Museum Directory of Airplanes* (London: Greenhill Books, 2002); Anthony S. Brandt, "The First Canadian Fairchild Company, 1922-29," *CAHS Journal* 9:2 (Summer 1971): 38-51; Kent A. Mitchell, *Fairchild Aircraft 1926-1987* (Santa Ana, California: Thompson, 1997), 5.

their input on improvements and found that they wanted an aircraft that was a high-wing monoplane, to increase visibility, with an enclosed, heated cabin, and easily changed landing gear so that it could be operated as a float, wheel or ski equipped aircraft. Not finding any such aircraft on the market, Fairchild organized Fairchild Airplane Manufacturing to design and build it, producing the FC 1.[39] It was an auspicious beginning for Fairchild's Canadian career as it initiated the company's tradition of responding directly to Canadian conditions. The aircraft was so well suited to Canadian bush flying needs that the basic design remained unchanged up into the 1930s, only being modified for size and power.

The aircraft's commercial version appeared in 1927 and was designated a passenger and transport aircraft, as well as an aerial surveying plane. The aircraft also used the now commercially available Wright J-5 Whirlwind, capable of 220 hp.[40] The larger power plant allowed the designers to widen the fuselage to accommodate the pilot and four passengers – although from a modern perspective the fuselage remained incredibly narrow. It was also the first commercial aircraft to incorporate oleo struts, a decision that made it better suited to cold conditions than the Fokker Super Universal.

When introduced to Canada in 1927, the FC-2 had a dramatic impact, especially because it was so different from other available aircraft like the surplus Jennies and HS-2L flying boats.[41] In fact, Canadian Airways added two FC-2s to their fleet that very

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[39] Brandt, "The First Canadian Fairchild Company;" Mitchell, *Fairchild Aircraft*; K.M. Molson and H.A. Taylor, *Canadian Aircraft Since 1909* (London: Putnam, 1982); J.A. Wilson to Cooke, 2 May 1925, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 5, Specific Correspondence, 1920-1942. A note on Fairchild model numbers: the FC stood for 'Fairchild Cabin'.
[40] For specifications, see Appendix I.
[41] Molson and Taylor, *Canadian Aircraft Since 1909*, 306.

year.[42] The machine became so popular in Canada that it seemed sensible to manufacture the plane on location and Fairchild awarded Canadian Vickers a manufacturing license. In fact, Canadian Vickers would build 11 Fairchild FC-2s over 1928, compared to the 12 Fairchild FC-71Cs that Fairchild Aircraft would build over six years.[43]

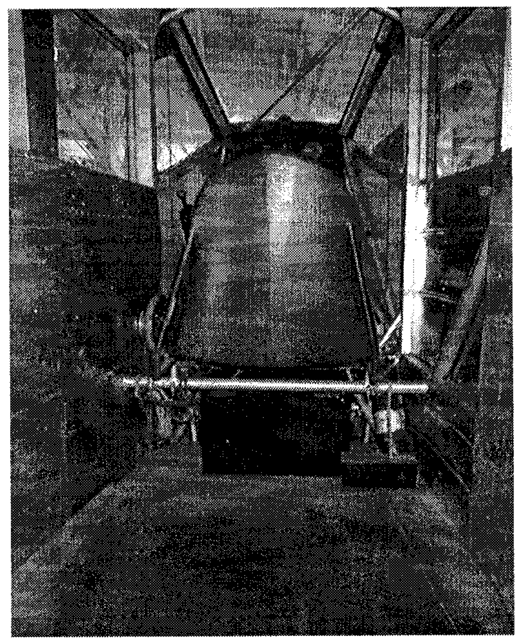

Figure 5.1: Interior of Fairchild 71.
Source: Fairchild 71, Alberta Aviation Museum, Personal Collection.

Canadian Vickers had been the leading Canadian aircraft manufacturer during the 1920s and had developed several flying boats specifically for the RCAF. However, when Richardson formed Western Canada Airways in December 1926, the company was not producing anything suitable for this sort of passenger and freight operation and the airline was forced to look outside the country for an appropriate craft. As the Canadian aviation situation continued to change and more operators moved away from flying boats, Canadian Vickers' market began to shrink. Looking for other sources of income, in 1927

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[42] Molson, *Pioneering*, Appendix IX, "The Aircraft Fleet of Western Canada Airways Limited, Canadian Airways Limited and Quebec Airways Limited," 265.
[43] Molson and Taylor, *Canadian Aircraft Since 1909*, 462.

they obtained the license to manufacture Fairchild aircraft at their plant.[44] Unfortunately, the drawings and specifications were fragmented and unclear, leading to manufacturing problems. After only a year of production, Fairchild rescinded the license when it decided to establish its own Canadian plant at Longueuil, Quebec.[45]

Although the FC-2 was very popular, other more powerful designs such as the Bellanca Pacemaker, carrying 300 hp with a 1050 lb payload, and the Super Universal, capable of 400 hp with stated a payload of 1200 lbs, soon challenged its status.[46] To meet that threat, Fairchild developed the FC 51. Not a new aircraft, the design retrofit the FC-2 for a 300 hp engine. The next variation, the FC-2W, used a 400 hp power plant. With twice the power of the original FC-2, it could lift heavier loads and rise off small northern lakes much faster. The FC-2W-2 was a further evolution of the same design, expanded to accommodate the pilot and six passengers. The company formalized this change as the

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[44] James A. Richardson to Frank M. Ross, 6 October 1927, CAL Collection, AOM, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg, Feb 18/27 – Sept 23/37.

[45] Canadian Vickers then picked up a license to manufacture Fokker aircraft, but again only for a limited time. Eventually, the company decided to focus on flying boat construction, but it was a poor decision. Canadian aviation was moving away from flying boats, and Canadian Vickers would loose its dominant place in the industry. Canadian Vickers Limited, "Resume of Aircraft Division," January 1929, CAL Collection, AOM, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg, Feb 18/27 – Sept 23/37; Canadian Vickers Limited, "Memorandum on Aviation," 18 March 1929, CAL Collection, AOM, MG 11 A 34, Box 23: Correspondence between CAL (old + new) + Canadian Vickers Ltd, 18 March 1929 – April 12/34; James A. Richardson to G.R. Cottrelle, 10 July 1930, CAL Collection, AOM, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg, Feb 18/27 – Sept 23/37; R. Ramsey, draft memo on Canadian Vickers aviation, 16 August 1933, CAL Collection, MG 11 A 34, Box 27: J.A.R. – Air and Vickers Mfg, Feb 18/27 – Sept 23/37; W.C. Sigerson to R.J. Moffett, 19 December 1933, CAL Collection, AOM, MG 11 A 34, Box 23: Correspondence between CAL (old + new) + Canadian Vickers Ltd, 18 March 1929 – April 12/34. For a detailed history of Canadian Vickers and its relationship with the Canadian government see, Rénald Fortier, "Intervention gouvernementale et industrie aeronautique, l'example Canadien, 1920-1965," (Ph.D. diss., Université Laval, 1990); Rénald Fortier, "L'instrument privilégié d'Ottawa: Canadian Vickers et la fabrication d'aéronefs au Canada au cours des années 1920," unpublished manuscript, 2005.

[46] See Appendix I for comparative performance figures.

71, but other than a few minor aesthetic differences, like an oval window on the 71, the 71 and 2W-2 were essentially the same aircraft. It was this design, the 71, that Fairchild Aircraft Limited's Canadian branch plant began manufacturing.[47]

Sherman Fairchild's business underwent a series of complicated purchases and reorganizations in the early 1930s with The Aviation Corporation purchasing Fairchild Aviation and its subsidiaries in 1930 and Sherman Fairchild beginning to repurchase them in 1931. When Fairchild Aircraft Limited, the Canadian branch, was once again in Fairchild's hands, the company began developing the Fairchild 71C and 71CM, modifications designed specifically for Canadian bush operators.[48] This tradition of responding to Canadian conditions would find its full articulation in the Super 71's glorious failure and the FC 82, the last of the FC-2's progeny. However, these developments would come in the mid-1930s. As Canadian Airways struggled to respond to the changing conditions in the Canadian North in the early 1930s, the 82 was not yet a gleam in its designers' eyes. Instead, Canadian Airways had to rely on its existing fleet, choosing to respond to increased Bear Lake traffic by transferring G-CARH, an FC-2, to the Mackenzie in February of 1932. Its addition was part of the company's efforts to accommodate higher levels of traffic and to counteract Mackenzie Air Service's competition.

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[47] Donald Morrison Bain, *Canadian Pacific Airlines: Its History and Aircraft* (Calgary: Kishorn Publications, 1987), 56-57; Molson and Taylor, *Canadian Aircraft Since 1909*, 305-314.

[48] R.H. Mulock to James A. Richardson, 26 January 1931, CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, 1929 – 1931.

AIRMAIL EXPANSION

The increased passenger and freight traffic that contributed to the pressures on Canadian Airways to change its fleet was only one dimension of Great Bear Lake's effect on Mackenzie aviation. The men and the companies generating the additional traffic also required mail service. The government's decision to expand airmail service to the area and Canadian Airways' success acquiring the contract would place further demands on the company's aircraft, reinforcing the significance of payload capacity and efficiency of operations as criteria of evaluation.

Although the government had just cut the intercity service in 1932, R.W. Hale, District Superintendent of Postal Services, recommended that the Post Office open an office to serve the community of miners and prospectors growing on Great Bear Lake's often harsh shores. When the rush began in March and April of 1932, Canadian Airways provided a sticker service to Great Bear in lieu of official airmail.[49] However, after visiting Great Bear in June, Hale strongly urged the government to extend the Mackenzie airmail service to include Great Bear Lake. By the spring of 1932, there were three major camps on Great Bear Lake: LaBine Point, the site of Eldorado; Glacier Bay, the Cominco site; and Hunter Bay, which had the government wireless station and had been the centre of local activity before the LaBine strike.[50]

During his visit, Hale found a bristling forest of mining and prospecting activity along the lake's eastern shore, reporting that the area included "200 single men

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[49] Arthur Webster to James White, 28 May 1932, NAC, RG 3 E-6 V 2673, file 10-4-185, vol. 2: 1931-1937.
[50] Watt, *Great Bear*, chapter 3.

representing 28 important mining companies and Dominion Government Departments."[51] These men generated a substantial amount of mail. In addition to the mail and express carried by commercial carriers and mining company aircraft, the Great Bear Lake camps produced 500 letters over the course of six weeks. There were also 300 lbs of mail accumulating at McMurray, waiting to be carried in. Hale estimated that once the Post Office established a regular mail service they could expect 100 lbs of first class mail per month.[52] Shortly after submitting his initial report, Hale sent an urgent telegram to E.J. Underwood, the Chief Superintendent Post Office Service:

> Re proposed post office Great Bear Lake need for office very urgent STOP New arrivals by boat and aeroplane have increased population fifty percent since my report mostly representatives of well known mining companies developing claims STOP Canadian Airways now providing free service embarrassing to ask them to continue this indefinitely.[53]

The Post Office accepted Hale's recommendation late that summer.

Once they had announced the service, the cash-strapped government sought the lowest price possible, a situation Canadian Airways was all too aware of when submitting their bid.[54] In his initial report, Hale had recommended that the mail be carried at a rate of 35¢ per pound.[55] Although aware of the government's pinched resources, Canadian Airways pointed out that to carry the mail at this rate was an outrageous demand.

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[51] R.W. Hale, Report on Great Bear Lake Application, 1932, NAC, RG 1 V 2319, file 12-1-CAM-185, vol. 1: 1930-1943.
[52] Ibid.
[53] R.H. Hale to E.J. Underwood, 12 August 1932, NAC, RG 3 E 6 V 2319, file 12-1-CAM-185, vol. 1: 1930-43.
[54] R.H. Mulock to G.A. Thompson, 16 August 1932, CAL Collection, AOM, MG 11 A 34, Box 14: Airmail: Great Bear-Resolution, 16 July 1932 – 7 June 1934.
[55] R.W. Hale, Report on Great Bear lake Application, NAC, RG 1 V 2319, file 12-1-CAM-185, vol. 1: 1930-1943.

Instead, they offered to carry it at a rate of 60¢ per pound, an offer accepted by the Chief Superintendent of Air Mail Services. The Chief noted

> there are other airplane companies operating in the Great Bear Lake district who might be willing to undertake this work at a rate lower than 60¢ per pound. However, while the Department is naturally anxious to secure this service at as low a rate as possible it is reluctant to enter into any agreement with any company which is liable to withdraw from the scene when the amount of commercial business offering becomes so low as to make their continued operation in that district unprofitable. In other words, before the Department would consider the offer of any company other than that of the Canadian Airways it would have to be well established that any such company would have to be adequately equipped with spare machines and have every indication of being more or less permanently located as operators in that district. Furthermore, it would be necessary that they guarantee a service as efficient as that which has so far been rendered by the Canadian Airways in the Mackenzie River district generally.[56]

The expanded airmail contract provided more income, but it also placed demands on Canadian Airways' fleet. Additional cargo meant the company had to have the carrying capacity to accommodate the mail while still capitalizing on as much Great Bear Lake traffic as possible. To do so required adequate payload capacity and the operational efficiency to enable multiple trips if necessary. The Junkers W 33/34 seemed to offer a solution.

STRENGTHENING THE FLEET: JUNKERS AIRCRAFT

Even before it secured the Great Bear airmail contract, Canadian Airways had expanded its fleet to accommodate higher traffic levels. As part of this process, in July

[56] Chief Superintendent Air Mail Services to Assistant Deputy Postmaster General, 23 August 1932, and Chief Superintendent Air Mail Services to R.H. Hale, 2 September 1932, NAC, RG 3 E 6 V 2319, file 12-1-CAM-185, vol. 1: 1930-43. Even with these low poundage rates, there was not enough left in government coffers to finance the route's expansion to include Coppermine. C.H. Dickins to G.A. Thompson, 10 November 1932, and W.C. Sigerson to R.H. Mulock, 2 December 1932, CAL Collection, AOM, MG 11 A 34, Box 15: Airmail: Mackenzie River (and Edmonton McMurray).

1932 they introduced CF-AQW, a Junkers W33/34, to assist with the end-of-season traffic. The W 33/34 was a hardy workhorse, the creation of Dr. Hugo Junkers, pioneer German aircraft designer. While he worked on German ground attack aircraft during World War I, after the war Junkers returned to designing civilian aircraft. His F.13, a low wing, single-engined monoplane, was the world's first all-metal passenger carrying aircraft, and as the Junkers-Larsen 6, a modification designed for the American market, this aircraft opened the Canadian North on the pioneering Imperial Oil flights of 1921.[57] This intrepid aircraft was also the immediate forerunner of the W33/34.

The W 33 and 34 both appeared in 1926. Developed as a mail carrier, though it could be converted to a six-passenger airliner, the W 33/34 was slightly larger than the F.13 and included a revised fuselage configuration, a larger payload capacity, and an enclosed cockpit. The W 33 boasted a water-cooled Junkers L-5 engine, while the W 34 was equipped with a radial engine, usually a Pratt & Whitney Wasp or Hornet. The designation W 33/34 would later apply to aircraft that had used both sorts of power plant. In April of 1928, it was one of these aircraft, the *Bremen*, which completed the first East to West Atlantic crossing, battling against the prevailing headwinds.[58]

In the summer of the same year the *Bremen* conquered the Atlantic, while still in Western Canada Airways' employ, W.L. Brintnell was in New York following up on an order of Fokker Universals and Super Universals when he had the opportunity to fly in a new Junkers W 33. After the flight he gleefully telegraphed WCA's head office:

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[57] Bain, *Canadian Pacific Airlines*, 60; Dan McCaffery, *Bush Planes and Bush Pilots* (Toronto: James Lorimer & Company, 2002), 27 –28; M.F. Painter, "The Saga of 'AQW: The 29 Operational Years of a Junkers W.33/34," *CAHS Journal* 32:3 (Fall 1994): 90-99, 90-91.

[58] Bain, *Canadian Pacific Airlines*, 60; McCaffery, *Bush Planes*, 28; Molson, *Pioneering*, 293; Painter, "The Saga of 'AQW," 91. See also Appendix I.

> Tested Junkers superlative performance out performing Super with only three hundred horsepower motor STOP … Strongly advise ordering one for in all my experience have never seen machine so exactly suitable our present and future needs STOP[59]

The company followed Brintnell's recommendation and the aircraft, CF-ABK, arrived in the spring of 1929 from Junkers' Swedish subsidiary, A.B. Flygindustri.[60] Purchasing the aircraft from this plant allowed Western Canada Airways to avoid buying German manufactured aircraft.[61]

Over the course of the next 6 years, Canadian Airways would add 7 more W33/34s to its fleet, along with the JU 52, CF-ARM, known as the flying boxcar. The Junkers aircraft would serve Canadian Airways well over the next decade, earning reputations as excellent bush planes and procuring the admiration of engineers and pilots alike. The W 33/34's payload of 1608 lbs as a seaplane and 2125 lbs on skis and its solid performance would help Canadian Airways address their concerns about carrying capacity and efficient operation. However, their ability to use the aircraft successfully in the Mackenzie required some minor adaptations.

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[59] W.L. Brintnell to John Hunter, 17 July 1928, CAL Collection, AOM, MG 11 A 34, Box 1: Correspondence Post-1918 – July 1929.

[60] John R. Ellis, "Canadian Civil Aircraft Register," *CAHS Journal*, 2:1 (Spring, 1964): 21-47, 23.

[61] Although CF-ABK was manufactured in Sweden, there is no indication that it had been specifically modified to suit northern aviation conditions. In fact, despite the Junkers branch plant, there was virtually no private aircraft industry in Sweden at this time. There were some state operations, which had partnerships with German aircraft designers. It was the Swedish government's creation of an independent Air Force in 1926 that created the market that encouraged Junkers to establish its Flygindustri branch plant, a plant that would be nationalized in 1935. Only later would the Swedes move on to develop their own indigenous designs. Klaus-Richard Böhme, *The Growth of the Swedish Aircraft Industry, 1918-1945: The Swedish Air Force and Aircraft Industry* (Manhattan, Kansas: Sunflower University Press, 1988).

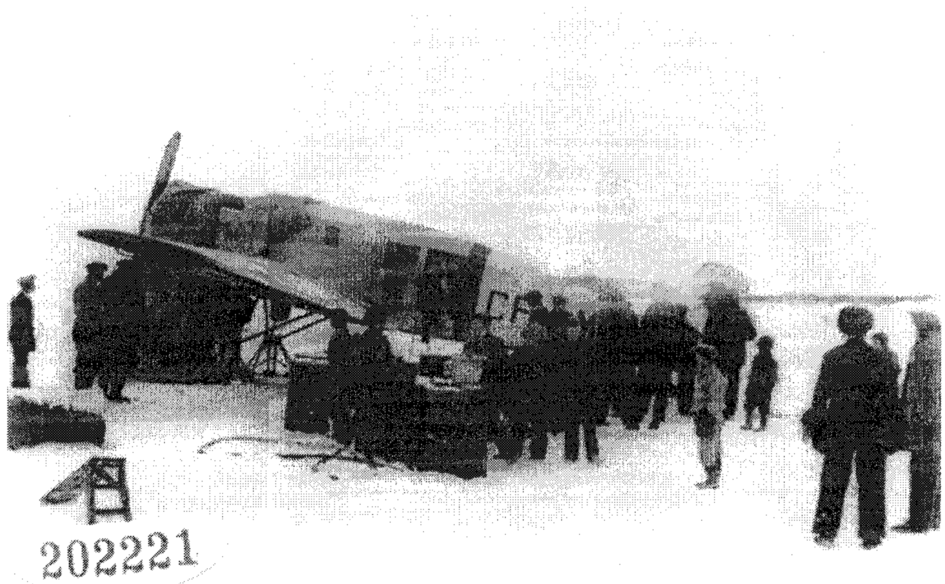

Figure 5.2: Junkers W 33/34. CF-AMZ at Fort Chipewyan.
Source: AAM Photo Collection, 202221.

Although Canadian Airways saw the W 33/34s as a potential solution to their traffic problems in the North, the company was experiencing worrying problems with the aircraft. Their first Junkers, CF-ABK, was unable to lift a full load when on floats.[62] Given that summer aviation in the North required float operations and the heavy traffic and predatory competition the company faced, this problem needed to be addressed before the Junkers could effectively serve in the Mackenzie.

The company initially identified the aircraft's power as the problem. Attaching floats to a plane originally designed as a wheeled aircraft changed the plane's aerodynamics, reducing its rate of climb and top air speed. Floats were also more difficult to get off the water than wheels or skis off land, thus they required more power for take off. Looking for explanations for CF-ABK's performance, James A. Richardson hypothesized that the L-5 engine did not generate sufficient power and that a Wasp

[62] James A. Richardson to G.A. Thompson, 7 May 1932; G.A. Thompson to G.C. Drury, 7 May 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932.

engine, with its greater power, would give better results.[63] Following up on this theory, G.A. Thompson noted that the Junkers, CF-AQW, equipped with an L-5 engine, and CF-AMZ, Wasp powered, had carried equal loads – on skis. However, Thompson recognised that "when it comes to using these two machines on water it is quite possible that due to the extra horse power in the Wasp, "MZ" may carry a larger load than "QW"."[64]

Subsequent test confirmed Thompson and Richardson's suspicions. On floats, the L-5 equipped CF-AQW could not lift off with a full load. It meant that "this machine is not as good as a Fokker Super Universal and could not be used in small lakes."[65] Thompson was particularly disappointed, as the company urgently required the machine on the Mackenzie River for hauling gas drums from Fort Norman to Fort Franklin because of the Junkers' large door. Thompson noted, "we cannot put these large drums in the Fokkers and we did not wish to ferry out the big Junkers [the Ju 52, CF-ARM] for this job unless necessary."[66] Unless they could address the lift problem, the company could not transfer the aircraft to the Mackenzie.

R. Beire, Junkers' Canadian representative, responded to these concerns with the suggestion that the float alignment on CF-AMZ or the propeller pitch of CF-AQW could be affecting the performance. Beire claimed,

> Of course the performances in taking off with the L-5 of only 310 HP on floats as well as on wheels or skiis are lower than with the Wasp, but is

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[63] James A. Richardson to G.A. Thompson, 7 May 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932.
[64] G.A. Thompson to G.C. Drury, 7 May 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932.
[65] G.A. Thompson to G.C. Drury, 18 May 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.
[66] Ibid.

> [sic] has been proved through official tests as well as repeated in practice, that the performances also with this engine, fully loaded and under normal conditions are absolutely sufficient for full practical operations.[67]

It seems to have been another case of the manufacturer not understanding the impact of operating conditions.

It was also another instance of Canadian input into the operation and configuration of a foreign aircraft in order to modify it for Canadian circumstances. Responding to Richardson's enquiries, T.W. Siers, head of Canadian Airways' maintenance, reported that even when CF-AQW was tested under the supervision of a Junkers representative with float and propellers set to Junkers' specifications, it failed to take off with a full operating load.

During the same test session, Siers made the following experiment:

> On going ashore I made the remark that although the new propeller was more efficient than the old one, it was holding the engine down, i.e., the engine was not turning up fast enough, and suggested that in order to overcome this we reduce the pitch of the propeller 10 millimetres. The Junkers' representative did not want to do this, his argument being that if the stabilizer was set right the machine would get off. However, after some discussion, with myself offering to take full responsibility if any damage was done, the propeller pitch was reduced until the reading showed 200 millimetres. The machine was then loaded until we had an operating load of 2,496 pounds, and on attempting to take off across the narrow part of the lake, the machine got on its step, and in both the pilot's and my own opinion the machine would undoubtedly have got off as it was all ready to leave the water, had there been sufficient room.

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[67] R. Beire to G.C. Drury, 26 May 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.
The pitch of a propeller refers to the angle of the blade with reference to the plane of rotation. Optimal performance angles will be different at different aircraft speeds, for instance for take-off versus cruising. By 1932, Hamilton Standard had developed a propeller whose pitch could be varied in flight and which would be used on the new passenger airliners. However, in the early 1930s, the aircraft used along the Mackenzie had propellers whose blade angle could not be changed while in operation, though they could be manually adjusted on the ground.

> … These tests proved without a doubt, that if the engine is allowed to turn up the propeller at or about 1400 R.P.M.s on the ground, this machine will get off the water with its full operating load.[68]

Siers pointed out that the Junkers' performance problems resembled the trouble the Super Universals encountered on arrival in Canada: "performances were poor until the propeller pitches had been reduced."[69] Siers believed that this had "something to do with climatic conditions… even if Junkers find a certain propeller setting to be satisfactory in Germany or Eastern Canada, this does not mean to say the same setting is satisfactory for the Prairie Provinces. This is something that must be worked out by our own personnel."[70] The aircraft had to be adapted to Canadian conditions by its users. Once these changes were made, Canadian Airways would be able to successfully use the W 33/34s along the Mackenzie.

While most of the company's officials were confident in the pilots' and engineers' experiential knowledge and were willing to accept their suggestions for modifications based on that experience, as with Siers and the W 33/34 propeller, others put more faith in scientific testing. For example, in 1932 the company engaged in a debate about whether or not to use a different type of engine oil during the summer months. C.H. Dickins followed the pilots' suggestions and passed a positive recommendation along to G.A. Thompson.[71] Thompson also put great stock in pilot knowledge and passed the information to W.C. Sigerson, commenting that he and T.W. Siers were "both of the opinion that where experienced pilots make recommendations of this kind that they

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[68] T.W. Siers to James A. Richardson, 16 June 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.
[69] Ibid.
[70] Ibid.
[71] C.H. Dickins to G.A. Thompson, 17 December 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil.

should be followed. This is another case in which theory and practice clash, which is the case time and again on operations."[72] Sigerson rejected the adjustment, replying that he did not believe pilots' knowledge should be unquestioningly accepted, "unless there is very good reason why the so called theory is in error."[73] That said, many of Canadian Airways' modifications reflected officials' confidence in experiential knowledge.

Adjustments made, when the W 33/34, CF-AQW, went north in July of 1932, it performed well. The craft worked primarily ferrying freight and passengers between Fort Norman on the Mackenzie River and Fort Franklin on the Keith arm of Great Bear Lake as well as other points on the lake, lifting extremely large loads in the process. For instance, on 8 July the plane carried a load of 2,380 lbs, consisting of five passengers with 1000 pounds excess baggage, plus operating load, from Fort Norman to Echo Bay.[74] A week later P.B. Calder, the pilot, noted, "aircraft will take off dead calm with 1500 lbs pay load and three hours gas."[75] Siers' adjustments had been successful.

Although CF-AQW performed well with its L-5 engine, the company began to focus on equipping the Junkers with Hornets and Wasps. After all, the L-5 water-cooled engines would have frozen in northern winters. However, the company's articulated concerns focused on performance and operations costs. G.A. Thompson agreed with Siers that equipping the aircraft with Pratt & Whitney Hornets,

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[72] G.A. Thompson to W.C. Sigerson, 21 December 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil.
[73] W.C. Sigerson to G.A. Thompson, 27 December 1932, CAL Collection, AOM, MG 11 A 34, Box 33: Gas and Oil.
[74] CF-AQW, Flight Report, 8 July 1932, CAL Collection, AOM, MG 11 A 34, Box 108: CF-AQW Flight Reports, Feb – Dec 1932.
[75] CF-AQW, Flight Report, 15 July 1932, CAL Collection, AOM, MG 11 A 34, Box 108: CF-AQW Flight Reports, Feb – Dec 1932.

> would undoubtedly give us better performance, particularly insofar as weight carrying is concerned on pontoons, although it is possible that extra head resistance [because of the engine's larger size] might cut down the speed a few mile per hour. Due to the increased power on the Hornet we could fly it throttled down a great deal more than was possible on the mail operation. The Hornet motor we had in Junkers "BK" did not burn more than 19 to 21 gallons of gasoline per hour, which compares more than favourably with the consumption of our Wasp engines in Fokkers and also in the Junkers.[76]

Thompson further argued that if and when the company purchased new W 33/34s, equipping them with Hornet engines would have other benefits. With its higher horsepower the Hornet engine would increase the craft's take off and climb efficiency. The lower gas consumption would reduce operating costs. Moreover, the change would find a use for Canadian Airways' surplus Hornet motors and, when those motors had reached the end of their useful life, they could be replaced with the small Wasp motors without any structural changes being necessary.[77] Following Thompson's suggestion, when the company ordered another W 34 later in the autumn of 1932, it would be Hornet equipped.[78]

While propeller adjustments enabled successful summer operations, winter flying would present its own challenges. Given that CF-AQW operated in the North only for

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[76] G.A. Thompson to W.C. Sigerson, 28 September 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence. When equipped with a Hornet engine the W 33/34, fitted out with skis or wheels, could achieve a cruising speed of 110 mph and had a range of 440 miles or 4 hours. The same plane on floats had a cruising speed of 105 mph and a range of 420 miles or 4 hours. R. Beier, Canadian Junkers Ltd, to G.C. Drury, 27 June 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers #1: Correspondence re. CF-AMZ & CF-AQW.

[77] G.A. Thompson to W.C. Sigerson, 1 November 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.

