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Aviation in Canada 1971

A STATISTICAL HANDBOOK
OF CANADIAN CIVIL AVIATION

Statistics Canada Statistique Canada

Cover

The DHC-4 Caribou transport developed and produced by De Havilland Canada was the first STOL aircraft able to operate from 1,000 foot strips with a four-ton payload. First produced in 1958, more than 300 Caribou are used around the world from the Arctic to the Tropics. This photo was taken over Toronto International Airport.

A De Havilland photo by Ron Nunney.

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AVIATION IN CANADA 1971

A STATISTICAL HANDBOOK OF CANADIAN CIVIL AVIATION

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FOREWORD

The publication of "Aviation in Canada 1971" was prompted by the obvious need to preserve and centralize diverse and scattered data and to provide a general reference and information source on Canadian civil aviation. While it is hoped that the statistically-minded will be satisfied with the tabular presentation of material contained in the report, the handbook is also designed to supply the general reader with available information on the subject in all its variety.

Four chapters emphasize the history and role of international organizations and the various levels of Government in flying in Canada since the turn of the century, and numerous other items of information such as the provincial distribution of flying, gliding, and aircraft safety. The chapter on "Aircraft Technology" covers Canadian research, the development and manufacturing of aircraft, imports and exports, and the operating characteristics of different aircraft in this country. Three other sections contain a review of the statistics relating to aircraft movements at Canadian airports, passenger and cargo traffic, and Canada's commercial services, primarily during the decade of the 1960's.

Acknowledgements are extended to all the officials of the Ministry of Transport, the Canadian Transport Commission, and Statistics Canada who gave of their time to offer valuable comment as the book progressed, and who guided the project on its journey to publication. Specifically, the contributions of Messrs. John Gray, Senior Legal Executive, and K. Parks, Information Services, both of the Ministry of Transport; R.W. Bradford, Curator of the Aviation and Space Division, National Museum of Science and Technology; and R.G. Halford, Editor and Publisher of "The Canadian Aircraft Operator" were gratefully received. Special acknowledgements are extended to Messrs. G.E. Clarey, G.C. Coleman, and K.J. Marks, all of the Aviation Statistics Centre, for their support and constructive criticism. Miss Maureen Keough and Mr. Robert P. McDougall, also of the Aviation Statistics Centre, likewise contributed extensively to the successful completion of the project. The graphical work was done by the Drafting Section of the Statistics Canada directed by Mr. L. Tessier.

"Aviation in Canada 1971" was initiated and coordinated by Mr. Jan Bekooy of the Aviation Statistics Centre, under the general direction of Mr. A.L. Brown, Director of the Transportation and Public Utilities Division.

Walter E. Duffett,
Chief Statistician of Canada.

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Chapter I

HISTORICAL BACKGROUND

Canadian aviation was born in 1909 in the small community of Baddeck on lake Bras d'Or in the hills of Cape Breton Island, less than six years after the Wright Brothers' historical visit to Kitty Hawk. There on a cold February day, twenty-two year old John Douglas McCurdy made the first successful flight of a heavier-than-air machine in Canada. From McCurdy's amazing 'first' to today's blasé acceptance of aircraft performance, there has been a rapid development in aviation brought about by many factors — by the geographic barriers encountered in the exploration of Canada's rich northland, by the availability of equipment from the United States and England, and by the strategic position of the nation on the air map of the world, but above all by the military urgency of the two world wars.

This section will portray briefly the historical development of Canadian aviation, from the first faltering steps before World War I to the establishment of today's polished industry with its scheduled transcontinental and international commercial services, and the correspondingly remarkable expansion in private flying.

Early Achievement, 1909-14

The guiding genius behind McCurdy's 1909 achievement was the famous Alexander Graham Bell, who had a summer home at Baddeck. Dr. Bell had turned to research in other areas after his success with the telephone, and through experimentation with man-carrying kites he became interested in the possibilities of mechanical flight. During the summer of 1907, deciding that he required the help of trained mechanics in testing his theories, he hired two recent graduates in engineering from the University of Toronto. They were John McCurdy and a friend, F.W. "Casey" Baldwin, who had both helped Dr. Bell in his kite flying trials.

The enterprise soon attracted enthusiasts — notably Glenn Curtiss, a motorcycle racer and manufacturer, and Lieutenant Tom Selfridge of the US Army, on official leave for the affair. In the fall of 1907, feeling the need to formalize arrangements, Bell and his four assistants banded together to form an "Aerial Experiment Association" with the objective of constructing "a practical aerodrome or flying machine driven through the air by its own power and carrying a man." Mrs. Bell financed the venture to a total of $35,000 and work was transferred to the Curtiss machine shop in Hammondsport, New York. The Association was 'off the ground'.

The group decided that each member should be allowed to design and build his own aircraft. The first model, designed by Selfridge and called the 'Red Wing' was completed in March 1908. Casey Baldwin made a successful run in the plane from the ice at Lake Keuka, N.Y., before a crack-up on his second attempt. Failure was attributed to a lack of lateral controls. Baldwin corrected this deficiency in his machine the 'White Wing' by introducing into the design the first ailerons in a North American flying machine. Next came the 'June Bug', designed by Curtiss, which made three successful flights in the summer of 1908 and won the Scientific American Trophy for the first airplane to fly a distance of one kilometer.

McCurdy's machine, the 'Silver Dart', was originally built and flown at Hammondsport, but it was taken apart, shipped to Canada, and reassembled at the Bell lab in Baddeck in the winter of 1908-09. The 'Silver Dart' was without doubt more sophisticated than aircraft previously flown. It embodied several new and very important features, notably a three-wheel undercarriage, tapered wings, and the use of aileron control. Driven by a fifty horsepower engine, it made its first flight February 23rd, 1909, a run of eight hundred yards at ten to thirty feet from the ground and a speed of approximately forty miles per hour.

With the flight of the 'Silver Dart', the purpose of the Association had been accomplished and it was decided to disband. To secure fresh financing to sustain the newly-born industry, John McCurdy and Casey Baldwin endeavoured to interest the Canadian Department of Militia in their work. They found a willing audience in Lieutenant G.S. Maunsell, M.E.I.C., then Director of Engineering Services at militia headquarters, who had followed their pioneer work with fascination. With his backing, McCurdy and Baldwin finally received Government approval to give demonstration flights before militia officers in August 1909.

A series of successful trial flights by the 'Silver Dart' and the 'Baddeck I' raised the hopes of the pilots and the interests of military observers, but unfortunately, the primitive airstrip at Petawawa was much rougher than the smooth ice at Baddeck, and both demonstration aircraft crashed on landing. The flyers were not injured, but the blow to Canadian aviation was nearly fatal.

With flying becoming increasingly popular, however, private financing proved sufficient. Exhibitions of flying were held throughout the country, and notable international aviators, such as Jacques de Lesseps, Comte de Suez, made the beauty and potential usefulness of flight readily apparent

to large numbers of Canadians. The Comte later married Grace MacKenzie, whose 1910 flight made her the first Canadian female aviator.

Improvement in the strength, reliability, manoeuvrability and payload of aircraft was rapid during this pre-war period. In 1910, Canadian-built aircraft such as the 'Silver Dart' and the Templeton airplane from Vancouver (with a silk-covered spruce and ash frame), were making short and cautious flights. By 1914 Lieutenant-Commander John Porte's planned attempt to fly the Atlantic was receiving as much encouragement from Newfoundlanders as it was from the Irish. This attempt was cancelled with the outbreak of war.

John McCurdy continued in the vanguard of the flying movement during this period. In 1910, he became the first pilot to use radio in flight. His next success was a flight from Key West to Havana on January 30th, 1911. The longest overseas flight to that date, this feat was not equalled for seventeen years until Charles Lindbergh flew over the same route to inaugurate airmail service between Florida and Cuba. McCurdy also won a much publicized race from Hamilton to Toronto against Charles F. Willard, a United States' pilot, in thirty-six minutes for thirty five miles.

The First World War, 1914-18

Despite the intense early interest in flying and despite its obvious potentialities for warfare, the Canadian Government, preoccupied with recruiting an infantry expeditionary force, made no effort to organize an effective air arm. This neglect of aviation was not peculiar to the Canadian Government alone — none of the world powers had realized in advance the important part aircraft would play in the War. At the outbreak of hostilities Canada had no aircraft nor any facilities for manufacturing them. In addition, there were practically no properly certified pilots because Canada did not have a flying school until 1915. Canadians who wanted to be pilots were told to pay their way to Britain and join the Royal Flying Corps (renamed the Royal Air Force in 1918), or to enlist in the Canadian Expeditionary Force and take their chances on a transfer once they arrived in Europe.

As flying services gradually proved their usefulness in reconnaissance and support, the Government began to move tentatively on the problems of air training. John McCurdy appeared again in the spring of 1915 as director of a flying school established at an American Curtiss plant outside Toronto. However, the Government was still following a "hands-off" policy and would-be pilots had to pay both the cost of training — about $400 — and the boat fare overseas. Then, in 1916, the situation changed.

Beginning during the bloody Somme battles, new, fast and manoeuverable German aircraft were introduced which could (and did) fly circles around the previously unchallenged French and British Sopwiths, Bristols and Nieuports. Soon Allied pilots were dropping 'like flies'. Reserves, rushed into the fighting after only a few hours of solo flying and a little gunnery practice, proved easy marks for the more experienced enemy airmen. As the number of casualties grew, both the Royal Naval Air Service and the Royal Flying Corps accepted on transfer from the Canadian Expeditionary Force, young pilots who had already learned to fly in private schools. In action, the exploits of Canadian pilots (such as William Avery "Billy" Bishop, and Roy Brown, who shot down the 'red Baron' von Richtofen), continued to draw attention to their natural ability in air warfare.

The federal government finally became convinced of the need for imperial co-operation in military aviation and negotiations with the Government of Great Britain occupied much of 1916. At the end of that year, funds from the Canadian Finance Department began to flow through the Imperial Munitions Board to aviation centres in Canada. The Curtiss plant in Toronto was bought by the Munitions Board and began production of the famous JN-4 "Jenny" trainers. Moreover, land at Long Branch and Camp Borden, Ontario, was set aside for the establishment of Royal Flying Corps training centres.

Beginning in 1917, the Royal Flying Corps began active recruiting in Canada to establish twenty new training squadrons. Five now aerodromes were established and by June, 1917, the first class of military pilots to be trained in Canada received their wings. By the end of the war some 2,500 cadets had been trained and sent overseas, and twenty-five percent of the RAF was Canadian-born. Canadian military aviation activity, however, was discontinued after the Armistice in November, 1918.

Canada's air contribution to World War I has an interesting post-script. A Royal Canadian Naval Air Service (RCNAS) was organized in the summer of 1918 to protect ship convoys on the Atlantic coast. American pilots were sent to the bases during August to initiate air patrols, while Canadian airmen were recruited and trained. After the Armistice had cut short the training program, the RCNAS was demoblilized. All flying materials, including twenty-four Curtiss flying boats, motors, and other equipment, were presented by the Government of the United States to Canada and later proved invaluable in building the forest patrol system organized by the Government.

The De Havilland biplane at Revelstoke during its flight from Calgary to Vancouver in connection with the trans-Canada air mail flight made by personnel and machines of the Canadian Air Force, in October, 1920.

Photo curtesy of the Aviation and Space Division, National Museum of Science and Technology.

Post-war Developments, 1919-29

There was considerable agitation in post-war flying circles for regulation and control of aviation in Canada. At least one federal department had considered obtaining flying boats to transport and supply scientific parties working in the more remote parts of northern Canada. Within a few days of the Armistice a meeting was held in Ottawa under the auspices of the Dominion Land Surveyors' Association to discuss the future of aircraft in such work. Similar discussions were proceeding overseas in Air Service messes where Canadian pilots were awaiting demobilization. At the same time, Canadian representatives at the Peace Conference in Paris were assisting in drafting the International Conference on Air Navigation for development of international civil aviation policy.

In March, 1919, the Canadian Pacific Railway asked Parliament for an extension of their licensed operations to include the use of aircraft. This brought matters to a head: the resulting Air Board or Aeronautics Act received Royal Assent on June 6th, 1919.

The structure of the Act will be discussed in the following chapter. Suffice it to say that the executive instrument of the legislation was an Air Board from 1919 to 1923, and the Civil Aviation branch of the Department of National Defense from 1923 to the creation of the Department of Transport in 1936.

The Air Board began its work by taking over the seaplane docks at Dartmouth and Sydney and establishing new bases at Vancouver; Morely, Alberta; Ottawa; and Roberval, Quebec. These bases housed the twenty-four Curtiss flying boats donated by the United States, and about one hundred land planes and flying boats donated to Canada by the British Government from its surplus war stock. These depots were the centres for the federal and provincial survey and forestry services.

A decision was also taken at the time to found a professional Canadian Air Force. However, there was an anti-military feeling in the country at the time and it was agreed that the operation of the Air Force should be largely of a civil nature. Early Canadian Air Force duties included flying for the Department of the Interior on forestry and water-power development missions, and undertaking patrol work for the Department of Marine and Fisheries to prevent illegal fishing. This made the Canadian Air Force of February, 1920, and its successor, the Royal Canadian Air Force formed three years later, unique among the world's air forces in that while it was a military organization it was doing work of an extensively civil nature.

The feverish production of the war years left a glut of aircraft on the post-war market, which were being disposed of at very low prices. Moreover, Government restrictions on private flying were non-existent. Anyone with the urge and the money could buy a plane and fly away with it, and thousands of young pilots, flooding back from the war full of enthusiasun for flying took advantage of the opportunities. Many formed small partnerships, bought one or two 'Jennies' and became 'gypsy' fliers or 'barnstormers'. Thousands of spellbound Canadians were introduced to aircraft by watching daring pilots do loops, wingwalking, transferring from aircraft to ground vehicles, and other hair-raising stunts at town fairs and exhibitions.

But the main impetus for commercial flying in this period was the lure of the vast, trackless North, rich in minerals and forest resources and almost totally devoid of regular transportation links. Here the new breed of 'coureurs de bois' had to master hazardous challenges — intense cold Arctic blizzards, rough landings in unknown country, inadequate supplies, rickety planes, and equipment generally unsuited to the geography and climate.

The first commercial flight into Canada's northland was made in October, 1920, when two pilots flew a LePas fur buyer named Stanley, five hundred miles north from Winnipeg in a cranky Aero 504 biplane. Despite blinding snowstorms, the journey was successfully completed in two days. Nonetheless, it was the discovery of crude oil in the Yukon which led to the first real commercial attempt to establish air transportation in the far north. In November, 1920, the Imperial Oil Company hired two German-made Junkers to carry its men and supplies from Edmonton to Fort Norman along the valley of the ice-locked McKenzie River. The first cabin-type planes to be used in Canada, the 'Rene' and the 'Vic' were ideally suited to the northern climate — strong, dependable, and adaptable to wheels, skis pontoons. When one plane ploughed into a snowdrift on its maiden voyage, new propellers and skis were constructed from oak sleigh boards and glue made on the spot from moose hide, and the aircraft flew safely home.

The value of airplanes, especially flying boats, in forest patrol and photographic work had been recognized since 1919. Between 1919 and 1921, aerial surveys were conducted by a branch of the Laurentide Pulp and Paper Company of Quebec, called Laurentide Air Services Limited. In addition, the company obtained a large contract from the Ontario government for photographing lakes, waterways,

and forests in the northern part of the province, and Laurentide was on its way to becoming the first of Canada's major air services.

Laurentide Air Services began operating a passenger and freight service to the Rouyn gold fields in Quebec. In 1924, their planes carried more than four thousand passengers and some forty tons of express and freight. This service showed the profitable nature of flying activities in the gold fields of Quebec and Ontario. Soon other flying organizations invaded the area and traffic grew to considerable proportions. Especially vital to the expansion of the North were survey and reconnaissance firms such as Western Airways (financed by the prominent Winnipeg businessman, J.A. Richardson), Dominion Explorers, Northern Aerial Minerals Exploration (N.A.M.E.), Prospectors Airways, Yukon Airways and Explorations, and Canada Airways, some of which served equally important roles as freight carriers.

As the payload of aircraft expanded, heavy mining equipment and machinery, teams of horses and oxen, and giant tractors all became commonplace in hitherto inaccessible outposts hundreds of miles from any roads or navigable rivers.

In 1928, Sherman Fairchild, the American who conceived the "Fairchild" high-wing monoplane for photographic work, granted a license to Canadian Vickers Limited in Montreal to manufacture the FC-2; that same year Bellanco and De Havilland began production in Montreal and Downsview, respectively. Like the Junkers, these aircraft were strong, dependable and adaptable to harsh conditions. But they also had the blessing of a heated cabin. From the standpoint of different models used, the number of aircraft in use, and the longevity of service, these aircraft played a leading role in opening up northern Canada.