[78] W.C. Sigerson to G.C. Drury, 15 November 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933. These engines began to wear out in 1934, at which time the company followed through on its plan to replace them with Wasp engines. G.A. Thompson to W.C. Sigerson, 17 May 1934, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

the summer season, it provided no indication of potential pitfalls. When the Junkers did serve in the North during the winter of 1933-1934, their undercarriages suffered.[79] That said, because of the undercarriage design the results were not extreme. Rather than the Fokkers' single load-bearing strut connected directly to the wing, the Junkers undercarriage had a thicker, cross-braced strut that fed into the underside of the fuselage, providing a stronger structure. The Junkers undercarriage also carried ball-end fittings designed to act as a crumple zone that would absorb abnormal stress. However, the fittings failed too easily under normal northern operating conditions and Canadian Airways hoped to adapt them.[80]

In the summer of 1932, Canadian Junkers was preparing to redesign the W 33 undercarriage, replacing the single axle with a double axle. However, Canadian Airways worried that this change would necessitate a second pedestal on each ski, which would add to the cost of the ski, and "after all is only an experiment."[81] As Thompson said, "what we requested was that the actual fittings be strengthened … We understand they are strengthening the fittings on the JU-52s as we requested, and we feel that this would be the best solution also for the W.33."[82] It appears that Canadian Junkers responded to this request. In the fall of 1932, the manufacturer developed modified fittings that would

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[79] On 27 January 1934, CF-ARI suffered a failure at Coppermine: "Port shock-leg failed in take-off on extremely rough ice at Coppermine. Leg replaced: no other damage than hole punched in skin of wing by broken 'leg'." On 10 February, the other leg failed on take-off. CF-ARI Flight Reports, 27 January 1934, and 10 February 1934, CAL Collection, AOM, MG 11 A 34, Box 104, CF-ARI Flight Reports.
[80] C.M. Forrest to G.C. Drury, 12 April 1933, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.
[81] G.A. Thompson to C.M. Forrest and J.A. Macdougall, 13 June 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.
[82] Ibid.

replace the existing fittings with stronger ones designed specifically for Canadian conditions, increasing the undercarriage's strength without endangering the airframe.[83]

Once the manufacturer had developed these modified fittings, they needed to be approved by the Canadian government. Canadian Junkers submitted an application for the alteration of its landing gear on Junkers types JU-52, W33/34, and F13s on skis. The company stated,

> These new designs have been made in consideration of and, in comparison with other countries, particularly difficult snow conditions of Canada. The alteration consists in the replacement of the original electron fittings on both axles by steel castings of special design and strength. In connection with this it was necessary to replace the axles and rear strut by those of bigger dimensions, in order to eliminate dangerous break-points in these parts, which were originally designed corresponding to the strength of the electron pieces.[84]

Rather than testing the modifications themselves, the government followed its pattern of waiting for approval from the manufacturers' country before issuing its own approval.[85]

However, the procedure seems to have stalled during the winter of 1932-1933. In January, T.M. Shields, the government inspector for the region, contacted J.A. Wilson to enquire about the modifications:

> Junkers W thirty three stroke thirty four Ju fifty two fitted with new type under carriages STOP Inspections revealed installation satisfactory STOP Although no approval these modifications received this office understand

[83] R. Beier to G.C. Drury, 29 September 1932, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence. In this letter, Beier refers to elektron fittings. In later correspondence, he would call them electron fittings.
[84] R. Beier to Department of National Defence Aeronautical Engineering Division, 27 October 1932, NAC, RG 12 A-1 V 755, file 5010-10-28 vol. 1, June 21, 1930 – Dec 1935.
[85] A.T. Cowley to R. Beier, 2 November 1932, NAC, RG 12 A-1 V 755, file 5010-10-28, vol. 1, June 21, 1930 – Dec 1935. See Chapter 4 for a discussion of the government's policy on licensing of foreign-built aircraft.

> country of origin approved alteration STOP advise immediately if you concur this change[86]

Wilson replied that the department had not received any approval from the German authorities and recommended that temporary permissions be granted until the situation was cleared up.[87] The government then contacted Canadian Junkers who replied with a copy of the telegram they had received from their parent company in Germany: "Undercarriage parts W34 and JU52 bear DVL [Deutsche Versuchanstalt für Luftfahrt] control stamp on pressed-in type plate STOP Furthermore DVL drawing approval is being sent."[88] Shortly thereafter, Beier submitted the DVL approved drawings to the Department of National Defence, and the matter appears to have ended there as the government sent Shields identification markings for the approved undercarriages.[89]

Despite these adaptations, Canadian Airways continued to have problems with the undercarriages. As C.M. Forrest wrote,

> Mr. Siers has reported to me that numerous breakages have occurred to the ball-end-fitting of Junkers W33/34 type undercarriage during the past Winter season. These breakages have not only been a cause of some slight annoyance to the Maintenance Department but they also have delayed operations to a considerable extent. Since November, 1932, Junkers "QW" has sustained no less than ten of these failures and Junkers "MZ" four. Usually it is the top ball-end fitting which breaks, but this causes the lower ball-end fitting to bend to such an extent as to be of no further use and it also has to be replaced.[90]

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[86] T.M. Shields to J.A. Wilson, 6 January 1933, NAC, RG 12 A-1 V 755, file 5010-10-28 vol. 1, June 21, 1930 – Dec 1935.
[87] Civil Aviation to T.M. Shields, 7 January 1933, NAC, RG 12 A-1 V 755, file 5010-10-28 vol. 1, June 21, 1930 – Dec 1935.
[88] M. Janikun to Department of National Defence, 9 February 1933, NAC, RG 12 A-1 V 755, file 5010-10-28, vol. 1, June 21, 1930 – Dec 1935.
[89] R. Beier to Department of National Defence, 24 February 1933; G.S. Abbott to T.M. Shields, 1 March 1933, NAC, RG 12 A-1 V 755, file 5010-10-28, vol. 1, June 21, 1930 – Dec 1935.
[90] C.M. Forrest to G.M. Drury, 12 April 1933, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

In response, Forrest noted that the ball-end was designed to function as a crumple zone, absorbing the force of impact and protecting the rest of the aircraft from serious damage. As he said, "our opinion is, however, that it should be of sufficient strength to withstand the ordinary strain put on it by the snow and ice conditions of Northern Canada."[91] Canadian Junkers worried that strengthening this particular fitting would transfer strain to the wing, which would be very difficult to repair compared to the axle fitting.[92]

The manufacturer appears to have won this round, and it does not appear to have altered these fittings. Surprisingly, the aircraft that went north that summer and stayed on through the next winter did not experience any serious undercarriage failures. It might be in part because the winter of 1932-33 had been so desperately hard that even the rugged Junkers experienced failures that winter but not subsequently. Interactions with the environment and the resulting mechanical failures had pushed the operator to look for modifications. However, the designers were reluctant to accommodate Canadian Airways because of their fears for the consequences of strengthening the ball-joints. Interestingly, environmental changes rendered the discussion moot as warmer winter temperatures in subsequent years reduced strain on the landing gear.[93]

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[91] Ibid.

[92] R. Beier to G.A. Thompson, 7 April 1933, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

[93] In fact, when the aircraft did go north, the mechanical problems they experienced seem to have been relatively minor, with most of the more serious problems clustered around the engine. For instance, CF-ARI experienced a series of problems with its number 6 cylinder spark plugs in September 1933, problems with its oil lines in December, and problems with operations in the extreme cold in December 1933 and January 1934. CF-AQW faced a series of leaks in its radiator, radiator hose and exhaust system in the summer of 1932. CF-AMZ's fuel pump created problems in September 1933 and again in August and September 1934. During October of 1933, it also experienced difficulties with its number 9 cylinder. CF-AMZ Flight Reports, 6 – 12 September 1933, 12 – 19 October 1933, 5 August – 30 September 1934, CAL Collection, AOM, MG 11 A 34, Box

In light of ongoing concerns about competition and profitability, Canadian Airways kept a close watch on the Junkers performance. Over the winter of 1932-33, the model developed an excellent reputation. According to W.E. Gilbert, "the Junkers were an extremely efficient job."[94] Not only did they have a larger payload than the Fairchilds, their maintenance was also less expensive.[95] Thompson was of the opinion that "the only new equipment available on the market today which is suitable for operations in Northern Canada is the Junkers W.33 and 34."[96] The company was so pleased with the aircraft that it purchased two new W33/34s in 1932, CF-ASI and CF-ATF, and two more in 1933, CF-ASN and CF-ARI, even though second hand 71s were available at much reduced prices.[97]

These purchasing decisions drew fire from the government because Canadian Airways was not buying Canadian or at least British planes. The company defended itself by pointing out that Canadian and British manufacturers were not producing

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100: CF-AMZ Flight Reports; CF-AQW Flight Reports, 5 – 24 July 1932, 20-21 August 1932, CAL Collection, AOM, MG 11 A 34, Box 103: CF-AQW Flight Reports; CF-ARI, Flight Reports, 8 – 27 September 1933, 5 December 1933 – 25 January 1934, CAL Collection, AOM, MG 11 A 34, Box 104: CF-ARI Flight Reports.

[94] W.E. Gilbert, Interview, ca 1967, NWT Archives, G-1988-008-0003.

[95] G.A. Thompson to W.C. Sigerson, 27 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933. Western Canada Airways' figures from 1929-1930 indicate that the total maintenance costs for Fairchild aircraft since acquisition were $1347.66. The total cost of maintenance on Junkers aircraft since acquisition was $2737.73. However, when one considers the cost in relation to operating hours, the cost per hour of flying was $9.18/hr on the Fairchilds and $6.70/hr on the Junkers. The average cost/flying hour for all of Western Canada Airways' fleet was $7.14/hr. "Notes of Maintenance Rates," 31 July 1930, CAL Collection, AOM, MG 11 A 34, Box 64: Miscellaneous WCA Rates and Costs, 1927-1930.

[96] G.A. Thompson to W.C. Sigerson, 15 October 1932, 18 October 1932, 27 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.

[97] Ibid.

anything remotely suitable for northern bush flying.[98] W.C. Sigerson attempted to explain the situation to J.A. Wilson:

> We wish to re-emphasize what we have said many time to representatives of British aviation equipment companies, that is, if they have suitable equipment for use in the operations of Canadian Airways it will be chosen or purchased, assuming, of course, that it comes even reasonably near to approaching the standards of perfection and performance of equipment manufactured in foreign countries.
> … [The Junkers W 33] was all-metal and in every particular was found to be most desirable for bush operation: its payload was relatively high, operating cost relatively low, and aircraft maintenance was practically nil.
> … British aircraft manufacturers have not gone in for manufacturing of freighters; they could have probably offered us a large multi-motored aeroplane with the required capacity of three ton payload (on wheels and skis), but multi-motored equipment is positively unsuitable for operation in winter in the north country involving temperatures as low as 50° below zero.[99]

As far as Canadian Airways' management was concerned, British manufacturers promised nothing suitable for Canadian conditions. This forced Canadian Airways to buy foreign manufactured aircraft.

Although it performed well technically, the Junkers W 33/34 did not entirely solve Canadian Airways' fleet difficulties. Originally designed as a freight carrier or airmail plane, the W 33/34 could be converted to a passenger aircraft. As such, however, it did have certain drawbacks. Of the three rows of seats, two faced backwards and the view from the windows was poor. As Thompson pointed out,

> passengers in the shape of mining engineers in the Mackenzie River District have adversely criticized the Junkers W.33 on account of poor visibility from the cabin. Mining engineers when they are flying wish to see the country they are going over, to study it from the viewpoint of

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[98] W.C. Sigerson to James A. Richardson, 4 January 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932; W.C. Sigerson to J.A. Wilson, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[99] W.C. Sigerson to J.A. Wilson, 23 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.

> formation. This is practically impossible with the present arrangement of windows in this machine. Furthermore, when passengers are unable to keep their interest occupied watching the country, they are more apt to become airsick.[100]

By Thompson's estimation, the Fairchilds were more comfortable passenger machines than the Junkers were.[101]

Fuel and oil	lbs	650	650	650	650	650	650	650	650	650
Crew	"	350	350	350	350	350	350	350	350	350
Passengers or luggage on 1st seats	"	/	/	/	/	350	350	525	525	900
" " " 2nd "	"	/	/	175	350	350	350	350	525	750
" " " 3rd "	"	/	*155	175	175	/	175	175	175	190
Tail-trimming-tank	"	*90	/	/	/	/	/	/	/	/
Loading	lbs	1090	1155	1350	1525	1700	1875	2050	2225	2840
Setting of tail plane ∢		+1,3°	+1,3°	+1,9°	+2,3°	+1,6°	+2,4°	+2,5°	+2,8°	+3,4°

Weight, empty + loading = Weight loaded } According inscription on tail end of fuselage

* Min. load in tail-trimming-tank or in loading-room.

The setting of tailplane ∢ also for each different load of fuel and oil.

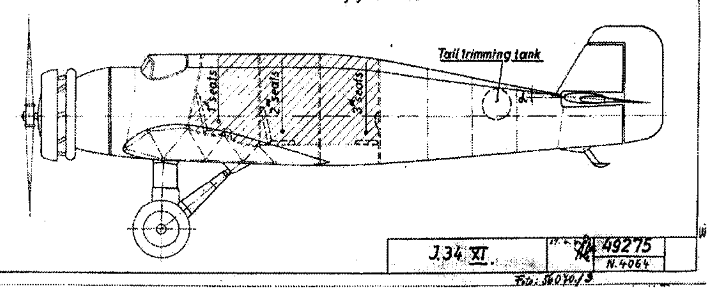

Figure 5.3: Junkers loading diagram, 1934.
Note that the first and second rows of seats face the rear of the plane.
Source: CF-AQV log book, CAL Collection, AOM, MG 11 A 34, Box 76: CF-AQV Logs, Jan 14/34 to May 23/35.

Initially, passenger comfort would have been a minor consideration as the aircraft's main competition was much slower and, in the case of dog sleds, much less comfortable. However, Mackenzie Air Service's appearance changed all that. With two airlines to choose from and every dollar of income so important, any perceived disadvantage could hurt Canadian Airways. The cut-throat rate cutting this competition engendered would only exacerbate the situation. Canadian Airways sought a response to

[100] G.A. Thompson to W.C. Sigerson, 17 October 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[101] G.A. Thompson to W.C. Sigerson, 27 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.

changing operating conditions through the introduction of the W 34s. Additional payload and good performance, while important for handling traffic levels, could not solve the problems created by Mackenzie Air Service's competitive practices. For instance, W.E. Gilbert reported that Mackenzie Air Service had to overload in order to compete with these Hornet-powered machines.[102] This overloading and rate cutting contributed to the preoccupation with payload and efficiency that would encourage Canadian Airways to introduce the Fairchild 71C and retire the Super Universals.

CUT-THROAT ECONOMICS: RATE CUTTING AND REGULATION

For Canadian Airways, the appearance of a new airline in the district was the most destabilizing event that occurred during this period and the changes in Canadian Airways' fleet represented the company's attempts to respond. Although the Great Bear Lake rush and the airmail route expansion were boons, the company was constantly afraid that Mackenzie Air Service would threaten this income, income vital to the airline as it tried to weather the Depression.[103] Thus, not only did Canadian Airways need to respond to economic developments like the Great Bear Lake rush, it also had to react to Mackenzie Air Service's presence. The competitor's existence magnified the difficulties caused by ongoing maintenance issues with the Fokker Super Universals, and the need for

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[102] W.E. Gilbert to C.H. Dickins, 23 September 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities, April 1/30 – Dec 18/33.
[103] G.A. Thompson to R.H. Mulock, 17 August 1932, CAL Collection, AOM, MG 11 A 34, Box 37: MAS Limited, 1932-1940.

a larger fleet to accommodate the district's growing traffic.[104] However, financial restrictions hampered the company's ability to respond.[105]

To make matters worse, Canadian Airways encountered rate competition from Mackenzie Air Service that would dog it through the rest of the decade. The company was convinced that their competitors could achieve their rates only by overloading their aircraft. In response, Canadian Airways attempted to have the government enforce the maximum weight regulations, but that proved an up-hill climb. To compensate, the airline modified their fleet to maximize the competitiveness of their operations. In this context the Super Universals that inaugurated Mackenzie District air service became obsolete five years after their introduction.

This conflict with Mackenzie Air Service began with reports of rate slashing and undercutting that reached Canadian Airways early in 1933.[106] Especially in combination with the series of Fokker Super Universal undercarriage failures Canadian Airways experienced in 1932 and the lack of sufficient equipment to cover all available traffic, Mackenzie Air Service' willingness to offer cut rates hurt Canadian Airways business.[107]

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[104] T.W. Siers to G.A. Thompson, 23 December 1932, CAL Collection, AOM, MG 11 A 34, Box 38: Maintenance.

[105] G.A. Thompson to W.C. Sigerson, 15 October 1932, and 18 October 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1932; Canadian Airways Limited to Prime Minister Bennett, [ca. June 1933], CAL Collection, AOM, MG 11 A 34, Box 64: CAL Statistics 1931-1933, 1934 (Accounting and Statistical Data, All Lines); W.C. Sigerson to G.A. Thompson, 2 January 1934, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

[106] G.A. Thompson to C.H. Dickins and W.C. Sigerson, 13 January 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities #1, April 1/30 – Dec 18/33.

[107] Hamden & Alley to W.E. Gilbert, 28 March 1933, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Services Ltd, 1932 – 1940; W.E. Gilbert to C.H. Dickins, 1 April 1933, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Services Ltd, 1932 – 1940; W.E. Gilbert to C.H. Dickins, 23 September 1933, CAL Collection, AOM,

To make matters worse, because they had bought their aircraft second hand, Mackenzie Air Service had made a lower initial investment and, because the smaller company did not require the same overhead as the larger Canadian Airways, for instance, there were no Montreal head offices for Mackenzie Air Service, the competition had lower costs to recoup.[108] In fact, the rate competition in the Mackenzie Valley would become the worst that Canadian Airways faced throughout the country.[109] The situation seemed to crystallize for C.H. Dickins in early January 1933. Given the increased traffic and Mackenzie Air Service's competition, aircraft payload and operational efficiency became his chief priority.[110]

Mackenzie Air Service's lower rates enticed business away from Canadian Airways. However, given that the competition operated similar machinery to Canadian Airways, staff were convinced that the competition could not be making money without overloading their aircraft.[111] Not coincidentally, concerns about Mackenzie Air Service overloading begin to appear in company records during the same period. According to Dickins' reports, in order to woo customers, W.L. Brintnell was broadcasting information that his Fokker Super Universals were capable of carrying up to 2200 lb loads – almost double the 1200 lb payload of Canadian Airways' Supers. However, Dickins was

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MG 11 A 34, Box 28: Competitors' Activities #1, April 1/30 – Dec 18/33; G.A. Thompson to C.H. Dickins, 21 February 1934, CAL Collection, AOM, MG 11 A 34, Box 37:Mackenzie Air Services Ltd, 1932 – 1940.

[108] G.A. Thompson to W.C. Sigerson, 24 June 1931, CAL Collection, AOM, MG 11 A 34, Box 3: Correspondence, Mar 1931-Dec 1931.

[109] D.R. MacLaren to W.C. Sigerson, 14 February 1934, CAL Collection, AOM, MG 11 A 34, Box 22: Correspondence Re Air Regulations, 8 August 1929 – 3 September 1938.

[110] C.H. Dickins to G.A. Thompson, 9 January 1933, 13 January 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.

[111] W.E. Gilbert to H.C. Ingram, Inspector Civil Aviation, 10 May 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938.

convinced that Mackenzie Air Service's fleet consisted of "two of the oldest Fokker Super Universals in existence… they are not licensed to carry as large loads as our Super Universals and the fact that they have been carrying larger loads is due entirely to gross overloading…"[112] Even more dangerously, Mackenzie Air Service flew with no gas reserve, pushing the limits of safe operation in an area that was most unforgiving of mistakes.[113] Although concerned about general safety, Canadian Airways main priority was the effect these practices had on their business.

To counteract Mackenzie Air Service's competition, Canadian Airways approached the government, asking it to enforce the aircraft's licensed maximum weight, but found it difficult to obtain any action. The same day that he reported Mackenzie Air Service's overloading to Thompson, Dickins suggested that the company press the Department of National Defence to inspect aircraft in the Mackenzie District, further suggesting that the Royal Canadian Mounted Police (RCMP) be employed to monitor air regulations.[114] Shortly thereafter, the government, in the person of J.A. Wilson, reported that the RCMP had been asked to consider an inspection role in the North.[115] R.H. Mulock also reported that the government inspectors had been instructed to raise the frequency of their visits to Fort McMurray and that the Department of National Defence

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[112] C.H. Dickins to G.A. Thompson, 13 April 1933, CAL Collection, AOM, MG 11 A 34, Box 14: Airmail: Great Bear – Resolution, 16 July 1932 – 7 June 1934.
[113] C.H. Dickins to G.A. Thompson, 6 April 1934, CAL Collection, AOM, MG 11 A 34, Box 34: Mackenzie Air Service Ltd, 1932 – 1940.
[114] C.H. Dickins to G.A. Thompson, 13 April 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938. There are echoes here of Samuel Insull's activities in Chicago, pressing legislators for regulation as a means of controlling competition. See Thomas Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: The Johns Hopkins University Press, 1983).
[115] J.A. Wilson to W.C. Sigerson, 8 May 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933- 5 Jul 1938.

was considering moving their Inspector's office from Regina to Edmonton.[116] Canadian Airways was hopeful Mackenzie Air Service could be brought under control.

Despite these promises, neither the government nor the RCMP followed up these complaints. As of September 1933, Department of National Defence's District Inspector had not visited McMurray. Nor was there "a single instance of checking the total loaded weight of any commercial aircraft operating throughout the District either by the R.C.M. Police or any representative of the Department of Civil Aviation."[117] The company continued to hold out hope when the government appeared to be allocating money to move the Inspector's office to Edmonton, but in March 1934 Thompson complained to Sigerson that Canadian Airways continued to report violations, but saw no action.[118]

However, a report from the field only four days later suggests that Mackenzie Air Service was beginning to feel the heat from inspectors. After a heated conversation with Brintnell in which Brintnell accused Canadian Airways of persecuting him through Department of National Defence Inspector Ingram, W.E. Gilbert reported,

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[116] R.H. Mulock to W.C. Sigerson, 5 June 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938.

[117] C.H. Dickins to G.A. Thompson, 23 September 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities #1, April 1/30 – Dec 18/33.

[118] R.H. Mulock to W.C. Sigerson, 18 November 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938; G.A. Thompson to C.H. Dickins, 21 February 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Services Ltd, 1932 – 1940.

> our local 'opposition' is becoming peevish, more and more regularly of late. And, as they are already operating at ridiculously low revenue under no apparent schedule of rates and without regard to the safety provisions of the Air Regulations, the only real conclusion to draw is that the 'shoe is beginning to pinch' and that the 'boomerang' of rate-cutting has already returned to the thrower, in some degree.[119]

After more than a year, the government had finally taken action.

While the RCMP had finally stepped up their supervision, the officers enforcing the regulations may have been somewhat confused. Thompson reported that "when examining Mr. Gilbert's machine at Resolution for overloading, the police advised him that he was 500 pounds underload. I am quite sure that Gilbert would not fly with 500 pounds less payload than he could carry, particularly at the busiest time of year and the only conclusion to draw is that the RCMP do not know how to check up on loads."[120] In fact, the government would not truly crack down on air regulations before the creation of the Department of Transport in 1937.

In part, the government's delay reflected the Department of National Defence's preoccupation with things military, but it also reflected the real logistical difficulties of enforcing regulations in the remote North. J.A. Wilson, responsible for the enforcement of air regulations as the Controller of Civil Aviation, enumerated some of these obstacles in a 1935 memo, emphasizing the consequences of Canada's expansive geography. To begin with, there was a complete lack of facilities in the North as the closest inspector was stationed in Regina. During the summer of 1933 Sigerson noted, "there are tentative plans to locate the Inspector who has been based at Regina in Edmonton so that he will

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119 W.E. Gilbert to C.H. Dickins, 18 March 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Services Ltd, 1932 – 1940.

120 G.A. Thompson to W.C. Sigerson, 1 May 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.

be more accessible to the area which is to be more closely inspected during the summer."[121] In February 1934 Thompson wrote, "the moving of Mr. Ingram to Edmonton is a step in the right direction," implying that the move had already been effected.[122] However, even after the Inspector moved to Edmonton, he was still a day's journey away from McMurray, let alone points north. As a result, the government was compelled to delegate the responsibilities to the RCMP and regulators were forced to rely on second hand information about the North.[123] It was a situation that enabled operators to bend or break the rules without much fear of being caught.

While the government dithered, Canadian Airways' had only two options with which to respond to Mackenzie Air Service's practices: overloading their own planes or maximizing efficiency. Overloading had been common procedure for Canadian Airways up until 1932, at which time the company issued a directive that the practice should be eliminated. A number of considerations led to this decision. To begin with, the company felt that its reputation could not sustain the damage that would be inflicted by an accident in which overloading played a part. Moreover, Pratt & Whitney had identified overloading as a potential cause of the series of engine failures on the Mackenzie in 1931.[124]

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[121] W.C. Sigerson to G.A. Thompson, 6 June 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities #1, April 1/30 – Dec 18/33.
[122] G.A. Thompson to C.H. Dickins, 21 February 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service Ltd, 1932-1940.
[123] J.A. Wilson, "Inspection – Northern Bases," 28 June 1935, NAC, MG 30 E 243, vol. 8, May 1937 – 1941; See also, "Overloading of aircraft," J.A. Wilson, 14 May 1934, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 7, Special Correspondence, 1920-1942, wherein he also enumerates the difficulty of convincing witnesses to give evidence against either their employers or the competition.
[124] Molson, *Pioneering*, 164.

Canadian Airways' correspondence also indicates that business acumen guided their decision. They realized that their poorer competitors could not operate at a profit if Canadian Airways could force them to keep to licensed loads.[125] However, if the government enforced its regulations, Canadian Airways would also be under scrutiny and thus its aircraft must also keep within the licensed limits.[126] With this in mind, overloading's potential costs in terms of maintenance, loss of business, and fines, seemed far too high.

The remaining option for the company was to provide the most efficient service possible, thus enabling it to match Mackenzie Air Service' rates.[127] This efficiency became all the more important when the amount of available traffic dropped in 1933. Although traffic to and from Great Bear Lake continued to increase, it was levelling off, and overall traffic along the Mackenzie was declining. In 1933, Canadian Airways' Mackenzie fleet carried 17,590 fewer lbs of mail, 4,805.75 fewer lbs of express, and 523 fewer passengers than in 1932. Great Bear Lake's contribution increased from 1932 to 1933, but not at the rate it had climbed between 1931 and 1932. In 1932, the company carried 210 passengers, 94,389 lbs of express, and 1,592 lbs of mail to and from Great Bear Lake. In 1933, the totals were 233 passengers, 110,076 lbs of freight, and 5292 lbs

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125 W.E. Gilbert to H.C. Ingram, 10 May 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938.

126 W.C. Sigerson to R.H. Mulock, 8 September 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938. Earlier that year Mulock wrote to Sigerson, "I expect very shortly this whole question of overloading will be checked up by the Mounted Police, and it will be rather hard luck on any company which infringes on the overloading regulations." R.H. Mulock to W.C. Sigerson, 29 April 1933, CAL Collection, AOM, MG 11 A 34, Box 14: Airmail: Great Bear – Resolution, 16 July 1932 – 7 June 1934.

127 W.E. Gilbert to C.H. Dickins, 1 April 1933, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service, 1932-1940.

of mail.[128] With concerns about competition and efficiency foremost in their minds, Canadian Airways management again re-evaluated the condition of their aircraft.

ANOTHER ROUND OF FLEET ADJUSTMENTS: THE FAIRCHILD 71C

Within the context of Mackenzie Air Service's competition and the economic depression, Canadian Airways' ability to carry Mackenzie traffic was essential. Thus, the failure of the Fokker Super Universal CF-AFL's undercarriage in February 1933, just as Dickins concerns about Mackenzie Air Service first came to a head, promised trouble. 'Wop' May, the pilot, wrote,

> While landing on mouth of [unclear: Quatre Fork?] on account of fog left undercarriage strut broke. Went down on left wing and broke it about 6 feet back. Not rough landing. Machine went 200 yards without skis leaving ground then undercarriage gave way.[129]

The loss of the Fokker Super Universal and its carrying capacity were of real concern. In response, the company transferred CF-AMZ, a Junkers W 33/34, from Sioux Lookout to the Mackenzie, along with a Fairchild.[130] Despite this move, G.A. Thompson continued to be worried. Notwithstanding the pending return of a Bellanca and an additional Fairchild from overhaul, he foresaw difficulties:

> "This will not help situation very much as two more Bellancas have to go in for overhaul STOP ... In case of necessity could probably sublet some of work to Brintnell but would rather not Might also be able to rent Wagners Fairchild in Winnipeg Would it be possible to rent Fairchild or Bellancas from Department of National Defence Please Advise."[131]

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[128] C.M. Forrest to W.C. Sigerson, 26 January 1934, CAL Collection, AOM, MG 11 A 34, Box 63: Statistics.
[129] CF-AFL, Flight Report, 11 February 1933, CAL Collection, AOM, MG 11 A 34, Box 76: CF-AFL Flight Reports.
[130] G.A. Thompson to C.H. Dickins, 18 February 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.
[131] G.A. Thompson to W.C. Sigerson, 13 February 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

Thompson's telegram had an edge of panic, as he feared that Brintnell's company would gain an advantage due to Canadian Airways' equipment shortage.

W.C. Sigerson and G.C. Drury's response must have alleviated some of Thompson's distress:

> Realizing the shortage of equipment in your lines and the urgent need of another machine we have today ordered a new Fairchild 71C with the C. of A. [certificate of airworthiness] of 6,000 pounds top weight delivery Monday 27th fly-away Montreal for approximate price of $9,300.[132]

W. Buchanan picked up CF-ATZ, a Fairchild 71C, at Montreal on 3 March 1933. After a short maintenance stop over in Winnipeg, the plane flew directly to the Mackenzie to help with the pre-break-up rush to Great Bear Lake.[133] Just as the 1932 introduction of a Fairchild FC-2 to the Mackenzie signalled the changing composition of Canadian Airways' fleet, CF-ATZ's appearance reflected significant changes in Canadian bush plane design. This aircraft was the first type intended specifically for freighting use in the Canadian North. Designed in Canada, this modified 71 was a transitional form between the foreign aircraft and the creation of an indigenous bush plane. The pilots' and manufacturer's experience with the 71C would inform the creation of Canada's first indigenous bush plane, the Fairchild Super 71.

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[132] W.C. Sigerson and G.C. Drury to G.A. Thompson and C.M. Forrest, 15 February 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

[133] CF-ATZ, Flight Reports, 3 – 11 March 1933, CAL Collection, AOM, MG 11 A 34, Box 106: Flight Reports, CF-ATZ, March – Oct 1933.

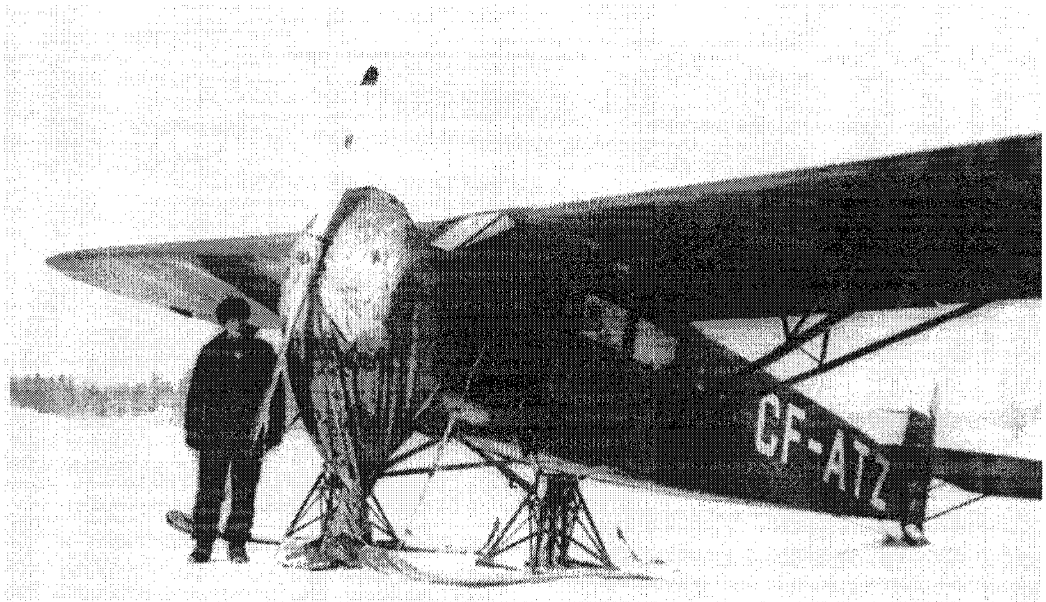

Figure 5.4: Fairchild 71 C.
Dick Leigh with Canadian Airways Fairchild 71 C CF-ATZ.
Source: AAM Photo Collection, 202234.