Aviation development in Canada received a further impetus for expansion by the governmental decision to support airmail freight. On June 24th 1918, a Curtiss 'Jenny' took off from Montreal's Polo Grounds carrying one hundred and twenty randomly selected letters for delivery in Toronto — Canada's first air-borne delivery. This exploit stirred public imagination at the time and focussed attention on the potentialities of the airplane as a rapid delivery vehicle.

One of the first tasks assigned to the Canadian Air Force by the Air Board was the survey and test-flying of a transcontinental airmail route. This was accomplished between October 7th, 1920, in a wide variety of land and marine planes, and through the extremities of fog, snow, darkness and storm traditionally associated with the postman's job. Travelling the three thousand miles between Halifax and Vancouver in forty-nine hours over ten days may appear trivial in these days of six hour jet crossings, but in its day it was an impressive feat and the beginning of an important air service.

By the mid-1920's, enterprising commercial flying companies such as Laurentide and Canadian Transcontinental were handling mail as routine cargo, along with freight and passengers, in the sparcely populated northern areas of Canada. The Post Office Department was delighted to co-operate because in many cases the existing surface transportation facilities consisted of river boats in summer and dog teams in winter.

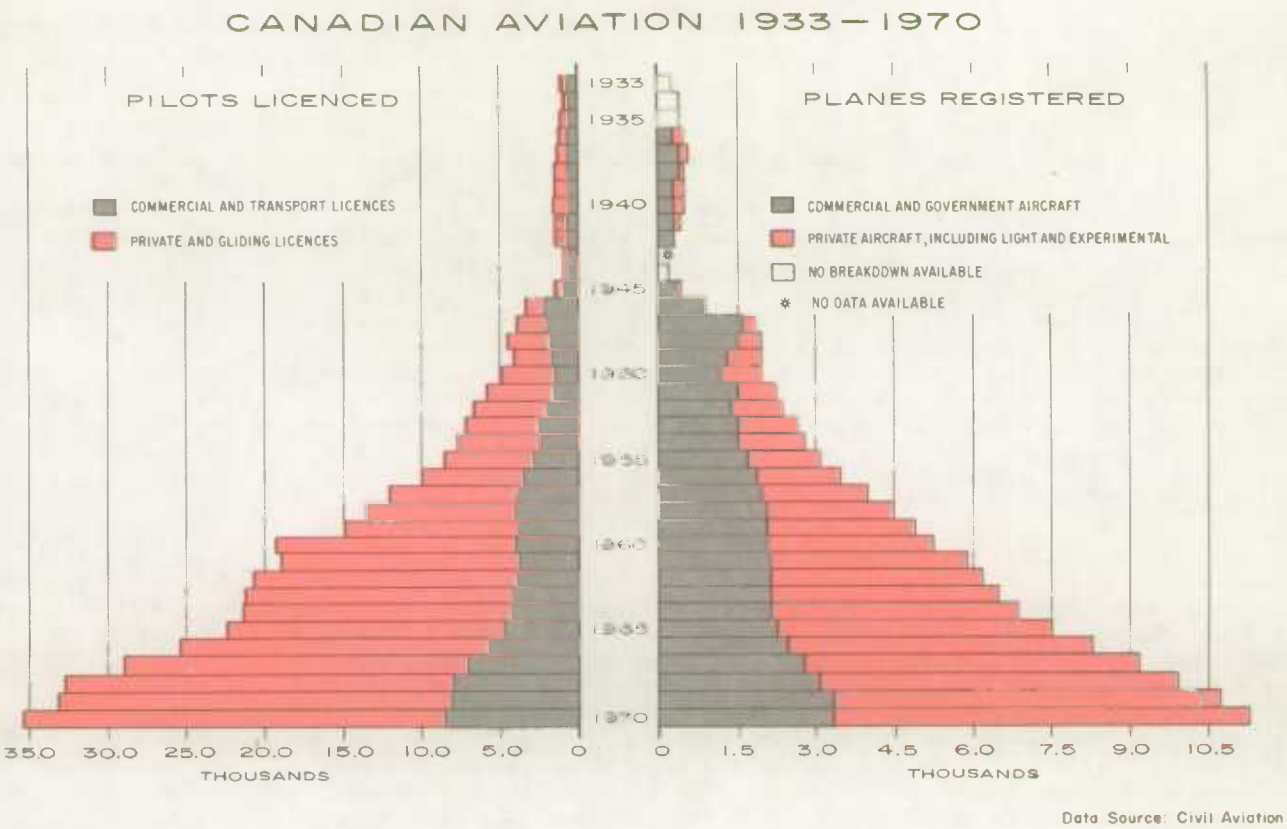
In 1927, official government airmail deliveries were authorized on an experimental basis in certain parts of Canada where surface deliveries were subject to interruption in winter weather. For example, London Air Transport was awarded the contract to make four round trips weekly during the winter months between Leamington and Pelee Island which lies seventeen miles out in Lake Erie. Other companies were awarded contracts on the north shore of the St. Lawrence, to the Magdelan Islands (between Prince Edward Island and Newfoundland) and to isolated Red Lake, Ontario.

By the following year, ten airmail routes were being operated under government contract, in addition to many being operated on a private cargo basis. One of the official routes was the Ottawa-Montreal-Rimouski service during the navigation season to speed the transatlantic mail. Others included a daily service between Montreal and Toronto, Montreal and Albany, NY, and an experimental Prairie run connecting Winnipeg, Regina, Saskatoon, Calgary and Edmonton.

At first, the Canadian Government permitted the operating companies to issue their own airmail stamps to defray aircraft operating costs. The mail carried also had regular Post Office stamps, whose cost reimbursed the Government for sorting and ground delivery expenses. This unique feature of Canadian aviation provides a most interesting philatelic memento of the early days of Canadian civil flying. However, it did not provide a satisfactory method of reimbursing the pioneer efforts of the early operators and the federal government was forced to take action.

Increasingly, after 1930, airmail carriers were compensated indirectly by the Post Office, which issued the only official stamps, collected all revenues, and paid the operators. Payment was made per mile flown regardless of weight carried, a situation naturally advantageous to the Government since an

FIGURE 1.1



increase in the quantity of mail produced more revenue at the same level of expense. The Post Office had also considered placing its air delivery service on a more uniform and unified basis. In early 1930 it initiated negotiations with the two major railroads for the formation of a national-scale airline which would receive most of its contracts. On June 27th, 1930, Canadian Airways was incorporated, absorbing both Aviation Corporation of Canada and Western Canada Airways. This airline flew a number of airmail routes in eastern and western Canada and by 1931 operated from coast to coast with an almost complete monopoly of the air transport business in Canada.

The Depression, 1929-36

Though the depression dealt the civil aviation industry a severe blow, it did not knock it out completely. The Government was forced to cancel many of its airmail contracts and only the Montreal-Rimouski run continued without interruption up to the Second World War. These cancellations hurt many small operators, but the larger carriers such as Canadian and Pacific Airways and numerous other operators whose income was not solely dependent on government delivery work, prospered. The re-evaluation of gold in the United States in 1933 to $35 per ounce brought a new boom in mining exploration, and the place of the airplane in transporting and supplying the new sourdoughs can be seen in the sudden jump in freight carried — from 2,370,000 pounds in 1931 to 26,439,000 in 1935. Despite the cancellation of the government contracts, private operators continued to obtain revenue from conducting airmail services. A minor price-war had knocked the pound-mile rate down to about fifty cents, and by the years 1936-37 the Government was back in the airmail business again, at a profit. Unlike many businesses of the time, the aviation industry was basically sound and uninflated. It survived where many others failed. (Table 1.3)

The depression also provided the opportunity for the Government to execute the airport construction necessary for completion of its airway development scheme, through the employment of thousands of Canadians at the various sites. This airway plan had been inaugurated after the early experimental airmail flights, which showed the blatant inadequacies of the existing ground facilities both in the sparcely-populated north and west, and in the more settled parts of Canada where the dependable and efficient transportation offered by the railroads had stunted the growth of aviation. Further impetus for the scheme had been engendered on the one hand, by the fact that the newer aircraft required smooth

runways for takeoff and landing; on the other hand, the rapid world development in international and inter-urban flying soon underscored the lack of Canadian enterprise demonstrated by the non-existence of a coast-to-coast air system.

The new system was based on a chain of airports built by air-conscious municipalities, encouraged and later supported by Ottawa. Operations began in 1928 with the founding of the Airports and Airways Section of the Civil Aviation Branch of the Department of National Defence, whose responsibility lay in providing auxiliary services to the municipal aerodromes — emergency landing fields, beacons for night flying, and radio and weather services, among others. The first concentration of effort lay in providing a safe route, day and night, for the Prairie Airmail System.

For daylight flying, the grass airways were marked by tall orange cones, while at night the runways were outlined with flare pots and headed by a lighted wind-sock to show wind direction. A rotating beacon marked major fields and acetylene beacons at ten mile intervals indicated the routes. Air traffic control from the ground was non-existent, but a teletype system transmitting weather reports across the country connected the air-strips to keep pilots informed. Finally, radio beacons were installed at two hundred and fifty-mile intervals across the Prairies which could be used for navigation by pilots with the right equipment. The first commercial aircraft to use this service was a Canadian Airways flight between Winnipeg and Moose Jaw in June, 1931.

There was still much room for improvement in airport facilities, particularly in Ontario and across the Rockies into British Columbia. In the middle of the depression though, great expense on aviation seemed an unlikely probability. Nonetheless, as the result of an idea of the then Chief of the General Staff, General A.G.L. McNaughton, it was decided in 1932, to put some of the 150,000 to 200,000 unemployed to work on government payroll to effect the improvement. As a result, between 1932 and 1936 fifty airports were built across Canada at one hundred-mile intervals: ten between Lethbridge and Vancouver on a route across Crowsnest Pass, a total of twenty-six in Manitoba and Ontario, including many in the long, lonely stretch between Cochrane, Kenora, and Winnipeg, and fourteen in Quebec and the Maritime provinces. The general plan of the major airports included paved strips three thousand to four thousand feet long, illuminated by double rows of lights and outlined by young spruce trees. There were also emergency landing fields strung at thirty-mile intervals along connecting routes.

As the country sank deeper into the financial morass of the depression it became increasingly obvious that municipal airport financing was impractical considering the high cost of rapidly increasing electronic facilities, the constant demand for extension of runways as new and larger aircraft became commonplace, and the necessity for all-weather, all-weight surfacing. Furthermore, many cities were having difficulty trying to support the interest payments of their airport bond issues.

The first major federal-municipal finance agreement was initiated in 1936 when Parliament consented to pay up to one-third of the costs of "terminal" airport construction. By 1939, almost $2 million had been pumped into this scheme; in more recent years, the federal government has shared much more in the costs of operation and maintenance — particularly since the takeover during the Second World War of existing municipal airports. (Table 1.1)

Prior to 1936, federal government involvement in aviation was minimal, the exceptions being the airway scheme and the civil activities of the RCAF. Airports were largely the responsibility of private individuals or communities. Airlines, expecially in the north, flew largely without government airmail subsidy, and usually without even navigational aids. Moreover, by 1936 the aviation industry had recovered from its brief slump and authorities recognized the key role of the airplane in the nation's overall transportation scheme. The formation of the Department of Transport's Civil Aviation Branch and the initial airport financing scheme, foreshadowed the government founding of Trans-Canada Air Lines and made 1936 a natural watershed year for Canadian aviation.

The Second World War 1939-45

As did World War I, World War II at once accelerated and channelled the development of Canadian aviation. On the one hand, in military and scheduled commercial flying, Canada progressed from an inferior force to a major voice in world aviation; on the other hand, private, charter, and small commercial operations slowed down considerably under the restrictions of the 1939 War Measures Act.

Probably the prime beneficiary of this new thrust was the RCAF which developed from a relatively insignificant, semi-military organization with largely civilian duties prior to 1936, to a powerful and

highly respected armed force. The Department of National Defense began, in the years of the mid-1930's to build up its regular and auxiliary strength, and to organize the construction of a chain of airports across the country. In this effort it was aided by the Civil Aviation Branch of the Department of Transport which had assumed the control of Canadian flying under the Transport Act of 1936, and by the reviving flying clubs movement. By 1939 Canada had a small but capable air arm which was entrusted, during the ensuing five years, with many vital tasks.

Undoubtedly one of the most important services rendered to the Allied cause was the British Commonwealth Air Training Plan (BCTAP) devised by Britain, Canada, Australia and New Zealand, which began in June, 1940. Canada had been selected as the setting for the operation because it was secure from attack yet close enough to the battlefield to keep transportation costs at a minimum. Through the war years, in co-operation with the flying clubs and the commercial airlines, the RCAF trained over one hundred and thirty thousand commonwealth airmen in all aspects of flying, earning Canada the rhetorical but largely accurate title, "The Aerodrome of Democracy".

Canadian aircraft production skyrocketed – assembly totalled over eight thousand training, and almost six thousand combat aircraft, including the Tiger Moth, the Mosquito and the Lancaster bomber. To facilitate an expeditious transport of planes manufactured both in the United States and Canada to the European theatre, the Atlantic Ferry scheme, or ATFERO, was launched in November, 1940. Initial arrangements were made by the Aircraft Production Minister, Lord Beaverbrook, with Canadian Pacific Air Lines, to fly the Hudsons, Lancasters, Liberators, Catalinas, and Fortresses, but the plan was taken over, late in 1941, by the RCAF which continued it successfully during the war. At the same time, both BOAC and Trans-Canada Air Lines were flying mail, strategic freight, and VIP passengers over "the ditch" on the first scheduled trans-Atlantic services.

Nearly seventy-three thousand Canadians served in the RCAF during the war, over twenty percent of whom died in battle. Twenty-one fighter squadrons fought throughout Europe, North Africa, and the Pacific, helping to win the Battle of Britain in Hurricanes, Spitfires and Typhoons, or harrying Rommel's forces across the Sahara. Fourteen Canadian units flew the mighty Halifax and Lancaster bombers which were used to destroy the industrial heart of Germany. Canadian Transport squadrons landed glider-flown troops behind enemy lines which helped to turn the tide of the battle for France. Less glorifed but of no less importance were the Atlantic Patrols in their Cansos and Stranraers who guarded the convoys and kept Britain's lifeline open.

At the war's end, Canada's contribution to the victory in the air was acknowledged as vital, the excellence of her aviators as unquestionable. This widespread respect elevated Canada to a leadership role in the international aviation policy debates which followed the war, and in the world of civil aviation to this day.

At home, perhaps the most valuable outgrowth of the war was the expansion of the airways and airports scheme. The wartime urgency and the requirements for BCAP facilities forced the Department of National Defense take-over of the administration of all airports in the war, pushed the Airways Scheme to completion in 1941, and initiated the construction of twenty-four additonal landing fields, chiefly in the Prairies, Quebec, and Southern Ontario. Furthermore, the necessity for hard-surface runways to accomodate the increased air traffic and heavier aircraft necessitated the resurfacing of runways and taxi strips at numerous main and relief airports.

Meanwhile, three joint Canadian/US projects provided Canada with a string of northern airports: the Northwest Staging Route sheltered by the Rockies along the Alaska Highway which served as the best all-season passage to Alaska and the Far East and was designed to keep communications open with Alaska in the event of a Japanese attack in the North Pacific; a string of airports along the McKenzie River to support the pipeline project along the CANOL route; and the Crimson route to Europe via Le Pas, Churchill, Coral Harbour, Fort Chimo, Frobisher, Greenland, and Iceland. Though these bases were little used during the war for ferrying purposes, the Canadian Government in post-war settlements, paid the United States' authorities over $110 million for the complete networks which proved themselves invaluable as access links to the Arctic meteorological exploratory, mining and scientific bases appearing in this hitherto remote region. All in all, almost three hundred airports of one kind or another had been added to the Canadian registry by 1945.

Another incisive domestic effect of the Canadian war experience was the phasing out of the government's direct involvement in civil flying operations. The RCAF became a purely military force: the Canadian Government for its air defense projects, such as the DEW Line and the McGill Fence, turned for transportation services to independent operators which, through various mergers and acquisitions during the decade after completion of the projects, emerged as Canada's scheduled, regional air carriers. Although government air arms do exist – Air Canada, the RCMP air wing, RCAF Search and Rescue, and provincial services in Ontario, Manitoba, and Alberta, among others – civil aviation in Canada today is dominated by the private operator.