The Fairchild 71C was an interesting hybrid design that blended existing Fairchild basics with modifications specific to Canadian users' needs. It was a transitional form between Fairchild Aircraft Limited's licensed production of FC-2W-2s and its later experiments with the Super 71. In 1932, Fairchild transferred one of its designers, Percival Beadle, to Fairchild Aircraft in Canada. There he designed a Canadian version of the 71, the 71C. While the basic design remained identical to the Fairchild 71, the 71C also boasted a metal-lined cabin, which protected the aircraft from freight; improved cowlings and cabin heating; and modifications to the rear cabin doors that facilitated 45 gallon oil-drum loading: with larger doors, the drums could be rolled up a ramp into the cabin – much easier than lifting upright drums though narrower doors. Most significantly, the 71C's maximum load increased 500 lbs to 6,000 lbs thanks to strengthening of fuselage members.[134] These changes all reflected Canadian operating experience. The increased capacity, greater ease of loading, and reinforced cabin would strengthen the plane's performance as a bush plane by enhancing freight carriage. The new cowlings improved engine protection during winter cold while the cabin heaters eased passenger and crew discomfort. These modifications continued Fairchild's history of responding to Canadian needs.

The alterations were well received. After approximately two months of service, C.H. Dickins offered Fairchild the following evaluation of the 71C. The aircraft, he felt, flew nicely and was very stable when fully loaded. With an average cruising speed of approximately 105 miles per hour, the 71C had satisfactory performance on skiis and no vibration was apparent at that speed. According to Dickins, the instrument board was well mounted and the pilot seat was very comfortable. He was particularly impressed by the metal cabin lining: "The metal lining of the cabin is particularly good as we use our aircraft more carrying freight than passengers and the metal will last much longer and looks better than either wood or fabric when it has been in use a short time."[135] Overall, it was a positive assessment.

Although CF-ATZ performed well overall, it did encounter a few difficulties. The first accident seemed to bode ill. While the company purchased ATZ to alleviate their equipment shortage, the Fairchild experienced its own failure only days after purchase. G.A. Thompson was not impressed:

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[134] Bain, *Canadian Pacific Airlines*, 57; Molson, *Pioneering*, 287; Molson and Taylor, *Canadian Aircraft Since 1909*, 311 – 312.

[135] G.A. Thompson to W.C. Sigerson, 14 March 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

> On March 9 when Fairchild "TZ" was being brought out of the hangar at Stevenson Field, prior to Mr. Dickins leaving for McMurray, the undercarriage collapsed allowing the machine to come down on one wing. … It is most fortunate that this happened at Stevenson Field and not several hundred miles out in the bush when the machine was landing or taking off. If it had occurred at this time the chances are that the machine would have been very seriously damaged and possibly personnel hurt. I have seen the fitting which broke, and I cannot conceive with proper inspection at the manufacturer's how a flaw of this nature could get by the examiner. It is difficult enough for the operator to have to contend with the forces of nature and the human frailty of their own personnel, without that of the manufacturer.[136]

Fairchild Aircraft blamed the failure on the heat-treating process designed to increase the metal's tensile strength. H.M. Pasmore noted that "the internal stresses set up due to this sudden cooling [from quenching the heated part in oil] are inclined, according to the shape of certain fittings, to start cracks."[137] However, he also pointed out that "this is the first time to [his] knowledge that this particular fitting has failed." It seems to have been an unfortunate anomaly, as CF-ATZ experienced no further problems with this part.[138]

That said, Dickins did offer several suggestions for future improvements. To begin with, he pointed out that "at present the pilot has no forward visibility with the machine on the ground as the seat is much too low."[139] Good visibility was essential on northern operations as pilots needed to be able to see potential hazards such as heavy

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[136] Ibid.

[137] H.M. Pasmore to G.C. Drury, 17 March 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

[138] C.H. Dickins to H.M. Pasmore, 20 April 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft. Although ATZ did break its undercarriage in the spring of 1934, this was the result of "a terrific downdraft while taking off at Spark Plug Lake." CF-ATZ, Flight Report, 23 April 1934, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ, Jan – Dec 1934.

[139] C.H. Dickins to H.M. Pasmore, 20 April 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

drifts or ice ridges. Because Mackenzie pilots often landed at new locations and landing conditions could change with the weather, a clear, unobstructed view was indispensable. Dickins suggested raising the pilot's seat and making the windshield two sections rather than three. Elevating the pilot would enable him to see over the aircraft's nose and removing one of the windshield supports would eliminate a visual obstacle. He also wanted to see a separate entry into the cockpit and a partition between the cockpit and the main cabin, even as simple as a wire mesh bulkhead just behind the cabin. A separate door meant the pilot would not need to clamber over the cargo to reach his seat or to unload freight, while the bulkhead would protect the crew from freight that shifted during flight.

With regards to freight loading, Dickins commented,

> The present doors are of a good size but one of them should be further back, at the very back of the cabin proper. The present doors are in the centre of the available cabin space and ordinarily all freight is loaded first, which then makes it extremely difficult for passengers to enter or exit and a door at the very back of the cabin space would considerably improve the loading and unloading facilities. It would also make it much easier for loading long pieces.[140]

He also requested that the short bracing tubes projecting through the floor of the cabin just forward of the door be eliminated as they prevented efficient loading of the cabin and were continually being dented or bent, which might in turn pull other tubes out of alignment. Finally, Dickins commented on the one consistent operational difficulty Canadian Airways experienced with the new Fairchild: it was cantankerous in very cold weather – not a positive feature on the Mackenzie. "Under the present arrangement, there is not enough heat getting to the carburettor in temperatures of –30 or lower it is very difficult to get the engine to take up full rpm in order to take off and there is considerable

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[140] Ibid.

danger of having the engine quitting when taking off due to the intake not having sufficient heat."[141] Running the engine for long periods on the ground did not seem to cure the problem so Dickins suggested installing hot air muffs fitted around the exhaust pipes and leading into the existing warm air intake to take advantage of extra heat from the exhaust.[142] While Fairchild did not incorporate the modifications into the 71C design, Dickins received word from the manufacturer that the company would endeavour to eliminate these disadvantages in their new all metal machine – the Super 71, currently in the design process.[143]

As time wore on and the company acquired more operating experience with the 71C, there were two problem areas that emerged: take-off and engines. Only the first seemed connected to the aircraft's design.[144] Almost as soon as CF-ATZ switched to

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[141] Ibid.

[142] Ibid.

[143] C.H. Dickins to G.A. Thompson, 8 May 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.

[144] CF-ATZ also experienced ongoing problems with its engines. Over the course of 2 year's service the aircraft went through 4 engines: a Wasp C, Wasp A, another Wasp C, and what is likely a Wasp A. All of them encountered problems. The first engine, Y-20, began running rough on 1 April 1933 because of lubricants solidifying due to cold temperatures. Less than two weeks later, gas consumption shot up, though this seems to have cleared up after servicing the engine. That summer, "50 miles out of Good Hope [the] engine started to throw oil badly. [The] Engineer[, F. Little,] checked everything possible at Good Hope [where he] found large precipitating [pieces of] white metal." After the following flight, "Engineer checked carefully again: Eclipse starter dog nut found to have sheared and hub badly chewed up, white metal or aluminium together with small pieces of nut found in oil strainer." Needless to say, the engine was changed.

The replacement, 859, performed well until after CF-ATZ was damaged following a failed take-off on 18 November 1933. Although the engine had functioned well for a month, when Z.L. Leigh took over as pilot he experienced engine trouble immediately. Replacing spark plugs on 15 April, he found them in bad shape and discovered two cracked intake manifolds. The following day he noticed that the carburettor hot spot casting had almost completely broken off. As he reported on 19 April, "Have had continual trouble with motor since taking over machine TZ on April 11-34. This motor was in very bad shape and have found broken and cracked parts all over floats, its pilots noticed the plane laboured to get off the water. After practicing operating the 71C on floats, W.E. Gilbert commented, "This aircraft takes long run on step to get off. Seems to ride too far back on step..."[145] After engine difficulties required a change, CF-ATZ's pilot, John Bythell commented that,

> since the new engine [a Wasp A] has been fitted the previous tendency of the aircraft to stick on the step has increased. A/c [sic] will get on step fairly easily with all loads but seems to stick there and no matter what one does will it increase speed past a certain spot. This has been borne out by Messrs May and Gilbert. I would not like to take this a/c [sic] out of a small lake.[146]

This characteristic forced Bythell to alter flight plans in order to accommodate CF-ATZ's performance: "Did not land at Fitzgerald as no wind and Smith is safer for TZ because of passengers and longish run necessary."[147] CF-ATZ's sluggish take-off could have seriously restricted its practicality. However, the problem was easily addressed. Just one week after Bythell's decision to avoid Fort Fitzgerald, CF-ATZ had its propeller changed

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it. Had to spend 2 days getting it into condition but consider it to be airworthy now." Leigh was right in his assessment. 859 experienced no further problems that summer.

On 10 June 1934, a Wasp C replaced 859. It immediately began showing difficulties, using extravagant amounts of gas. However, this was corrected by adjusting the propeller settings for the C-type engine. After this, it performed well. The final engine installed in 1934, 944, experienced no immediate difficulties.
CF-ATZ, Flight Report, 1 April, 11 April, 16 April 1933, CAL Collection, AOM, MG 11 A 34, Box106: CF-ATZ, March – Oct 1933; CF-ATZ, Flight Reports, 11 April 15 April, 16 April, 19 April 1934, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, Jan – Dec 1934; CF-ATZ, Flight Reports, 11 June, 14 June 1933, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, March – Oct 1933.

[145] The step refers to the angled portion at the rear of the float. A plane is said to be 'on the step' when the front of the floats are lifted out of the water and the plane's nose tilted up. CF-ATZ, Flight Report, 13 May 1933, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, March – Oct 1933.

[146] Despite the awkward phrasing, Bythell meant that the plane would not increase its speed past a certain point while on the step. CF-ATZ, Flight Report, 1 July 1933, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, March – Oct 1933.

[147] CF-ATZ, Flight Report, 12 July 1933, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, March – Oct 1933.

and, as with the Junkers, this seems to have eliminated the problem – at least for the remainder of 1933.[148]

When Canadian Airways complained of the problem to Fairchild Aircraft, the normally cooperative company blamed the poor performance on engine power, not Fairchild's floats or the aircraft's design.[149] However, it seems to have been inherent in the float or float undercarriage design as the problem reappeared in 1934. On 7 July 1934, CF-ATZ "was unable to get off on Contact Lake with maximum load," and again on 10 July CF-ATZ was "unable to get larger load out of Spark Plug Lake due to smallness of lake and wind being east right across the cliffs and also due to poor take off performance of TZ".[150]

The machine's poor performance on floats was exacerbated by the 71C's poor payload. Although the government had increased the plane's gross licensed load by a full 500 lbs, its actual payload was less than machines manufactured several years previously.[151] On floats, CF-ATZ had a disposable load of 2356 pounds. With an average float operating load of 1330 lbs (including gas, oil, crew and equipment), the

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[148] CF-ATZ, Flight Report, 19 July 1933, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, March – Oct 1933.
[149] G.A. Thompson to H.M. Pasmore, 8 August 1933; H.M. Pasmore, 8 September 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.
[150] CF-ATZ, Flight Reports, 7 July, 10 July 1934, CAL Collection, AOM, MG 11 A 34, Box 106: CF-ATZ Flight Reports, Jan – Dec 1934.
[151] G.A. Thompson to C.H. Dickins, 19 July 1933, CAL Collection, AOM, MG 11 A 34, Box 22: Overloading, 1 Feb 1933 – 5 Jul 1938; G.A. Thompson to H.M. Pasmore, 8 August 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

payload for CF-ATZ was 1026 lbs, not much more than the Fairchild 71's or the Bellanca's maximum.[152]

Company complaints on this score irritated Pasmore. In response he snapped,

> With reference to the present weight of the "71-c" as compared with the FC2W2. We would very much prefer to build an "FC2W2" for you if that is the type of aeroplane you want. You are perfectly correct when you state that the payload is almost as much. The difference in weight is actually what we have put into the aeroplane in order to make it a better machine. By better we mean more durable, stronger, and in appearance more in keeping with the general line of production now prevailing in the United States and other countries. For example, we could very easily save weight by giving you exhaust manifolds as originally manufactured, about one-half the present gauge (which would be cheaper for us); we could cut out the plate glass windows and substitute celluloid windows as a number of British and American manufacturers do; we could supply cowling sheet the same gauge as other manufacturers do, viz. .025" instead of .035"; we could supply cheap cowling hinges instead of made up steel hinges which we believe will last considerably longer; we could do away with the dural lining for the interior of the cabin; we could do away with the fairing strips which keep the fabric away from the longerons and which are so essential for seaplane work to avoid dampness attacking the members. We could also put a cheaper finish in the cabin by cutting out the bakelite roofing if you would prefer it. We could cut down considerable weight by giving the original number of doping coats, viz. five instead of nine as at present. We could go back to the old system of 3/8" gasoline lines instead of 1/2" which we believe to be superior, and a host of other minor details which have tended to increase the weight of the aircraft slightly and make it considerably more expensive for us to manufacture. All this has been done in an effort to give you a better aeroplane. You can be sure that we would not wish to spend money in time and materials if we did not think it necessary and were doing something which in our opinion gave the operator a better machine.[153]

It seems that quality came at a price.

What motivated Fairchild, an American company, to integrate these changes and produce a specifically Canadian design? The company did have a history of responding

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[152] G.A. Thompson to C.H. Dickins, 8 June 1933, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence. See Appendix I.

[153] H.M. Pasmore to G.A. Thompson, 8 September 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

to Canadian conditions. After all, Canadian pilots' experience heavily informed Fairchild's first designs.[154] It also seems to have made a difference that Fairchild Aircraft was a Canadian-based subsidiary of the main company, dependent on the Canadian market. This made it more sensitive to Canadian interests. The company's interest in pilots' experience with the plane and its willingness to incorporate their suggestions in future designs reflects their need to meet that market's expectations. With other, non-Canadian manufacturers like Fokker, Bellanca, and Junkers, one sees neither the development of Canadian adaptations (rearranging the seats in a Junkers W34 hardly seems to count) nor the creation of designs specifically for Canadian bush operations. The foreign-based companies were not reliant on or as responsive to Canadian conditions, likely because they had other, larger markets to which they needed to respond.

Fairchild had one contemporary as a major Canadian aircraft manufacturer: Canadian Vickers.[155] However, unlike Fairchild, Canadian Vickers displayed little sensitivity to the Canadian market and suffered as a result. It too had a history of indigenous design, beginning with the Vedette, a modified version of the Vickers Viking. Unfortunately for Canadian Vickers, its parent company, the British manufacturer Vickers, did not have a good sense of the Canadian market and painted the company into a corner through their decision to focus only on flying boats. This meant that Canadian

[154] As J.A. Wilson wrote to Charles G. Grey, "The Fairchild Company built their models largely on Canadian experience and gave us what we wanted." 18 January 1933, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 6, Special Correspondence, 1920-1942.
[155] See Fortier, "Intervention gouvernementale" and Fortier, "L'instrument privilégié d'Ottawa".

Vickers did not keep up with Canadian users' needs and only Fairchild was left to focus on Canadian demands.

This seems to have been an ongoing problem with British manufacturers: although Canada was a British dominion and Canadian operators wanted to purchase aircraft from British manufacturers, and were encouraged to do so by stiff tariffs on German and American aircraft, British aircraft firms mainly produced aircraft suitable for European intercity services or for long-distance imperial routes.[156] These multi-engined passenger machines were ill-suited to northern operations because, as W.E. Gilbert pointed out, "twin engines are more maintenance and unless you have good single engine performance, you just have twice as much chance of coming down as you do with one."[157] American and German designs were much better adapted because their manufacturers were producing mid-sized aircraft that could function as both transport and passenger aircraft and could be converted to floats without substantial loss of performance. Fairchild, in particular, had an ongoing history of responding to Canadian operating conditions. This meant they could produce a plane like the 71C, the first of the bush planes modified specifically for the Canadian North.[158]

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[156] Between 1927 and 1934, the tariff rate on British and other Imperial aircraft was 10%. Over the same period, the rate on American and German aircraft was 27.5%. G.A. Thompson, "Aircraft Imported Into Canada," 1939, CAL Collection, AOM, MG 11 A 34, Box 65: "Northern Air Transport". According to Rénald Fortier, most Canadian aircraft manufacturing firms were branches of British or American aircraft firms, in part as a way of avoiding these tariff barriers. Fortier, "Intervention gouvernementale," 643.

[157] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.

[158] While very successful in the Canadian North, the 71C was not marketed outside the country. Of the 12 71Cs Fairchild Aircraft built, all were sold in Canada. Molson and Taylor, *Canadian Aircraft Since 1909*, 497.

OBSOLESCENCE AND THE FOKKER SUPER UNIVERSAL

In an effort to adapt to changes in the Mackenzie District, Canadian Airways had added Fairchilds and Junkers to the regional fleet. At the same time, it re-evaluated the condition of the aircraft already operating in the area. Though the Fokker Super Universals had experienced a series of serious undercarriage failures, by the winter of 1933 this difficulty appeared to be eliminated. However, even as they solved the problem, the airline began withdrawing the aircraft from the Mackenzie. This decision was not the product of problems internal to the aircraft. Rather, the aircraft's context had changed in such a way that a technology the airline previously considered state of the art was now obsolete.

With the rise of Great Bear Lake and the attendant traffic, aircraft payload became a preoccupation, especially when Canadian Airways faced competition from an airline ready to overload its aircraft. Unfortunately, the Super Universal's once generous payload paled in comparison to the other aircraft available. Moreover, the Super's operating costs became a serious concern as the company strove to squeeze as much profit as possible from the route. Passengers' perceptions also changed and the Fokkers now seemed uncomfortable when judged alongside other aircraft. Compared to other aircraft the Super came up short. Its speed, payload, reliability, and comfort could not withstand the assessment. Considered within this framework, the Fokker Super Universal lost its lustre as Canadian Airways sought to modernize its northern fleet.

The company first became dissatisfied with the Super Universal during the Great Bear Lake rush. With the boom around Great Bear Lake, the northern travel routes were becoming busier and busier.[159] At the same time, Canadian Airways was trying to compete with Mackenzie Air Service. As we have seen, doing so pushed Canadian Airways' fleet to its limits. As early as February 1932 the company was using its machines to their fullest capacity and, without more pilots and machines, worried it would have to turn business away.[160] Heading into freeze-up in the fall of 1932, G.A. Thompson worried that the company's western fleet was tightly stretched.[161] A year later Thompson would express the same concerns.[162] In fact, early in 1933 Canadian Airways faced the prospect of having to subcontract some of its business to Brintnell, just so the jobs would be completed.[163] Canadian Airways faced this crisis in part because the Super Universals could not keep up with the new route's demands.

Seen in this context, the Super Universals appeared to be liabilities. According to C.H. Dickins, their payloads now appeared inferior to other aircraft. Canadian Airways' rate structure was based on an average gross load of 1200 pounds.[164] However, achieving a load of 1200 pounds in the Supers along the Mackenzie River required carrying a smaller load of gas and refuelling at each point of call. Because of the distance between Fort Rae and Great Bear Lake, this was not an option. With the load of gas necessary for

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[159] J.A. Wilson to Charles G. Grey, 6 April 1932, J.A. Wilson Papers, NAC, MG 30 E 243, vol. 6, Specific Correspondence, 1920-1942.
[160] G.A. Thompson to C.M. Forrest and J.A. Macdougall, 12 February 1932, CAL Collection, AOM, MG 11 A 34, Box 4: Correspondence, Jan 1932 – Sept 1932.
[161] G.A. Thompson to W.C. Sigerson, 15 October 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[162] G.A. Thompson to C.H. Dickins, 18 February 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.
[163] G.A. Thompson to W.C. Sigerson, 13 February 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.
[164] G.A. Thompson to W.C. Sigerson, 11 January 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.

the trip, the Supers could carry only 800 lbs.[165] This meant Canadian Airways achieved a smaller profit on loads carried in the Supers as the operating cost per pound of freight was higher.

The situation was even worse in the summer. On the four Supers operating along the Mackenzie, when equipped with floats, their payloads ranged between a minimum of 560 pounds for G-CASK and a maximum of 725 pounds for CF-AFL. Even by eliminating a ride-along flight engineer, the payload could only be increased by a maximum of 195 pounds, a paltry total when placed alongside the carrying capacity of the company's Bellancas.[166] Planning for the summer of 1933 Dickins compared the available aircraft, noting,

> the Bellanca aircraft, particularly of the later series, have a greater disposable load as seaplanes than the Fokker Supers and have a payload therefore greater at a considerably reduced operating cost. Assuming the same conditions as for the Fokkers, I find the average summer operating load of the Bellanca aircraft to be 1045 pounds, which leaves a payload of 937 pounds for either KI or ML. ... The operating cost of the Bellanca is also lower than the Fokker Supers.[167]

The Fokkers, he believed, could be used more efficiently in districts where short trips were the norm and a pilot was the only crew. However, they could not carry an efficient load on floats in a district like the Mackenzie where the average trip was at least 150 miles, requiring nearly full tanks of gas.[168] As a result, Dickins wanted to replace the Fokkers with Bellancas, especially CF-AKI and CF-AML, because of their higher

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[165] C.H. Dickins to G.A. Thompson, 9 January 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.
[166] C.H. Dickins to G.A. Thompson, 13 January 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33. See also Appendix I.
[167] Ibid.
[168] Ibid.

payloads and large gas tanks, which made them capable of handling northern distances. He also sought two Fairchild FC-2W-2s for summer operations, citing their good performance on floats and summer payload of 1200 pounds.[169]

The Super Universal received another blow when it became more economical to operate faster machines than to operate the old stand-by. Bellancas, of much the same age as the Fokkers, had a higher top speed, could handle a larger operating load, and had a lower operating cost.[170] Moreover, these faster planes could provide cost savings because they would allow the company to make more trips over the same period of operation, thus bringing in greater revenue.[171] It seemed that the Super Universals had been eclipsed by other aircraft designs. As a result, Dickins wanted to trade in his Fokkers for Bellancas, Junkers, and Fairchilds, a policy that G.A. Thompson endorsed, advocating that the company "should replace these Fokker Super Universals on the Mackenzie River as early as possible".[172]

At the end of 1933, Dickins wrote that because of the strained fleet, "we have already lost considerable business through inability to handle it, and it had been a very nice Christmas present for our opposition."[173] He worried that if the company did not update and expand its fleet, they would miss new business and give their competitors an opportunity to become well established. Thompson shared his concerns and suggested

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[169] Ibid.
[170] Ibid. See Appendix I.
[171] G.A. Thompson to W.C. Sigerson, 17 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[172] C.H. Dickins to G.A. Thompson, 9 January 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933; C.H. Dickins to G.A. Thompson, 13 January 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.
[173] C.H. Dickins to G.A. Thompson, 28 December 1933, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.

that "the officials reconsider their policy of purchasing new aircraft for northern transportation [i.e. their policy not to purchase new equipment]."[174] Thompson followed up with Sigerson two weeks later, pointing out that,

> out of a complement of nineteen machines which can be used on northern transportation, at the time of writing, eight are out of commission ... One of Canadian Airways' strongest selling points has always been that we had sufficient equipment in reserve to take care of emergencies, but unfortunately this is no longer true, and will not be even when the above machines are again serviceable.
> There are two solutions to this situation, one being the purchase of new equipment which is not feasible at the present time, and the other being subletting of traffic to independent operators.[175]

Even if the entire fleet had been serviceable, Canadian Airways would still have had to compete with Mackenzie Air Service's overloaded machines. If the company wanted to stay within the boundaries of air regulations, this meant planes with larger carrying capacities. This capability was also important in light of the increased amount of northern freight bound for Great Bear Lake

One might have responded by increasing the Mackenzie District's fleet size. However, the whole of Canadian Airways' Western Lines were experiencing an equipment shortage during this period and Canadian Airways laboured under financial constraints that limited their ability to purchase new aircraft.[176] Moreover, Mackenzie Air

[174] G.A. Thompson to Wilfred C. Sigerson, 2 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[175] G.A. Thompson to Wilfred C. Sigerson, 16 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[176] G.A. Thompson to W.C. Sigerson, 15 October 1932, CAL Collection, AOM, MG 11 A34, Box 5: Correspondence Oct 1932 – Aug 1933; G.A. Thompson to W.C. Sigerson, 13 February 1933, W.C. Sigerson and G.C. Drury to G.A. Thompson and C.M. Forrest, 15 February 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft: Individual Fairchild Aircraft; W.C. Sigerson to G.W. Hutchins, 23 February 1933, CAL Collection, AOM, MG 11 A 34, Box 64: Statistics: CAL Statistics 1931-1933, 1934 (Accounting and Statistical Data, All Lines); G.A. Thompson to C.H. Dickins, 21

Service had the same aircraft on their fleet, Fokker Super Universals, which may have limited the pressure on Canadian Airways to purchase new aircraft. Of the eight aircraft Canadian Airways purchased in 1932, only four were utility aircraft and of those four, only CF-ASI and CF-ATF, the two Junkers, were new. The other two, G-CATL and CF-AAN, both FC-2W-2s, were second hand. More significantly, of the eight aircraft, the company purchased all but CF-ATF before the cancellation of the intercity airmail service. The following year, Canadian Airways was able to purchase 10 aircraft, of which a full 6 were utility aircraft suitable for bush operations: 1 each FC-2W-2, 71, 71C, 71CM, and two Junker W34s. Of these, the 71C, and the two Junkers, were new. While these might seem like extravagant purchases for a company struggling financially, the numbers did not replace the 22 aircraft lost or retired in 1932 and 1933.[177] Instead, the best the company could do was to use the machinery they already had as efficiently as possible.[178]

Four types of utility aircraft were available: Fokker Super Universals, Bellancas, Fairchilds, and Junkers.[179] Based solely on performance, the Fokker Super Universal came up short. Not only was it slower than the other available aircraft, its payload was lower and it had a history of mechanical failures that worked against it.

There were other fronts of comparison, however. The Super Universals were bare-boned freighting machines and, while plush compared to overland travel, to a public

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February 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Services Ltd, 1932 – 1940.

177 Molson, *Pioneering*, Appendix IX.

178 G.A. Thompson to C.H. Dickins, 18 February 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33; W.C. Sigerson to G.A. Thompson, 2 January 1934, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

179 See Appendix I.

becoming more familiar with air transport, they began to seem rather Spartan. Comparing Super Universals to Fairchilds, W.E. Gilbert, Canadian Airways pilot on the Mackenzie River, pointed out that the Supers were uncomfortably cold whereas "the Fairchild by reason of its better cabin construction is very much more comfortable." He pointed out that,

> regardless of the fact that climatic conditions are largely similar throughout the North, our operations here require entirely different methods from those farther East or West. And here are the reasons.
>
> Passengers dressed for ordinary Winter travel are not likely to experience much discomfort even in under-heated machines in flights of less than an hour's duration ... The average flight in this District over a year's time is in excess of 50 minutes duration, while the usual "legs" in our "through" traffic to Great Bear Lake are all in excess of 2 1/2 hours (McMurray to Fitzgerald: Fitzgerald to Rae: Rae to Cameron Bay). Conditions of cold or cramped sitting which may be endured for an hour are much aggravated when met for 8 hours in one day, in stages of 2 1/2 hours each.
>
> ...I do not think that the Company has ever given enough thought to the psychological effect of petty discomforts on the passenger's general attitude toward the Company, especially when the passenger happens to be an important customer for freighting.[180]

The heretofore luxurious experience of flying rather than sledding north was beginning to pale. Air travellers across Canada were becoming more accustomed to the sorts of services offered on southern runs. G.A. Thompson noted that the company was receiving more and more complaints about the discomforts of bush aircraft in comparison to the service and comforts available on trunk lines, especially in the United States.[181]

Closer to home, in fact right across the McMurray snye, the company faced Mackenzie Air Service's competition, which also affected passenger expectations. This

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[180] W.E. Gilbert to G.A. Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.
[181] G.A. Thompson to W.C. Sigerson and C.H. Dickins, 7 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.

airline introduced an updated Super that had been fitted with the latest modern conveniences, though the basic design remained the same. According to Gilbert, Mackenzie Air Service's newest Super, which was taking off for a profile raising flight as he wrote, catered to passenger comfort in a way that neither Commercial nor Canadian Airways had done. According to Gilbert, Brintnell's new Super was a

> newly-refined job, with an exceptionally good heating system, a toilet, and a lot of other 'frills', which, while they don't mean much in fact, are going to be the means of causing the passengers that ride with him to find ground for a great deal of comparisons unfavourable to our equipment. As Mr. Brintnell will have little or no traffic to handle, (at the start, at least) he can temporarily provide clear, warm, comfortable cabins.[182]

Only a few months later, Dickins remarked that,

> There has been a considerable amount of very sarcastic criticism passed around concerning our aircraft and personnel and a considerable amount of enlargement upon the wonderful capabilities of the aircraft at present used by MacKenzie [sic] Airways. It is generally broadcasted that these, of course, are new aircraft and are capable of carrying 1600 pounds cabin load on skiis and it has been openly boasted that they have carried 2200 pounds cabin load. We hear on authentic information that these are two of the oldest Fokker Super Universals in existence, being considerably older than all our Fokker Super Universals. The Wasp engines in them are also the oldest type engines, which is proven by the fact that they have the old style pistons and the master rod installed in No. 1 cylinder. I am positive that they are not licensed to carry as large loads as our Super Universals and the fact that they have been carrying larger loads is due entirely to gross overloading, which considerably impairs the safety of the flying operations.[183]

In comparison, Canadian Airways had to find a way of counter-acting the perception of its Supers as outdated and weak. Dickins suggested replacing two Supers with two Junkers as a means of rebutting Mackenzie Air Service' claims about Canadian

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[182] W.E. Gilbert to G.A. Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933.
[183] C.H. Dickins to G.A. Thompson, 13 April 1933, CAL Collection, AOM, MG 11 A 34, Box 14: Airmail: Great Bear – Resolution, 16 July 1932 – 7 June 1934.

Airways' freighting ability.[184] By placing the Junkers, with their greater payload and more powerful engines, alongside Brintnell's Fokkers, Canadian Airways hoped to demonstrate the inadequacies of Mackenzie Air Service's machines. The airline also retaliated by instituting a special passenger service between McMurray and Great Bear Lake using Bellanca and Fairchild aircraft, with freight confined to other machines as far as possible. The company wanted this to be "a de luxe service and every comfort possible will be provided for passengers in an endeavour to give them a speedy and comfortable service."[185] Notably, Canadian Airways did not use the W34s to provide this deluxe service as they lacked the necessary passenger comforts.[186] It was the same set of opinions that guided the company to steer female passengers to the Fairchilds, because they were more comfortable.[187]

Speed was another component of efficiency and comfort. Thompson felt it was important to consider the aircraft's speed both as a means of shortening passenger flights, thereby minimizing discomfort, and as a means of improving efficiency. He argued,

> I am not merely interested in higher speed for scheduled bush runs solely on account of the additional sales factor provided but from the actual cost standpoint. Competition and general business conditions have forced our rates to a level which at our present cost of operations it is impossible to keep going indefinitely. One of the factors which would greatly reduce our cost is speed, providing the cost of equipment is not too expensive.[188]

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[184] Ibid.
[185] G.A. Thompson to W.A. Scott and W.C. Sigerson, 18 February 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[186] G.A. Thompson to W.C. Sigerson, 17 October 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[187] W.E. Gilbert to G.A. Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[188] G.A. Thompson to W.C. Sigerson, 17 March 1933, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.

That is, it was actually less expensive to operate at higher speeds. While the Fokkers' speed compared favourably with the 71 and W 34, the Fairchild and Junkers aircraft could achieve these speeds with much larger loads, resulting in more efficient performances. In both payload and speed, the smaller Bellanca easily out performed the Fokker Super Universal.[189] Given the situation, the Super Universals seemed less than ideal.

The airline also began to feel pressure to modernize its fleet, as the age of the machines became a sore point. Gilbert pointed out that, while the machines appeared to be holding up well, the constant pounding they received on northern operations would only cause more and more deterioration as the aircraft's metal aged.[190] Not only were the structures aging, the machines looked old compared to the more luxurious Bellancas and Fairchilds. For the flying public along the Mackenzie, newness itself had become a virtue.[191]

This attitude carries minor echoes of the messianic culture of aviation that Joseph Corn describes. As he points out, the airmindedness that characterised the American culture of aviation during the first half of the twentieth century drew heavily on cultural associations between technology and social progress. These beliefs reflected the conviction that technological developments would lead inexorably to progress and often contained the interference that new technologies were therefore good. Eric Schatzberg

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[189] See Appendix I.
[190] W.E. Gilbert to G.A Thompson, 29 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence, Oct 1932 – Aug 1933.
[191] C.H. Dickins to G.A. Thompson, 13 April 1933, CAL Collection, AOM, MG 11 A 34, Box 14, Airmail: Great Bear-Resolution, 16 July 1932 – 7 July 1934; C.H. Dickins to G.A. Thompson, 19 April 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.

makes a similar observation, arguing that the aviation community of the period was deeply immersed in the ideology of technical progress, committed to the idea that the inevitable progress of technology would lead directly to human betterment. This ideology also implies that any change is developmental and therefore good. Both Corn and Schatzberg argue there is a link between these ideologies and the Enlightenment idea of progress that links modernity with progress, placing the new in opposition to tradition and linking the new to an unquestioning faith in the inevitable improvement of the human condition. In the nineteenth century, technology was introduced into the equation as technological developments became sources of change and progress.[192]

The attitudes Canadian Airways observed in the Canadian North may also have been tangentially related to this culture of technological progress. The public's desire for new aircraft along the Mackenzie and its willingness to see new or new-looking aircraft as better aircraft had echoes of this cultural commitment to the link between technological newness and progress.[193] The belief would have serious consequences for the Super Universal. In light of both its appearance and its comparative performance, the formerly cutting edge aircraft was now considered obsolete.[194]

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[192] Joseph J. Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950* (Oxford: Oxford University Press, 1983); Eric Schatzberg, *Wings of Wood, Wings of Metal: Cultural and Technical Choice in American Airplane Materials, 1914-1945* (Princeton: Princeton University Press, 1999).

[193] Schatzberg also argues that it was the 1931 crash of a wooden winged Fokker trimotor that spelled the end of wooden passenger aircraft in the American passenger airline industry. Although this event likely influenced American airlines' fleet choices, there is no evidence that it had any direct bearing on Canadian Airways' fleet composition. That said, it may have contributed to the flying public's perception of the Fokker Super Universal as outmoded and unmodern. Schatzberg, *Wings of Wood, Wings of Metal.*

[194] W.E. Sigerson to C.H. Dickins, 2 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence: Sept 1933 – May 1934.

The Fokker Super Universal's story illustrates the nature of obsolescence, demonstrating that it is a complex condition not necessarily reflective of an aircraft's internal workings. Unlike the collapsing undercarriage, the Super's obsolescence was not a function of the machine's ability to operate in its environment. Rather, it was a comparative phenomenon, reflecting its relationship to other machines in the same field. As other aircraft such as the Pacemaker, 71C, or W 34 became available, the Fokker's performance no longer seemed as spectacular. The second dimension of the Supers' obsolescence involved perceptions of the technology, particularly its perceived modernity. In the case of the Fokker, changing conditions affected users' valuation of the aircraft. The development of Great Bear Lake increased the distances traversed, magnifying passenger discomfort and highlighting the plane's comparatively diminished payload capacity. Moreover, as aircraft services in the south changed, passenger perceptions and expectations responded, and the Fokker became *passé*. Newness became a value and the company would be hard pressed not to consider this. As conditions and perceptions changed and new aircraft became available, the Super's status altered. Thus, just as the company addressed the design's technical limitations, it became obsolete.

CONCLUSION

Given the aircraft's inability to meet Canadian Airways' needs, the company phased out the Supers over the course of 1933, and by the year's end, the fleet appeared to have stabilized.[195] Two W34s were permanently stationed on the Mackenzie, CF-AMZ

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[195] The company still needed more machines to handle the business. In fact, at the end of 1933, the new Northrop Delta caught Dickins' eye. W.C. Sigerson to G.A. Thompson, 27 November 1933, and C.H. Dickins to G.A. Thompson, 28 December 1933, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence Sept 1933 – May 1934.

and CF-ARI, along with two Bellancas, CF-AKI and CF-AIA, and one Fokker Super Universal, CF-AFL. Fairchilds were transferred in and out to cover busy periods. This fleet make-up remained constant into the mid-1930s, reflecting the new set of northern conditions.

Over the short period between 1932 and 1934, conditions created by the Great Depression, Great Bear Lake rush, and the appearance of Mackenzie Air Service forced Canadian Airways to redefine its ideas about what aircraft were best suited to the Mackenzie District. In light of new definitions of what made a technology desirable, Canadian Airways made important changes in its fleet, relying more intensely on the Bellanca Pacemakers, introducing Fairchild and Junkers aircraft to the region, and displacing the Fokker Super Universals. The Fairchild's appearance was particularly significant, as the company produced, first, the 71C and would shortly develop the Super 71 specifically for use in the Canadian North. As aircraft plied the Mackenzie, they created new operating conditions that encouraged the airline to adapt its fleet composition in response. This process of adaptation reflects the dialogue between technology and context that helped refine users' ideas about what made a good bush plane. In the mid-1930s Canadian aircraft manufacturers would translate these ideas into the first indigenous Canadian bush planes.

Unfortunately, financial conditions still hamstrung the company, preventing management from purchasing all of the new planes it would have liked. W.C. Sigerson to G.A. Thompson, 2 January 1934, CAL Collection, AOM, Box 36: Junkers Aircraft, Correspondence; W.C. Sigerson to C.H. Dickins, 3 January 1934; G.A. Thompson to W.C. Sigerson, 16 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence Sept 1933 – May 1934.

6 - Indigenous Design and the Birth of the Canadian Bush Plane, 1934-1937

Although bush flying had been an identifiable Canadian practice since the mid-1920s, before 1934 no one had designed an aircraft specifically for use in the Canadian North as a multi-purpose transport. Instead, Canadian operators had relied on foreign-conceived aircraft modified to suit operations in the Canadian North. In the middle of the 1930s, however, this would change with the appearance of indigenous Canadian bush planes. These aircraft were the products of a process of selection, adaptation, and modification that took place over the late 1920s and early 1930s, culminating in the appearance of the Fairchild Super 71, 1934, and the Noorduyn Norseman, 1935.[1]

In their creation, designers and manufacturers translated northern conditions, as filtered by northern users, into aircraft designed specifically for bush flying. These aircraft were products of their ambient conditions in three senses. First, a combination of economic conditions, changes in domestic and international aircraft manufacturing, maturing user needs, and the accumulation of experience with Canadian bush flying, triggered the creation of indigenous designs. Second, the designs themselves reflected northern flying conditions, translating users' experience with the northern context into the

[1] The story of the Canadian bush plane mirrors the established pattern of technology transfer, moving through the process of adoption and modification, to the eventual production of indigenous designs. See: David J. Jeremy, *Transatlantic Industrial Revolution: The Diffusion of Textile Technologies Between Britain and America, 1790-1830s* (Cambridge, Mass: The MIT Press, 1981); Nathan Rosenberg, *Inside the black box: Technology and economics* (Cambridge: Cambridge University Press, 1982); John M. Staudenmaier, S.J. *Technology's Storytellers: Reweaving the Human Fabric*, (Cambridge, Mass: The MIT Press, 1985).

machines' designs. Finally, the designs' ultimate success or failure depended, not only on their technical arrangements, but also on the fit between the aircraft and its context. Focusing on the conditions surrounding the emergence of the Super 71 and the Norseman provides insight into how Canadians moved from the modification and adaptation of foreign-designed aircraft to the creation of indigenous bush planes conceived specifically for operation in Canada, planes that embodied their northern context.

DEFINING THE BUSH PLANE

To argue that the Super 71 and the Norseman represented an important development in Canadian aircraft manufacturing, one must understand how these aircraft differed from their predecessors and why they qualified as indigenous bush planes while other aircraft did not. Initially, the bush plane was defined by patterns of use, specifically location of operation and types of tasks, and in many ways, this is still true. Any aircraft used to fly into the Canadian bush, landing on natural landing strips provided by lakes and rivers, could be called a bush plane, seeing as it was engaged in the practice of bush flying. Often, these planes were involved in supporting resource development, though this was not a pre-condition for their being called a bush plane. In addition to supporting prospectors and resource developers, bush planes might transport local residents, medical cases, and mail, so long as they flew into the Canadian bush and did not use a permanent land runway. However, something set the new designs apart.

Initial appearance was not the feature that distinguished the bush plane from other types of aircraft. At the time it emerged, there were a number of aircraft that fell into the category of high-wing cabin monoplanes. Nor was pattern of use a sufficient characteristic to define the type. Many aircraft that have been used in bush flying are not essentially bush aircraft. The sleek Lockheed Vega used by Commercial Airways was one such example. Even the famous Fokker aircraft were not originally intended as bush planes. For it is this feature that marks the bush plane as an independent type: it has been created as a bush plane. While aircraft appropriated for use in the North, like the Super Universal, Fairchild FC-2, or Junkers W 33/34, have been given the name bush plane in virtue of their activities, they do not constitute a distinct type of aircraft. Moreover, modifications of existing designs to make them more suitable for bush operations may be special bush variations of underlying models, but they too do not constitute a distinct type. Rather, it is the intentionality behind the design and the features it includes in light of this defined purpose that makes the indigenous bush plane a distinct type of aircraft.

The indigenous bush planes shared a number of features and incorporated the experience of aircraft operation in the North precisely because they were created to perform a particular set of tasks in the Canadian bush. To begin with, the bush plane was generally a high-wing cabin monoplane. In addition to easing freight loading, the high wing reflected operating experience by providing clear views for both pilot and passengers. For the pilot this was important when navigating over unfamiliar territory and in landing the aircraft. This was also important for the passengers, according to Canadian Airways' records, because it enabled them to enjoy long flights and because mineral developers, a particular sub-set of passengers, wanted to see the territory over which they were flying.[2] The closed cabin was also a northern essential, especially because bush aircraft needed to be able to operate through the winter. The aircraft body enclosing the cabin was usually a robust shape in order to allow the plane to carry

[2] G.A. Thompson to H.M. Pasmore, 11 October 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

substantial freight loads of often bulky materials. Finally, it was essential that the aircraft could easily be converted from skis to floats and, sometimes, to wheels.

The focus on performance points to another set of characteristics shared by the bush planes. The bush plane needed to be able to lift substantial loads, and, at the same time, to take off and land within relatively short spaces. In the post-war era, this would translate into Short Take Off and Landing (STOL) aircraft like the de Havilland Beaver, but in the mid-1930s it meant that good lift along with lower landing and take off speeds were important features. Once in the air, the aircraft had to be able to travel efficiently over long distances. Accordingly, the power of engines and their rates of fuel consumption were important considerations because they helped determine the aircraft's performance.

The environment in which the planes would operate and the tasks they would be required to perform dictated the presence of these features. They were incorporated into the aircraft design precisely because the designers sought to create aircraft for this environment and these tasks. The designers' willingness to respond to northern conditions and the needs of bush operators was the result of a combination of contextual conditions, including the economy's state, developments in aircraft manufacturing, the maturation of users' needs, and the accumulation of knowledge regarding northern flying conditions.

Ambient Conditions

At first glance, Canadian conditions in the early 1930s do not seem favourable for the emergence of a new type of aircraft. After all, 1932 was the nadir of the Great Depression. Nevertheless, a series of developments between 1932 and 1935 set the stage for the bush plane's entrance. To begin with, the economy began to slowly recover, giving the airlines the ability to purchase new aircraft. At the same time, bush flying's maturation and the solidification of the northern aerial transport system established a permanent market for the bush plane and encouraged operators to refine the set of characteristics they sought in a bush plane. Moreover, important developments in mainstream aircraft manufacturing, particularly the dramatic arrival of the modern passenger airliner, meant that just as the Canadian bush market acquired some permanence, foreign manufacturers that had previously supplied mid-sized utility planes shifted their focus to other types of aircraft. Luckily, the Canadian aircraft manufacturers that had appeared in the late 1920s were available to fill the gap. While these companies had previously concentrated on adapting foreign models for Canadian operations, the loss of their mail plane and light aircraft markets during the Depression encouraged domestic manufacturers to focus on the niche that seemed to have potential: the bush plane market. These companies were able to respond to that market's demands because of the knowledge about northern operating conditions and the characteristics required of Canadian-specific modifications that both designers and operators had acquired through the 1920s and early 1930s. The combination of these events created a set of circumstances that encouraged Canadian manufacturers to design aircraft specifically for Canadian bush flying, thereby producing the indigenous bush plane as a distinct type of aircraft.

The Economy

However bleak things seemed, after 1932 the Canadian economy began to slowly recover, supported in part by the rising price of gold. Despite the good news, the recovery was relative and even by the end of the 1930s, Canadians remained poorer than they had been in 1929.[3] However, in January 1935, the American President raised the price of gold to $35. Especially in the Canadian North, this precipitated increasing investment in prospecting and mining.[4] The influx of capital meant more money for exploration and development. It also meant there was a sharp increase in the amount of airfreight moving into the Shield, reflecting the fact that there was money available to hire aircraft. This was good news for airlines in the Mackenzie District, especially Mackenzie Air Service, which had an exclusive arrangement with Eldorado, the LaBines' radium mine, to carry the bulk of their freight, including radium ore. Although Canadian Airways did not have the Eldorado contract, it too was doing well. In fact, 1934 was the best year Canadian Airways had had since 1930. Along the Mackenzie, expanded exploration paid off in discoveries of gold at Yellowknife and Outpost Island on Great Slave Lake. With more money coming in, higher levels of traffic, and aging aircraft, better economic conditions meant Canadian airlines, including Canadian Airways and Mackenzie Air Service, could begin buying more aircraft. These new additions would include the first bush planes.

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[3] Robert Bothwell and J.L. Granatstein, *Our Century: The Canadian Journey*, (Toronto: McArthur & Company, 2000), 91.

[4] C.H. Dickins to G.A. Thompson, "Operations – Bear Lake," 19 April 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence, 9 February 1928 – 17 November 1938; G.A. Thompson, "Northern Air Transport," Parliamentary Brief, 1939, CAL Collection, AOM, MG 11 A 34, Box 65: Brief Entitled "Northern Air Transport"; John Herd Thompson with Alan Seager, *Canada 1922-1939: Decades of Discord* (Toronto: McClelland & Stewart, 1985); Morris Zaslow, *The Northward Expansion of Canada, 1914-1967* (Toronto: McClelland & Stewart, 1988).

Bush Flying Matures

As it matured, changes in the nature of bush flying defined the precise characteristics of the bush aircraft Canadian airlines wanted to purchase. Bush flying had begun by serving the forest industry and the surplus HS-2L flying boats, along with the Canadian Vickers designs that eventually replaced them, were well suited to this seasonal work. Soon, mining became the dominant industry and bush flying began to focus on aerial surveying and mineral exploration. This work was also seasonal and did not require large payloads. Thus, aircraft operators could continue to use flying boats and light aircraft. For instance, the Northern Syndicate conducted its 1926 exploration work north of Great Slave Lake using Viking flying boats and was quite successful.[5] However, as the industry moved from exploration to intensive prospecting and claim staking, needs changed.

The relationship between aviation and mining that developed in the later 1920s helps to explain the shift away from flying boats to enclosed cabin monoplanes. In order for mineral prospectors to have an early start in the field, they needed to access areas of interest before the spring break-up made travel impossible. Thus, aircraft needed to be ski-equipped to land on still-frozen lakes and flying boats could not fulfil that goal. Moreover, as the mining industry moved from exploration to development and operation, mines needed to be supplied year round. While the mines could bring heavy freight in by boat in the summer and send ore out on the return voyage, along the Mackenzie this possibility was limited by a short shipping season. For example, Great Bear Lake saw the Hudson's Bay steamer only twice per summer. Thus, northern mines depended on

[5] Canada, Department of National Defence, *Report on Civil Aviation for 1926* (Ottawa: 1927), 27.

aircraft for the timely delivery of fresh supplies, mail service, and sometimes even ore cartage. Reinforcing these pressures, airmail contracts required year-round operation. Since the market demanded year-round service, ski aircraft, not flying boats, seemed the better option. With them, the airline could produce income year round. As conditions evolved, the characteristics users valued in their aircraft changed. Users responded to these shifting conditions by moving from flying boats to ski and float equipped aircraft.

In addition, northern conditions were so harsh that continuous operations required closed-cabin aircraft. While long-distance passenger boats did have enclosed cabins, they were too large to operate out of northern lakes and rivers. The flying boats of a size suitable for northern lakes did not have this feature. In theory, light aircraft could have provided this type of service. For example, Patricia Airways used a Curtiss Lark, along with an HS-2L, for their passenger, express, and mail service from Sioux Lookout to Red and Woman Lakes beginning in 1926.[6] However, increasing freight levels soon meant light aircraft could no longer serve as all-purpose bush aircraft. Thus, in 1927 the government noted a sharp increase in the number of 'modern aircraft' imported into Canada, specifically cabin monoplanes designed around the Wright Whirlwind engine, as airlines redefined their equipment needs in light of changing circumstances.[7]

As mining moved from exploration to development and operation, aircraft were now used to carry large, heavy mining equipment. Freight levels for an operating mine

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[6] Canada, *Report on Civil Aviation for 1926*, 29; The following year the Lark soldiered on, but two Stinsons replaced the HS-2L. Canada, Department of National Defence, *Report on Civil Aviation for 1927* (Ottawa, 1928), 25.

[7] Canada, *Report on Civil Aviation for 1927*, 63. According to G.A. Thompson, in 1927 Canadians imported 13 aircraft and by the end of 1928 had imported 80 aircraft: 3 from France, 25 from the United Kingdom and 52 from the United States. G.A. Thompson, "Aircraft Imported into Canada," 1939, CAL Collection, AOM, MG 11 A 34, Box 65: Brief Entitled "Northern Air Transport".

were also higher than for prospecting parties. If, as with Eldorado, the mine sent ore out by aircraft, this too was extremely heavy. Between 1924 and 1927, the total amount of airfreight carried in Canada rose from 78,606 lbs to 1,113,030 lbs. In the Patricia mining district in 1926, Patricia Airways carried 14,000 lbs of freight while Western Canada Airways carried 850 lbs in its few days of operation. By 1927, freight levels in the area had risen to 67,613 lbs of express for Patricia Airways and 290,000 lbs express for Western Canada Airways. Light aircraft and flying boats of the type built in Canada could not carry these sorts of loads. The Curtiss Lark belonging to Patricia Airways had a useful load of 1021.5 lbs, out of which one needed to take fuel, oil, pilot, and operating equipment weight. The HS-2L boats had a useful load of 1,864 lbs. However, after one accounted for fuel, oil and pilot weight, one was left with approximately 688 lbs payload, roughly 200 lbs less than the Fokker Super Universal. Compounding the low payload was the HS-2L's range of 575 miles and low maximum speed of 91 mph.[8] Moreover, aircraft operations now stretched long distances, and smaller aircraft could not carry the large loads over the necessary distance. Thus, as the main Canadian market for aircraft shifted from forestry to mining development and as Canadian Shield mining matured, bush airlines' requirements for their aircraft also changed.

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[8] Canada, Department of National Defence, *Report on Civil Aviation for 1924* (Ottawa, 1925) 42; Canada, *Report on Civil Aviation for 1926*, 29; Canada, *Report on Civil Aviation for 1927*, 19, 25; K.H. Molson, "The 'H'-Boats in Canada: Curtiss HS-2L and the Canadian Vickers HS-2L," *CAHS Journal* 4:3 (Fall, 1966): 67-71; J. Phipps, "Curtiss Lark G-CAFB: Technical Data," *CAHS Journal* 3:4 (Winter, 1964): 100. W.B. Burchall, "The Contribution of the Aeroplane to Canadian Industrial Development," 1934, CAL Collection, AOM, MG 11 A 34, Box 38: Mining (Misc. Data), 1934-1953; W.J. McDonough, "Canada's Aircraft Industry," Text of address to the Canadian section, Society of Automotive Engineers, Toronto, 15 November 1944, Arthur George Sims Fonds, NAC, R 2385-0-5-E.

By the early 1930s, bush flying into the Shield had become an established type of Canadian aviation. While exploration and prospecting continued to be important aspects of northern mining activity, especially after the United States government's revaluing of gold in 1935, by the early 1930s there were a number of permanent mines in operation throughout the Shield. While this sometimes led to the establishment of water routes and rail lines, along the Mackenzie mines remained dependent on aircraft because of the distance, the short navigation season, and the difficult terrain which prevented the construction of roads or rail lines. In the Mackenzie, the airmail contract reinforced the air route's permanence, as did the aircraft's replacement of the dog team as the dominant form of long-distance winter travel, at least for mining developers, government employees, and trading company personnel. Even fur traders came to rely on aircraft.[9] The northern transportation system now depended on aircraft, providing the airlines with a market and ensuring the ongoing existence of bush flying. The persistence of these services in turn created an opening for suitable aircraft and meant that a company that invested in the design and development of an aircraft for bush flying would have a

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[9] "In 1928-29 when aviation got into its stride in Western Canada, air transportation was still classed as a luxury and by no means a necessity. When the rich finds were made at Bear Lake late in1929 they were not considered of much importance due to their inaccessibility, except by air, which was considered too costly. Gilbert LaBine, however, had faith in the richness of the Eldorado property and definitely proved that even over long distances preliminary development of mining claims could be economically carried out by air transport. Since then it has also been proven in other districts, notably in Manitoba, and air transport is now looked upon as an integral part of any mining development in the North.

In addition to this, after two years' propaganda and actual operations, we have proved to the fur traders and trappers that aviation is as necessary to their business as to mining."

G.A. Thompson to W.C. Sigerson, 12 Aril 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 - May 1934.

market. Thus, bush flying's maturation encouraged the appearance of indigenous designs specifically created for the practice.

Changes in Canadian Aircraft Manufacturing

While conditions affecting Canadian aircraft users had changed, there were also significant changes on the production side, most notably the appearance of the modern airliner. Just as the Canadian bush transport market acquired some permanence in the early 1930s, aircraft design in other parts of the world took a radical turn. This dramatic design shift had important consequences for Canadian aviation, reducing the supply of foreign-built mid-sized utility aircraft as foreign manufacturers shifted their focus to long-distance passenger travel and the new passenger airliners. This left an opening for those Canadian aircraft manufacturers who developed aircraft specifically for the bush market.

While Canada was using aircraft to explore its internal wilderness and develop its natural resources, commercial aviation in America and Europe increasingly began to focus on long distance passenger travel. By the mid-1920s, the United States had a lighted transcontinental air system and Europe had a well-integrated international system. As the 1920s became the 1930s, attention in much of the world shifted to the development of long-distance international routes. For instance, by 1929, Britain had a regular, fortnightly service between London and India, and three years later had pioneered a London-Cape Town service.[10] French airlines had reached North Africa in 1919 and the Belgians followed with a route to the Congo in 1925. Lindbergh crossed

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[10] For a full history of aviation in British Africa during the period see Robert Lewis McCormack, *Aviation and Empire: the British African Experience, 1919-1939* (Ph.D. diss., Dalhousie University, 1974).

the Atlantic in 1927 and the Germans began a trans-Atlantic service to New York using Zeppelins in 1928. Aeropostale had a South Atlantic service between Africa and South America by 1930. Halfway round the world in Australia, a group of entrepreneurs formed the Queensland and Northern Territories Air Service (QANTAS) in 1920 and by 1934 had expanded their service to include the Singapore-Brisbane leg of Imperial Airways' international service, thus linking Australia to England by air.[11] Outside Canada, aviation increasingly concentrated on long-distance passenger transport.

Within this context, American and European aircraft designers turned their attention to the development of appropriate aircraft. The watershed in this process was the creation of the modern airliner. Sleek and modern, these aircraft shifted the industry's focus as European and American firms concentrated on their home markets.[12] Thus, just as Canadian aviation settled into mature bush flying, the interest of many American and British manufacturers moved away from the mid-sized transport that had proved so adaptable to Canadian conditions.[13] Even Fokker, the original mainstay of the

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[11] Canada, Department of National Defence, *Report on Civil Aviation for 1925* (Ottawa: 1926), 7; Canada, *Report on Civil Aviation for 1926*, 7; Canada, *Report on Civil Aviation for 1927*, 10; Canada, Department of National Defence, *Report on Civil Aviation for 1928* (Ottawa: 1929), 80; Canada, Department of National Defence, *Report on Civil Aviation for 1929*, (Ottawa: 1930), 65.

[12] "From its inception commercial aviation in Canada has been handicapped through having to purchase aircraft produced in foreign countries and adapt them at considerable expense to Canadian conditions. These foreign manufactures, mainly British and American, have been so taken up with home markets, which are infinitely larger than the Canadian demand, that it has not been economical to cater to Canada…" G.A. Thompson to J.A. Richardson, 12 August 1935, CAL Collection, AOM, MG 11 A 34, Box 7: Correspondence, June 1934 – Sept 1936.

[13] John D. Anderson Jr., *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002), 201; Roger E. Bilstein, *Flight in America: From the Wrights to the Astronauts*, 3rd ed. (Baltimore: The Johns Hopkins University Press, 2001); Edward W. Constant II, *The Origins of the Turbojet Revolution* (Baltimore: The Johns Hopkins University Press, 1980), 129-131; John Rae, *Climb to*

Canadian Airways fleet could no longer meet their needs, having been taken over by General Motors. After the aircraft division merged with North American Aviation Incorporated in 1933, the company chose to concentrate on all-metal airliners, meaning they were no longer interested in the rough and ready transports required for bush operations.[14] Unfortunately for Canadian operators, the all-metal, multi-engined, wheeled aircraft that now dominated aircraft production were wholly unsuitable for bush operations.

The shift opened a niche for the Canadian aircraft manufacturing industry that had sprung up during the late 1920s. While the size of Canada's post-World War One aircraft market made it difficult for Canadian manufacturers to match the pace of international design and production developments, the situation began to change during the early 1930s. Responding to the development of Canadian aviation, the Canadian aircraft market as a whole grew substantially during the 1920s, supported largely by the Royal Canadian Air Force's (RCAF) purchasing program and the federal government's flying club and airmail programs.

Before World War One, Canadians had built experimental aircraft, but there had been no real commercial production. During the war, the Imperial Munitions Board established a factory in Toronto to build planes for use in air force training. Despite this spurt of wartime production, immediately after the war there was no demand for new aircraft, surplus aircraft were flooding the market, and the microscopic Canadian industry ceased production. However, "in 1923 the demand for civil aircraft in Canada became

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Greatness: The American Aircraft Industry, 1920-1960 (Cambridge, Mass: The MIT Press, 1968), 58.

[14] Marc Dierikx, *Fokker: A Transatlantic Biography* (Washington: Smithsonian Institution Press, 1997); see especially chapter 7.

urgent and the manufacture of aircraft began in earnest."[15] This round of manufacturing started with Canadian Vickers, which concentrated on flying boat design and construction, although the company also built Fairchild and Fokker aircraft under license.