Private Flying and the Flying Clubs, 1919-70

One of the most startling changes in the Canadian civil aviation picture since 1936 has been the vast increase in private flying (Figure 1.2). This can be traced to a number of root causes, the earliest of which is probably the flying clubs movement begun during the First World War with the foundation of the Aerial League of Canada. Although it could be argued that the Aero Club of Canada incorporated in 1916 was actually the first flying club in the country, its role was primarily military. As the Canadian Government had no officials qualified to pass or reject student pilots at this time, the Aero Club was recognized as the authority for the granting of Canadian pilots' licenses during the war and up to the time that the Air Board assumed the function in 1919. The Aero Club subsequently petered out.

The Aerial League which first came into being on February 20, 1919, held itself responsible for the co-ordination of flight training, the standardization of licensing requirements, and the general encouragement of recreational and commercial flying. One of its most adventurous projects resulted in the first flight across the Rockies, by E.C. Hoy in a Jenny biplane in the middle of August, 1919. The Aerial League achieved modest but appreciable success in its goals, but by 1927 the demand for airmail and bush pilots had placed such a strain on the supply of qualified flyers that the Government had been forced to recruit aviators, at a considerable expense, from overseas.

The first initiative of the RCAF was to establish a school at Camp Borden for commercial pilots, or persons with a firm offer of employment as commercial pilots. Only the cost of the training, transportation, and aircraft rental would be paid by the Government; all other expenses were to be borne by the students. The first classes were held during the winter of 1924-25 using the old Royal Canadian Naval Air Service flying boats, and the graduates, pilots of Laurentide Air Services, were accordingly enrolled in the military reserve and certified as able pilots. By the late 1920's it was decided that only refresher and advanced courses would be offered at Camp Borden to keep Canadian pilots up-to-date with modern technological advances. In 1931, for instance, Canadian Airways was successfully pressuring the Government for training courses in night-flying and radio beacon navigation.

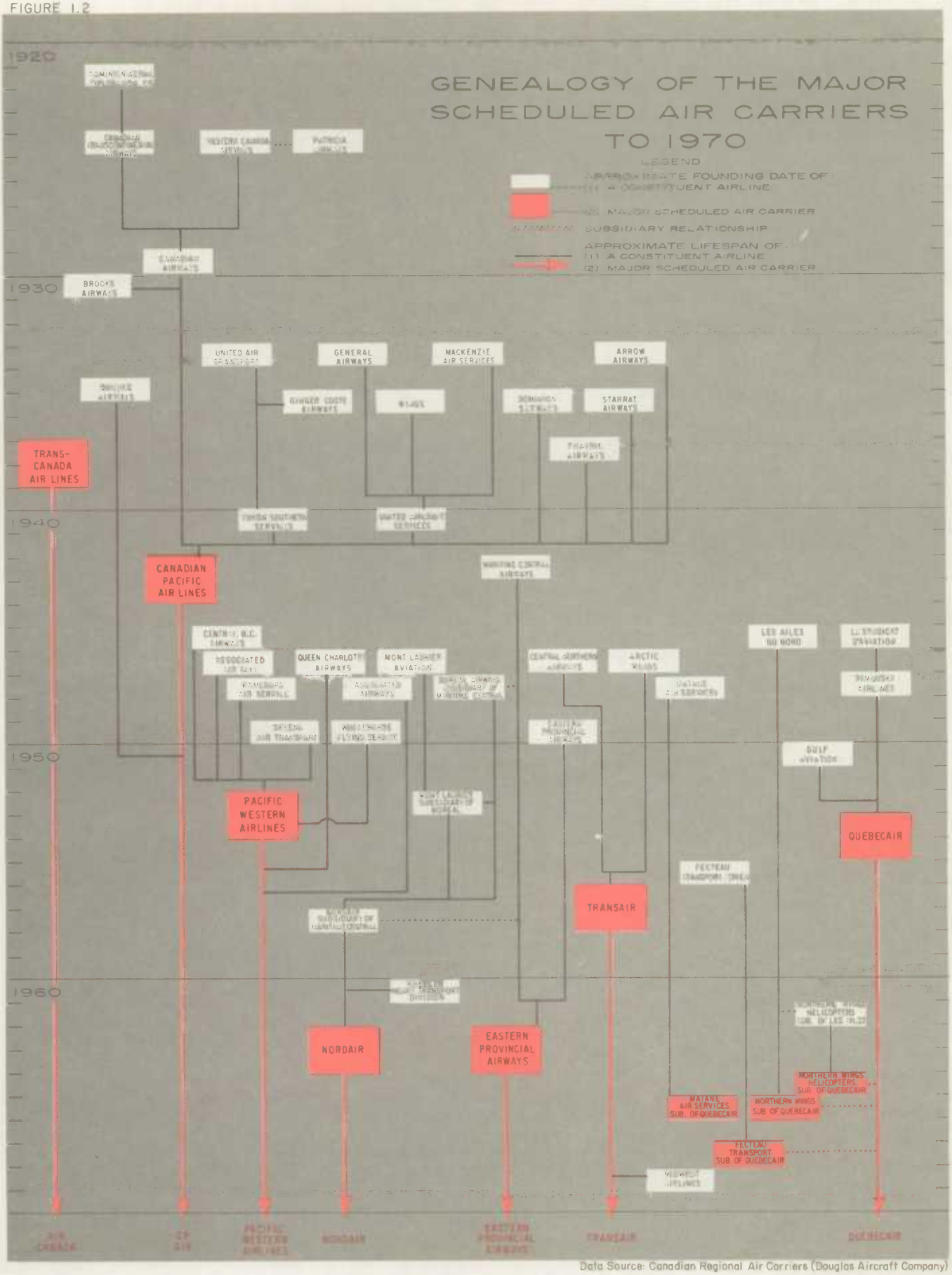
The Civil Aviation Branch was also becoming concerned with the quality of private instruction: in 1928, taking a leaf from the British folio, the federal government decided to initiate a Canadian Flying Club Movement to stimulate both pilot training and the municipal airport construction which served as a basis for the proposed trans-Canada airway system. To accomplish these aims, the Civil Aviation Branch promised to donate two light aircraft to any non-profit organization that would set up an aerodrome with adequate accomodation for housing and maintenance of the machines, engage the services of an instructor and an air engineer, and provide its members with training in flight principles. In addition, the Department of National Defense agreed to issue one additional aircraft per year for the next five years providing the club would match the gift with a new aircraft of its own purchase.

To provide incentive for membership drives to the clubs, the Government guaranteed a $100 grant to the club for every pilot trained, to a maximum of $3,000 a year to each club. The qualification of 139 pilots in sixteen clubs from Halifax to Victoria at the end of 1928 attests to the success of the movement, to the popular appeal of the new, light, and highly manoeuvrable aircraft being manufactured, and to the popularity of flying in a prosperous Canada.

After this initial success, flying clubs were confronted with numerous difficulties: competition from commercial flying schools, accusations of high accident rates due to insufficient discipline and poor training methods, and other attempts to have the movement suspended. The obvious need for a central authority was filled in 1930 with the formation of the nation-wide Canadian Flying Clubs Association with a permanent secretariat in Ottawa and an annual government operating grant. The new organization helped carry the movement over the early lean years of the depression with such programs as the Trans-Canada Air Pageants (a touring summer air show which crossed the country beginning in 1931), and annual competitions for the best amateur pilot which have continued, uninterrupted except for the war years, to this day. A considerable blow was dealt to the movement when, in 1933, the Department of National Defense (DND) decreed that only pilots with special licenses could offer dual instruction. On discovering that Canada had only forty-nine such qualified flyers, DND commenced in 1935 to train flying instructors free at Camp Borden in all phases of visual, instrumental and night flying. The first instructors trained in specially-equipped Fleet-10 aircraft under this scheme were A.H. Wilson of the Aero Flying Club of BC, and J.R.K. Main of Toronto, later to become director of Civil Aviation in Canada and a noted historian in the field. The Flying Clubs Association was also responsible for the publication of the invaluable 'Manual of Ground School Instruction' in 1936, revised in 1954.

So successful was the flying club movement during the 1930's that the supply of pilots far exceeded commercial demand. Some of the surplus was absorbed by the Department of National Defense which organized a number of RCAF auxiliary squadrons. Furthermore, the Department of National Defense

FIGURE 1.2



Data Source: Canadian Regional Air Carriers (Douglas Aircraft Company)

began in the summer of 1939, to enter contracts with the flying clubs for the training of military pilots under BCATP. The flying clubs were to act as Elementary Flying Schools, and by 1945, twenty-two clubs had trained over forty thousand pilots to aid the Allied cause. By the end of the war, the Canadian Flying Clubs Association had been so efficient that it was able to return $6 million to the Government. Moreover, in appreciation for its contribution to the war effort, the King granted the Association the privilege of adding "Royal" to its name. The federal government not only allowed it to occupy many of the one hundred and fifty wartime hangers built across the country, but also sold it, at a low price, a considerable number of surplus Tiger Moths, and contracted it for the post-war refresher training of RCAF pilots. Although there have been rough stretches since, by-and-large the Royal Canadian Flying Clubs Association has continued to prosper, contributing by the mid-1960's, a sizeable portion of the hours flown in Canada.

Naturally enough, with all available pilots away in Europe and all usable factories in war production, the numbers of both private and non-military pilots licensed during the 1939-45 period dropped substantially (Figure 1.2). At the end of the war, however, the trend was reversed, and as large numbers of pilots returned from the Front, both commercial and private flying shot skyward. This upsurge has continued except for a brief time in the early 1950's when the economic recession and the exodus of pilots to the Korean battlefields restrained growth momentarily. Between 1946 and 1970 the total number of pilot licenses issued expanded from 3,188 to 35,187. The number of aircraft flown in Canada doubled between 1946 and 1947, between 1947 and 1957, and between 1957 and 1966 to reach the 1970 high of 11,315.

Probably the most startling feature of the popularity of flying is the extensive number of privately registered pilots and planes, in contrast to the previous commercial domination. By 1958 there were more private planes than commercial, and by 1970 the ratio of private to commercial pilots was over 3 to 1. Numerous factors can account for this phenomena: the increased manufacture of safer, cheaper planes; the efforts of the RCFCA and the RCAF/RCN Air Cadet program; and finally, the extended use of company-owned aircraft by business executives.

Moreover, in 1948, as an encouragement to the formation of a large corps of private pilots, the Department of Transport commenced to pay $100 to any pilot becoming certified, as well as reintroducing the traditional $100 grant to the clubs that had been discontinued during the war. In 1969, this double bonus to pilots-in-training was discontinued, causing considerable consternation and predictions of doom for flying schools and clubs. Nevertheless, both the number of planes registered in Canada and the number of pilots licensed continued to rise steadily in 1969 and 1970.

Until recently, the numbers of commercially-owned aircraft and commercial pilots remained comparatively constant due partially to the practice followed by many airlines of buying bigger planes instead of more planes to handle the expansion of passenger traffic. Yet by the mid-1960's fast-growing passenger and cargo traffic loads reinduced an increase in commercially-owned aircraft registrations (Chapters III and VII).

Commercial Aviation, 1936-70

If the growth of private flying after 1936 was the most dramatic aspect of the expansion in aviation, certainly the broadening in scope, services and sophistication of commercial air operators was no less interesting or important. The modern era in Canadian commercial air services began in this key year with the transfer of control over civil aviation from the Department of National Defense to a newly-created Department of Transport, with the Honorable C.D. Howe as first Minister.

Mr. Howe came into office with powers over a wide range of matters – inspection and registration of aircraft and airports, licensing of all aviation personnel, and the control of air routes. On the other hand, he had many problems to face – despite Canada's enviable record in bush operations, her transcontinental and other air connections were far behind those of Europe and the United States. Travel was easiest to the south, and most Canadians used American airways for rapid transit across the continent. American interests were pressing Parliament for the right to operate a transcontinental service within Canada. At the same time, Commonwealth nations were pressing Canada to join an all-British round-the-world air route. Howe's solutions were to complete the airway system and to organize a financially secure Canadian trans-national and trans-Atlantic airline.

Initially he hoped that existing firms would take up the transcontinental challenge. Efforts had been made by private airline companies prior to this time to schedule such a service. Canadian Airways seemed the most logical company to acquire such a route: not only did it have very extensive operations in Canada, but its pilots were well-trained in the more advanced American flying schools and it had just purchased two Lockheed 10A aircraft for a passenger service between Vancouver and

Seattle. But the Airline felt it could not meet the financial cost of setting up such a system without government assistance; this, and the delicate political nature of the enfranchisement of any one particular company to a trans-Canada service lent extra support to Mr. Howe's preference for a government-financed airline.

The Minister, therefore, approached Canadian National Railways (CNR), Canadian Pacific Railways (CPR), and Canadian Airways jointly with a proposal for a new airline company which would be a non-profit organization guaranteed by the Government against loss. In addition, Howe also promised to furnish the necessary airports and communication system to make the airway operable. The proposal, however, fell through over the issue of government appointees on the Board of Directors; the Government was back at square one. Finally, a solution was reached on April 10, 1937, with the establishment, by Act of Parliament, of Trans-Canada Airlines (TCA). The firm was organized on a common-stock basis, with fifty thousand shares totalling an authorized capital of five million dollars. All shares were purchased by CNR, and a provision was made that all stock sales had to be approved by the Minister of Transport. Air Canada, as TCA was renamed in 1964, is still a completely owned subsidiary of CNR, which nominates four members to a seven-man Board of Directors, to the Government's appointment of three. Nevertheless, the airline functions as a fully independent Crown Corporation, reporting to Parliament separately from its holding company.

In order to establish the new airline on a sound financial basis, the Government granted TCA exclusive use of certain routes, and directed the Post Office to enter into airmail contracts in certain areas with this official carrier only. Moreover, the airline received the same guarantee of federal financing to cover any annual deficit as had earlier been offered the CNR / CPR / Canadian Airways consortium. James A. Richardson, President of Canadian Airways and a director of CPR, strenuously objected not only to the formation of a government-controlled and favoured airline, but also to the fact that the operation-manager and most of the executives of the new firm were recruited from United Airlines, an American firm. This opposition laid the foundation for the competition of later years between TCA and Canadian Pacific Airlines.

Operational headquarters were established in Montreal, the repair base in Winnipeg. The first flight of the new air service was run in 1937 when two Lockheed 10A Electras flew passengers and mail from Vancouver to Seattle. By the next year, an enlarged fleet of Electras had pushed passenger service from Vancouver to Winnipeg, and mail service to Montreal; by 1941, an all weather day-or-night service was in effect between Vancouver and Halifax, first by Lockheed 14H aircraft, later by Lancasters. During this period, however, the airlines were running into considerable pressure from the Post Office for delivery of more mail at lower prices, and from the military authorities in a takeover bid to incorporate the entire concern lock, stock and propeller into the BCATP. C.D. Howe was largely responsible for guiding TCA through its difficulties, for resolving satisfactorily the postal issue, and for arranging for an order-in-council exempting TCA and all its pilots from military service.

TCA's contribution to the war effort was not unimportant for being indirect, however. The Winnipeg shops laboured long hours overhauling engines and instruments for use in the BCATP while the Dorval headquarters provided mechancial backing for the BOAC trans-Atlantic wartime flights. The loan of TCA crews to the latter likewise provided valuable training prior to 1943 when TCA launched a trans-Atlantic service of its own. These flights by the sturdy Avro Lancasters, were designed to regularize the sporadic mail deliveries between Canadian families and their army in Europe, but in practice it was intended as a beginning for a Canadian overseas commercial service. In 1945 a ticket office was opened in London, and in 1947, with a fleet of the dependable new North Stars replacing the veteran Lancasters, Trans-Canada Air Lines (Atlantic) was formed. It was the only section of TCA to show a profit that year.

The post-war years have generally been good to Air Canada. The world-wide increase in passenger travel has sustained the high costs of successive purchase of larger and more modern aircraft, from the venerable DC3's to the turbo-prop Viscounts, DC-8's and Boeing 747's. Although domestic cargo operations proved unprofitable in the earlier years, an equitable airmail scheme had been reached by 1948 with a standard pound-mile rate and the introduction of air delivery for all domestic first-class mail. This put Canada in the van of world mail services, a position maintained by the 1971 decision to ship all overseas mail by air. New routes added prestige and revenue to the fleet — particularly the international flights to the Caribbean (since 1948), to Europe via London, Paris and Dusseldorf (1951-52) now changed to Frankfurt, and finally, as the first North American airline to fly into the USSR (1966). At home, although the high costs of all-jet aircraft on short-distance runs has phased out air routes into smaller centres, Air Canada has continued its dependable trans-continental routes securing its worldwide reputation for service and safety.

The late 1930's and early war years were not profitable for small private airlines. The mining "boom" was over – most producing mines had turned to road and rail transport, and prospecting had dwindled. The RCAF was still doing much of the nation's air survey and forestry patrol work. Furthermore, not only did the war drain off many young men who might otherwise have been exploring the north for minerals, but the fighter units were also receiving all the new planes and spare parts that the aviation industry could produce, to the detriment of civil aircraft in need of repair and replacements. Military flying commanded most of the Government's attention, and TCA had been granted the most lucrative airmail contracts. With their clients slowly disappearing at a time when more and more air firms were entering competition, it was little wonder that rate-cutting, bankruptcy, and general acrimony prevailed among the bush flyers.

Canadian Pacific Railways, despite its 1936 rejection of participation in the TCA scheme, had retained its interest in aviation and determined to start a national service itself. In 1942, Canadian Pacific Air Lines (or CP Air as it was renamed April 1st, 1969) was formed by the amalgamation of large and small bush operations throughout the country. To its own airline which had been operating since 1919, CPR added by stock purchase, ten private aviation firms in Canada, including Canadian Airways, Ginger Coote, Prairie Airways, Arrow Airways, MacKenzie Air Services, Yukon Southern Air Transport, Dominion Skyways, Starratt Airways and Wings Limited. The only significant firms remaining independent were M & C in Saskatchewan, Leavens Brothers of Toronto, and Maritime Central Airways on the east coast. By 1944, routes had been licensed in the BC/Yukon region, across the Prairies and Northern Ontario, and along the St. Lawrence Valley east from Montreal in the name of the new firm Canadian Pacific Air Lines (CPAL). The service quickly fulfilled expectations of lower operating costs through standardization and centralization of aircraft purchase and maintenance, and through elimination of route duplication.

CPAL fell heir during the war years, to numerous contracts made by its constituent firms, including the massive freight and passenger services needed for the construction of the aluminum works in Chicoutimi, and the oil pipeline between Norman Wells and Whitehorse along the McKenzie River. It trained twenty-nine thousand airmen in seven observer and Elementary Flight Schools for the BCATP, and like TCA, donated its repair shops and mechanics for overhaul of training aircraft. It made all the initial arrangements, training programs, navigational solutions, and operational decisions for the ATFERO "Ferry Service" scheme. CPAL also participated in the military activity occurring in the north during these years, contracting with the United States' Army for support of the construction along the Alaska Highway and receiving in return, up-to-date American aircraft unavailable at the time to any other Canadian airline.

Its ATFERO experience had given CPAL training for and aspirations to postwar continental and overseas flights, and in 1944 it made application to the Board of Transport Commissioners for routes across Southern Ontario which would, in effect, have given the airline a connected transcontinental service. This challenge to TCA was presenting the Government with certain problems.

To resolve the issue, the Government refused to consider the CPAL application and placed a "freeze" on all new route licensing for the duration of the war. Legislation was simultaneously introduced in Parliament transferring route licensing under the Aeronautics Act from the Board of Transport Commissioners to a new Air Transport Board. Further amendments stipulated that, in the interests of breaking transportation monopolies and of giving returning war pilots a field for commercial entry, no surface carriers could own an airline as well. Fortunately, this amendment, which jeopardized the future existence of CPAL, was modified after the war to exclude railways from the divestment order.

The four-year period after the war was one of cautious consolidation for CPAL under the leadership of its president, Grant McConachie. Obsolete equipment and unprofitable runs were eradicated and new routes, chiefly in BC, the Prairies and East Quebec, were commenced. With far-sighted management, the airline expanded rapidly internationally in the decade following 1949. CPAL acquired its much desired first international route to Tokyo and Asia in 1949 after TCA had exercised its right of "first refusal". The Korean campaign in the early 1950's increased passenger volume on the Far East route to such an extent that what was initially a "prestige" run soon became a profitable tenure for the airline. Two new international routes were added to the CPAL map in 1955: a Vancouver/Amsterdam 'polar flight', and a 'southern service' to Mexico and South America obtained from TCA in exchange for the St. Lawrence Valley domestic services.

Internationally, CP Air's routes, including its 'South Seas' schedule connecting Australia, Fiji, Honolulu and British Columbia, and its 'Orient' run to Tokyo and Hong Kong, form a vast cross radiating from Vancouver and displaying the Canadian flag in five continents.

Domestically, CP Air has attained its major goals. It was the prime transporter for the DEW Line Project and it maintains profitable regional cargo and passenger operations, principally in the

west and north. Following a brief struggle in 1958 which resulted in the hiring of an independent economic analyst, Stephen Wheatcroft, to examine submissions by both TCA and CPAL, the Air Transport Board agreed to license the private airline to operate a single, daily transcontinental flight from Vancouver to Montreal. This has been expanded in recent years to approximately twenty-five percent of Air Canada's passenger capacity on the route.

In forty years, what began as the amalgamation of a loose network of bush operators has become a significant world airline with a fifty thousand mile route pattern crossing the international dateline, the Greenwich meridian, the Arctic Circle, both tropics, and the equator. CP Air is highly respected at home and abroad for its passenger service and its operational efficiency.

The post-war years were kind to small as well as to the large operators. Bush flying flourished once again in the mining and northern development of the late 1940's and early 1950's. There was also an incredible expansion in charter services as well as the introduction of helicopter operations. Certain secondary aviation companies achieved considerable strength and financial stability, and five of them (Pacific Western Airlines, Transair, Nordair, Quebecair and Eastern Provincial Airlines) were accorded the status of "regional carrier" in 1966.

The two areas in which significant growth took place were the international services of CP Air and Air Canada (Figure 1.1) and the increased transborder traffic between the United States and Canada. Of all such Canadian air agreements, the oldest are with the United States dating back to a reciprocal airmail agreement between Montreal and Albany first flown in 1927 (Canadian Airways flew south and an American line north, over the same route.) Treaties signed between Canada and the United States in 1929 and 1938 covered recognition of foreign licensing and admission of transborder commercial flights respectively; specific agreements reached in 1940, 1949 and 1959 gave Canadian and US carriers limited mutual access to each other's airports. The first extended services were inaugurated April 1st, 1950 between Montreal and New York, and on April 2nd of the same year between Toronto and Tampa.

A breakthrough came in the early 1960's when President John F. Kennedy asked Canadian-born economist John Kenneth Galbraith to prepare a paper on the situation: the eventual report, which advocated a continental approach, maximum usage of aircraft, and first-priority consideration to consumer preferences, led to the creation of a joint US-Canada Board with monopoly powers over transborder routes. Today, penetration by Canadian and US aircraft into many parts of the other country have become commonplace and generally of mutual profit both to the airlines and to the flying public.

The aggregate commercial picture can be viewed in Table 1.3. Between 1946 and 1970, all scheduled passenger services increased by a factor of twenty — from 850 thousand to 15 million, while total passenger miles (the sum total of all miles flown by each passenger) rose even faster — from 200 million to 12 billion. This indicates that the average passenger is flying four times as far as he used to: the present-day figure is about 800 miles per passenger. Airmail poundage has expanded to 40 thousand tons, annually. While income has fluctuated through periods of loss (circa 1950 and 1960) and waves of relative prosperity (in the mid 1950's and 1970's), both revenue and total assets (Chapter VI) have increased consistently. Table 1.3 also shows the upshot in both hours flown and operating revenues received from services by Canadian commercial aircraft, and it is interesting to note that, thanks to more efficient operation and larger planes, companies receiving approximately $200 per flying hour overall in 1950 acquired about $300 an hour in 1960, and over $500 in 1970.

Whatever tomorrow may hold, however, Canadians can say without exaggeration, that from the earliest beginnings on the ice at Baddeck, to the roar of a 747 taking off from the modern international airports spaced from coast to coast, this country has earned its place among the world leaders of the airborne.

TABLE 1.1 Federal Expenditures for Airport Development, 1933-70

Year	Number of airports(1)	Direct government investment(2)	Aid to municipalities(2)	Remarks
		dollars		
1933	118			
1934	130			
1935	123	1,835,000	212,000	Unemployment relief projects (1932-37)
1936	155			
1937	158			
1938	123	2,342,000	375,000	
1939	116	2,498,000	1,262,000	
1940	97	2,837,000	1,365,000	1/3 cost-sharing with municipalities
1941	91	1,348,000	446,000	(1938-42)
1942	90	1,353,000	260,000	
1943	90	2,375,000	–	
1944	88	2,770,000	–	No aid to municipalities during war
1945	98	8,377,000	–	years; DND takes over airports
1946	161	8,050,000	–	
1947	273	101,631,000	25,000	Purchase of airports on Alaska route
1948	354	23,244,000	–	and Crimson airfields from US (1947)
1949	361	16,132,000	25,000	
1950	415	8,107,000	122,000	
1951	403	6,609,000	196,000	Municipal aid $25,000 maximum (1947-53)
1952	415	6,099,000	164,000	
1953	433	7,085,000	92,000	
1954	470	8,336,000	150,000	
1955	495	10,307,000	130,000	
1956	519	20,543,000	150,000	
1957	550	26,927,000	208,000	50/50 cost sharing added to $25,000
1958	456	35,499,000	99,000	maximum (1954-59) for municipal aid
1959	483	53,538,000	192,000	
1960	483	52,542,000	99,000	
1961	546	52,907,000	89,000	
1962	589	60,900,000	98,000	Contribution (1958-65): $50,000
1963	657	48,748,000	88,000	maximum for remote airports; 50/50
1964	672	27,709,000	101,000	cost-sharing for local or municipal
1965	698	40,255,000	36,000	airports.
1966	711	42,459,000	773,000	
1967	782	52,016,000	653,000	
1968	818	45,893,000	1,018,000	$1,000,000 ceiling for total municipal aid (1965-)
1969	808	59,119,000	1,393,000	
1970	844	36,961,000	721,000	

(1) Licenced only, as of 31 December 1933-66; as of 1 April 1967-70.
(2) Excludes grants for terminal buildings and equipment garages at municipal mainline airports.
Sources: Historical Statistics of Canada, MacMillan, 1965; Civil Aviation, Statistics Canada, 1963-69; Public Accounts of Canada, 1961-70; DOT Annual Report, 1937-70; Aviation Statistics Centre files.

TABLE 1.2 Canadian Civil Aviation Activity, 1933-70

Year	Total registered aircraft	Commercial and government aircraft	Private aircraft(1)	Total licensed pilots	Private pilots(2)	Commercial pilots(3)
1970	11,315	3,398	7,917	35,187	26,729	8,458
1969	10,772	3,359	7,413	33,093	25,111	7,982
1968	9,973	3,130	6,843	32,694	24,798	7,896
1967	9,162	2,775	6,387	29,035	22,115	6,920
1966	8,310	2,532	5,778	25,232	19,628	5,704
1965	7,542	2,337	5,208	22,381	17,654	4,727
1964	6,933	2,211	4,722	21,201	16,922	4,279
1963	6,501	2,184	4,317	21,140	17,058	4,082
1962	6,249	2,161	4,088	20,510	16,561	3,949
1961	5,885	2,177	3,708	18,764	15,100	3,664
1960	5,318	2,067	3,251	19,153	15,145	4,008
1959	4,857	2,077	2,780	14,896	10,972	3,924
1958	4,509	2,071	2,438	13,387	9,347	4,040
1957	4,005	2,001	2,004	11,897	8,119	3,778
1956	3,541	1,857	1,684	9,867	6,460	3,407
1955	3,148	1,682	1,466	8,543	5,760	2,783
1954	2,800	1,513	1,287	7,573	5,139	2,434
1953	2,654	1,503	1,151	7,102	4,644	2,458
1952	2,411	1,425	986	6,646	4,617	2,029
1951	2,306	1,454	852	5,684	4,065	1,619
1950	1,960	1,222	738	4,827	3,460	1,357
1949	2,001	1,334	667	4,038	2,488	1,550
1948	2,021	1,477	544	4,353	2,508	1,845
1947	1,873	1,574	299	3,827	1,786	2,041
1946	911	866	45	3,188	1,123	2,065
1945	381	336	45	1,427	389	1,038
1944	247	—	—	822	255	567
1943	—	—	—	762	242	520
1942	318	274	44	1,276	656	620
1941	440	335	105	1,317	760	557
1940	473	339	134	1,354	825	529
1939	488	325	163	1,299	795	504
1938	471	360	111	1,255	734	521
1937	604	419	185	1,157	635	522
1936	450	301	149	1,046	559	487
1935	380	—	—	910	496	414
1934	368	—	—	834	429	405
1933	345	—	—	879	405	474

(1) Including gliders and other miscellaneous categories.
(2) Including glider licenses.
(3) Including transport licenses.
Note: As different sources were consulted for different periods, and as different compilers use different methods, exact consistency is not implied.
Sources: Civil Aviation, Statistics Canada, 1933-69; Historical Statistics of Canada, MacMillan, 1965.

TABLE 1.3. Fifty-year Summary of Canadian Commercial Aviation, 1921-70

Year	Canadian and foreign carriers					All Canadian carriers	
	Passengers (1)	Passenger-miles(2)	Cargo(3)	Mail	Hours flown(4)	Net income(5)	Gross revenue(6)
			pounds			dollars	
1970	14,768,275	10,278,287,378	651,375,138	80,185,838	1,299,350	1,300,944(6)	821,751,745(6)
1969	13,237,724	8,813,017,643	581,319,688	76,978,315	1,228,167	2,820,154	721,112,496
1968	11,857,701	8,066,168,412	471,745,746	68,294,540	1,188,228	11,924,455	630,393,139
1967	11,596,102	7,558,559,689	374,183,884	61,666,351	1,128,736	10,618,104	558,146,074
1966	9,023,691	6,025,992,516	359,719,124	53,929,067	963,067	16,211,517	473,447,373
1965	7,838,539	5,065,493,215	291,499,029	54,677,855	801,129	13,181,834	392,806,566
1964	6,774,652	4,200,293,067	250,789,269	50,705,488	679,784	8,393,110	334,930,874
1963	6,278,298	3,822,248,493	229,636,108	45,210,723	646,956	1,390,060	308,835,913
1962	6,064,074	3,666,655,321	218,487,619	41,596,384	642,284	4,597,327	284,618,321
1961	5,740,577	3,352,704,994	211,044,506	39,024,564	649,107	- 13,146,423	254,873,901
1960	5,451,716	2,847,022,735	217,220,865	37,472,145	712,371	- 6,450,886	235,973,562
1959	5,316,001	2,495,682,456	214,391,889	35,558,226	798,527	- 2,484,178	220,423,558
1958	4,555,251	2,142,276,186	200,388,312	33,628,013	709,337	- 1,806,744	201,713,936
1957	4,319,920	1,835,183,870	264,812,177	31,413,504	742,056	- 552,897	190,043,015
1956	3,864,818	1,547,279,882	319,260,401	27,914,288	734,822	4,699,586	182,168,850
1955	3,249,099	1,223,825,448	233,561,830	26,616,505	605,913	4,132,752	152,739,018
1954	2,792,348	1,066,805,242	109,299,256	24,228,571	472,817	849,647	108,864,289
1953	2,724,432	942,269,095	177,451,345	20,319,952	498,891	1,120,441	104,255,500
1952	2,298,194	805,642,141	135,055,106	18,328,310	469,677	1,372,385	90,519,295
1951	1,889,950	679,819,451	59,199,354	16,824,652	507,745	5,311,541	62,084,519
1950	1,500,361	550,534,058	41,586,726	14,501,110	267,282	410,977	46,367,317
1949	1,258,614	464,609,486	35,119,684	13,752,434	245,956	- 2,081,544	39,581,021
1948	1,092,825	385,334,811	35,301,494	10,340,024	251,593	1,730,381	33,712,329
1947	909,394	273,867,217	32,291,824	7,118,074	229,382	- 2,787,482	26,834,090

See footnotes at end of table.