Despite Canadian Vickers' dominance of the Canadian aircraft industry through much of the 1920s, by 1928 new manufacturing firms began appearing, including de Havilland Aircraft of Canada, an off-shoot of the British company, Curtiss-Reid Aircraft, another light aircraft manufacturer, and the Ottawa Car Company, which acted as the agent for A.V. Roe, manufacturers of the Avian. In the same year, engine manufacturers established plants in Canada, including Canadian Wright, Canadian Pratt & Whitney, and Armstrong-Siddely.[16] In 1929, the Canadian aircraft industry remained small, but there were still more new entrants, particularly Fairchild Aircraft Ltd, Boeing Aircraft of Canada, which would focus on flying boat and mail plane production, and Bellanca Aircraft of Canada Limited. The Bellanca company began as a distributor for American manufactured Bellanca aircraft and planned to begin local manufacturing as conditions warranted.[17]

The establishment of these plants may have reflected the parent companies' desire to avoid high tariff levels. After all, while members of the British Empire paid only a 10% tariff, aircraft from the Netherlands and France were charged 25% and aircraft from

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[15] Canada, *Report on Civil Aviation for 1928*, 70.
[16] Canada, *Report on Civil Aviation for 1928*, 71-72; Kenneth H. Sullivan and Larry Milberry, *Power: The Pratt & Whitney Canada Story* (Toronto: CANAV Books, 1989).
[17] Canada, *Report on Civil Aviation for 1929*, 57-60. It is interesting to note that Canadian aircraft manufacturing was concentrated in and around Montreal.

Germany and the United States faced tariffs of 27.5%.[18] At rates like that, it might be worth establishing a Canadian branch plant.

Based on the types of aircraft that domestic companies produced, there were three major components to the Canadian aircraft market prior to the creation of Trans Canada Airways in 1937: airmail planes, trainers, often for flying clubs, and bush aircraft. Unfortunately for the aircraft manufacturers, the portions of the Canadian airmail system that employed special purpose aircraft like the Boeing 40B mail planes, namely the intercity and prairie mail routes, disappeared in 1932 after government cutbacks. The flying club market that gobbled up so many de Havilland Moths and other light aircraft appears to have been saturated by the early 1930s and the general economic downturn deeply affected this portion of the industry.[19] Government requirements also dried up at this time. During the 1920s, the RCAF had provided a major market for Canadian manufactures and their purchases had supported Canadian Vickers' work developing new flying boats designed specifically for RCAF forestry and aerial photography work. However, in 1930 the federal government passed responsibility for natural resources to the provinces, and, as a result, removed itself from resource management, including forestry patrols. This meant the nature of RCAF equipment requirements changed substantially. This shift eliminated an important market and an equally important source

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[18] G.A. Thompson, "Aircraft Imported into Canada," 1939, CAL Collection, AOM, MG 11 A 34, Box 65: Brief Entitled "Northern Air Transport".
[19] Canada, Department of National Defence, *Report on Civil Aviation for 1931* (Ottawa: 1932), 69-71.

of design and development funding. Canadian Vickers was particularly hard hit as their major market disappeared.[20]

These changes encouraged firms to find new markets. Thanks to the relative health of bush flying through the Depression's dark days and to foreign designers' concentration on producing passenger airliners for long distance travel, the niche market for bush transports remained an attractive option. Canadian manufacturers could not compete with large American airliner manufacturers and had no domestic market for airliners, but they did have the bush transport market available.

Government regulations also encouraged this new focus. In 1933, the government passed protective regulations that banned the import of second hand aircraft. High import tariffs on foreign-built new aircraft also encouraged Canadian operators to purchase domestically-built aircraft.[21] Not surprisingly, at this moment Fairchild Aircraft and Noorduyn began developing aircraft to serve this market. The changes in international aircraft design had created an opening for Canadian manufacturers to redress the loss of their business by serving the now firmly established bush market. Government regulations and high tariffs would make their products attractive, but only if they answered the users' needs by responding to northern bush conditions. The ability to do so was the result of knowledge and experience accumulated by Canadian users and manufacturers.

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[20] D.A. Newey, "Canada's Early Aircraft Industry: A Personal View," *CAHS Journal* 10:3 (Fall 1972): 68-70.

[21] K.M. Molson, *Pioneering in Canadian Air Transport*, 2nd Edition (Winnipeg: James Richardson & Sons, Limited, 1975), 153; W.J. McDonough, "Canada's Aircraft Industry," Text of Address to the Canadian Section, Society of Automotive Engineers, Toronto, 15 November 1944, Arthur George Sims Fonds, NAC, R 2385-0-5-E.

Developing Indigenous Design Experience

In order to create aircraft for Canadian bush flying, the producers required designers knowledgeable about and able to design aircraft especially for Canadian conditions. Although still relatively young, a tradition of indigenous design within the industry had already begun with Canadian Vickers. While companies outside Canadian Vickers had not yet produced indigenous designs, the Canadian aircraft industry had been developing aircraft for Canadian conditions for some time and it did have a history of modifying aircraft to suit Canadian conditions.[22] The Fairchild 71C was the most obvious example, but others had done similar work, albeit on a smaller scale. For instance, de Havilland had conducted considerable experimental work at its factory, producing components and special accessories designed specially for Canadian flying conditions.[23] Boeing too modified its aircraft, reinforcing its mail planes so they were better able to handle Canadian conditions.[24] These modifications indicate that Canadian manufacturers were acquiring greater understanding of Canadian operating conditions and their impact on aircraft functioning, along with a body of knowledge about how to respond effectively to those conditions.

These sorts of modifications also reflected an accumulation of operating experience on the part of aircraft users. Canadian companies had now been flying in the northern bush for many years, under all sorts of conditions, with several types of aircraft.

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[22] This history of modifications included the adaptation of JN4 undercarriages to withstand hard winter landings during World War One air force training north of Toronto. S.F. Wise, *Canadian Airmen and the First World War, The Official History of the Royal Canadian Air Force, Volume I* (Toronto: University of Toronto Press, 1980), 97.
[23] Canada, *Report on Civil Aviation for 1928*, 71.
[24] Canada, Department of National Defence, *Report on Civil Aviation for 1930* (Ottawa: 1931), 69.

This experience gave the users, especially the pilots and engineers, a very clear idea of what did and did not work in the North, along with an understanding of the qualities and characteristics they wanted in an aircraft. As will become apparent, the ongoing communication between the users and manufacturers allowed designers to incorporate these insights into aircraft that reflected the Canadian operating context.

The translation of users' experience into technological designs also reflected the specific experience of Fairchild and Noorduyn designers in working with bush aircraft. Fairchild's designers had worked on the 71C and 71CM and had a history of correspondence with Canadian Airways. Noorduyn too had a background in bush transport design. Although the company was new, the founder, Robert Noorduyn, had worked for Fokker on the Universal and Super Universal. As part of this process, he had visited Canada and worked with Canadian pilots. Moreover, he had worked as a designer for Bellanca, designing the very successful Bellanca Pacemaker. Thus, the two companies had designers experienced in working in Canadian conditions. This enabled the manufacturers to create aircraft specifically for the niche bush market that appeared in the 1930s. As they responded to this situation, Fairchild and Noorduyn conceived aircraft that translated northern activities and conditions into physical realities.

The Fairchild Super 71

Fairchild Aircraft of Canada began in 1929 as a branch of the American aircraft manufacturer. Although American in origin, the first commercial Fairchild aircraft, the FC-2, had incorporated a number of features based on the experience of Canadian aerial surveyors. The company's tradition of responding to Canadian conditions continued through the adaptation of the Fairchild 71C and the company's development of an aircraft designed expressly for use as a bush transport: the Fairchild Super 71. In the process of designing this new model, Fairchild integrated northern conditions into the aircraft itself.

This focus represented an important shift in how manufacturers and designers saw bush aircraft. Unlike previous aircraft that became bush planes in virtue of their use in that environment, the bush plane was now seen as a special purpose aircraft with its own particular characteristics, requirements, and performance parameters. These characteristics reflected both bush flying's use patterns and use-context. The Fairchild Super 71 translated those conditions into physical form, thus moving from the modification that had previously defined bush plane manufacturing to the creation of indigenous designs that arose out of local operating conditions. This shift produced a new type of aircraft, one that would be both a product and a victim of northern Canadian operating conditions.[25]

In an effort to ensure the model's commercial success, Fairchild began the design process by soliciting operators' suggestions for the new plane's design, attempting to incorporate northern users' needs into the machine. With Canadian Airways Limited the process began with reports on the performance of Fairchild's previous design, the Fairchild 71C. C.H. Dickins noted that he was pleased with the 71C and its performance and particularly impressed with the metal cabin lining, which helped protect the aircraft from damage by large, heavy pieces of cargo. However, Dickins did note that the 71C's visibility could be improved. He also suggested modifications to the doors and the

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[25] It appears that all 13 of the Fairchild 71Cs manufactured spent the entirety of their careers in Canada. J.R. Ellis, "Canadian Civil Aircraft Register," *CAHS Journal* 3:3 (Fall, 1965): 84; 3:4 (Winter, 1965): 115-116; 4:2 (Summer, 1966): 51; 5:1 (Spring, 1967): 24; K.M. Molson and H.A. Taylor, *Canadian Aircraft Since 1909* (London: Putnam, 1982), 497.

internal bracing to improve the aircraft's cargo loading capabilities.[26] The company assured Dickins that the new aircraft would reflect these suggestions.

After reviewing the proposed design for the Super 71, Dickins remarked to G.A. Thompson that he was optimistic about Fairchild's proposed project and believed that, "if it is reasonably successful in achieving the performance which [the company] estimates, [it] will be a better aircraft for us than the Junkers 34 as it will have a better speed range and will carry very nearly the same load provided the cabin is improved... [It] will operate about 25% less cost per mile."[27] However, when Thompson evaluated the proposed design in October of 1933, he was not as impressed. He was particularly concerned with the visibility problems presented for pilots and passengers, as well as the plane's low cruising speed. Thompson also expressed concern about the craft's landing speed, "which is very important on northern operations in winter due to the hard drifts," a fact Canadian Airways had discovered through hard experience. He suggested that Fairchild consider fitting trailing edge flaps or wing slots into their design in order to address this problem.[28] Fairchild responded to these concerns by assuring the airline that these suggestions would be incorporated into the forthcoming Super 71.[29]

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[26] C.H. Dickins to H.M. Pasmore, 20 April 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

[27] C.H. Dickins to G.A. Thompson, 8 May 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33; Fairchild claimed performance capabilities with a cruising speed of 120 mph and a range of 600 miles.

[28] G.A. Thompson to H.M. Pasmore, 11 October 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

[29] "I have received a reply from Mr. Pasmore commenting favourably on most of my observations and stating that they are endeavouring to eliminate a good many of the disadvantages in their new all metal machine." C.H. Dickins to G.A. Thompson, 8 May 1933, CAL Collection, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.

Dickins and Thompson's comments reflected the company's Mackenzie District experience. Cockpit visibility was essential when landing on unfamiliar terrain, a situation that often occurred in the course of charter operations and when landing conditions varied with the weather. Even a familiar lake could behave very differently at different times of the day and under different weather conditions and could quickly sprout new hazards like floating logs or glassy water. The reflections on glassy water, for instance, made it difficult for the pilot to assess the aircraft's height, making it impossible for him to decide on an appropriate approach speed. Under these circumstances, a pilot could easily bring the aircraft in too hard or cut the engine too early. Likewise, winter storms, winds, or temperature changes could alter landing conditions by producing potentially damaging snowdrifts. The pilot needed good forward visibility in order to land the aircraft successfully and to navigate through the landing surface without injuring his aircraft.[30] Thompson's concerns about the landing speed also reflected the difficulties of northern landings and the company's experience with the series of undercarriage failures that had struck its fleet.

In addition, the two Canadian Airways officials focused on the 71C's cargo capacity and the flight performance of the proposed Super 71, reflecting the centrality of freight cartage in northern flying and the pressures exerted by the company's competition, Mackenzie Air Service. Strong carrying capabilities meant the company could offer a broader range of more efficient service to its customers. According to Dickins, the new plane's projected performance and cargo capacity would reduce the

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[30] G.A. Thompson to H.M Pasmore, 11 October 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

company's operating costs, enabling Canadian Airways to compete by either lowering its rates or by enabling it to extract greater profit from its existing rates.[31]

These comments made their way to Fairchild through Fairchild Aircraft's President, Hubert Martyn Pasmore, and the final production model reflected many of Dickins' and Thompson's comments, incorporating knowledge of northern operating requirements. The close communication between designers and users exhibited by this correspondence is an interesting feature of aircraft manufacturing and one that meant the eventual results of the design process would reflect the North. Beginning with Canadian Vickers and the RCAF and extending through the bush plane's growth, Canadian aircraft manufacturers sought to respond directly to users' needs. In the bush plane's case, initial discussions centred on post-production adaptation, for example, the Fokker Super Universal's undercarriage.[32] While existing designs were adapted, certain manufacturers went on to develop specific modifications like the 71C. With the Super 71 and the Norseman, the process expanded to include design consultation, giving users direct input into the eventual results.

In the United States, this relationship manifested itself in formal associations between manufacturers and airlines, connections that persisted until the Air Mail Act of 1934 required the combines' separation.[33] Canada never experienced this strong an association between manufacturers and users, but there were close ties. For instance, James A. Richardson, President of Canadian Airways, served on the board of Canadian

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[31] C.H. Dickins to G.A. Thompson, 8 May 1933, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #8, Jan 3/33 – Dec 30/33.
[32] See Chapter 4.
[33] Tom D. Crouch, *Wings: A History of Aviation from Kites to the Space Age* (New York: W.W. Norton & Company, 2003), chapter 7.

Vickers. Although the links were not formalised, relations remained firm with information flowing between users and manufacturers. The Canadian aviation market's small size encouraged these connections because manufacturers had to ensure that they would have customers. After all, development investment would be wasted if no one bought the result. It was therefore important to maintain connections with users in order to ensure that products would meet their needs. These sorts of relationships made the aircraft industry different from many others and encouraged designers to consult potential users.

In some ways, this pattern confirms Ruth Schwartz Cowan's arguments for the efficacy of the consumption junction as a locus of historical analysis. In "The Consumption Junction," she advocates placing the consumer at the centre of historical analysis as a means of exploring technical diffusion and the eventual success or failure of technologies.[34] The approach is useful because it brings users into the history of technology, taking one outside the moment of invention and offering a means of revealing what happens to a technology when it gets out into the world.

However, the relationship between aircraft users and manufacturers requires that one go beyond Schwartz Cowan's limited focus on the consumer. By concentrating on the moment of purchase, the consumption junction may obscure the input of users whose views influence the purchaser, but do not make the purchase themselves. For instance, engineers seem to have little direct input into the airline's purchasing decisions.

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[34] Ruth Schwartz Cowan, "The Consumption Junction: A Proposal for Research Strategies in the Sociology of Technology," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch (Cambridge, Mass.: The MIT Press, 1987), 261-280.

However, as we have seen, their reflections on aircraft designs, along with those of the pilots, were important considerations for Canadian Airways executives. Moreover, conceiving of the user as consumer allows only one sort of feedback mechanism: the decision to acquire the technology, or not. However, in the aviation industry there is clear evidence of direct communication between the users and manufacturers, particularly during the design of the Super 71 and the Norseman. Concentrating solely on the moment of consumption, while useful for a number of reasons, carries some risks and, for the history of aviation, it is more productive to conceive of users as users and not purely as consumers. Doing so allows one to see the interactions between designers, purchasers, and users.

The eventual results of Fairchild's consultation attempted to integrate northern conditions and operational patterns into the aircraft's physical form. The Super 71 sported an all-metal monocoque fuselage topped with a wood and fabric parasol wing virtually identical to the 71's wing, though the Super 71's did not fold, and a cockpit perched behind that wing. In fact, it was the first all-metal monocoque fuselage produced in Canada. It used the monoplane form as "the most logical type for Canadian operating conditions, efficient for ease of loading and [providing] better visibility for pilot and passengers,"[35] though pilots would eventually agree with Thompson's pre-production assessment that the cockpit arrangement compromised visibility. Fairchild had also incorporated features to maximize cargo capacity, offering a 1-ton payload in over 200 cubic feet of cargo space (13 feet 6 inches long and 5 feet 3 inches wide), accessible

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[35] H.M. Pasmore to W.E. Sigerson, 5 February 1934, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft

through large doors available on either side of the cabin.[36] An insulated cabin, cabin heating system, and extra wide seats provided for passenger comfort. Details like the detachable engine mount, accessible power plant, top side carburettor, electric starter, preheating system, controllable engine and oil temperature, and a tail plane and elevators that cleared spray and ice all contributed to the plane's operability and reduced maintenance problems.[37] These features responded to both Dickins' suggestions and to the nature of northern bush transport. Where Dickins and Thompson had commented on the importance of visibility, loading and cargo capacity, and aircraft performance, Fairchild delivered an aircraft that sought to address these criteria with improved loading facilities, good cargo capacity, and solid performance.

Notwithstanding Thompson's initial concerns, the overall technical assessment of the Super 71 was positive. Pilots who tested the plane were pleased with its performance. F.W. Bone flying out of Oskelaneo, Quebec, reported that, "the machine's performance is the air is good and very nice to fly."[38] He felt that it made a good bush machine and had been very useful at Senneterre during the winter of 1934-1935. However, he was

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[36] The Super 71s' total possible payload on floats was 1989 lbs and on skis was 2051 lbs. In operation, the average payload was closer to 1600 or 1650 lbs. See Appendix I. "Summary of Comparative Operating Cost Efficiency as between Junkers 34, Northrop Delta, Fairchild Super," 9 October 1934, CAL Collection, AOM, MG 11 A 34, Box 44: WCA and CAL Machine Operation Costs, 1928-1935; FW Bone to GA Thompson, "Super 71 –General Report," 14 August 1935, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft: Individual Fairchild Aircraft.

[37] H.M. Pasmore to W.E. Sigerson, 5 February 1934, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft; "New Type of Plane for North," *The Northern Miner*, 20 June 1935, 86; Molson, *Pioneering*, Appendix IX; J.P. Juptner, K.M. Molson, and T.K. Rinehart, "The Fairchild Utility Monoplanes: A Production Record and Illustrated Type Description," *CAHS Journal* 11:1 (Spring 1973): 11-22.

[38] F.W. Bone to G.A. Thompson, 14 August 1935, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

concerned about the machine's take off capabilities, noting that, "the Junkers and the 71C will get out of small lakes where the Super 71 would not."[39] Even with an empty cabin and a reduced tank of gas, the Super 71 took longer to take off than the 71C, a sharp criticism given the 71Cs problems with take off performance. Bone also noted that it was difficult to carry a canoe, a staple of northern cargo, on the new machine.[40] Thompson's own evaluation reflected Bone's experience, noting that the machine's speed was disappointing. Where Fairchild claimed a cruising speed of 125 mph, Canadian Airways' Super 71 averaged 110 to 115 mph on floats and only 105 mph on skis.[41] The Super 71 also suffered from a number of petty failures that Thompson put down to a lack of designer experience.[42]

Despite these shortcomings, when consulted by the Department of National Defence, Thompson reported, "all pilots report that it is remarkably nice, very easy to fly, has good control and no tricks whatever."[43] In fact, the Super 71 met a number of the criteria listed in an internal Western Canada Airways memo from 1930 that described the ideal aircraft for general Canadian conditions. For example, the memo suggested that the ideal bush plane should be an all-metal, high wing monoplane convertible to wheels, floats, and skis for passenger and freight carrying. The aircraft should also have large cabin doors, a large cabin space with detachable seats and a strong undercarriage, all

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[39] Ibid.
[40] Ibid.
[41] G.A. Thompson to Col. Steadman, DND, 14 August 1935, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.
[42] Ibid.
[43] Ibid.

features of the Super 71.[44] Technically, at least, the Super 71 seemed to be a generally successful aircraft, incorporating northern aviation conditions as mediated to the designers by users, making it Canada's first special purpose bush plane.

In spite of these reviews, the first indigenous bush plane did not have a long career. Although it received positive evaluations, only one Super 71 saw civilian service and only two military machines served with the RCAF. Unfortunately, there are no clear indications in the archives to explain why Canadian Airways did not purchase more of the new Fairchilds. Given the generally positive assessment, the Super 71's failure cannot be attributed solely to technical shortcomings. While the archives are silent on the subject, company correspondence of the period suggests that the airline's financial circumstances in 1934 and 1935 restricted its ability to purchase new aircraft. Rather than focusing on the aircraft's design to explain its failure, one must look outside the aircraft frame to the conditions that surrounded it, especially the economic conditions facing Canadian Airways' northern service in 1934.

Just at the moment the Super 71 was born, Canadian Airways was experiencing financial difficulties, largely because of general economic conditions during the 1930s and because of the airmail contract cancellations.[45] This meant that the company could not afford to purchase the machines it would have liked.[46] In fact, 1934 was such a bleak year that in May, W.C. Sigerson recommended reducing pilot salaries, moving the head

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[44] "Memorandum in Connection with Suggestions for Ideal Machine to Suit General Canadian Conditions," [ca. October or November 1930], CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, 1929-1931.
[45] Memo to the Prime Minister, 1933, CAL Collection, AOM, MG 11 A 34, Box 64: Statistics, CAL Statistics 1931-1933, 1934 (Accounting and Statistical Data, All Lines).
[46] W.C. Sigerson to G.A. Thompson, 2 January 1934, CAL Collection, AOM, MG 11 A 34, Box 36: Junkers Aircraft, Correspondence.

office from Montreal to Winnipeg, eliminating the Eastern and Pacific lines' general offices, and requiring district superintendents to perform at least 30 hours of flying per month.[47] In fact, the company decided to make these changes that same month.[48] Within this climate it is little wonder that James A. Richardson wrote to Sherman Fairchild regarding the Super 71, "Pasmore, I believe, is very anxious that this ship should come into our hand, but we are not going to buy, particularly in these times, any ship either off a drafting board or one that has not been fully tested in the field."[49] That said, Richardson did indicate that the company would be willing to cooperate with the manufacturer to test the ship in operation.[50]

Notwithstanding this willingness, the airline was in no position to purchase new equipment in 1934 and early 1935. As Thompson wrote to Dickins, "It is easy enough to talk about purchasing new equipment, but not so easy to obtain the money."[51] Despite favourable pilot reviews, according to K.M. Molson and H.A. Taylor, the cost of the all-metal aircraft was too high given the economic climate of 1934 and further aircraft were never produced.[52] The Super 71's experience highlights the importance of ambient context in the success of both the adoption of foreign technologies and the appearance of new technologies. A machine can be technologically appropriate to its environment, as the Super 71 was, but fail to match other conditions, in this case the economic climate.

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[47] W.C. Sigerson to James A. Richardson, 9 May 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[48] W.C. Sigerson, "Canadian Airways Limited Bulletin to the Field," 29 May 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[49] James A. Richardson to Sherman Fairchild, 21 June 1934, CAL Collection, AOM, MG 11 A 34, Box 7: Correspondence, June 1934 – Sept 1936.
[50] Ibid.
[51] G.A. Thompson to C.H. Dickins, 1 March 1935, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.
[52] Molson and Taylor, *Canadian Aircraft Since 1909*, 318.

Although there is no archival evidence, one cannot help speculating that the Super 71s ungainly appearance also contributed to its short life span. The main fuselage was a sleek, all-metal structure reminiscent of racing planes of the period. By the logic that condemned the Fokker Super Universal to obsolescence, this should have contributed to a modern, streamlined, attractive silhouette. However, these modern lines were disrupted by the parasol wing and the pilot's cockpit aft of the wing. The overall effect produced a feeling that the aircraft was poorly balanced and unstable. As we have seen with the Fokker Super Universal, appearance could contribute to a bush plane's acceptance or rejection, and there may be good reason to believe that it shortened the Super 71's production run.

BACK TO THEIR ROOTS: THE FAIRCHILD 82

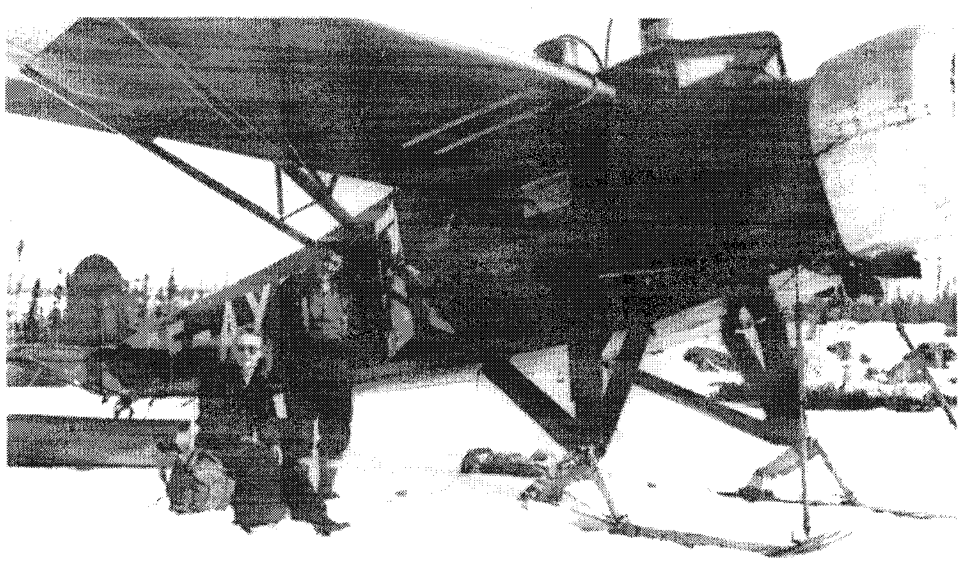

Figure 6.1: Fairchild 82, Mackenzie Air Service's aircraft, CF-AXN
Source: AAM Photo Collection, 202218

Disappointed in the Super 71's career, Fairchild returned to its previous design series, focusing its attention on creating the Fairchild 82. Though still a plane targeted at the Canadian bush market, this aircraft was essentially a larger version of the Fairchild 71/71C. Its four longeron, fabric-covered fuselage, and Fairchild 71 wing reverted to the more typical Fairchild design conceived with the FC-2. Nevertheless, the 82 repeated a number of the features incorporated into the Super 71, including the large access doors that were wide enough to accommodate 45-gallon fuel drums.[53] Canadian Airways purchased its first Fairchild 82, CF-AXE, in February of 1936 and a second machine in September of that year. Their competitor, Mackenzie Air Service, also purchased three 82s: CF-AXM, CF-AXN, and CF-AXQ.

Based on Canadian Airways' records, the machine performed well under northern conditions and company correspondence indicates no major problems. Fuselage members in the rear of the aircraft did need to be strengthened, but this was easily accomplished.[54] Somewhat sluggish on water, the plane's performance improved easily with the installation of Edo-designed floats.[55] CF-AXE did run into engine problems over Hay Camp, quitting without warning at an altitude of 2500 ft and forcing pilot A.M. Berry to glide in for a landing. While frightening, the incident proved isolated.[56] The aircraft's success demonstrated Fairchild had a solid grasp of the characteristics

[53] Longerons are the longitudinal structural members of the fuselage that run from nose to tail and form the outline of the fuselage.
[54] W.R. May to A.G. MacDonald, 6 August 1936, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft; CF-AXE, Logs, 14 May 1936, 22 June 1936, CAL Collection, AOM, MG 11 A 34, Box 77: CF-AXE Logs, Feb 1, 1936 – Oct 10, 1937.
[55] CF-AXE Flight Report, 24 May 1936, CAL Collection, AOM, MG 11 A 34, Box 107: CF-AXE Flight Reports, Feb – Dec 1936.
[56] CF-AXE Flight Report, 30 May 1936, CAL Collection, AOM, MG 11 A 34, Box 107: CF-AXE Flight Reports, Feb – Dec 1936.

necessary for northern aviation and had the ability to build reliable aircraft. Although successful, the 82 did not represent a major breakthrough in bush plane design inasmuch as it represented the extension of an existing design.[57] However, by the time it arrived, the ambient economic conditions had improved sufficiently that the 82 succeeded where the Super 71 had not.

A CANADIAN BUSH PLANE: THE NOORDUYN NORSEMAN

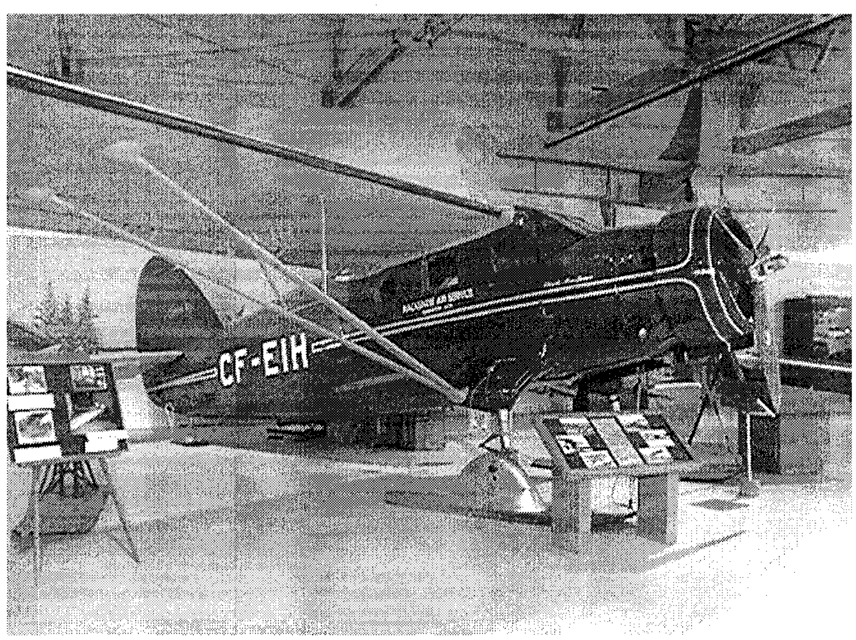

Figure 6.2: Noorduyn Norseman.
Source: Alberta Aviation Museum, Personal Collection.

Just as Fairchild began developing the 82, another Montreal-based company launched the aircraft that would become the first iconic bush plane: the Noorduyn Norseman. Like the Super 71, the Norseman was designed specifically for northern bush flying conditions. As with the Super 71, northern conditions were translated into the aircraft's design through the medium of users' knowledge and experience. This

[57] Juptner, Molson, and Rinehart, "The Fairchild Utility Monoplanes;" Molson, *Pioneering*, Appendix IX; CF-AXE Certificate of Registration, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

relationship between the Norseman's design and its context was evident from the beginning. For instance, previous aircraft were designed with wheeled undercarriages and their performance targets evaluated with that arrangement. When converted to floats, the aircraft's performance would drop dramatically, meaning that a bush operator could never depend on his aircraft living up to the performance specifications in the manufacturer's publicity. The Norseman, by contrast, was designed first as a float-equipped aircraft on the theory that the conversion to skis or wheels would only result in improved performance.