TABLE 1.3. Fifty-year Summary of Canadian Commercial Aviation, 1921-70 – Concluded

Year	Canadian and foreign carriers					All Canadian carriers	
	Passengers(1)	Passenger-miles(2)	Goods(3)	Mail	Hours flown(4)	Net income(5)	Gross revenue(6)
			pounds			dollars	
1946	855,381	206,776,408	23,838,762	5,930,338	164,648	– 753,693	21,987,969
1945	537,718	153,504,833	13,143,271	6,418,944	125,569	– 457,782	17,355,154
1944	392,243	111,127,010	11,182,902	7,296,265	105,815	– 1,042,046	17,119,291
1943	302,267	100,530,892	12,338,275	7,568,809	101,169	– 377,835	16,386,989
1942	215,702	70,554,377	11,408,001	5,470,209	92,314	659,157	11,751,964
1941	193,011	53,891,516	14,826,250	3,411,971	88,536	284,832	9,193,477
1940	137,619	38,438,439	12,990,551	2,710,995	80,796	566,546	7,994,754
1939	133,776	21,840,483	21,253,364	1,900,347	87,717	– 587,829	5,839,941
1938	104,117	10,913,409	21,704,587	1,901,711	100,262	– 1,712,338	3,691,224
1937	110,864	12,658,264	26,279,156	1,450,473	126,869	– 697,816	3,234,280
1936	99,451	8,724,790	25,387,719	1,161,060	101,953	11,223	2,501,242
1935	140,379	7,936,950	26,439,224	1,126,084	88,451	–	–
1934	72,085	6,266,475	14,441,179	625,040	75,871	–	–
1933	53,299	3,816,862	4,205,901	539,358	53,299	–	–
1932	76,800	2,869,789	3,129,974	413,687	144,080	–	–
1931	100,128	4,073,552	2,372,467	470,461	73,645	–	–
1930	124,875	–	1,759,259	474,199	92,993	–	–
1929	96,375	–	2,489,189	576,831	51,571	–	–
1928	54,913	–	1,641,250	316,631	28,719	–	–
1927	16,664	–	380,433	14,684	4,209	–	–
1926	4,800	–	65,308	3,960	2,321	–	–
1925	3,683	–	38,580	1,080	1,351	–	–
1924	4,314	–	77,385	–	1,893	–	–
1923	2,328	–	11,600	–	2,830	–	–
1922	4,282	–	11,481	–	2,541	–	–
1921	9,153	–	79,850	–	4,347	–	–

(1) Totals crew and passengers, 1921-32; revenue passengers only, 1933-70; passengers include unit-toll and charter.
(2) Passengers and crew, all services, 1931-35; unit-toll services' passengers only, 1936-70.
(3) Total goods, 1921-39; revenue cargo only, 1940-70; includes unit-toll and charter.
(4) Total hours, 1921-37; revenue hours of unit-toll and charter services only, 1938-70.
(5) Operating revenue less operating expenses, 1936-42; income after taxes, 1943-70.
(6) Income and revenue figures for 1970 include only those airlines with over $150,000 annual income.

Sources: Air Carrier Operations, Statistics Canada, 1970; Civil Aviation, Statistics Canada, 1936-69; Historical Statistics of Canada, MacMillan, 1965.

Chapter II

GOVERNMENT AND CIVIL AVIATION

Few industries are as dependent on government assistance as aviation and in turn acquire so much federal regulation. The reasons are many – the safety requirements of air travel, the high cost of modern airports and communications equipment, the protection of sovereignty, and the need to avoid mutually destructive competition over the air travel market, among others, all necessitate support and control at a level only government can provide.

Working through the International Civil Aviation Organization, the International Air Transport Association, the domestic air transport organizations, the airport authorities, the airlines themselves and the aircraft manufacturers, government regulation wraps the airplane in a protective cocoon. It is reflected in the reliable radio beams that help to guide aircraft; it reaches into the flight deck, observing pilot technique and proficiency; and it even touches the private lives of the air crew.

Though the groundwork for national regulations is laid internationally, there is still a good deal of room for action in adjusting and applying the principles evoked to the national needs. This section will examine the web of control and support of Canadian Aviation – international and federal, financial and operational.

International Organization

The development of the airplane into a major instrument of transport has brought with it international problems – the co-ordination of techniques and laws, the dissemination of technical and econocomic information – far beyond the ability of individual governments to solve. Though the complexity of international involvement in aviation today would presuppose more than twenty-seven years of development, it has only been since World War II that specific laws of worldwide applicability have come into existence.

A first, but unsuccessful, attempt to reach international agreement was made by nineteen European nations in 1910, only seven years after the Wright Brothers' flight at Kitty Hawk. Between 1919 and 1943, there was no commonly recognized law under which aircraft on "innocent passage" could navigate the air freely as ships did the open sea. The air-law that existed was contained in the International Convention for Air Navigation (ICAN), drawn up in Paris in 1919 during the Peace Conference. ICAN endeavoured to provide for international uniformity in technical matters, but was rather limited in scope and implementation due to the opinion prevalent into the 1930's that the airplane was a regional, rather than a worldwide means of transport. The Convention was ratified by most European states, and by Canada through its membership in the British Empire, but neither the United States nor the Soviet Union were signatories.

For civil aviation, the years prior to the Second World War were characterized by numerous bilateral agreements between governments. Institutional developments proceeded along regional lines only, resulting in two bodies, one based in Europe, the other in the United States, whose efforts remained uncoordinated and subject to duplication. Separation was also reinforced by differing governmental attitudes: in Europe, particularly in Great Britain, the airlines were heavily state-subsidized and state-controlled; in North America, private, independent commercial airlines flourished with a minimum of federal financing and regulation.

Great strides were made during World War II in many aspects of cooperation. There was incredible progress in technical matters – in uniformity and coordination with respect to air routes, navigation procedures and communications. Naturally, in legal and administrative affairs, progress at global co-ordination was virtually non-existent as the furors of war consumed national energies.

Aroused interest in the future of aviation was visible both in the UK and US by 1944. Preliminary discussions for an international agency were initiated during the last week of March of that year in talks among Canada, the United States and Britain. Canada favoured a post-war organization with wide regulatory powers – an International Air Transport Authority administered by a convention having universal application whose signatories would surrender certain of their sovereign rights in respect of aviation.

On the basis of these debates, invitations were sent by the US to fifty-five allied and neutral states to meet at Chicago in November, 1944, for a conference on civil aviation. Canada's voice was one of the most influential at the Convention, due in large measure to her high rank among the Allies in terms of wartime flying achievement. Moreover, the Canadian draft proposal, the most comprehensive of any submitted at the conference, formed the basis of the final charter.

The constitution of the International Civil Aviation Organization (ICAO) which ultimately emerged, was built upon the Canadian proposed "Five Freedoms of the Air": (1) the right to fly over the territory of a foreign nation without landing; (2) the right to land on the territory of a foreign nation for non-traffic purposes (for example — refueling, emergency repairs, shelter from inclement weather); (3) the right to put down in a foreign country passengers, mail and cargo taken on in the state whose nationality the aircraft possesses; (4) the right to take on passengers, mail and cargo in a foreign country for the state whose nationality the aircraft passesses, and, (5) the right to put down (or take on) in a foreign country passengers, mail and cargo from (or for) the territory of a foreign country.

Since not all countries were willing to endorse all five freedoms, optional arrangements were permitted for partial acceptance. Canada has made approximately twenty bilateral treaties under the first four freedoms but, in congruence with the general feeling in many countries, only a few commitments under freedom five have been signed.

ICAO is basically a technical organization responsible for developing a standardized system for such matters as air navigation, licensing, safety and landing procedures. It also has an advisory capacity in economic affairs. ICAO determines the oceanic control zones, designates the countries responsible for the air traffic control over the oceans, and has recently had outerspace placed under its juridical umbrella.

Although never formalized on paper, one of the most important and extensive compromises reached at Chicago was a decision to promote the organization of the International Air Transport Association (IATA) to control rates and charges and supervise the general conditions of operation, by mutual agreement between the major commercial airline companies. A similar association formed for the mutual protection of the airlines, had been functioning in prewar Europe under the name of the International Air Traffic Association. The idea was expanded to worldwide proportions and incorporated under a special act of the Canadian Parliament.

IATA sets forth international rates for air routes and attempts to develop more productive ground procedures for passengers and cargo. Although some non-scheduled airlines are not members of IATA, the practice of recognizing its decisions has become worldwide and has made it, in the economic field, the greatest stablizing influence in world aviation today. In this country, the Air Transport Association of Canada implements many of IATA's regulations.

The most significant difference between IATA and ICAO is in their orientations: IATA is an economic association of commercial airlines which establishes rates for international air routes; ICAO, a specialized agency of the United Nations, is an organization of governments which publishes standards for general aviation to which governments should aspire. Yet, though they differ, much still remains in common for IATA and ICAO — a strong desire for first-class airports, improved traffic control systems, safer planes, highly qualified pilots, and efficient operations.

Canada has continued to hold a leading position in the international aspects of aviation, due largely to recognition of her technical competence. Both of the major international aviation organizations maintain their central administrations in Montreal. In ICAO statistics of the world busiest airports (by commercial flights only: Table 2.1), the Canadian listing of three airports is bettered or equalled only by the United States, Great Britain and West Germany, all of which have higher populations. In addition, Canada's international carriers both rank in the ICAO listing of the top world airlines by tonne-kilometers flown (Table 2.2). Overall, by this measurement Canada ranks behind only eight countries — the United States, the United Kingdom, France, West Germany, Japan, the Netherlands, Italy, and the SAS consortion (Denmark, Norway, Sweden) in international services. In domestic operations, Canada holds second place behind the United States, and in combined operations is preceded only by the US and Great Britain. The Ministry of Transport has been instrumental through the Canadian International Development Agency and the Colombo Plan in applying Canadian construction expenditure for building airports in many undeveloped areas, most recently in Katunayake (Ceylon) and in the West Indies. Finally, in ICAO membership dues, which are calculated partially on a nation's contribution to aviation, Canada has paid the highest per capita levy for some years.

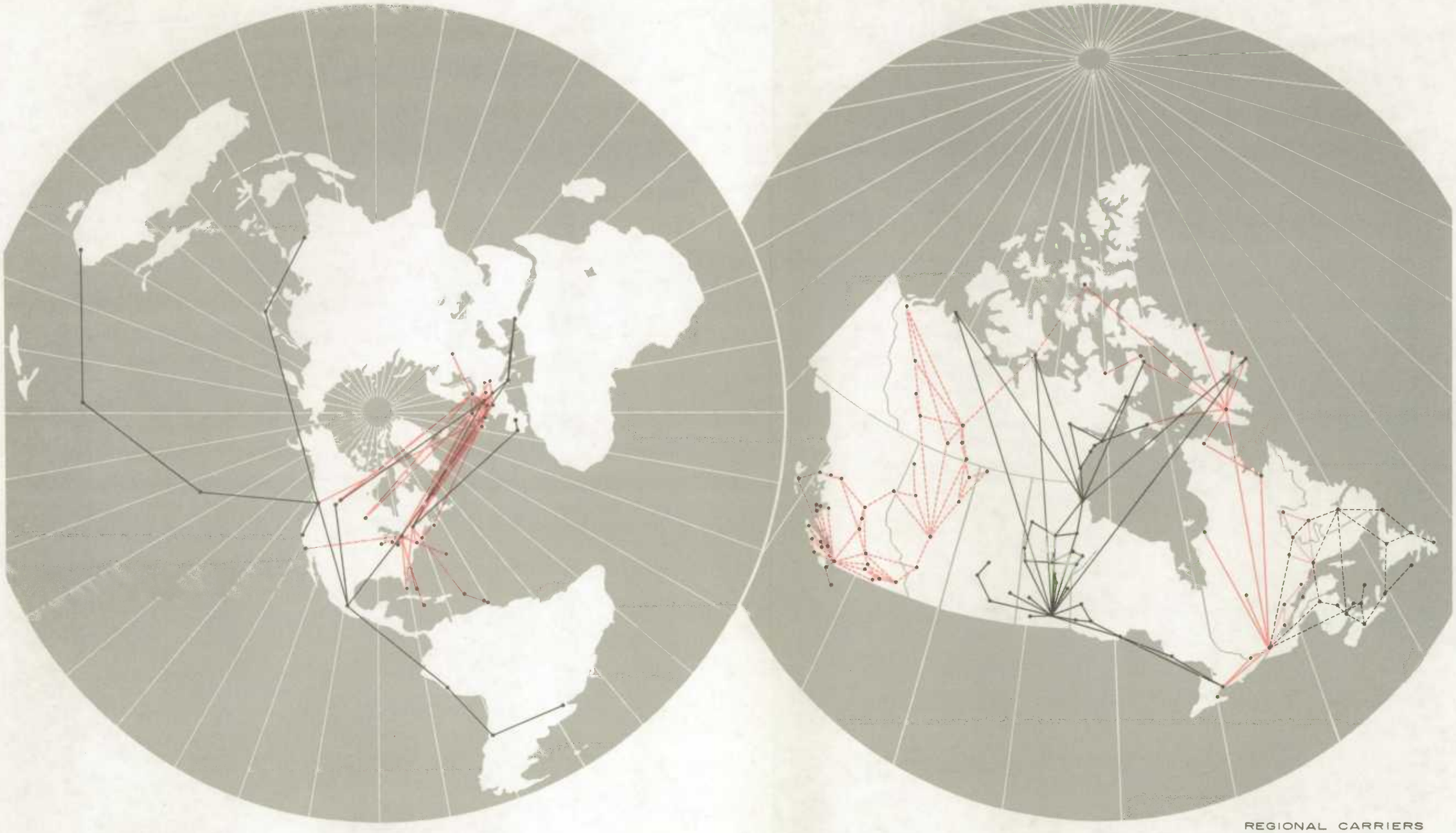
National Organization

In Canada, the orderly planning and co-ordinated implementation of civil aviation policy has, by virtue of the national scope of aircraft activity, increasingly been placed under federal control.

FIGURE 2.1

ROUTES OF CANADIAN CARRIERS

SUMMER 1971



SCHEDULED INTERNATIONAL ROUTES OF

AIR CANADA

CP AIR

REGIONAL CARRIERS SCHEDULED SERVICES

PACIFIC WESTERN

TRANSAIR/MIDWEST

NORDAIR

QUEBECAIR

EASTERN PROVINCIAL

Data Source: Airline Schedules

The winter climate demands the energies of sophisticated heavy equipment at Canadian airports.

MOT photo.

The Canadian government's activity in civil aviation takes numerous forms: certifying pilots, licensing aircraft, building and operating airports, providing weather information, and deciding how much competition is acceptable to airlines on a given route. Changes in emphasis take place within the basic governmental structure so that it can accomodate itself, to some extent, to the increasing demands placed upon it by a rapidly expanding industry. In this section, both the relationship between the air transport industry and the federal government, and the financial administration of civil aviation in Canada will be considered.

The British North America Act of 1867 accords the federal and the provincial governments separate legislative jurisdictions, but of course makes no reference to aviation. Municipal governments, which took, and which often still take the initiative in airport construction, usually consult the federal government in air terminal planning and operation, but an overwhelming majority of such facilities are not directly municipally-controlled due to the financial pressures of operation.

Prior to World War II, there was considerable agitation from provincial capitals for a share in the control of civil aviation, culminating in the Supreme Court decision Reference re Legislative Powers as to the Regulation and Control of Aeronautics in Canada (1932), contesting the federal government's rights to pass dominion legislation to enforce the ICAN agreements. This Aeronautics Case, appealed to the Privy Council in London, was decided in favour of Ottawa, and federal authority has prevailed in civil aviation from that time. Today, the Ministry of Transport operates under many enactments including the Aeronautics Act, the Carriage of Goods by Air Act, the Foreign Aircraft Third Party Damage Act, the Air Canada Act, the Department of Transport Act, the Transport Act, and the National Transportation Act.

On June 6, 1919, the Canadian Parliament passed the Air Board Act. It was a far-sighted piece of legislation governing such interests as scientific research and contruction of airports, the naming of air routes, the licensing of aircraft and personnel and the investigation of accidents. It has been amended from time to time to keep pace with changes in technology in civil aviation.

The present Act is divided into three parts: Part I outlines the requirements for the registration of aircraft, the licensing of pilots, the establishment and maintenance of airports and facilities for air navigation, air traffic control, accident investigation, and the safe operation of aircraft; Part II is concerned with the economics of commercial air services and it assigns to the Canadian Transport Commission certain regulatory functions in this connection; Part III provides for the internal administration required for the implementation of the enactment. In addition to this legislation the air regulations made under the Act cover a range of activities from inspection of pilot qualifications, airplanes, airports, and the enforcement of navigation laws to the specification of conditions for the carriage of goods, mail and passengers, and the designation of navigational routes, their use, and control.

Acting under the Air Board Act the Government appointed an Air Board which by the end of 1919 had drawn up the first air regulations in Canada. One of its stipulations required the immediate licensing of all pilots. A reconstituted Air Board in 1920 put these regulations into effect, licensing the first Canadian pilot, J.S. Scott in January of that year. The Aeronautics Act (which is the original Air Board Act, with a large number of amendments and additions) remains the basis of Canadian air law to this day.

The control of aviation in general, remained with the Civil Aviation Branch of the Department of National Defense until 1936 at which time the Hon. C.D. Howe became the first Minister of the Department of Transport, and assumed responsibility for Canada's non-military flying. The Ministry of Transport which became responsible for implementing the air regulations specified by the Aeronautics Act, considers as well such matters as accident investigation, enforcement of safety legislation, control of traffic in the air and at airports, the management of air terminals and airport property, and the appropriation of grants for municipal airport construction and operation.

Between 1938 and 1944, the licensing of commercial air routes was handled by the Board of Transport (or Railway) Commissioners which held the responsibility for all aspects of Canadian transportation. From 1944 to 1967 this function was handled by the Air Transport Board whose authority was acquired through an amendment to the Aeronautics Act.

On September 19, 1967, the Canadian Transport Commission (CTC) was established under the National Transportation Act, inheriting all the powers and duties of its predecessors, the Air Transport Board, the Board of Transport (or Railway) Commissioners for Canada, and the Canadian Maritime Commission.

Organizationally, the Commission consists of a committee of seventeen and is concerned with the regulation of the various modes of transport. The Air Transport Committee maintains control over the classicication of commercial air carriers in Canada. The designated groupings include first, domestic air carriers — the scheduled transcontinental and regional airlines, plus the specific point, charter, contract, and specialty air carriers and the flying clubs; and second, international air carriers — scheduled and non-scheduled. (Table 2.6 outlines in detail these two divisions).

The Commission is responsible for the commercial regulation of air services within Canada and abroad and to foreign air services operating into and out of Canada. This is accomplished through the licensing of all services and the subsequent regulation of the licenses with a view to maintaining economically viable operations and the provision of adequate service to the public. The Commission also makes orders or gives directives with respect to accounts, records, reports, traffic tolls and tariffs, under the authority of the Aeronautics Act or the Commercial Air Services Regulations.

The CTC has taken over the role of the Air Transport Board in regulating the services of commercial aircraft operators. In general, the various boards and the Air Transport Committee of the CTC have adhered to the principle of "regulated competition", allowing two airlines to serve the same route only when it appeared economically feasible to do so.

In the past, the policy of the regulating authorities was to favour TCA (or Air Canada, as it became), as the "chosen instrument", both domestically and internationally. To quote Prime Minister William Lyon McKenzie King (2nd April, 1943):

"The government sees no good reason for changing its policy that TCA is the sole Canadian agency which may operate international services. Within Canada, TCA will continue to operate all transcontinental systems, and such other services as may from time to time be designated by the government. Competition between air services over the same route will not be permitted ... between a publicly owned service and a privately-owned service".

Both the international and domestic structures of this policy have been revised in recent years, however; for example, CP Air has been allowed to carry up to twenty-five percent of transcontinental passengers in competition with Air Canada, as well as maintaining an extensive international service. The CTC also administers the allocation of route areas among the regional carriers — Pacific Western Airlines in British Columbia, Alberta and the Arctic; Transair in Manitoba, Saskatchewan, Western Ontario and the Arctic; Nordair in Western Quebec, Eastern Ontario and the Arctic; Quebecair in Quebec and Labrador; and Eastern Provincial Airlines in the Maritime Provinces with a link to Montreal (Figure 2.1). Administration of these air services is based on federal government regional policy outlined in 1966 and detailed in 1969. It involves the careful control of route allocation and competition between the regional carriers, the smaller operators, and the two international carries. Occasionally, federal funds are used to subsidize regional carriers on an unproductive run judged to be of public benefit, but this factor is used on a minumum of occasions.

Moreover, the Commission takes an active part in the work of the International Civil Aviation Organization on behalf of Canada, although it is the Department of External Affairs, on the advice of the Air Transport Committee, which actually negotiates international air agreements. Bilateral agreements arrange both for foreign airlines to serve Canada (Chapter VI) and for Canadian airlines to serve foreign countries. By April 1971, the CTC had licensed four Canadian scheduled airlines to operate internationally — Pacific Western to Victoria/Seattle; Nordair to Hamilton/Pittsburg; Air Canada to Europe, the USSR, the USA, and the Caribbean; and CP Air to Vancouver/San Francisco, the Polar and Southern Routes to Europe, South and Central America, Asia and the South Seas (Figure 2.1). A number of international services are also operated between Canada and the United States under an exchange of diplomatic notes.

In early 1970 it was announced that the former Department of Transport would be reorganized to encompass broadened and decentralized responsibilities in the field of national transportations. The new "Ministry of Transport" comprises administrations for Air, Surface, Marine and Artic Transportation, a Transportation Development Agency, the Canadian Meteorological Service, the Canadian Transport Commission, and the Crown Corporations (Air Canada, Northern Transportation Company, and CNR) (Figure 2.2). The Ministry headquarters, through its Transportation Council, is responsible for co-ordination of government policy in these sectors.

Over the past decade, the Ministry has aspired to the provision of better planning and co-ordination in the various elements of the national transportation framework, applying the principles of long-range forecast, anticipated development, and recoverable financing to the areas of national unity, regional and especially northern development, and the restriction of growing environmental problems. Aviation planning and research have been undertaken on both the theoretical aspects: the effects of new

aircraft types, the future of air cargo operators, and the long-range integration of airport facilities into overall urban transport needs — and likewise on the practical aspects: radio interference, pollution from jet engines, cloud seeding, hail, ozone production, wind patterns, noise levels, weeds and ice on runways, collisions with birds, and underwater wreakage retrieval. Even the uses of outer space have come under study by the Aviation Services sector.

Parallel to this expanded planning and administrative function, and coupled with the rapid expansion in flying, is the steady growth in federal expenditures for aviation services during the last ten years (Tables 2.2-2.5). Operating costs have sharply increased, while capital outlay has oscillated about a slowly declining axis. Both air services and terminal construction were increased in all six MOT regions (Pacific, Western, Central, Ontario, Quebec and Maritime) in 1970, with projects across the country, particularly in the west and north. Moreover, quarter-million dollar grants were made to the flying club movement and to universities (primarily for meteorological research), and three million dollars was paid in ICAO membership dues.

The complexity of civil aviation administration is reflected in the organizational apparatus necessary for its control, and the demand for financial support, by the level of government expenditure.

Airport Construction and Operation

The capital cost of a major modern airport is prodigious, and in order to ensure that federal funds are wisely spent, Ministry of Transport planners have, in the last decade, formulated a master-plan for national airport development in Canada. Overall plans have been drawn up for such centres as Vancouver, Calgary, Toronto and Montreal, and work is proceeding on the realization of the two latter schemes: a major terminal in Southern Ontario to compliment Malton due for completion in the late 1970's, and a $400 million facility at St. Scholastique, near Montreal, scheduled to open in 1974. On the Atlantic Coast, TOPS (the Trans-Oceanic Plane Stop) by offering lower landing fees, successful public relations, and new radar, terminal and runway construction, aims to attract trans-oceanic jet flights to stop and refuel at Gander, Goose Bay and Ottawa (as their piston-engined ancestry did), on their way to and from the American West Coast.

Plans are designed to fit the projected growth in transportation needs for particular geographical areas, to accomodate possible advances in technology and even to take into account unique developments. The emphasis is on foresight — the additional airport facilities for Expo '67 started in 1963, plans for runway and terminal expansion to handle "jumbo jets" and the SST's commenced in 1967, and work has already begun for the integration of the Toronto International complex with the new Southern Ontario airport network, not yet off the drawing boards.

While these plans are proceeding to fulfilment, an average of $50 million per year is expended for construction and/or improvement of runways, buildings, and equipment at Canadian airports — a total outlay of almost half a billion dollars since 1960 (Table 1.1).

Over the past twelve years, a wave of terminal construction has provided the country with a string of functional yet artistic aviation centres from Gander to Victoria. An understanding of the expenses involved can be governed from a rough cost-breakdown of the newly completed Vancouver airport additions: twenty-four million dollars for general construction, six million for new equipment, three million for turnways and runways, and two million dollars each for land acquisition, for sand and cement, for lighting and utilities, and for the construction of access roads, bridges and ramps. The total cost approached $50 million.

The capital costs of keeping the air traffic control and meteorological systems up to date have totalled over $160 million since 1963, an average of $20 million per year. More tracking and other equipment is necessary than one would surmise from a consideration of the average number of aircraft arriving or departing (the maximum, 2 per minute, is reached at St. Hubert), since slack and busy periods are the rule, and sometimes 200 planes must be handled in one hour.

Runways have traditionally proved important sources of expense, not only as a result of the constant wear and tear, but also because advancing aircraft technology demands longer and stronger takeoff and landing strips for its progressively bigger and heavier products. When the DC3's were introduced into commercial service in 1946, runways had to be extended to 4,500 feet; the advent of the Constellations in the mid-1950's increased this distance to 7,500 feet, while modern aircraft require up to two miles at the major Canadian airports. (Many Canadian airports now have runways exceeding this distance). Other qualities, such as braking capacity and bearing strength must be continually tested and updated. ICAO has set suggested standards in these areas, including a minimum of one 12,000 foot, 150,000-pound bearing-strength runway at every international air terminal. Requirements seem always to remain one step ahead of reality.

While supporting airport construction directly, the federal government has also continued to support the erection of air terminals by local or municipal bodies (Table 1.1). With the full return of Canadian airports to civilian control in 1947, a series of $25,000 grants were authorized to aid communities in updating their air facilities for commercial operators. This scheme continued in operation until 1959, with a modification in 1954 that this federal contribution would constitute no more than 50 percent of the project cost. In the period 1949-59, a total of over $1.5 million dollars was disbursed, as compared to $3.2 million in the 1930's. Commencing in 1960, grants were increased and placed on the basis of airport category (Chapter IV): a maximum of $50,000 per "remote" facility and of $100,000 (on a 50/50 cost-sharing basis) per "local" facility. In 1965, a $1 million per year maximum was placed on federal aviation aid to municipalities: during the decade 1960-70 a total of almost $5 million was granted to over seventy local, remote and developmental projects.

As Table 2.7 clearly shows, a majority of the 1,600 airports in Canada are privately owned (including such relatively large strips as Wabush and Buttonville), although substantial numbers are municipally-operated, and a lesser number are run by the Ministry of Transport or by the armed forces of the United States or Canada. However, most of the major commercial airports are operated by the Ministry. Several communities, such as Regina, Hamilton, Waterloo, Oshawa, Brandon and Edmonton, have chosen to retain control of their own air facilities but the operation of a major airport is a difficult, costly, and often thankless job, and not many areas with federally-run terminals have appeared willing to assume their management despite Ottawa's guarantee to absorb any operating deficits.

One reason for the reticence is purely financial (Table 2.5): while airport capital expenditure has slowly, if eratically, declined over the last decade, operating costs have almost doubled, from $20 million in 1963 to an estimated $40 million in 1970-71, or a total of $250 million during the eight-year period. Even with some revenue from landing and hangar fees (based on the size and weight of the aircraft), rentals of counters and concessions in the terminal, and utilities charges, the federal operating deficit last year alone was $10 million. And even where a break-even situation was guaranteed, a consciencable level of operating, maintenance and capital expenditure would weigh very heavily on any municipal budget.

A second cause for reluctance is political — a major airport almost invariably becomes entangled in controversy among the proponents of industry, suburban dwellers, environmental activists, transportation planners and the holders of the city's purse.

Certainly, another prime source of hesitation is the organizational complexity of air terminal operations. To begin with, a large airport like Dorval may give employment to as many as 8,000 people — airlines personnel, concessionaires, air traffic controllers, maintenance and security staff, mechanics, runway specialists, emergency officers and clerks — of whom perhaps twenty to twenty-five percent work for the Government, and all of whom must be coordinated and directed to serve the ever changing flow of aircraft, cargo and passengers passing through the terminal. Lighting must be arranged to keep the airport open safely, and all night-time activities must be controlled to keep disturbances to surrounding neighbourhoods to a minimum. Runways must be cleared of snow, weeds, and other materials, to ensure the aircraft's landing safety. Fire alarm circuits must be installed, crash equipment purchased, and crews trained for emergency situations. Even nesting and migration of indigenous birds must be studied, for more than one crash has been blamed on high-speed collisions with innocent avians (Chapter III).

Typical of the complexity of the problems facing airport managers is the issue of snow and ice removal from winter runways. Early in the decade, hot sand and a giant revolving steel brush were used for this task. As jets were introduced, it developed that the engines were particularly susceptible to damage by ingested gritty particles, and a massive blower was brought into service to remove the snow and sand more effectively. At the same time, research was begun to discover a method for reducing the necessary quantity of sand, and eventually urea was discovered to have the necessary properties. Then in 1967, lighting units sunk flush into the runways were introduced at Malton 05 Right, and it was found that the revolving steel bristles tended to damage the illuminators. The answer to this episode in the constant battle was the invention of a rubber snowplow blade. So the problems continue.

These are only some of the many and various problems which must be solved by an airport management (Table 2.9). All must be done while maintaining a calm and orderly front for the occasionally querulous travelling public, and while supplying satisfactory facilities to the highly competitive airline companies. It is hardly surprising, then, that airport management has become a separate course at many schools of business administration, or that so few municipalities are eager to take over major airports from the federal government.

Air Traffic Control

Because of the tremendous growth in air traffic in Canada, safety and efficiency in the use of airspace at once takes on new significance and becomes more difficult to ensure. Because of the greater speeds and higher altitudes attainable by new types of aircraft, further demands are being made on airspace utilization. In addition, the factors of nonaeronautical use of airspace, weather blocks, and noise abatement procedures are complicating the solution to the problem of efficient aircraft movement. The foremost answer to such intricate problems is found in Air Traffic Control (ATC) – the controlling mechanism for every aspect of a plane's activity from terminal to terminal, in the air, and on the ground.

The prime concern of ATC is to provide safe, efficient airspace utilization. All planes coming onto the screen of an ATC radar are advised of their speed, direction, altitude, and the airspace in which they are permitted to fly to avoid interference with other aircraft. As a plane navigates, it passes from one air traffic control zone to another so that its flight is kept under constant surveillance.

The work of air traffic controllers is divided into five specialized functions. Ground controllers direct movements of aircraft and service vehicles across the runways and taxiways, ensuring that planes landing or taking off have a clear path. Airport controllers, who generally occupy the upper floor of the ATC tower and use visual contact, direct the takeoffs, landings, and near-terminal flight patterns of most aircraft close to the airport. Terminal controllers, who use ASR or AASR radar (thirty-mile range), for contact, handle instrument arrivals and departures at major airports, while area controllers maintain similar coordination over blocs of the airways. Finally, Precision Approach Radar (PAR) operators, using a highly sensitive electronic hookup, guide instrument landings in poor-visibility conditions.

Historically, Canada's federal aviation policy tended towards dependence upon aircraft pilots to avoid mishaps under all conditions. However, municipal and federal governments assisted with traffic control measures after the need was demonstrated by individual failures. Initial regulations were air traffic "rules of the road" followed at first by terminal control measures, then by traffic control "en route".

In 1937, the Department of Transport took over from the Department of National Defense's seven 'radio range' markers which pinpointed important airports. During the ensuing few years, these were replaced by newer, more powerful and more precise 'Adcock' ranges, to the total of forty-four by 1942. At the same time, the congestion resulting from the war forced the introduction of radio and air traffic control at major airports (beginning at St. Hubert in 1940), and along principle airways (commencing in 1942). Subsequently, this service switched to instrument control and fully-manned, twenty-four-hour air traffic towers were opened at all major airports. The chain was linked together by additional towers and airway control centers both in Canada and in adjacent areas across the border.

This control system necessitated the formation in Canada of a school for the training of civilian and military traffic control officers and assistants. As ATC has grown in scope and complexity, training has become more intense, standards more rigid, and the controllers themselves more professional. Today, Canada's one thousand air traffic controllers belong to the Air Traffic Control Association, responsible for the promotion of the competence and good conduct of its members, and for the improvement of the safety and efficiency of ATC in Canada. Federally, the Air Traffic Control Branch of the Ministry of Transport, which has the tenure over Canadian controllers, continually works to improve the Government's role in ATC.

Post-war developments displayed the incredible increase in electronic technology that had resulted under wartime pressures. In 1948, homecoming beacons, which were uni-directional and could guide aircraft better than the radio ranges, were introduced, and in April of that year the first Instrument Landing System (ILS) in Canada became operational at Dorval Runway 10. Experimentation in Very High Frequency (VHF) transmissions had already begun, and special weather stations were established to monitor flying conditions. By 1953, there were ninety-six radio ranges, sixteen radio beacons, twenty-three ILS systems, seventy-five VHF systems, and four aviation weather stations operating in Canada.

Two major developments in the next few years revolutionized ATC. In the first place, Very High Frequency Omni-Directional Ranges (VOR's) gradually phased out the less sophisticated radio ranges and beacons in the more congested airspaces. Secondly, the injection of radar systems into the ATC system commenced with the Raytheon and Decca models ordered in 1956 and continued through the PAR's (Precision Approach Radars) set up initially at Toronto in 1961, the AASR's (Airport and Airways Surveillance Radars), and the SSR's (Secondary Surveillance Radars) for airway surveillance, installed in 1965. By 1963 Canadian airports and airways numbered two hundred and sixty-three non-directional radio beacons,

thirty-six VOR stations, thirty-nine ILS systems, three PAR and fifteen AASR radar systems, and seventy-seven radio ranges.