Other design goals also reflected the needs of Canadian operators. According to Robert Noorduyn and his design team, the machine needed to be at home on water, rough landing strips and snow; it needed to be able to carry a variety of cargo and be easily adapted to suit both cargo and passengers; it needed to have good cockpit visibility to allow easy navigation, fire spotting, timber cruising, and search and rescue; it needed to have a comfortable two-person cabin to allow the engineer to serve as navigator; and it needed to be easy to maintain and repair in sub-optimal conditions. These priorities all reflected the needs of Canadian operators.[58]

Like the Super 71, the Norseman was the product of extensive consultation with Canadian bush pilots. Not content to build only on his own experience, Noorduyn conducted surveys of Canadian pilots and operators to determine what characteristics they would most value in a plane. Unfortunately, most of the Noorduyn records were destroyed when the company's assets were transferred to Canadian Car and little

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[58] Hal C. Craig, "Designing the Norseman: The First Year," *CAHS Journal* 17:3 (Summer 1979): 76-78, 76; Robert G. Halford, "The Saga of the Norseman," *CAHS Journal* 17:3 (Fall 1979): 67-73, 70.

evidence of the pilots' requests and comments remains.[59] Although the records of the interaction have been lost, one can see the results in the Norseman's design.

While Canadian Airways as a company was not heavily involved in the initial design process, Noorduyn did solicit the airline's opinions for subsequent modifications.[60] As with the company's comments on the Super 71, these evaluations were derived from actual operating experience, funnelling pilot comments through the upper administration to the manufacturer. Although the pilot's opinions did not go directly to the manufacturers, their ideas formed the content of Canadian Airways' influence on designs.

Interestingly, engineers' comments do not appear as independent documents. However, there are indications that their ideas did make their way into pilots' remarks . For instance, Dickins December 1936 reports to Noorduyn reflected T.W. Siers' concerns about the Norseman's skis and shock absorbers.[61] When C.M. Farrell reported on Norseman operation in April 1937, he asked for a reinforced patch on the nose for mechanics to stand on while putting on or taking off the engine covers.[62] Furthermore, pilots communicated to Dickins the mechanics' frustrations with the Norseman's oleo

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[59] Walter Henry, "Introduction," to Halford, "The Saga of the Norseman," 67-68

[60] See for example, C.H. Dickins to R.B. Noorduyn, 21 December 1936, and 14 April 1937 CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[61] C.H. Dickins to R.B. Noorduyn, 21 December 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft: Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[62] C.M. Farrell to W.R. May, 21 April 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft: Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

legs leaking and sticking, who then passed them on to the manufacturer.[63] Although they do not appear to communicate directly with the manufacturer, the engineers' opinions were filtered through the pilots' comments.

On the design side, operational responses were filtered through and combined with Noorduyn's design experience, experience that made him particularly well qualified to design a successful bush plane. Born in 1893 in Nijmegen, the Netherlands, Robert B. Cornelius Noorduyn emigrated to England, his mother's home, in 1913. In England, he entered the aircraft industry as an apprentice at Sopwith Aviation, subsequently working for Armstrong Whitworth and British Aerial Transport. In 1920, Noorduyn joined Anthony Fokker's company, accompanying Fokker to the United States where he later became Fokker's American representative and manager. During his time with Fokker, Noorduyn was responsible for the design and production of the Fokker Universal.[64] In 1929, Noorduyn left Fokker to become Vice-President of the Bellanca Aircraft Corporation. With this company, he gained experience with the needs of Canadian operators as he sold them Bellanca Pacemakers. Following a brief sojourn with Pitcairn Aircraft Inc, where he helped develop the Autogyro, Noorduyn moved to Montreal in 1934 to form the company that would produce the Norseman.

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[63] C.M. Farrell to C.H. Dickins, 25 May 1938; W.J. Windrum to C.H. Dickins, 6 June 1938; R. Miller to C.H. Dickins, 18 September 1938, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft: Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[64] Although used extensively as a bush plane, the Universal was not designed as such. Rather it represented state of the art design for commercial aircraft of its period. Halford, "The Saga of the Norseman".

As Hal Craig, a member of the initial design team notes, the combination of these experiences made Noorduyn well equipped to create a Canadian bush plane.[65] The Fokker and Pacemaker were both popular planes and as the company representative, Noorduyn had the opportunity to meet with aviators and to discover what it was they wanted in an aircraft.[66] Moreover, his experience with the Pitcairn autogiro made him fully aware of the benefits of short takeoff and landing.[67] Although Noorduyn did not have a degree in engineering, he convinced Walter C. Clayton, who did have a degree in aeronautical engineering, to work for him at Noorduyn and used Clayton's expertise to translate his knowledge and experience into the Norseman's design. Noorduyn's links with both Fokker and Bellanca highlight the important role that designers' skills and experience played in creating the bush plane. Like the pilots and operators, designers too had gained experience with the North that they could now incorporate in their designs.

The arrangement of elements in the new aircraft reflected Noorduyn's goal of producing a bush plane specifically for the Canadian environment. In keeping with the information Noorduyn obtained from bush pilots and his own ideas of what made a successful bush plane, the Norseman had a sizeable cabin with a loading door that featured a removable section to facilitate 45-gallon fuel drum loading. The flexible

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[65] Craig, "Designing the Norseman".
[66] "During 1930 and 1931 I spent a great deal of time in Canada, on the Bellanca business, and made an extensive study of the aviation situation there, with its particular problems and prospects." D.H. Martin, quoting R. Noorduyn, to J. Stephen, 22 May 1933, CAL Collection, AOM, MG 11 A 34, Box 27: JAR – Air and Vickers Mfg, Feb 18/27 – Sept 23/37
[67] Craig, "Designing the Norseman;" Halford, "The Saga of the Norseman," 70. The autogiro was developed by Spanish engineer, Juan de la Cierva. It had a passive rotor mounted on top of a machine equipped with a conventional propeller attached to its engine. As the propeller moved the machine forward, the motion would turn the rotor, which, in turn, would lift the aircraft into the air. Pitcairn, an American aircraft manufacturer, bought the autogiro's American rights. Crouch, *Wings*, 464-466.

seating, bench seats for nine or bucket seats for six, increased the aircraft's cargo versatility. The somewhat stubby fuselage facilitated proper load distribution. Other novel features included landing flaps, which reduced necessary landing and take-off speeds so the aircraft could use smaller lakes as runways, thereby increasing its mobility, and cabin insulation, a welcome addition during cold northern winters. Passengers also appreciated the separate crew and cabin doors that meant the pilot and engineers no longer had to climb through the cabin to enter or exit the aircraft, though the new door did mean a draft on the pilots' feet.

Significantly, Noorduyn also paid attention to the plane's appearance. Despite its being constructed in essentially the same manner as previous bush aircraft using a steel tube fuselage, wooden wings, and fabric skin, the well-faired fuselage, smooth lines, and glossy finish all contributed to the plane's modern look. The Norseman's modern appearance echoed the sleek lines of aircraft like the streamlined racing planes of the 1930s and the new passenger airliners. As Canadian Airways saw with the Fokker Super Universal, a modern look was becoming important even on Northern routes. Both the Norseman's design features and its modern appearance reflected the needs of bush flying along the Mackenzie.

Strikingly, Noorduyn's design did not incorporate any revolutionary elements. What Noorduyn had done was bring existing technologies together. Like the DC-3, the Norseman achieved an important design breakthrough through the synthesis of existing technologies and acquired knowledge.[68] One can see the influence of the new synthesis

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[68] Anderson, *The Airplane: A History of Its Technology.*

as the features persisted into post-war design, appearing in the Beaver, perhaps the best small bush plane design of the twentieth century.[69]

The plane that resulted from the combination of Noorduyn's experience and skill with pilot feedback would go on to be very successful. This success was the result of a number of conditions. First, the plane succeeded in meeting the needs and expectations of its users. It was also capable of operating in the northern environment. At the same time, it managed to look appealing, an important consideration in the competitive Mackenzie environment. Other conditions also influenced its success, including changes in Mackenzie Air Service's fleet composition and improving economic conditions. Where the Super 71 had met conditions unfavourable to its adoption, circumstances were now such that the Norseman could thrive. The Norseman was a success, not only because it responded to the needs of bush pilots and customers, but also because the plane was pleasant to fly and fit the northern context well.

Overall, pilots enjoyed flying the Norseman, commenting on its smooth controls, stability, and responsiveness.[70] Along with other pilots, C.M. Farrell reported, "Its natural stability in taking off under poor conditions and the fact that it has no cranky habits at slow flying speeds gives the pilot a lot of assurance when at times he is placed in a difficult corner."[71] The plane's performance at low speeds was the result of an important

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[69] Sean Rossiter, *The Immortal Beaver: The World's Greatest Bush Plane* (Vancouver: Douglas and McIntyre, 1996).
[70] C.H. Dickins to R.B.C. Noorduyn, 6 May 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; John T. Dart, "A Few Recollections," *CAHS Journal* 4:3 (Fall 1966): 72, 74.
[71] C.M. Farrell, CF-BAU flight report, 14 December 1936, CAL Collection, AOM, MG 11 A 34, Box 107: CF-BAU Flight Reports, Dec 1936; C.M. Farrell to W.R. May, 21 April 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft,

design detail: wing flaps. In their simplest form, flaps consist of hinged sections along the trailing edge of the wing that can be lowered by the pilot. By increasing the wing's curvature, the flap increases the wing's lift while also increasing the aircraft's drag, slowing the plane. This combination of forces allows the plane to achieve a much slower landing speed than possible in an aircraft without flaps. Without the flaps, the pilot has to maintain a higher speed just to keep the plane in the air.[72] Canadian Airways pilot Romeo Vachon reported that the Norseman had a landing speed of only 58 mph and that "the descent is rapid but the machine is on the level. I mean the nose not down, which makes it safe for landings on glassy water or glaring snow when the area to land in is small and you cannot fly on with the motor."[73] Archie McMullen echoed these thoughts, recalling that the flaps were quite a selling feature as they allowed a steeper dive, slowing the aircraft down faster and allowing it to take off faster, meaning it could get into and out of smaller spaces.[74] The flaps compensated for the Norseman's high landing speed and meant that it could be used to land on smaller lakes, increasing its utility in the North.

While Noorduyn had succeeded in designing a plane that could land on small lakes, the Norseman was less suited to difficult locations. Regarding take-off, Vachon noted, "with 8 passengers including the pilot, full tanks of gas (One tank being just short of being full up to the top), the machine took off in about 25 seconds, that take-off was fair, as there was practically no wind, and what little wind there was, was a cross-wind,

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Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[72] Bert A. Shields, *Theory of Flight and Aircraft Engines: Air Pilot Training* (New York: McGraw-Hill Book Company, Inc. 1942).

[73] Romeo Vachon to G.A. Thompson and T.W. Siers, 2 July 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[74] Archie McMullen, interview, 16 September 1978, NWT Archives, G-1988-008-0009.

up current about 5 mph."[75] This meant a pilot could lift off from a relatively small lake under less than optimal conditions without having to waste time and gas ruffling the water or building up speed in multiple passes. Unfortunately, Vachon was less impressed with the Norseman's ability to climb.[76] This would present difficulties for a pilot trying to lift off from a small lake surrounded by any substantial hills and would limit where he could land the plane. In fact, Canadian designers would not fully realize their goal of a plane capable of short take-offs and landings until the development of the de Havilland Beaver after the Second World War.

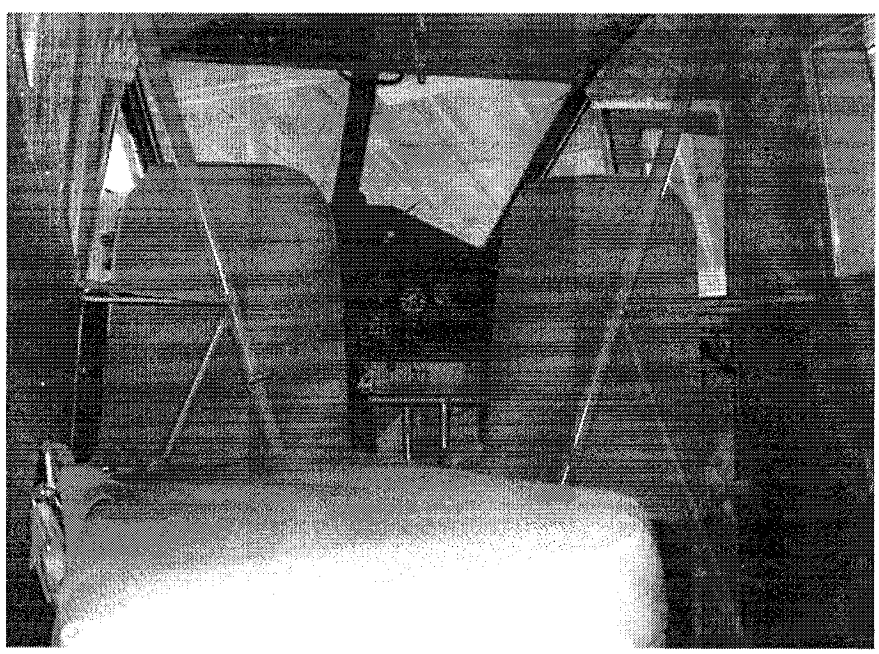

Figure 6.3: Interior of Norseman cockpit.
Source: AAM Noorduyn Norseman, Personal Collection.

[75] Romeo Vachon to G.A. Thompson and T.W. Siers, 2 July 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.
[76] Ibid.

Along with the plane's performance capabilities, the designers also paid attention to the comfort of the pilot and crew, beginning with the size of the cockpit. According to Craig, Noorduyn reasoned that if the pilots liked the plane, they would help to sell it to the operator. The existing competition was not stiff. The Fairchild 71 had a tiny, uncomfortable cockpit, barely wide enough for the single pilot's seat that occupied its entire width.[77] By comparison, the Norseman supplied a comfortable, roomy cockpit, large enough for two side-by-side seats, which meant that the engineer no longer occupied a passenger's seat and could now serve as a navigator for the pilot. Good visibility from the cabin further improved navigational abilities and made the plane suitable for fire spotting and forest monitoring. The cabin also included features such as a bulkhead separating the cockpit from the rest of the plane. This made the passenger and cargo cabin much quieter and prevented drafts from circulating through the cockpit. It also protected the pilot from shifting freight. In addition, Noorduyn paid attention to the pilot's comfort, providing adequate heating and ventilation, along with adjustable seats and rudder pedals. Doors on either side of the cabin meant the pilot could dock more easily. Noorduyn and his team also gave some thought to passenger welfare, providing a large passenger door, a ladder that disappeared into the main cabin and the option of comfortable chairs, as opposed to the Spartan benches that lined most bush aircraft.[78]

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[77] See Figure 5.1.

[78] Craig, "Designing the Norseman," 76; C.H. Dickins to W.R. May, 5 October 1937; Noorduyn Norseman drawings, [ca 1936]; G.A. Thompson to C.H. Dickins, 27 September 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; C.H. Dickins to H.M. Pasmore, 20 April 1933, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft.

Beyond pure flying comfort, the designers attended to the ease with which the aircraft could be used and serviced. For instance, they provided an accessible oil tank with a funnel oil filler on the lower nose, along with an oil temperature regulator that allowed the pilot to control the engine oil temperature. A step on the leg strut allowed the pilot to climb in and out of the cockpit easily.[79] When it came to maintenance, Noorduyn wanted the plane to be easy to repair and its construction reflected this goal. W.E. Gilbert commented,

> the Norseman will require much less mechanic labor to maintain and service it, once the personnel get used to it. Though it is not perfect from an "accessibility" viewpoint (what airplane is?) it certainly embodies a lot of labor-saving gadgets never introduced before plus a surface easy to keep clear of oil, and an engine which runs about as clean as any one could hope for.[80]

The fuselage was also easy to maintain, being a fabric covered steel tube structure, faired with round and oval sections with spruce stringers.[81] The wings too followed standard construction techniques, with wood members and fabric coverings. While not cutting edge, these materials did offer the advantage of being familiar to aircraft mechanics and of being easier to repair in the bush than metal.[82] Attention to this sort of detail made the plane much easier to use and maintain.

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[79] Craig, "Designing the Norseman," 76.

[80] W.E. Gilbert to C.H. Dickins, 12 May 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[81] Fairing is a wooden superstructure that supports the skin. While the Norseman's steel fuselage structure was rectangular, oval or round wood fairing provided the smooth round shape of its outer skin. The stringers are the longitudinal members attached to the fairing's rings that keep them in place. Fairing can also refer to any construction on the aircraft designed to reduce drag. Shields, *Theory of Flight and Aircraft Engines*, 21-23.

[82] Fred Shortt, "Norseman Specifications," *CAHS Journal* 17:3, (Fall, 1979): 86-87, 85.

Given that bush aircraft were used for a variety of purposes, it was essential that the Norseman be able to handle a substantial cargo, be easy to load, and perform well fully loaded. This meant the aircraft had to have good lift, an accessible cabin, and a design that minimized the performance changes that resulted from load distribution and changes in the aircraft's centre of gravity. When completed, the Norseman had a disposable load of approximately 1360 lbs when fully loaded with fuel, equipment, and crew. An additional 75 lbs could be obtained if the seats were removed, and still more cargo weight added if a corresponding amount of gas were removed. This weight could be arranged in the large cabin or in a 20 cubic foot metal baggage hold under the cabin floor. Although the disposable load was approximately the same as the Fairchild 82's (2764 lbs as a ski plane and 2622 lbs as a float plane), the Norseman was a faster aircraft, and therefore more efficient.[83]

Getting cargo into the plane was also a consideration. The high wing made it easier to load freight from the shore to a floatplane, a problem encountered by the low-winged Junkers W34. Moreover, Noorduyn equipped the aircraft with doors on both sides of the cabin, allowing the plane to exploit any advantage that would allow it to draw closer to shore, and made the doors four feet wide, enough to accommodate a 45 gallon drum of gasoline being rolled into the cabin. Doors this size would also make it easier to

[83] Weights calculated from CF-BAU flight reports, CAL Collection, AOM, MG 11 A 34, Box 107: CF-BAU Flight Reports, December 1936; Noorduyn Norseman drawings, [ca 1936], CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; G.S. Thompson to Mr. Hutchins, 16 October 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; CF-AXE Certificate of Registration, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft, Individual Fairchild Aircraft. See also Appendix I.

load bulky pieces of freight. The cabin itself was short and squat, meaning that load distribution had less of an effect on the aircraft's centre of gravity. A lifting stabilizer (the horizontal tail plane) also helped to counteract the effects of awkward loads.[84] The aircraft's cargo capacity and other freight-related features were the result of successfully translating operational experience with and knowledge about northern flying into the new design.

Although it was a well-designed plane, the Norseman did encounter difficulties in operation and required modification before it could be completely successful. The Norseman prototype that appeared in 1935 was equipped with a Wright R-975-E3 Whirlwind engine that produced 420 hp. The company claimed that the machine could achieve a high speed of 158 mph and a cruising speed of 140 mph. Its range, according to the company, was 700 miles as a land plane and 625 miles when equipped with floats, a level of performance that seemed adequate for the North. In reality, the plane was underpowered with the 420 hp Whirlwind and performance suffered as a result, making it different to get out of small lakes. In fact, the aircraft would not achieve its full potential until equipped with the 550 hp S3H1 Pratt & Whitney Wasp.

In 1936, Noorduyn introduced the Norseman Mk III, powered by the 420 hp Wasp SC. Designed to allow companies to use existing stocks of Wasp SC engines, this model offered only marginal improvements on the performance of the Mk I and II, and Canadian Airways became interested in the aircraft only when it became equipped with

[84] Craig, "Designing the Norseman," 76; Noorduyn Norseman drawings, [ca 1936], CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

the new 550 hp Wasp engine.[85] The manufacturer claimed that with the S3H1 the Norseman could reach a top speed of 170 mph (or 155 mph as a float plane), a cruising speed of 150 mph (135 mph as a float plane) and would have a range of 600 miles. In reality, the airline's trials revealed that the actual cruising speed of a loaded Norseman was 120 mph, 130 mph when empty. After two years of service, Canadian Airways calculated that the actual average winter speed of these craft was 118 mph.[86] Although slower than the manufacturer claimed, the Norseman was about 15 mph faster than the Fairchild 82, its main competition. Though an apparently small difference, as C.H. Dickins pointed out, on the long Mackenzie run the extra speed would mean considerable savings over the course of a year.[87] With the increased power, the plane was able to reach speeds and lift loads that made it a viable option for northern operators.

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[85] In fact, only six aircraft were produced before the change over to the Wasp S3H1.Molson and Taylor, *Canadian Aircraft Since 1909*, 396-398; G.A. Thompson to R.B.C. Noorduyn, 15 June 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.
[86] J.R. Ellis, "Canadian Civil Aircraft Register," *CAHS Journal* 4:1 (Spring 1966): 25-28; 26; L.M. Coughtry to James A. Richardson, 4 September 1935, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; 4 June 1936, G.A. Thompson to R.B.C. Noorduyn, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; K.M. Molson and H.A. Taylor, *Canadian Aircraft Since 1909* (London: Putnam, 1982), 403; Fred Shortt, "Norseman Specifications," *CAHS Journal*, 17:3 (Fall 1979), 86-87; W.H. Irvine to G.A. Thompson, 25 February 1936; R. Vachon to G.A. Thompson and T.W. Siers, 2 July 1936; C.M.G. Farrell to W.R. May, 21 April 1937, all CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; C.H. Dickins to W.R. May, 21 May 1937, CAL Collection, AOM, MG 11 A 34, Box 38: Maintenance.
[87] C.H. Dickins to G.A. Thompson, 16 October 1936; and C.H. Dickins to G.A. Thompson, 17 October 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

Overall, the Norseman reflected the needs of northern flying. Like the Super 71, it too met a number of the requirements Western Canada Airways had outlined for the ideal Canadian transport. For example, the Norseman was a high winged monoplane, which assisted in manoeuvring around shorelines. It was easily convertible to wheels, floats, or skis, and had a cockpit forward of the wing that had good visibility forward and down, enabling easy navigation. As the airline suggested, the aircraft had a large door on each side of the cabin, a large cabin with detachable seats, and a separate baggage compartment with outside doors. The machine was stable to operate as a floatplane, had a good cruising speed and acceptable take-off and landing performance. The cockpit was also well heated to provide for crew comfort. Details such as easy access to the oil filter, which had to be checked daily, also appeared in the Norseman. While the airplane was not all metal, the company had found with the Super 71 that this feature made an aircraft rather expensive. By incorporating these features, the Norseman integrated the knowledge, experience, and desires developed by users through northern bush flying during the late 1920s and early 1930s.[88]

Although a popular plane, the aircraft was not without faults. Once in northern service, the Norseman briefly had trouble with its shock absorbers. T.W. Siers reported that Mackenzie Air Service were having difficulties with the shocks on their Norseman aircraft because the fluid was too heavy for a Canadian winter – the legs would compress, but the oil was so congealed that the leg would not rise up and would often jam the ski

[88] "Memorandum in Connection with Suggestions for Ideal Machine to Suit General Canadian Conditions," [ca. October or November 1930], CAL Collection, AOM, MG 11 A 34, Box 2: Correspondence, 1929-1931.

pointing downwards.[89] Changing the fluid in the legs could easily address this problem. Unfortunately, after two years in operation, Canadian Airways' Norseman, CF-BAU, continued to experience difficulties. It appeared that the struts were leaking air due to faulty valves. Noorduyn responded by developing a new type of valve for the oleo struts, which appears to have solved the problem.[90]

More seriously, Canadian Airways had difficulties with the engine valves on CF-BAU. Based on the correspondence from W.R. 'Wop' May, it appears that Canadian Airways experienced an engine failure on one of their aircraft early in 1937. May concluded that the valves burned out because the small nose plate openings in the engine cowling failed to force air on to the cylinder heads, allowing them to overheat. While the company tried flying the plane without its cowling, May argued that they could not operate the machine without the cowling in cold weather, as the engine would be far too cold. With the cowling on, however, the grease surrounding the rocker heads melted out within ten minutes. May compared the operation of Canadian Airways' planes with Mackenzie Air Service's fleet and noted that Mackenzie Air Service had no problems with their engines and that their nose plates were 4" wider in diameter. As a result, he asked Siers and Thompson to send a 30" nose plate. Dickins communicated this problem to Noorduyn and to Canadian Pratt & Whitney, asking them to develop a solution

[89] T.W. Siers to C.H. Dickins, 7 December 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.
[90] C.M. Farrell to C.H. Dickins, 25 May 1938; R. Miller to C.H. Dickins, 18 September 1938; and C.H. Dickins to R.B.C. Noorduyn, 21 December 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

because, as C.M. Farrell pointed out, one could run the machine without its cowling, but that decreased its speed and detracted from the machine's appearance.[91]

The pilots also noted a number of small improvements that would greatly facilitate the operation of the machines. Writing to Noorduyn, C.H. Dickins commented that

> we wish to draw your attention to a couple of small items which we consider were omitted on our first machine. There must be a step installed on the right hand side so that the hand cranking apparatus can be used. It is also necessary to have some form of hand grip which should be easily reached by anyone when cranking the machine by hand. We also consider it essential that the cables which run through the baggage compartment must be covered in order to make sure that these cables are not fouled by articles such as engine covers et cetera when placed in the baggage compartment.[92]

C.M. Farrell pointed out that the cowling in front of the cockpit window required reinforcement so that the engineers could stand on the nose when putting on and taking off engine covers. While there was a small, reinforced square in the present design, Farrell wanted to see it expanded to prevent the cowling from buckling. He also suggested that the flap dial be moved from the ceiling to the instrument board to make it easier for the pilot to see and that the compass also be made more visible. In addition, Farrell noted that the ski gear needed improvement in the bungee arrangements and needed to be reinforced with a metal plate on the rear fitting of the ski pedestal to prevent

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[91] W.R. May to T.W. Siers and G.A. Thompson, 27 January 1937; W.R. May to C.H. Dickins, 8 February 1937; C.H. Dickins to R.B.C. Noorduyn and James Young, 7 May 1937; and C.M. Farrell to W.R. May, 21 April 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[92] C.H. Dickins to R.B.C. Noorduyn, 14 April 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

the ski from cracking.[93] Unfortunately, there is no indication in the records of Noorduyn's response to these requests.

Although the Norseman was not without imperfections, it was still an excellent aircraft. Despite its minor flaws, the Norseman's performance, cargo arrangements, service and maintenance features, and attention to crew and passenger comfort all contributed to its success as a northern bush plane. In fact, these characteristics represented the successful integration of northern flight experience into aircraft design. Even so, it had required some adaptation before it completely fit with northern bush flying conditions.

Even as the Norseman responded to northern operating parameters, it also matched cultural perceptions of design modernity. Not only was the Norseman well suited to its northern labours, the workhorse was presented in an attractive package. It was a sleek, well-faired aircraft with a shiny, high-gloss finish and an attractive interior. Unlike the boxy 71 or the ungainly Super 71, the Norseman's four longeron frame was ringed with round and oval wood frames, then covered with spruce stringers and a tight fabric skin to produce a smooth, rounded fuselage that flowed back from a streamlined NACA cowling.[94] The Norseman's major competition, the Fairchild 82, continued the boxy lines of its predecessors. Even the futuristic Bellanca Air Cruiser had the square lines of its contemporaries. By contrast, the Norseman's shape echoed the streamlining

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[93] Elastic bungee cords running from the front of the skis to the pedestal or leg kept the skis' tips elevated while the aircraft was in flight. C.M. Farrell to W.R. May, 21 April 1937, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft, Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[94] Fred Shortt, "Norseman Specifications," 86. "Where the Norseman or any of the new airplanes was clean and sometimes sleek, the 71 was bony with a lot of straight lines and things hanging out all over it." Dart, "A Few Recollections," 72, 74.

that formed a central element of the new *style moderne* that developed in the 1920s and 1930s, linking the Norseman to the flowing lines of modern industrial design.[95]

From the operator's perspective, the modern shape that echoed the smooth lines of racing planes and modern airliners would appeal to their customers. It also seduced Canadian Airways representatives. G.A. Thompson wrote, "I was very much taken with the Noorduyn Norseman when I saw it on floats in Montreal and I am beginning to think that it is probably a very much more efficient machine than the Fairchild."[96] Indeed, the fuselage's lines seem to have been more a question of image than practicality. The Norseman's speed, with its 550 hp Wasp engine, was only 15 mph faster than the Fairchild 82 CF-AXE, which was equipped with a Pratt and Whitney SC-1 Wasp producing 450 hp.[97]

Finally, the plane suited the economic context of the Mackenzie District in the mid-1930s. With the reviving economy and the increased value of gold, mineral exploration and development grew. As we have seen, the influx of capital meant more money for exploration and development and more airfreight. Increased traffic, combined

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[95] Crouch, *Wings*, 305-307.

[96] G.A. Thompson to W.H. Irvine, 3 March 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft: Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38.

[97] C.H. Dickins to G.A. Thompson, 16 October and 17 October, 1936, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft: Correspondence re Individual Noorduyn A/C plus CAL Correspondence re Noorduyn Aircraft, Sept 4/35 – Dec 21/38; Molson and Taylor, *Canadian Aircraft Since 1909*, p 323; Ellis, "Civil Aircraft Register", *CAHS Journal* 4:1 (Spring 1966): 25. It is unclear whether the Norseman ever received any wind tunnel testing. There is no indication in the Canadian Airways records of this taking place and, unfortunately, the Noorduyn records were largely destroyed when they were transferred to Canadian Car. However, there were wind tunnel facilities available at the University of Toronto as early as 1918, and by 1932 the National Research Council also had wind tunnel facilities, so the possibility remains that the aircraft could have been tested there.

with the age of its fleet, meant Canadian Airways needed new equipment to contain the traffic. In fact, in 1934, Canadian Airways had suffered an equipment shortage on the Mackenzie because three of their ships, CF-AMZ, CF-ATZ, and CF-AKY were unserviceable. The requests for more and newer equipment persisted into 1935, but the initial response from head office tended to be, "It is easy to talk about purchasing new equipment but not so easy to obtain the money."[98] In spite of the automatic response, the company was able to find the resources to replace some equipment in 1935, adding the Super 71 and another Junkers W33 to its fleet. However, it was not until 1936 that the company could afford to substantially increase its fleet. C.H. Dickins was adamant that some of this new equipment was needed to deal with the amount of traffic along the Mackenzie.[99]

While the increase in freight placed significant demands on Canadian Airways' existing fleet, it also highlighted the obsolescence of Canadian Airways' equipment, especially in comparison to competitors' fleets. Looking back, G.A. Thompson pointed out that,

> new incorporations publicly financed purchased the newest equipment, procuring aircraft designed more for the comfort of passengers than for utility and economy. After flying in this newer equipment, passengers began complaining of having to travel in older equipment. To hold this traffic other operators were forced to buy newer and more comfortable

[98] G.A. Thompson to C.H. Dickins, 1 March 1935, CAL Collection, AOM, Box 15: Airmail: Mackenzie River (and Edmonton McMurray).