Modern developments in Canada's ATC comprise the placement of TACAN (Tactical Air Navigation) military systems for the RCAF, the establishment of Decca MR-75 weather radar systems, and the introduction of Doppler VOR's (first at Port Hardy in 1964). In addition, computers now play a vital role in ATC: an APT system links satellite photography units with airport tower weather display terminals and computerized flight data records are becoming commonplace. The primary computerized system was installed at Gander in 1968 and models have since been made operational at Toronto, Montreal, and Moncton.

The current Canadian ATC picture is extremely fluid due to the large number of Department of National Defense operations being turned over to the Ministry of Transport for control. Nonetheless, facilities at April 1st, 1971, included two hundred and ninety-four non-directional beacons, fifty-eight VOR's, twenty-eight TACANS, and fifty-two ILS systems (including a few newer models designed for low ceilings and poor visibility). A total of twenty-six PAR's and ASR's (Airport Surveillance Radar, with a range of approximately thirty miles) are in use at Canadian airports, along with eight AASR units and twenty-six SSR systems (maximum range of four hundred miles). These radar systems, which record only the range and bearing of an aircraft, may soon be superseded by a new network called the Beacon Video Digitizer (BVD). Combined with the computerized flight data system, the BVD can determine, display and record range, bearing, altitude, azimuth, identity, flight path and airspeed. When it becomes fully operational, BVD will create an automated, nation-wide system placing Canada in the forefront of ATC.

En route control traditionally has been imposed only on instrument flights in Canada although procedures (including, since 1960, a radar advisory service) do allow for voluntary inclusion of visual flights below twelve thousand, five hundred feet in the Rockies, and below ninety-five hundred feet elsewhere. Since about 1960, IFR flights have increased faster than VFR flights (Table 2.10) and the growing number of aircraft has shifted the balance between controlled and uncontrolled airspace towards the former. These factors have combined to greatly increase ATC responsibilities.

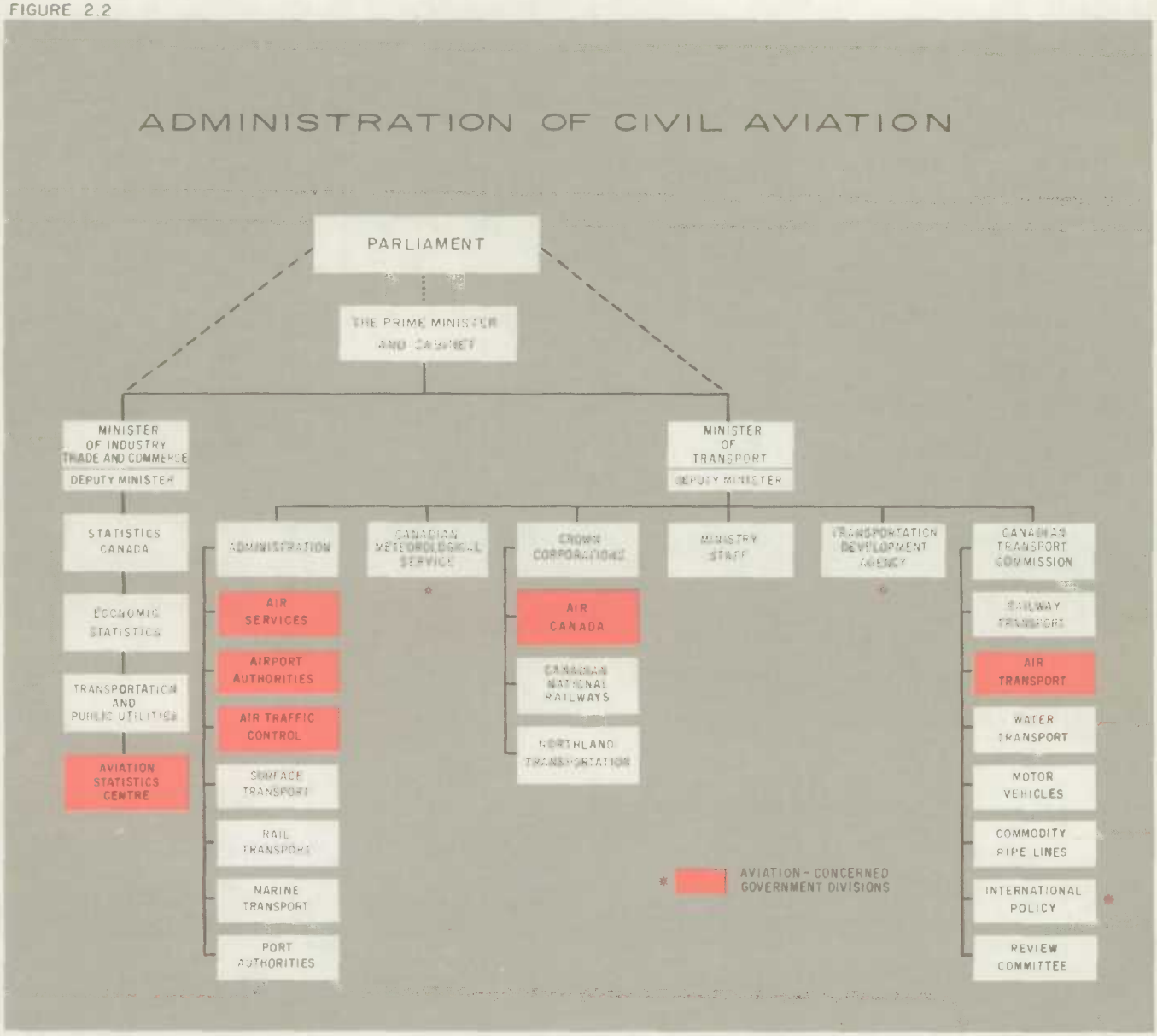
While there are no designated categories of uncontrolled airspace there are numerous ones for controlled airspace. Starting generally at the lower altitudes and going up, there are control zones, transitional areas, additional control areas and extensions, continental control areas, jet routes and advisory areas, and positive control routes and areas. Furthermore, there is an extensive list of airspace used for special purposes such as restricted areas, military climb corridors, caution areas, prohibited areas, controlled firing areas, student jet training areas, warning areas, and flight test areas. The rapid growth of aviation is evidenced in the expansion of total airspace from under seventy thousand miles in 1965 to over one hundred thousand miles in 1971.

In the past, navigation has not been of major concern to Canadian ATC both because sufficient margin for navigational error was provided for in the designated vertical and horizontal separation standards, and because the pilot in the low-speed, relatively slow aircraft of the era generally had sufficient time to devote to navigation to maintain a constant knowledge of his position. But this has undergone significant change in Canada for several reasons. The rapid growth in aviation is dictating a more thorough examination of all possible means for coping with the great increase in airport congestion including the possibility of considerably reducing separation standards from the present altitude of 1,000 or 2,000 feet, the lateral separation of ten miles, and the longitudinal distance of ten miles flying time. In addition, pilot workload has increased to the extent that less time is available for navigation. And finally, the increase in the numbers and speed of aircraft has forced a greater percentage of all traffic to operate under adverse weather conditions, thus placing much greater demands on navigational equipment, the pilot, and the air traffic controller.

Looking towards the future, ATC will have to continue to treat such problems as noise and sonic boom, shortage of terminal capacity, the separation of commercial and private recreational flying, and the effective movement of V/STOL aircraft. The demand for ATC service is expected to rise even faster than aviation activity in general. Overall, the demand for ATC service is expected to almost treble present capacity by 1980, and to treble again by 1995. Increasing costs will undoubtedly demand greater attention by the federal government. In the summer of 1968, a special committee of the Ministry of Transport was created for the purpose of recommending an ATC system for the 1970's and beyond. ATC facilities and procedures are in the process of being renovated in a massive program designed to correct deficiencies and to update the service in the light of recent advances in the electronic industry.

In such areas as standards of training, terminal control, air routes, and the North Atlantic control zone, the quality of Canada's ATC effort is second to none.

FIGURE 2.2



Data Source: Aviation Statistics Centre

Interactions between governmental organizations in Canada and the air transportation system will undoubtedly increase in proportion to the augmenting complexity of the industry.

Certain trends seem apparent for the future. Integration of airport planning into regional planning will necessarily increase as airport problems are recognized as part of the total urban area planning responsibility. Distribution of commercial air services via satellite airports, and assignment of pleasure flying and less essential general aviation activities to more remote airports, represent significant trends. The continued upgrading of safety systems and regulations in Canada during the next decade will have a great impact on the performance requirements and licensing standards for airmen, mechanics, and personnel in related fields.

In an era of intensifying congestion and scarcity of usable airspace and terminal facilities, more control of all aspects of Canadian aviation seems inevitable.

TABLE 2.1. World Airports, 1969, by Total Commercial Movements

Overall rank(1)	Airport	City	Aircraft move-ments(2)	Rank	Passenger flow(3)	Rank	Cargo flow(4)	Rank
			'000		'000's		'000 tons	
1	O'Hare(5)	Chicago	632.0	1	28.10	1	410.8	2
2	Kennedy	New York	352.0	3	19.51	3	683.5	1
3	Los Angelos	Los Angelos	411.2	2	21.31	2	342.4	4
4	San Francisco	San Francisco	306.9	4	13.97	5	275.5	5
5	Heathrow	London	236.0	9	14.09	4	343.4	3
6	Miami	Miami	275.4	6	10.56	7	244.5	7
7	Le Bourget/Orly(6)	Paris	209.4	11	10.54	8	217.8	8
8	Frankfurt-Main	Frankfurt	159.7	13	7.51	12	258.0	6
9	Logan	Boston	243.8	8	9.65	10	119.5	14
10	Love Field(5)	Dallas	275.3	7	10.26	9	100.6	17
11	Metropolitan	Detroit	213.1	10	7.42	13	141.0	11
12	Tokyo	Tokyo	141.9	14	7.60	11	157.4	10
13	Dulles/National(6)	Washington	285.2	5	11.92	6	56.2	27
14	Philadelphia	Philadelphia	195.3	12	7.13	14	124.4	13
15	Kastrup	Copenhagan	126.7	20	5.23	16	112.0	15
16	Fiumicino/Ciampino(6,7)	Rome	127.8	17	5.03	19	88.4	19
17	Hobbey(8)	Houston	141.2	15	4.51	23	—	—
18	Isla Verdo	San Juan	126.9	19	4.52	22	98.5	18
19	Schiphol	Amsterdam	93.6	27	4.27	24	157.5	9
20	Honolulu	Honolulu	127.8	18	5.24	18	64.4	25
21	Osaka	Osaka	123.4	21	6.43	15	54.7	28
22	MALTON(9)	TORONTO	118.2	23	5.26	17	71.6	24
23	Seattle-Tacoma	Seattle	108.1	24	4.80	21	84.2	22
24	DORVAL(9)	MONTREAL	105.8	25	4.07	25	84.9	21
25	Zurich	Zurich	91.3	28	3.77	28	85.9	20
26	Friendship	Baltimore	133.4	16	3.04	21	41.7	34
27	Moisant	New Orleans	120.0	22	3.77	27	38.4	36
28	Barajas	Madrid	74.7	31	3.77	29	48.6	31
29	Brussels	Brussels	62.5	38	2.45	39	102.5	16
30	Malpensa/Linate(6,7)	Milan	63.5	36	2.66	36	78.7	23

See footnotes at end of table.

TABLE 2.1. World Airports, 1969, by Total Commercial Movements — Concluded

Overall rank(1)	Airport	City	Aircraft movements(2)	Rank	Passenger flow(3)	Rank	Cargo flow(4)	Rank
			'000		'000's		'000 tons	
31	Arlande/Bromma(6)	Stockholm	77.9	30	2.95	33	43.2	33
32	Tempelhof	Berlin	73.5	32	4.91	20	24.3	49
33	Mexico	Mexico	64.3	35	3.03	32	38.9	35
34	Ton Son Nhut	Saigon	56.9	43	1.85	47	127.3	12
35	Portland	Portland	94.6	26	2.64	37	29.6	41
36	Dusseldorf	Dusseldorf	65.7	34	2.90	34	29.3	42
37	Central	Athens	68.2	33	2.72	35	24.6	48
38	Tampa	Tampa	90.3	29	3.06	30	19.6	59
39	VANCOUVER(9)	VANCOUVER	62.5	37	2.25	42	29.1	43
40	Aeroparqua/Ezeiza(6)	Buenos Aires	59.5	40	2.17	44	36.7	39
41	Son San Juan	Palma (Mallorca)	59.9	39	4.06	26	17.0	62
42	Hamburg	Hamburg	57.6	42	2.54	38	25.3	47
42	Hong Kong	Hong Kong	38.5	57	1.90	46	51.0	29
44	Barcelona	Barcelona	49.4	51	2.40	41	27.9	44
45	Munich	Munich	58.9	41	2.44	40	21.5	56
46	Maiquetia	Caracas	49.9	50	1.27	58	50.6	30
47	Geneva	Geneva	52.2	46	2.22	43	24.0	50
48	Anchorage(10)	Anchorage	50.3	49	1.06	66	61.8	26
49	Manila(8)	Manila	52.6	45	1.75	48	—	—
50	Dublin	Dublin	37.6	58	1.69	49	37.3	38
51	Khalde	Beirut	38.9	56	1.27	59	47.6	32
52	Manchester	Manchester	36.0	60	1.55	51	38.0	37
53	Congonhas/Viracopos(6)	Sao Paulo	50.9	48	1.48	53	21.0	58
54	Johannesburg	Jonannesburg	43.3	52	1.46	54	27.4	45
55	Lod	Tel Aviv	17.1	93	.99	68	26.3	46
56	Los Cerrillos	Santiago	16.4	94	.64	79	31.6	40
57	Broward County	Fort Lauderdale	51.7	47	1.30	56	4.4	111
58	Palm Beach	Palm Beach	54.1	44	.74	73	3.5	120

(1) Order of average ranks for aircraft, passenger and cargo flows.
(2) Ranked continuously only above 50,000.
(3) Embarking plus disembarking; ranked continuously only above 2,000,000.
(4) Loaded plus unloaded; ranked continuously only above 25,000.
(5) Passengers = embarked X 2.
(6) Total of two airports.
(7) 6 months (January-June) X 2.
(8) Cargo data not given; approximate ranking interpolated.
(9) Estimates, scheduled services only; all other figures scheduled plus unscheduled.
(10) Cargo includes mail.

Note: Altanta (15.5 million), New York/La Guardia (11.7 million), New York/Newark (7.1 million), Denver (7.0 million), and Cleveland/Hopkins (5.3 million), are also major airports by passenger flow, but data is not available from this ICAO source.

Source: Airport Traffic 1969, ICAO Digest No. 153.

TABLE 2.2 ICAO Ranking Top World Scheduled Airlines(1), 1960-70

Airline	Country	Millions of ton-kilometers flown (passengers & goods)			
		1970 rank	1970 performance	1960 rank	1960 performance
Pam American	USA	1	2,904	1	989
BOAC	United Kingdom	2	1,493	2	439
Lufthansa	West Germany	3	1,184	9	153
Air France	France	4	1,155	4	283
Trans World	USA	5	1,073	6	207
Japan Airlines	Japan	6	973	16	65
KLM	Netherlands	7	929	3	356
Alitalia	Italy	8	921	12	129
SAS	Scandinavia(2)	9	644	5	232
AIR CANADA	CANADA	10	608	13	112
Swissair	Switzerland	11	581	10	137
Qantas	Australia	12	538	7	155
Iberia	Spain	13	450	24	35
Sabena	Belgium	14	412	11	134
British European	United Kingdom	15	384	8	155
Seabord	USA	16	364	18	50
Varig	Brazil	17	339	33	20
El Al	Israel	18	335	19	47
Northwest	USA	19	311	14	89
UTA	France	20	310	20	44
Air India	India	21	281	15	69
CP AIR	CANADA	22	274	17	58
Aerlinte	Ireland	23	218	22	38
SAS	South Africa	24	206	25	32
Olympic	Greece	25	198	30	21
Braniff	USA	26	191	28	23
Argentines	Argentina	27	165	23	37
Icelandic	Iceland	28	157	34	20
Air Afrique	Yaounde(3)	29	148	–	–
TAP	Portugal	30	143	35	20

(1) Does not include Aeroflot (USSR).
(2) Sweden, Norway, and Denmark.
(3) Twelve African treaty states: Cameroon, Central African Republic, Chad, Congo, Dahomey, Gabon, Ivory Coast, Mauritania, Niger, Senegal, Togo, and Upper Volta.
Source: ICAO Circular 105-AT/26, 1971.