[99] 16 January 1934; C.H. Dickins to G.A. Thompson, 23 February 1935; and G.A. Thompson to C.H. Dickins, 1 March 1935, CAL Collection, AOM, Box 15: Airmail, Mackenzie River (and Edmonton McMurray); Canadian Airways Limited, Annual Reports, 1935 and 1936, CAL Collection, AOM, Box 23: Annual Reports; C.H. Dickins to G.A. Thompson, 17 October 1936, CAL Collection, AOM, Box 39: Dart, "A Few Recollections," 72, 74.

> equipment. They had to do so although their aircraft in use were not fully depreciated, and were to all intents and purposes far from obsolete.[100]

Canadian Airways was experiencing pressure to purchase new aircraft on a number of fronts. The company needed to have the capacity to carry the growing amounts of traffic, and passengers wanted modern, comfortable aircraft. Mackenzie Air Service's competition only added to the pressure.

As in the period between 1932 and 1934, competition from Mackenzie Air Service continued to influence the composition of Canadian Airways' fleet. Concerns about an equipment shortage had persisted, but Canadian Airways' fleet remained stable through 1934 and 1935. While requirements for newer and greater amounts of equipment remained, in light of the company's overall financial position, it could not afford to purchase the necessary aircraft.

Through 1934, Canadian Airways added only one aircraft, CF-AWS, a Fairchild 71C, and Dickins continued to complain of an equipment shortage along the Mackenzie.[101] Late in 1933, he noted that rising traffic levels left him "convinced that the Company should take immediate action in purchasing some new machines as the general improvement in business conditions is very marked and before March we will have far more work than we can possibly handle. For the Mackenzie District alone I will require eight aircraft, together with pilots and engineers…." He continued, "we have already lost considerable business through inability to handle it, and it has been a very nice Christmas present for our opposition, who would be practically idle if it were not for this excess

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[100] G.A. Thompson, "Northern Air Transport," Parliamentary Brief, 1939, CAL Collection, AOM, MG 11 A 34, Box 65: A Brief entitled "Northern Air Transport".
[101] CF-AWS was actually a rebuilt aircraft containing parts from CF-AUA, the 71CM, which had been damaged at Senneterre, Quebec, during a windstorm in August 1934. J.R. Ellis, "Civil Aircraft Register, *CAHS Journal* 3:4 (Winter 1965): 113, 116.

traffic. . . ." "If some action is not taken very soon," Dickins concluded, "I feel almost sure that we are going to 'miss the boat' and that there will be a splendid opportunity of our competitors setting themselves up in business on a very sound basis."[102]

Thompson echoed Dickins' concerns in a letter to W.C. Sigerson:

> Out of a complement of nineteen machines which can be used on northern transportation, at the time of writing, eight are out of commission [including 3 in the Mackenzie District alone] ... One of Canadian Airways' strongest selling points has always been that we had sufficient equipment in reserve to take care of emergencies, but unfortunately this is no longer true, and will not be even when the above machines are again serviceable.[103]

Unfortunately, as Thompson knew, the purchase of new equipment was out of the question at the beginning of 1934.[104] The company simply did not have the money. Moreover, as he noted to W.E. Gilbert, the company could not have purchased equipment in sufficient time to address the Mackenzie equipment shortage – aircraft were not available overnight.[105] W.C. Sigerson did leave open the possibility that, if the company had a good year, they might be able to purchase new aircraft.[106] However, he did not see additional equipment as a panacea, especially when Canadian Airways faced rate cutting from its competition.[107]

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[102] C.H. Dickins to" G.A. Thompson, 28 December 1933, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[103] G.A. Thompson to W.C. Sigerson, 16 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[104] Ibid.
[105] G.A. Thompson to W.E. Gilbert, 21 February 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service Ltd, 1932-1940.
[106] W.C. Sigerson to C.H. Dickins, 2 and 3 January 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[107] "I feel that in your sincere enthusiasm you [G.A. Thompson] are being guilty of some fallacies in coming to your conclusion that the purchase of, for example, four Northrop Deltas in the Western Lines would bring the Company out of the red. Your difficulty, in my opinion, seems to be that you conclude that after the introduction of more efficient

As activity rose, so too did competitive pressures. At the same time, rates fell because of fiercely competitive undercutting. Mackenzie Air Service was quoting fares as much as 30% lower than Canadian Airways' posted rates. Canadian Airways was reluctant to follow Mackenzie Air Service's lead and attempted to wait them out, hoping that the other airline would eventually collapse from lack of revenue. In fact, in December of 1937 the two companies began to discuss a program of stabilized rates in an effort to avoid the destructive consequences of rate competition.[108]

According to Sigerson, purchasing new aircraft was not the solution because competitors could easily purchase the same equipment as Canadian Airways, eliminating the airline's competitive advantage. Although competitors could also theoretically purchase additional equipment, Thompson pointed out to Sigerson that the supply of inexpensive second-hand equipment was practically exhausted, in part because of the government's embargo on importing second-hand aircraft, making it more difficult for competitors to replace their fleets because they did not have access to the same resources

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equipment price conditions will remain the same. My thought on the contrary, is that so long as competition is unrestricted there is no bottom to the price structure, and the only bottom will be the out-of-pocket expenditures of the marginal producer, namely, the individual operator working "on a shoe string". Herein lies the fundamentally unsound phase of the Company's transportation business problem. To be sure the equipment problem is important, but what is the use of putting our capital, even assuming that we had any considerable amount available, into new equipment when the price structure is unsound and unstable. For example, even assuming that we did buy new and more efficient equipment, what assurance have you that independent operators competing with us will not buy the same equipment and, likewise, increase their efficiency." W.C. Sigerson to G.A. Thompson, 26 March 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.

[108] G.A. Thompson to C.H. Dickins and W.C. Sigerson, 13 January 1933, CAL Collection, AOM, MG 11 A 34, Box 28: Competitor's Activities; G.A. Thompson, "Northern Air Transport," Parliamentary Brief, 1939, CAL Collection, AOM, MG 11 A 34, Box 65: Brief entitled "Northern Air Transport"; W.E. Gilbert to G.A. Thompson, 26 August 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service Ltd, 1932-1940.

as Canadian Airways.[109] Despite this exchange, no new Mackenzie District equipment was forthcoming.

Again in 1935, Dickins pressed Thompson for new equipment, but Thompson replied that the equipment along the Mackenzie was adequate, especially considering the alternate methods of transportation available, namely dog sled and barges.[110] At the same time he was putting Dickins off, Thompson was in fact urging James A. Richardson to purchase new, Canadian aircraft.[111] The Super 71 had been such a plane, but it had been too expensive to be successful. In fact, any serious expansion of the Canadian Airways fleet waited until the appearance of the Norseman IV.

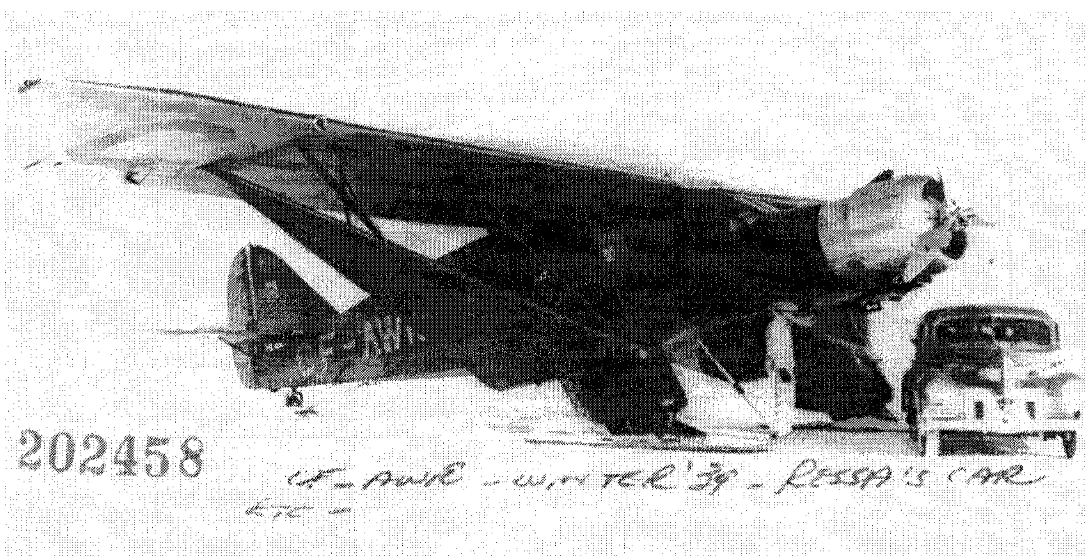

Figure 6.4: Bellanca Aircruiser. Mackenzie Air Service's Bellanca Air Cruiser, CF-AWR.
Source: AAM Photo Collection, 202458.

[109] G.A. Thompson to W.C. Sigerson, 12 April 1934, CAL Collection, AOM, MG 11 A 34, Box 6: Correspondence, Sept 1933 – May 1934.
[110] C.H. Dickins to G.A. Thompson, 23 February 1935; G.A. Thompson to C.H. Dickins, 1 March 1935, CAL Collection, AOM, MG 11 A 34, Box 15: Airmail, Mackenzie River (and Edmonton McMurray).
[111] G.A. Thompson to James A. Richardson, 12 August 1935, CAL Collection, AOM, MG 11 A 34, Box 7: Correspondence, June 1934 – Sept 1936.

In the meantime, Mackenzie Air Service did introduce a new aircraft in the spring of 1935. The Bellanca Air Cruiser, CF-AWR, was a large, single-engined, high-wing monoplane with lower struts that acted almost as a sesquiplane.[112] Their airfoil shape contributed almost 30 percent of the plane's total lifting area, augmenting its weight capacity. With a Wright Cyclone engine of 715 hp, the brawny aircraft could carry a gross licensed load of 10,853 lbs, almost double the aircraft's empty weight of 5,983 lbs, at a cruising speed of 137 mph over a range of 700 miles.[113] Mackenzie Air Service used the Bellanca primarily for Eldorado traffic, for which it had acquired an exclusive arrangement. Unfortunately, company records are scarce for this period, but there was no immediate response to the Air Cruiser apparent in Canadian Airways' fleet composition. Despite the Air Cruiser's enormous capacity and the carrier's arrangement with Eldorado, Canadian Airways continued to carry more passengers and cargo than Mackenzie Air Service did.[114] There seemed little reason to adapt the fleet in response to the Air Cruiser's introduction, especially given the financial conditions and constraints.

The real changes in Canadian Airways' Mackenzie District fleet composition began late in 1935. Mackenzie Air Service added CF-AXH, a Fairchild 82B, to its fleet

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[112] A sesquiplane is something between a biplane and a monoplane. It retains the full top wing and a stub of the bottom wing. For example, the Canadian Vickers Vigil and Fairchild 45-80 Sekani were both sesquiplanes.

[113] Donald Morrison Bain, *Canadian Pacific Airlines: Its History and Aircraft* (Calgary: Kishorn, 1987), 49.

[114] R.R. Brough to James A. Richardson, 16 August 1934, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service Ltd, 1932 – 1940; In 1935 Canadian Airways carried 310, 921 lbs of freight and express along the Mackenzie, as well as 1,384 passengers. Mackenzie Air Service, by comparison, carried 223,866 lbs freight and express and 903 passengers. G.A. Thompson to James A. Richardson, 12 March 1936, CAL Collection, AOM, MG 11 A 34, Box 28: Competitors' Activities #2, Jan 2/34 – Aug 23/39.

in December 1935.[115] However, they were unsatisfied with its performance and after testing it, declined to purchase the aircraft.[116] Canadian Airways acquired its own Fairchild 82, CF-AXE, in December of 1935. While it did not acquire the 82, Mackenzie Air Service did purchase a Norseman early on: a Norseman Mk II, CF-AZA, acquired in April 1936.

There is no indication in Canadian Airways correspondence that the Norseman occasioned serious concern – in fact, the company found that the Fairchild 82 outperformed the Mk II Norseman.[117] However, when Norseman performance improved with the Mk IV, Canadian Airways ordered one. According to Dickins, he hoped the model's super-charged Wasp engine and gross load of 6450 lbs would allow Canadian Airways "to compete very actively with [its] competitors as [the company] will have better equipment than others in the district. The extra cruising speed of this Norseman should make considerable difference in the long trips to Aklavik."[118] Although Canadian Airways had not responded directly to changes in Mackenzie Air Service's fleet, the competitive pressure exerted translated into an ongoing desire to purchase new, faster, planes that were better adapted to the Mackenzie. The addition of the Norseman MK IV was the first time the company was able to satisfy this desire with a Canadian designed bush plane.

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[115] J.R. Ellis, "Canadian Civil Aircraft Register," *CAHS Journal* 4:1 (Spring 1966): 25.
[116] R. Vachon to G.A. Thompson, 17 March 1936, CAL Collection, AOM, MG 11 A 34, Box 37: Mackenzie Air Service Ltd, 1932 – 1940.
[117] C.H. Dickins to W.R. May, 9 April 1936, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #3, March 12/36 – Nov 17/38.
[118] C.H. Dickins to W.R. May, 2 November 1936, CAL Collection, AOM, MG 11 A 34, Box 42: Edmonton and McMurray Base Correspondence #3, March 12/36 – Nov 17/38.

While the addition of a Norseman and a Fairchild 82 seemed to indicate Canadian Airways' willingness to purchase new aircraft, in 1937 the company had returned to a policy of maintaining, as opposed to expanding its fleet. This reflected the retrenchment made necessary by the Government's decision to create a crown corporation to operate the new trans-Canada airline, an operation that Canadian Airways had long sought and had long been convinced it would receive. Canadian Airways had invested extensive resources in preparation for becoming the national carrier, including instrument training for some of its pilots. That investment was wasted when Trans-Canada Airlines was born. In addition, the new company robbed Canadian Airways of its major southern routes and the income from these airways. Moreover, rate undercutting remained a problem. These two issues could help explain why the company did not buy more Norsemen, though they were generally pleased with their operations. It could also reflect the fact that their competitor, Mackenzie Air Service, was not expanding its fleet of Norsemen.[119]

CONCLUSION

Canadian Airways added the Norsemen to the Mackenzie fleet because of local conditions, particularly a chronic equipment shortage in the area and pressure from their competition. The company was able to do so because of the recovering economy that produced more activity in the district, which in turn generated more income for the airline. This income provided the resources that allowed Canadian Airways to purchase

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[119] In fact, in December of 1936 Mackenzie Air Service purchased a Beechcraft C-17R. While the aircraft did operate on floats and skis, its ovular, all-metal fuselage with a low, cantilevered monoplane resembled the new passenger airliners. Unlike other bush aircraft, this plane, CF-BBB, was used primarily for passenger and light freight transport. J.R. Ellis, "Canadian Civil Aircraft Register," *CAHS Journal* 4:2 (Summer 1966): 52.

more planes and, by the time they were able to add to their fleet, there were Canadian-designed and built bush planes available to choose. These planes, the Norseman and the Super 71, were also products of northern conditions, reflecting operational experience Canadian Airways had gained in the North.

Canadian aircraft manufacturers produced homegrown bush planes because of conditions that reached far beyond the Mackenzie Valley. The combination of a recovering economy and the increasing stability of bush flying created a permanent market for bush aircraft. However, just as the market stabilized, the traditional supply of foreign-designed mid-sized utility transports dropped because of the manufacturing industry's increasing concentration on the modern passenger airliner. This provided an opportunity for Canadian manufacturers who had lost their mail and light plane markets during the Great Depression. Fairchild and Noorduyn both responded by designing bush planes for use in Canada.

These companies wanted to be sure they could sell their aircraft and engaged in extensive consultation with prospective purchasers. Unlike previous models, these two aircraft were designed specifically for use in the Canadian North. By drawing on the experience of northern users and designing aircraft based on that experience, Fairchild and Noorduyn translated the northern aviation environment into material forms. What set these aircraft apart was this process. Rather than adapting designs that had been created with other purposes and contexts in mind, these two firms created aircraft specifically for the sorts of tasks and conditions encountered by bush aircraft operating in the Canadian North. These tasks and conditions set certain parameters that produced designs with similar characteristics, but what truly distinguished them as bush planes was the intent to create aircraft especially for northern bush flying. Through that process, the aircraft came to embody the elements of their context.

As a result of this consultation, the technology fit the North quite well. However, the aircraft's success depended on ambient conditions beyond northern geography and northern bush flying practices. The Norseman succeeded where the Super 71 had failed because it fit the northern geography, users' expectations and needs, cultural perceptions of technological modernity, and the company's economic needs. The Norseman matched these conditions so well primarily because of a design that integrated experience of northern flying into the machine's configuration. Its appearance as the first successful Canadian bush plane was the result of contextual conditions that surrounded both its initial emergence and its eventual success.

7 – CONCLUSION

By the time war broke out in 1939, the Mackenzie District was a very different place from the one it had been ten years earlier. At the end of the Great War the region's sparse population of fur traders and trappers had lived lives centred on the fur trading posts sprinkled along the major waterways. By 1939, mineral development had superseded fur trading as the dominant economic activity. The blossoming of this new economy was intertwined with the expansion of aviation into the Mackenzie. At every step aircraft offered important support by enabling extensive prospecting and mine development and by sustaining the communities that grew up around the mines, providing regular cargo and passenger transport, airmail service, and, sometimes, much needed medical transport. At the same time, the use of aircraft along the Mackenzie resulted in the expansion of a white, industrial society. Unlike the collection of white trappers and traders that staffed the fur posts, these new communities had little to do with the indigenous inhabitants, the Dene and Inuit, most of whom continued to depend on the so-called traditional hunting and trapping economy. It was as though mineral development had deposited a second stratum of society over the existing one.[1]

These new communities became relatively permanent resource towns – relatively permanent because their ongoing existence depended on the mines' continued operation.

[1] For a more detailed description of the social changes experienced in the Mackenzie and across northern Canada, see Morris Zaslow, *The Northward Expansion of Canada, 1914-1967* (Toronto: McClelland & Stewart, 1988) and Morris Zaslow *The Northwest Territories 1905-1980*, The Canadian Historical Association, Historical Booklet no. 83 (Ottawa: The Canadian Historical Association, 1984).

As support industries and businesses migrated north to these communities and as mine workers and managers started to bring their families north, the inhabitants began to press for the extension of services like hydro-electricity, running water, and the establishment of schools for their children. Amongst the white inhabitants, pressure also grew for the creation of responsible local government beyond the Northwest Territories Branch of the Department of the Interior (established 1921). While services, such as electricity, appeared relatively quickly in some places, local government would have to wait until after the Second World War. Regardless, life in the North was now very different.

Through their diffusion, aircraft had redefined the Mackenzie transportation network. While the main trunk still followed the river, by 1939 the side routes were dictated by mineral development, not fur. Changes in transportation also meant that the area was now much more intimately linked to the south. Before the First World War, overland travel on foot or by dog team would have taken many weeks to reach the railhead at Waterways and boat travel on river steamships was available only during the short summer navigation season. The presence of aircraft now meant that at any time of year other than freeze-up and break-up, the railway was only hours away from Aklavik, which was located at the very mouth of the Mackenzie. These changes were the result of the aircraft that enabled exploration, supported development, and were now the primary link to the outside world.

The war that began in 1939 brought another set of changes. During World War Two the Canadian North functioned as a resource basket for the war effort and in the drive to obtain these resources, governments financed exploration, development, and the expansion of transportation systems. The air age also meant the North acquired military significance. In the east, Goose Bay, Labrador, and Gander, Newfoundland, served as jumping off points for the Atlantic Air Ferry that carried aircraft manufactured in Canada and the United States over Greenland to isolated Britain. In the west, United States military priorities guided development. The Alaska Highway and the Northwest Staging Route (a series of airfields reaching through the Yukon to Alaska) provided the means of moving supplies, equipment, and personnel to the Alaskan front. Although theoretically overseen by a joint Canada-United States planning board, in reality the Americans dominated the planning and provided most of the funding. Alongside the highway and air route, the two countries built the Canol pipeline to bring oil from Norman Wells to Whitehorse and from there to Alaska.

Neither the Northwest Staging Route nor the Alaska Highway concerned the Mackenzie Valley or the Northwest Territories, but the Canol project was another story. Not only did the project contractor support extensive oil exploration in the territory, it also expanded the winter tractor-train supply system and improved the river transport system at the same time as it built a series of gravel and dirt airstrips at major points along the route to Norman Wells.[1] While the pipeline was abandoned and removed after the war's end, the transportation infrastructure would remain, leaving an indelible impression on the North. The reopening of the Eldorado mine in 1942 (it had closed in 1940) also had an impact on the Mackenzie, increasing air traffic in the North. Wartime activity opened the area even further and resulted in a greater integration of northern and southern transportation networks, particularly with the construction of permanent airfields.

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[1] Zaslow, *The Northwest Territories*, 11.

The airfields' appearance fundamentally changed the character of aviation along the Mackenzie by opening it to a completely new type of aircraft: wheeled passenger airliners.[2] Gradually, these airliners came to dominate flying along the main trunk line. In the post-war era of the Cold War, the military presence in the North would continue to expand the area's transportation and communication services, including the construction of the Distant Early Warning (DEW) line stations in the late 1950s. Yet, there remained a role for the bush planes that continued to support prospectors, hunters, trappers, and sports fishermen, as well as serve isolated communities. While most settlements now have their own airfields, there continue to be locations that are accessible only by air and only by a bush plane. Even today, the bush plane's drone remains a familiar sound over northern rocks and lakes.

Figure 7.1: Refuelling CF-AWR, Summer 1936.
Source: AAM Photo Collection, 202739.

[2] For instance, Yellowknife opened its first airstrip in 1944. Ray Price, *Yellowknife* (Toronto: Peter Martin Associates Ltd, 1967), 300.

Indeed, this landscape helped to create the indigenous Canadian bush plane. The Mackenzie District is a vast area of boreal wilderness. Encompassing the northern reaches of the Canadian Shield, it is a region of rolling rock hills that cradle countless lakes and swampy muskeg bogs. For mineral developers, the land had its own value, promising access to wealth, both in the rich mineral deposits and in the lakes and rivers that allowed aircraft to reach potential mines. For aviators it offered a life of freedom and adventure. According to Con Farrell, it was a good life:

> It was interesting, tremendously interesting and there was always something new. You were always finding out this or that or the other. And the people were wonderful. None of these ideas, if I haven't been introduced to him I can't speak to him, that's it. No, it was just – flying in those days was – well, I think we could call it the romance of the north. And it was, it was something. Just got in your blood and you loved it.[3]

For Archie McMullen it was the freedom that was so attractive: "You were on your own. Your life was in your own hands. Your destiny was in your own hands and it was up to you to take care of it."[4] Walter Gilbert echoed those thoughts:

> Oh yes! It's the most wonderful life a person can ever have. If you could repeat it as it had been then, because your organization gave you an airplane, you were, I guess, as completely in control of things as the skipper of an ocean liner and you did your own planning. You had the work to perform. You laid it out as it was, if other work came along and you had time to do it, you continued. Nobody worried about you. ...Nothing ever seemed to happen to anybody. There were very few accidents. So it was a carefree life and hard work, hard physical work, and you didn't have any stewardesses running up and down to feed you hot meals two or three times a day, and when you wanted to refuel, you fuelled from barrels that were either frozen down to the ice in the winter, or stuck in the mud in the summer – a lot of hard work, freight handling and the rest. There was much more time spent in manual work than there was in flying, but it was a good healthy life, people liked us and we liked people, and had a good income. I ask nothing better.[5]

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[3] Con Farrell, Interview, 20 August 1967, NWT Archives, G-1988-008-002.
[4] Archie McMullan, Interview, 16 September 1978, NWT Archives, G-1988-008-0009.
[5] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.

Intriguing in its own right, the bush plane's history offers a window onto important ideas in the history of technology. Enquiring into the process of indigenization that follows a technology's introduction into a new environment shows us how local use context is translated into a new technology, emphasizing the role of the user as the vector in this process. The user's important role reminds us that the process of use is an important component of technical history and that the history of technology encompasses more than just the moment of design or the period of innovation. It reaches out to include the life of a technology once in operation and the consequences of that process for the user, the use context, and the artefact itself.

Bush flying's earliest history illustrates the way in which the interaction between technology and a particular use context can lead to the development of unique forms of technical application. That is, the practice of bush flying grew out of particularly Canadian conditions during the 1920s and 1930s. For instance, Canada's long distances, lack of large population centres, and difficult geography discouraged the development of European or American style intercity passenger services until the end of the 1930s. Of course, the government's unwillingness to support commercial aviation contributed to this situation. However, the same geography that blocked a transcontinental airway, the Canadian Shield, also presented an opportunity. The Shield provided the resource industries, forestry and mining, and the flexible landing places on lakes and rivers, that allowed Canadians to develop a new style of aviation: bush flying. This practice would be the basis for an important component of Canada's aviation development and would ultimately lead to the creation of a new sort of aircraft, the Canadian bush plane.

The bush plane's history is also significant because it highlights geography's role in the history of technology. When bush flying came to the Mackenzie region at the end of the 1920s, geography would have specific effects on local bush flying patterns and practices and on the technology itself. For instance, the Mackenzie Valley's geography shaped the plane's routes. To begin with, the aircraft followed the traffic, and that traffic came from the existing settlements, primarily fur posts, which were located along the river because of a dependence on the river for transportation. The river's role as an emergency landing field reinforced the tendency to replicate the old river route. As mining development became a bigger source of income, the land's geology, which determined the location of mineral deposits, also shaped flight patterns. Moreover, seasonal patterns of activity were heavily influenced by climate: the planes could not access the North during fall freeze-up or spring break-up. Northern aviators adapted the rhythm of their operations to these conditions.

This climate and geography would also influence the types of aircraft that were appropriate for northern aviation. When Western Canada Airways began flying the Mackenzie in 1929, they used a fleet of Fokker Super Universals, variants on the Fokker Universals that had successfully plied the air of Northern Ontario since 1926. However, the interaction between aircraft and place, specifically northern winter operating conditions, required specific adaptations if the Super Universals were to continue to function in their new environment. Although Western Canada Airways selected the Fokker Super Universal based on what it thought it knew about northern operating conditions, actual experience along the Mackenzie would demonstrate that the region's geography was different from others previously encountered and this realization would affect the technology's design. For example, the cold winters and harsh landing conditions of the Mackenzie Valley proved too strenuous for the Super Universals, resulting in catastrophic undercarriage failures and forcing the airline to push the manufacturer to develop suitable modifications. In response, the users worked directly with the manufacturer to produce an adaptation that would enable to machine to survive in its new use context.

The airline's experience with the Super Universals is made even more striking by their parallel experience with the Bellanca Pacemaker. Initially purchased by their competition, Commercial Airways, the Pacemakers became part of Western Canada Airways' fleet when the company absorbed Commercial Airways in 1931. These aircraft, especially when compared to the Supers, were well adapted to the environment, and when they did experience technical difficulties, these were minor and were quickly addressed by the manufacturer. The contrast between the two aircraft highlights the important role that the compatibility of a technology and its physical environment can play in the success or failure of technology transfer and the pressure these conditions exert on a technology. Users' choices in response to these pressures would shape the bush plane's evolution.

At the same time as it underscores the effect of geography on technological design, the bush plane's history reminds us that the process is not unidirectional. Just as the Mackenzie moulded the bush plane's technology, aircraft influenced the Mackenzie's geography. While geography shaped the machine, the aircraft were also hard at work reshaping the Mackenzie District's geography. The strongest example of this process was the role of the airplane in discovering and developing the Great Bear Lake radium fields. In this case, aircraft supported the initial prospecting parties, providing transportation of crews and supplies. Indeed, Gilbert LaBine's identification of the potential for radium ore occurred from the window of a Western Canada Airways Fokker Super Universal. Then, during staking and development, aircraft were essential in transporting people and provisions to the area, especially given the short period of open navigation on the lake. The appearance of these camps and later, these mines, reconfigured Mackenzie District operating conditions by changing traffic patterns, opening a new arm of the Mackenzie airmail contract, and extending the range aircraft were required to regularly travel.

This episode also recalls history's complexity by illustrating that technological change is the result of more than geography. Economic and political conditions during the early 1930s also played significant parts in the bush plane's development. The swelling rush to Great Bear Lake in 1932 was a boon to a company beleaguered by the Great Depression and consequent cancellations of southern airmail contracts. However, even as it provided much needed business, the rush placed increased demands on Canadian Airways' aircraft and encouraged the emergence of competition in the form of Mackenzie Air Service. These changes, when seen in the context of wider political and economic conditions that reduced the airline's income from other sources, particularly airmail, made it essential for Canadian Airways to remain competitive along the Mackenzie. Increased competition and changing passenger expectations led the airline to refine its definition of an appropriate aircraft for the Mackenzie District.

Within this new environment, the Super Universal no longer competed only against the dog team. Compared to Mackenzie Air Service's overloaded aircraft, the

Super lacked the payload capacity, passenger comforts, and modern appearance that the new circumstances encouraged operators to value. As their definitions of technological 'goods' changed, the Super's status declined and just at the moment it became adapted to the North, it became obsolete. Unlike the failing undercarriages, this obsolescence was not a consequence of the machine's ability to operate in the physical environment. Instead, it reflected changes in operating conditions in the Mackenzie District that, in turn, had caused the operator to redefine what it considered desirable in an aircraft. As a result, the airline decided to change the composition of its northern fleet. In place of the Fokker Super Universals, Canadian Airways substituted Junkers W 33/34s and Fairchild 71s, including the 71C, a specialized Canadian variant on the 71 design.

The response to the Great Bear Lake rush was the last time Canadian Airways would be able to select only from foreign designed aircraft, because, it was just shortly thereafter that indigenous Canadian bush planes began to appear. Over the preceding period, Canadian aviators and airlines had acquired the experiential knowledge that manufacturers and designers could translate into new aircraft designs. This process reveals the role of users in translating use conditions into context-specific adaptations and indigenous designs.

Given the nature of aircraft design, which requires heavy capital investment in the design and development of new models, aircraft manufacturers were obviously keen to ensure that there was a market for their products before embarking on major design developments. Thus, one sees a good deal of communication between aircraft users and manufacturers. The obvious exception is Bellanca Aircraft and the reasons for the lack of correspondence between the manufacturer and Canadian Airways remain unclear from the airline's archives. However, with other manufacturers such as Fokker and Fairchild, user feedback concerning operating experience and conditions resulted in modifications and eventually found itself incorporated in new aircraft designs. Because of the nature of aircraft manufacturing, user feedback was an important component of the design process. This provided a means for inscribing experience with northern use conditions on the new indigenous bush plane.

In the bush plane's case, users' experience with northern operating conditions led, first, to context appropriate modifications. These began with small adaptations such as the Fokker Super Universal's undercarriage adjustment. Technically, it was quite a small change, but it had enormous operational significance and its conception quite clearly reflects the influence of conditions in the Mackenzie Valley. After these sorts of changes, one begins to see Canadian-specific modifications of existing designs, specifically the Fairchild 71 C. For instance, the 71C's metal-lined cabin protected the structure from damage by heavy freight, the improved cowlings and cabin heating responded to northern winter conditions, and the modified rear cabin doors allowed 45 gallon fuel drums to be rolled into the cabin. Through these sorts of adjustments, Fairchild began incorporating northern operating conditions into its designs.

The final stage in the process of technological adaptation came in the mid-1930s with the appearance of the Fairchild Super 71 and the Noorduyn Norseman. In these machines, the northern context became concrete. Their designs reflected the operational requirements and physical environment of northern aviation because their designers had incorporated the knowledge and experience of these conditions gained by the aircraft users. The aircraft that emerged were products of their ambient conditions. To begin with, a network of conditions, including economic circumstances, growth in the Canadian manufacturing industry, the appearance of the modern airliner and the subsequent shift in the focus of foreign aircraft manufacturers, the maturation of bush flying and therefore of its users' needs, and the accumulation of user experience that could be communicated to Canadian manufacturers, conspired to trigger the creation of Canadian bush plane designs. These developments encouraged Canadian aircraft manufacturers to see the bush plane market as an attractive niche and to work with Canadian bush fliers to develop an indigenous Canadian bush plane.

Although the archives provide little detail on the development process, they do indicate that both Fairchild and Noorduyn consulted with northern aircraft users during the design of their new models and the results reflect a number of northern use conditions. For example, the practice of bush flying required a versatile aircraft that could handle loads that ranged from fuel drums and passengers to mining equipment and, sometimes, a combination of cargos. Both Fairchild and Noorduyn sought to accommodate this requirement. For instance, both had seats that could be removed from the fuselage to allow for full loads of freight. The Norseman's stubby body minimized complications that might arise from load distribution and Fairchild hoped to address similar concerns by placing the pilot's cockpit behind the wing, thereby balancing weight that might be placed at the front of the fuselage. More obviously, both types could be used with skis, floats, or wheels, and the Norseman was even designed as a float aircraft to ensure that no speed would be lost in the conversion from skis to floats.

Bush flying in the Mackenzie also required a reliable and rugged aircraft that could be maintained and repaired easily. Operating in the wilderness over areas that were inaccessible and unpopulated, the crew and company needed to be able to rely on their planes and to be confident that they could withstand harsh operating conditions. Far from repair centres, safety required that the flight engineer and pilot be able to repair the plane in the bush so that they would not be stranded in the event of a minor technical problem. The ability to repair the plane on site also protected the airline's capital investment by ensuring that the plane would not be removed from service for prolonged periods. Moreover, northern operators did not have access to extensive parts depots or repair equipment. As a result, a machine that could be repaired with on-site materials meant that aircraft would not have to be sent to the central shops for minor repairs. Finally, work conditions on northern runs were less than ideal. Much of the maintenance and repair work required the flight engineer to perform his tasks without heavy mittens or gloves. In the winter, this meant working with metal parts in temperatures that were far below freezing. Thus, any arrangements that made maintenance and repair work easier were much appreciated by northern users. Both the Super 71 and the Norseman incorporated arrangements to facilitate maintenance. For instance, the Norseman offered an oil tank with funnel filler located on the easily accessible lower nose while the Super 71 had features such as a detachable engine mount. However, the Norseman's construction of wood and fabric was easier to repair on site than the Super 71's all-metal, monocoque fuselage. Nevertheless, each manufacturer responded to northern maintenance and repair conditions.

Even the aircraft's configuration reflected northern operating conditions. As we have seen, the Norseman's relatively stubby fuselage enabled the aircraft to contain the variety of cargos provided on a northern bush run without destabilizing the aircraft. The fact that the bush plane was a mid-sized aircraft also reflected the load sizes regularly available in the north. In addition, it enabled the aircraft to land and take off from a greater number of lakes. A larger aircraft would require a longer distance to land or lift off and thus would be limited in the number of potential destinations. The mid-sized arrangement was a compromise between sufficient load size and maximizing landing sites. Moreover, the bush plane's good lift reinforced its ability to get into and out of many locations, expanding its potential market. Finally, even the choice of the high-wing monoplane reflected northern bush conditions. This configuration eased loading of cargo and passengers and improved pilot visibility over unfamiliar territory or on unfamiliar landing sites. The choices of designers and users that made their way into the Canadian bush plane reflected the northern operating conditions and the knowledge of northern bush flying that they had gained along the Mackenzie. They were all-purpose utility aircraft fine-tuned to accommodate northern needs and withstand the northern environment.

Specific features such as the extra wide doors that could accommodate 45-gallon drums of gasoline were also the direct result of northern conditions, in this case, the need to transport fuel to remote locations, but it was the overall flexibility characteristic of the bush plane that was truly the legacy of northern aviation. This versatility was a product of bush flying's characteristics, including the need to carry many types of cargo to a variety of locations. In these remote areas, operators did not have the luxury of specialized services that separated types of cargo, for example airmail or passenger runs, and specialized facilities like maintained landing fields. The indigenous bush planes of the 1930s responded by offering versatile, manoeuvrable, reliable, multi-purpose aircraft.

The contrast between the Super 71's failure and the Norseman's success reinforces the importance of use-conditions in the history of technology. Just as their designs reflected the North, the planes' success and failure depended on ambient operating conditions. Both the Norseman and the Fairchild Super 71 fit well with the northern geography and both could operate successfully, at least in a technical sense. The Norseman had two advantages, however. First, it had better aesthetic lines than the ungainly Super 71, an important consideration in a market such as the Mackenzie that continued to be hotly competitive. Second, whereas the Super 71 had appeared as the aviation market was shrinking and Canadian Airways was pursuing drastic restructuring just to stay afloat, the Norseman arrived as the aviation economy began to recover. The Norseman's success, just like the Super 71's failure, the features of their design, and the initial impetus to create the aircraft, were the result of aviation conditions in the North.

The lessons drawn from the bush plane's history have important implications for our approach to the history of technology. The bush plane's history points us towards the role of the user in the history of technology, prompting us to expand our frame of analysis to not only include purchasers, but also to examine the impact of other technical users on a technology's eventual shape. Such an analysis reminds us of the importance of use and use context in informing technical change and in so doing highlights the role of geography in technical development. Finally, the bush plane's story reminds us of the complexity of technological histories. The machines that we examine exist within rich webs of historical conditions and often play important roles in reshaping those conditions. Accounting for this richness requires that we adopt a flexible approach to history, recognizing that conditions change over time and circumstances that may have heavily influenced our subject at one point, may not be relevant within another context or at another time.

Though it was not the only influence at work, the bush plane's story highlights geography's importance in the history of technological development, reinforcing the materiality of technology. Granted, these aircraft were all designed, constructed, selected and used by people, all of whom took actions and had input that shaped the technology's history, but the machines also exist in the material world, a fact that historians of technology must not forget. This is not a deterministic argument that seeks to remove human agency and choice from the history of technology or claim that cultural and social structures and conditions have no role in technologies' creation or lives. In fact, I am firmly committed to the idea that it is human choice in response to material and non-material conditions that create new adaptations, modifications, and designs. Rather, I want to prompt us to remember material conditions of use when we examine the history of technology. To do so in the context of the bush plane and the Mackenzie encourages us to focus on local use conditions, particular local geography.

Nevertheless, the bush plane's history also indicates that Canada as a country has its own technological history. We may be, as several historians of Canadian technology suggest, a nation of technological borrowers, but we have also produced adaptations and indigenous designs that respond to the conditions we encounter here in Canada. One sees it especially clearly with the bush plane. As an examination of its evolution in the context of the Mackenzie District demonstrates, Canadian geography, economics, politics, and culture all played a role in its maturation. This fact suggests the utility of the concept of national styles of technology and it is useful, but sometimes other units of analysis may be equally useful. For instance, in the bush plane's case it may be equally informative to consider it, as does this thesis, in terms of regional conditions. It is my hope that future studies in Canadian aviation history will provide other regional studies against which to place this work. Such comparisons will only enrich our understanding of the relationship between local conditions and aviation's technical evolution. One might also pursue the idea of the bush plane as a frontier technology, comparing it to other technologies that evolved in similar circumstances in order to evaluate the idea of the frontier as a useful unit of analysis in the history of technology. Such an investigation awaits further study.

The Norseman was both an end and a beginning. On the one hand, the aircraft represented the culmination of the technology transfer process. Whereas, previously, operators had depended on importing foreign-designed aircraft and adapting them for use in the North, they now had an aircraft type indigenous to Canada. On the other hand, it also represented a beginning. The Norseman was the first in a line of Canadian bush planes that went on to diffuse outwards from the Canadian North and find service in other, dramatically different regions of the world. The Norseman itself was eventually adopted by the American military, seeing service with the United States Army Air Force (USAAF), establishing a staging route across Greenland to support the ferrying of aircraft to Britain and Europe during World War Two. After the Americans entered the war, Noorduyn produced a modified version of the Norseman specifically for the USAAF, which the RCAF also purchased. At least six other air forces also employed the Norseman, including the Royal Australian Air Force, the Brazilian air force, the

Netherlands East Indies, Honduras, the Royal Norwegian Air Force, and the Royal Swedish Air Force.[6]

There were other bush planes that would follow in the Norseman's footsteps, including de Havilland Canada's ever-popular Beaver and Otter designs. There was a twelve-year gap between the Norseman's birth in 1935 and the appearance of the Beaver in 1947. The delay can be explained by a number of conditions. First, the creation of Trans-Canada Airlines and the opening of a transcontinental passenger service in Canada shifted the focus of Canadian aviation to intercity passenger transport. Moreover, the decision to create a government corporation to fly the route dealt a severe blow to Canadian Airways. The company had hoped to be selected as the government's chosen instrument. Instead, C.D. Howe and the Liberal government created a crown corporation and forced Canadian Airways to abandon its intercity routes and to concentrate on its bush lines. The decision was a body blow. The company that had developed many of Canada's bush air routes was no longer the major force in Canadian aviation. It had been supplanted by the southern passenger carrier. Shortly after Trans-Canada Airlines' creation in 1937, James A. Richardson himself died in June, 1939 and management of the company quickly passed to the Canadian Pacific Railway. The aviation industry no longer saw bush aircraft as the central component of the Canadian aircraft market.

In addition, the lead up to World War Two encouraged manufacturers to focus on military design and production.[7] During the war, aircraft manufacturing focused almost exclusively on wartime needs, leaving the design of new bush aircraft for another day.

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[6] K.M. Molson and H.A. Taylor, *Canadian Aircraft Since 1909* (London: Putnam, 1982) 398-403.

[7] Rénald Fortier, "Intervention gouvernementale et industrie aeronautique, L'example Canadiene, 1920-1965," (Ph.D. diss., Université Laval, 1990), 47-48.

Luckily, the experience with military production laid a solid foundation for de Havilland Canada, which they would draw on when designing the Beaver and Otter.

CF-FHB-X, de Havilland Canada's Beaver prototype, first flew in 1947.[8] This rugged short-take-off-and-landing (STOL) aircraft would become the iconic bush plane of the second half of the twentieth century. Described by some as a flying pick-up truck because of its gritty ability to carry substantial loads, the Beaver had a very successful career in the Canadian North. In some ways, this success was unsurprising. The Beaver was the result, not only of de Havilland's wartime construction experience, but also of extensive consultation with Canadian bush pilots. As Walter Gilbert remembers,

> Punch Dickins retired, you could say, into de Havilland. He became sales manager for de Havilland Aircraft and he immediately decided that something should be done .... He sent out the same old questionnaires, but when they came back, they were studied and the direct result of those was the de Havilland Beaver, which had never been a more wonderful bush aircraft [sic].[9]

What Gilbert remembered most was

> Its fantastic performance – takeoff; economic cruise; easy to fly and good visibility – just everything we wanted. They sat down and made an honest effort to get that. And, they established themselves a lead that hasn't been lost.[10]

Interestingly, the very features that made the Beaver so popular on bush operations coincided with the needs of the post-war United States Army Air Force. While the Americans began with a small order, de Havilland eventually supplied 976 Beavers to the United States military. They were used in a variety of roles, including carrying supplies and medical patients in and out of unprepared spaces right near the

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[8] For the history of the de Havilland Beaver see Sean Rossiter, *The Immortal Beaver: The World's Greatest Bush Plane* (Toronto: Douglas & McIntyre, 1996).
[9] W.E. Gilbert, Interview, ca. 1967, NWT Archives, G-1988-008-0003.
[10] Ibid.

front lines in Korea and Vietnam. The planes also served as troop transports and as instrument flight trainers. The Americans were not the only ones to recognize the Beaver's potential and the aircraft served with the British Army Air Force in Commonwealth countries around the world. The plane also served in places as diverse as Cambodia, Ghana, Finland, Laos, Argentina, Pakistan, and Peru. In Australia and New Zealand, the plane was used for aerial fertilization and on the Commonwealth Trans-Antarctic Expedition. The Beaver's ability to fill a variety of roles around the world reflected the bush plane's central characteristic: its flexibility. This quality, which arose out of the nature of aviation along the Mackenzie Valley and other parts of northern Canada, made the bush plane highly adaptable and able to spread out from the Canadian north. This versatility was the product of a process of technological adaptation that began in 1929 with the first commercial operations along the Mackenzie River.

While one might worry that a detailed examination of a national myth might strip it of its magic, in the case of the Canadian bush plane this exploration reveals a fascinating web of interconnected historical influences that came together in the Mackenzie to influence the evolution of a new, Canadian type of aircraft. The intersection of geography, economics, politics, cultural perceptions, and technological characteristics that occurred in this region during the late 1920s and early 1930s reminds us of the richness of the history of technology. At the same time, it recalls us to the richness of Canadian history and the important place of the North within that history. While the North is often treated as a mystical place through which and against which southern Canada defines itself, the bush plane's history reveals that the North's history is no less fascinating than the cultural myths that so often obscure its reality. The same is true of the Canadian bush plane. A figure in colourful folk history, the bush plane's technical history is also fascinating, offering a chronicle that reminds us of the complexity at work in the history of technology.

APPENDIX I: TECHNICAL APPENDIX

BELLANCA CH-300/PACEMAKER

Source: AAM Photo Collection, 202280, CF-BFC Bellanca, Canadian Airways Limited, 1938

First Flight:	1928
Dimensions:	
Wingspan:	46'
Length:	27'9"
Height:	8'4"
Cabin Size:	78" *l*, 41.5" *w*, 57.5" *h*
Payload:	1050 lbs
Engine:	Wright J-6 Whirlwind, 300 hp
Cruising Speed:	140 mph
Range:	850 miles

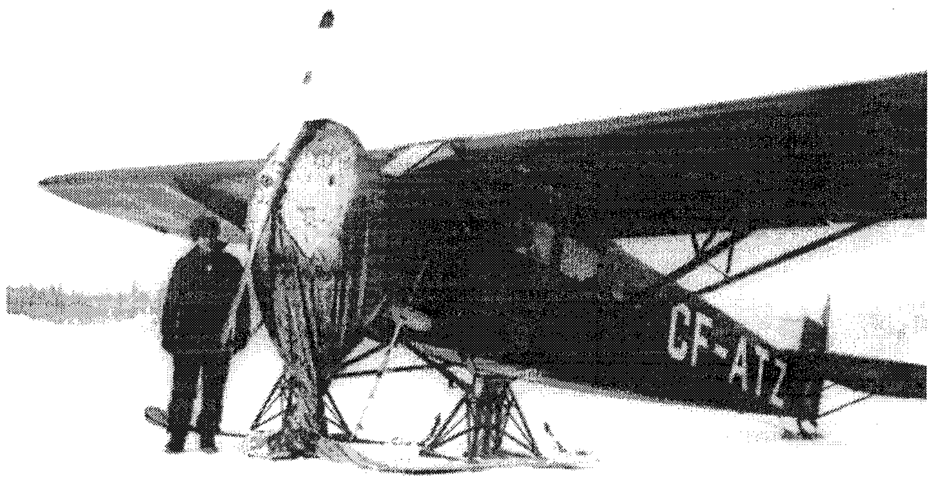
Source: G.A. Thompson to W.G. Sigerson, 7 December 1932, CAL Collection, AOM, MG 11 A 34, Box 5: Correspondence Oct 1932 – Aug 1933; "Description of Aircraft," CF-AML Logs, CAL Collection, AOM, MG 11 A 34, Box 75: CF-AML Logs 2 June 1930 – 1 September 1932; Molson, *Pioneering*, 276

Fairchild FC-2

First Flight:	1927 Fairchild FC-2W appeared later in 1927 Fairchild FC-2W2 appeared in 1928
Dimensions:	
Wingspan:	44'
Length:	30' 11.25"
Height:	9'
Cabin Size:	*unavailable*
Payload:	543 lbs
Engine:	Wright J-5, 200 hp Fairchild FC-2W:Pratt & Whitney Wasp, 400 hp
Cruising Speed:	103 mph
Range:	600 miles

Source: G-CARH Logs, CAL Collection, AOM, MG 11 A 34, Box 79: G-CARH Logs, 13 December 1931 – 31 July 1932; J. Juptner, K.M. Molson, T.K. Rinehart, "The Fairchild Utility Monoplanes: A Production Record and Illustrated Type Description," *CAHS Journal*, 11:1 (Spring 1973) 11-22; Molson, *Pioneering*, 285

FAIRCHILD 71

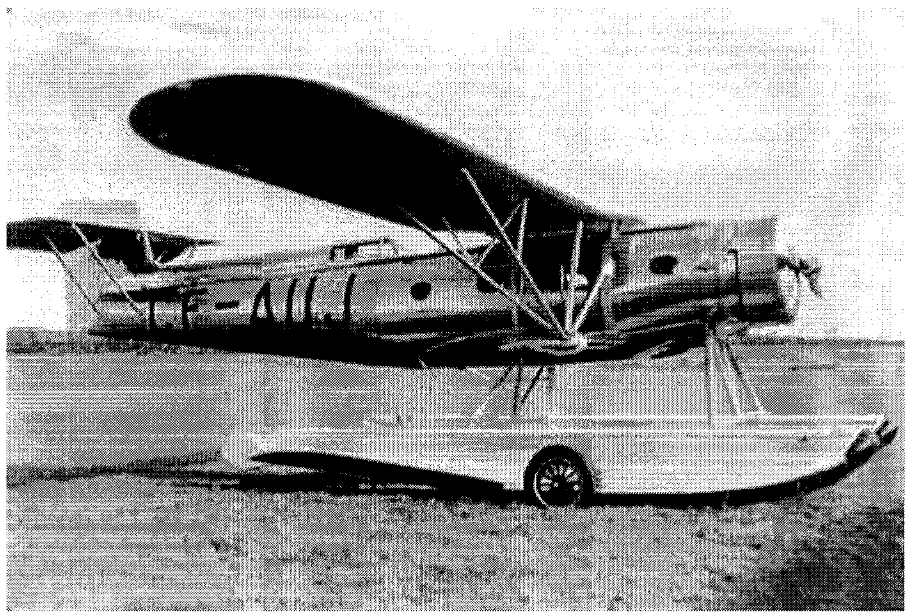


Source: AAM Photo Collection, 202234, CF-ATZ, Fairchild 71C, Canadian Airways Limited, Late 1930s, Dick Leigh

First Flight:	1928
Dimensions:	
Wingspan:	50'
Length:	32'10"
Height:	9'4"
Cabin Size:	72" *l*, 37" *w*, 57" *h*
Payload:	1025 lbs (floatplane) 1365 lbs (landplane)
Engine:	Pratt & Whitney, Wasp C, 425 hp
Cruising Speed:	102 mph (floatplane) 110 mph (landplane)
Range:	650 miles (floatplane) 750 miles (landplane)

Sources: "Handbook of Instruction, Fairchild Seven Place 'All Purpose' Cabin Monoplane Model '71'", [no date] WCAM AC-I43; CF-AKY Initial Analysis, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft: Individual Fairchild Aircraft; CF-AKY Certificate of Airworthiness for Export, CAL Collection, AOM, MG 11 A 34, Box 31: Fairchild Aircraft: Individual Fairchild Aircraft; J. Juptner, *et al*, "The Fairchild Utility Monoplanes," 11-22; Molson, *Pioneering*, 287

FAIRCHILD SUPER 71



Source: WCAM, Fairchild Collection, 4750, CF-AUJ, 1934

First Flight:	1934
Dimensions:	
Wingspan:	58’
Length:	35’6”
Height:	10’6”
Cabin Size:	13’6” *l*
Payload:	1989 (floatplane) 2051 (ski plane)
Engine:	Pratt & Whitney Wasp T1D1, 525 hp
Cruising Speed:	125 mph (floatplane)
Range:	817 miles

Sources: J. Juptner, *et al*, “The Fairchild Utility Monoplanes,” 11-22; Molson, *Pioneering*, 288; Molson and Taylor, 316-319; “Summary of Comparative Operating Cost Efficiency as between Junkers 34, Northrop Delta, Fairchild Super,” 9 October 1934, CAL Collection, AOM, MG 11 A 34, Box 44: WCA and CAL Machine Operation Costs, 1928-1935

FAIRCHILD 82

Source: AAM, Photo Collection, 204015, CF-AXO, Fairchild 82, Mackenzie Air Services, Coppermine, 1938

First Flight: 1935

Dimensions:
- **Wingspan:** 51'
- **Length:** 36' 10.75"
- **Height:** 9' 4.5"
- **Cabin Size:** *unavailable*

Payload: *unavailable*

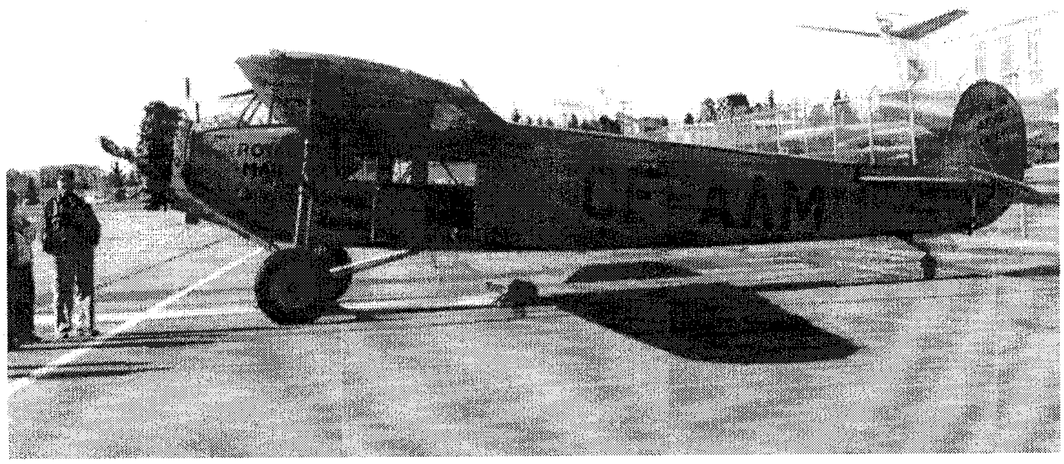
Engine:
82A: Pratt & Whitney WC-1 Wasp, 450 hp, T1D1 Wasp, 525 hp, or S1D1 Wasp, 550 hp
82B: Pratt & Whitney S2H1 or S3H1 Wasp, 600 hp

Cruising Speed:
82A: 128 mph (with T1D1 Wasp)
82B: 130 mph (with S3H1 Wasp)

Range: 82A: 657 miles

Sources: J. Juptner, *et al.* "The Fairchild Utility Monoplanes," 11-22; Molson, *Pioneering*, 289; Molson and Taylor, 320-323

FOKKER SUPER UNIVERSAL



Source: CF-AAM, Fokker Super Universal, Restored by Alberta Aviation Museum, Bob Busse, Alberta Aviation Museum, Personal Collection

First Flight: 1928

Dimensions:

- **Wingspan:** 50'7"
- **Length:** 36'7"
- **Height:** 9'5"
- **Cabin Size:** 108" *l*, 42" *w*, 50" *h*
  Additional 30 cubic foot baggage compartment

Payload: 750 lbs – 780 lbs

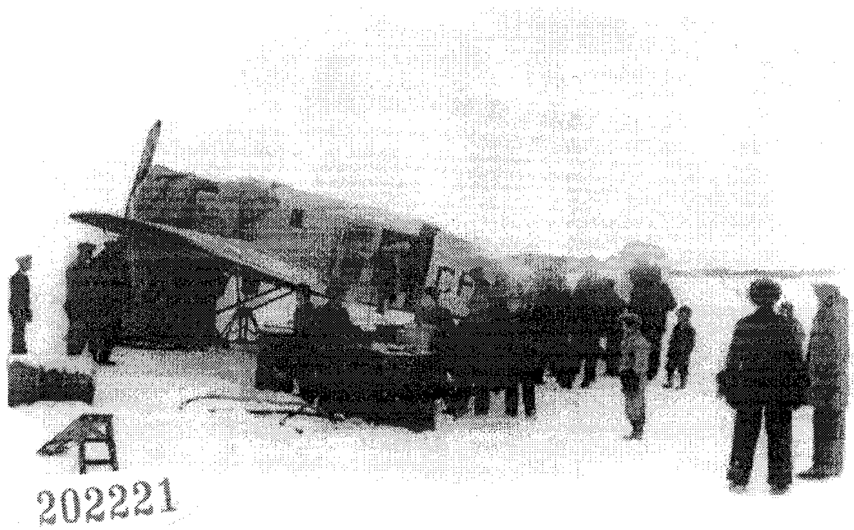
Engine: Pratt & Whitney Wasp, 400 hp

Cruising Speed: 118 mph

Range: 700 miles

Sources: CF-AJC, Aircraft Initial Analysis, [no date]; CF-AJC, Certificate of Registration of Aircraft, 25 June 1930; CF-AJF, Aircraft Initial Analysis; CF-AJF, Certificate of Registration of Aircraft 7 January 1930; G-CASN, Certificate of Registration, 17 December 1928; G-CASQ, Certificate of Registration, 16 January 1928: CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft; "Sales Specifications," Atlantic Aircraft Corporation to Western Canada Airways, 16 January 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft; "Standard Specifications Fokker Super Universal Monoplane – Pratt & Whitney 'Wasp' engine," Atlantic Aircraft Corporation, 12 June 1928, CAL Collection, AOM, MG 11 A 34, Box 32: Fokker Aircraft: Individual Fokker Aircraft J.W. Phipps, "Fokker Super Universal," *CAHS Journal*, 7:2 (Summer 1969) 43-44;

JUNKERS W 33/34



Source: AAM, Photo Collection, 202221, CF-AMZ, Junkers W33/34, Canadian Airways Limited, Fort Chipewyan [no date]

First Flight:	1926
Dimensions:	
Wingspan:	58'6"
Length:	34'5"
Height:	11'5"
Cabin Size:	102" *l*, 50" *w*, 45" *h*
Payload:	1608 lbs (floatplane) 2125 lbs (landplane)
Engine:	Pratt & Whitney Wasp, 400 hp
Cruising Speed:	100 mph (floatplane) 108 mph (landplane)
Range:	490 miles (floatplane) 530 miles (landplane)

Sources: CF-ARI Logs, CAL Collection, AOM, MG 11 A 34, Box 76: CF-ARI Logs; CF-AMZ Logs, CAL Collection, AOM, MG 11 A 34, Box 76: CF-AMZ Logs; Molson, *Pioneering*, 293

NOORDUYN NORSEMAN – MK IV

Source: AAM, Photo Collection, 202571, CF-AZA, Noorduyn Norseman, Mackenzie Air Services, Mike Finland of Consolidated Mining and Smelting with his party tied up on Northern River, late 1930s

First Flight:	Mk IV: 1936 Mk I prototype: 1935
Dimensions:	
Wingspan:	51'8"
Length:	32'4" (landplane)
Height:	12'2" (floatplane) 10'3" (landplane)
Cabin Size:	10'6" *l*, 4'3" *w*, 4'7" *h*
Payload:	1500 lbs
Engine:	Pratt & Whitney Wasp S3H1, 550 hp
Cruising Speed:	135 mph (float and ski plane) 150 mph (landplane)
Range: with 65 Imp gals gas	350 miles (float and ski plane) 390 miles (landplane)
with 105 Imp gals gas	550 miles (float and ski plane) 600 miles (landplane)
with 150 Imp gals gas	780 miles (float and ski plane) 870 miles (landplane)

Sources: Roy W. Dishlevoy, "Noorduyn Norseman," *CAHS Journal*, 5:1 (Spring 1967) 9; Neil McArthur, "Pratt & Whitney, Canada," *CAHS Journal*, 26:3 (Fall 1988) 98-103; Fred Shortt, "Norseman Specifications," *CAHS Journal*, 17:3 (Fall 1979) 86-87; LM Coughtry to James A. Richardson, 4 September 1935, CAL Collection, AOM, MG 11 A 34, Box 39: Noorduyn Aircraft

Appendix II: Chronology of Model Introductions in the Mackenzie District

Year	Model	Company
1921	Junkers JL-6	Imperial Oil
1926	Vickers Viking	Northern Syndicate
1929	Avro Avian	Commercial Airways
	Bellanca Pacemaker	Commercial Airways
	Fokker Super Universal	Western Canada Airways
	Lockheed Vega	Commercial Airways
1932	Fairchild FC-2	Canadian Airways Limited
	Fairchild FC-2W2	Canadian Airways Limited
	Junkers W 33/34	Canadian Airways Limited
1933	Fairchild 71	Canadian Airways Limited
	Fairchild 71C	Mackenzie Air Services Limited
1935	Bellanca Air Cruiser	Mackenzie Air Services Limited
1936	Fairchild 82	Mackenzie Air Services Limited
	Noorduyn Norseman	Mackenzie Air Services Limited

ABBREVIATIONS OF ARCHIVAL SOURCES

AAM	Alberta Aviation Museum, Edmonton, Alberta
CAL	Canadian Airways Limited Collection, Archives of Manitoba, Winnipeg, Manitoba
AOM	Archives of Manitoba, Winnipeg, Manitoba
NAC	National Archives of Canada, Ottawa, Ontario
NWT Archives	Northwest Territories Archives, Prince of Wales Northern Heritage Centre, Yellowknife, Northwest Territories
WCAM	Western Canada Aviation Museum, Winnipeg, Manitoba

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