TABLE 2.3. Federal Government Expenditures on Civil Aviation, 1963-70

Year ending March 31	Net expenditure on aviation(1)			
	MOT air services	CTC	ATB	Totals
1963	115,491,000	–	819,000	116,310,000
1964	99,759,000	–	636,000	100,395,000
1965	103,450,000	–	688,000	104,138,000
1966	113,677,000	–	1,132,000	114,809,000
1967	132,997,000	355,000	402,000	133,754,000
1968	136,217,000	1,151,000	500,000	137,868,000
1969	149,651,000	1,281,000	–	150,932,000
1970	143,556,000	3,394,000	–	146,950,000
Totals	994,798,000	6,181,000	4,177,000	1,005,156,000

(1) Gross expenditure less actual revenue.
Source: Public accounts of Canada, 1963-70.

TABLE 2.4. MOT Expenditures on Air Services, 1969-70(1)

Division	Year	
	1970	1969
Operating		
Air service administration	6,316,846	5,409,434
Construction administration	6,540,212	6,357,586
Civil aviation	9,126,981	9,851,036
Airport operation	10,083,592	– 806,897
Air traffic control	18,593,004	15,871,294
Telecommunications	22,485,675	24,689,305
Meteorology	31,582,719	26,505,804
Totals, operation (vote 30)	104,729,029	87,877,562
Capital		
Airport construction & grants	39,628,742	62,456,626
Totals, capital (vote 35, 40)	39,628,742	62,456,626
Totals	144,357,771	150,334,188

(1) Gross expenditures less anticipated revenue.
Source: Public accounts of Canada, 1970.

TABLE 2.5. MOT Gross Expenditure on Aviation, 1963-70
(in millions of dollars)

Division	Year ending March 31(1)								
	1963	1964	1965	1966	1967	1968	1969	1970	1971
Airport:									
Capital	48.7	27.7	22.7	25.0	36.4	30.6	25.8	20.4	22.5
Operation and Maintenance	19.8	20.3	24.1	26.4	28.9	33.5	33.1	34.0	37.3
Totals	68.5	48.0	46.8	51.4	65.3	64.1	58.9	54.4	59.8
Civil aviation	4.0	5.1	6.7	6.3	7.7	9.9	4.6	5.0	7.3
Construction administration	3.7	3.8	4.0	4.5	5.0	5.7	6.4	6.6	9.2
Air administration	1.9	1.9	2.1	2.2	2.9	4.8	5.4	6.5	8.5
Navigation aids(2)	35.8	37.7	45.9	48.0	50.4	53.8	63.9	64.5	82.1
Meteorology	19.2	20.6	21.8	23.7	26.6	28.1	32.7	34.4	38.1
Totals capital	59.4	38.9	39.9	43.8	53.7	45.2	50.8	36.4	47.2
Totals operating	73.8	78.2	87.5	95.3	106.6	121.2	129.3	136.2	165.2
GRAND TOTALS	133.2	117.1	127.4	139.1	160.3	166.4	180.1	172.6	212.4

(1) Actual 1963-69; projected 1970-71.
(2) Telecommunications, air traffic control, flight aids.
Source: MOT, Air Administration.

TABLE 2.6. CTC Classifications for Commercial Licensing of Air Carriers

Class	Domestic Carriers
1	Scheduled Air Carriers offer public transportation of persons, mail and/or goods by aircraft, serving designated points in accordance with a fixed schedule at a fixed charge per passenger or per weight of cargo.
2	Regular Specific Point Air Carriers offer public transportation of persons, mail and/or goods by aircraft serving designated points on a route pattern and with some degree of regularity, at a fixed charge per passenger or per weight of cargo.
3	Irregular Specific Point Air Carriers offer public transportation of persons, mail and/or goods by aircraft from a designated base, serving a defined area or a specific point or points at a fixed charge per passenger or per weight of cargo.
4	Charter Air Carriers offer public transportation of persons and/or goods by aircraft from a designated base, at a fixed charge per mile or per hour for the charter of the entire aircraft, or at such other charges as may be permitted by the Air Transport Committee.
5	Contract Air Carriers transport persons and/or goods solely in accordance with one or more specific contracts.
6	Flying Clubs are air carriers incorporated as non-profit organizations for the purpose of furnishing flight training and recreational flying for club members.
7	Specialty Air Carriers operate for purposes not provided for by any other class.
8	International Scheduled Air Carriers are designated by the government of any state to operate international scheduled air services between Canada and any other state, pursuant to an international agreement.
9	International Non-scheduled Air Carriers operate, between Canada and any other state, any commercial air service that is not a scheduled service.

Source: MOT.

TABLE 2.7. Number of Canadian Airports by Category, 1970

	Number			
	Land	Water	Helicopter	Totals
Operated by MOT:				
Licensed	87	4	4	95
Unlicensed	27	20	–	47
Totals	114	24	4	142
Operated by municipalities:				
Licensed	161	24	–	185
Unlicensed	81	19	1	101
Totals	242	43	1	286
Operated privately:				
Licensed	137	331	43	511
Unlicensed	372	120	4	496
Totals	509	451	47	1,007
Operated by DND	28	3	–	31
Operated by USAF	7	–	–	7
Operated by USN	1	–	–	1
Operated by RCMP	–	–	–	1
Abandoned or operator unknown	53	53	–	106
Total licensed	385	359	47	791
Total unlicensed	480	159	5	644
Total military and RCMP	36	4	–	40
GRAND TOTALS	954	575	52	1,581

Directory, Department of Energy, Mines & Resources, March 1971.

TABLE 2.8. Fire Losses at MOT Airport Sites, 1961-70

Year	Fire losses
	dollars
1961	100,002.00
1962	539,234.63
1963	117,728.00
1964	12,214.50
1965	61,085.28
1966	8,020.44
1967	24,377.41
1968	323,387.91
1969	10,029.81
1970	8,460.00

Source: MOT.

TABLE 2.9. Typical Air Terminal Functions

Aircraft and Vicinity

Necessary: Flight and schedule information; passenger facilities (ramps, etc.); baggage handling (loading, unloading); meal loading; cargo handling (loading, unloading); communication between plane and terminal; emergency services; parking areas; hanger facilities; maintainence shops; fueling areas; cleaning areas; kitchens (for meals); utilities (power, water); ground crew ready rooms; specialized storage areas (refrigerated, livestock, hazardous materials); communication, general administration; employee service and rest areas; fire protection, provision for service vehicle traffic; utilities; air traffic control; ground control; airport maintainence (terminal and runways); snow removal; garbage disposal; flight operations room; air crew ready rooms; crew movements space; flight filing; weather forecast access; runways and taxiways.

Desirable: Telephone communication; interterminal transit (STOL/ground); special shipments; computerized flight data information; transport to parking (moving sidewalks, etc.).

In Airport

Necessary: Restaurant services; medical services; customs processing; restrooms; security services; newsstand; flight and schedule information; telephone; taxi stands (also bus/limousine); possible V/STOL unloading areas, rail stations, baggage handling; cargo warehouses; customs cargo inspection areas; transport to/from aircraft;

Desirable: Automobile loading/unloading and parking; inter-carrier cargo transport, including palletized transport facilities; access to computerized cargo/passenger/flight data; facilities for related industries; storage for repair supplies, tools, parts.

Convenience: Recreational services; mail receiving; hotel and motel accommodations; miscellaneous stores (gifts, barber, etc.); bar.

Near Airport

Necessary: Restrooms, security; accommodation; flight and schedule information; telephone; passenger loading/unloading from surface or V/STOL transports; auto rental facilities; baggage handling; cargo handling from ground transports; warehouses (general and specialized); communications; spare parts storage; satellite airports.

Desirable: Restaurant; access to computerized data.

Convenience: Mail receiving; newsstand; small shops; bar.

Optional on-near terminal

Necessary: Ticketing; baggage check/claim; insurance; auto rentals; flight meal catering; reception of individual small cargo lots; reception of regular large cargo lots; reception of cargo from all types of surface transport; bonded storage; breakdown of pallets; delivery of cargo to receiver or to all sorts of ground transport; cargo tracing, routing and other administration; major overhaul of aircraft.

Source: Air Transportation 1975 and Beyond, M.I.T. Press, 1968.

TABLE 2.10. Number of IFR and VFR Flights Filed, 1958-70

Year	IFR flights filed	VFR flights filed(1)
1958	744,900	226,037
1959	801,939	228,487
1960	728,425	225,594
1961	675,593	222,444
1962	694,572	209,569
1963	691,808	196,573
1964	701,725	188,767
1965	744,915	196,520
1966	792,570	223,781
1967	886,481	239,755
1968	1,048,440	240,878
1969	1,118,981	245,928
1970	1,228,942	247,659

(1) This does not, of course, include all VFR flights made.
Sources: DOT Annual Report, 1959-66; Air Traffic Control MOT, 1967-71.

Chapter III

GENERAL AVIATION

Such diverse aspects of Canadian aviation as general aviation activity in Canada from 1960 to 1970, private and commercial flying, aircraft in use – gliders, autogyros, and balloons – as well as Canada's accident and safety record will be reviewed in this section.

Overall View

The activity level of civil aviation in Canada can be assessed from commercial carrier reports to the federal government, departmental submissions, applications for certificates of aircraft airworthiness, the number of aircraft registered by MOT, and the licensed aviation personnel in the country. Figure 3.1, and Tables 3.1 to 3.4 outline various details in these categories. The total of over 2.6 million hours flown by all types of aircraft in Canada in the years of the late 1960's, is a fifty percent increase over the beginning of the decade; this growth is primarily by commercial flying and interestingly enough, represents seven minutes of flying per year for each Canadian citizen.

Pilot, aerodrome, and aircraft licensing in Canada is one of the international conventions covered by the former ICAN agreements. Initially, all tests for the licensing of both aircraft and personnel were conducted by an RCAF inspector, usually an air engineer employed by the Air Regulations section of the Department of National Defense's Civil Aviation Branch. During the decade after DOT had been created and assumed the management and regulation of civilian flying in this country, regional offices sprang up in Vancouver, Regina, Winnipeg, Toronto, Montreal, and Moncton; in 1948 they were granted permission to issue licenses independently of Ottawa.

Today, this decentralization is still in effect. MOT inspectors in centres throughout the country are specially trained in testing techniques to ensure maximum pilot safety in the airways. Personnel licenses must be periodically renewed – from every six months for commercial and airline pilots to every five years for glider airmen. Of the average annual increase of 1,700 licenses since 1960, the number of commercial pilots has grown the most rapidly. During this same period, the numbers of navigators, air traffic controllers, flight and maintenance engineers, have expanded from 2,869 to 4,400.

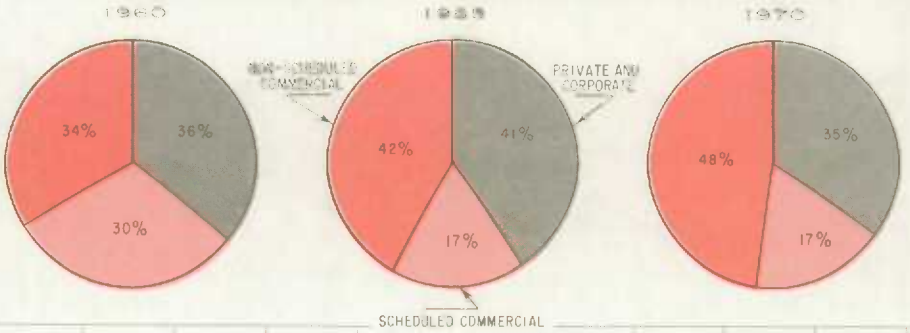
Similar to licensing, aircraft registration has been the responsibility of the federal government since 1919. In the years following Versailles, Canada received "GC" markings because of its association with Great Britain whose mark was "G". However, in 1927, Canada was granted thirteen new series of five letters each. The first series chosen, "CF" followed by any three letters, was inaugurated on January 28th, 1929, when "CF-CAK" was allocated to a De Havilland "Gypsy Moth" owned by the Hamilton Aero Club. As there are 17,576 possible combinations in this series, it remains the only one in use. However, a new bloc may have to be initiated in this decade if registration growth continues at its present rate.

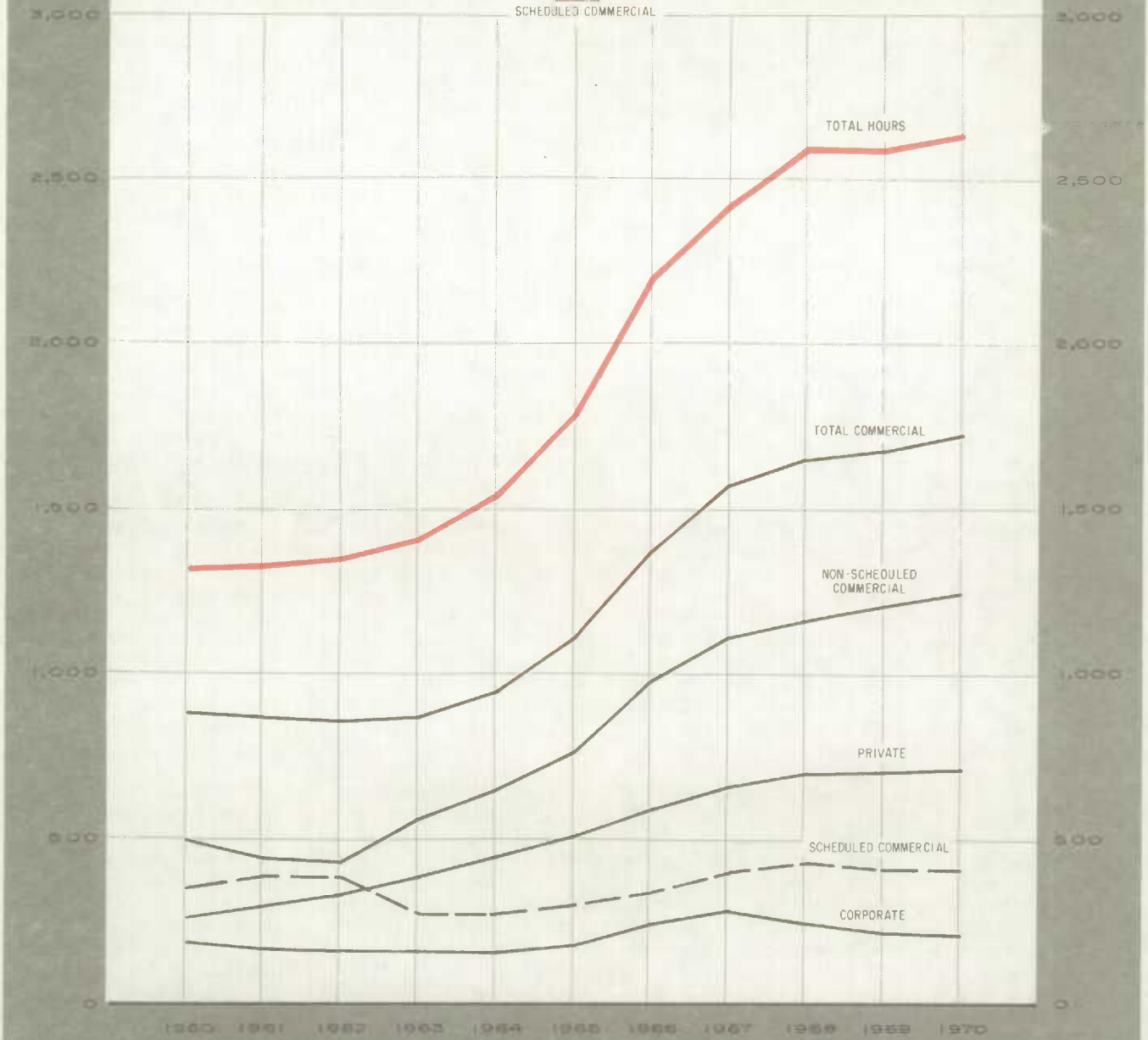
Today, between two-thirds and three-quarters of Canada's aircraft are privately registered, if 'ultra-light' planes not technically heavy enough for MOT certificates of airworthiness, are included. Commercial licenses dominate the remainder of the 11,315 aircraft currently on file – federal and provincial government airplanes number but a token 200. It is interesting to note that, since 1960, the under two tons, 'light-plane' registrations have more than doubled – from 4,965 to 10,793 – reflecting the surge in private flying in Canada. In addition, more than 10,000 of the aircraft registered at present are power-driven, fixed-wing models; 552 of the remainder are helicopters, 245 gliders, 84 gyrocopters and autogyros, and 10 ballons. Two of the aircraft registered deserve particular mention: an Avro 504K owned by the National Museum of Science and Technology is on of Canada's oldest registered aircraft – the first model was produced in 1913; one 1917 Nieuport Scout is also privately owned by an Ontario resident.

Table 3.5 depicts the distribution of the aircraft fleet by manufacturers and provinces. Only a limited number of companies supply the majority of aircraft currently flown in Canada. In the 'light-plane' sector, the most popular models are the Cessnas and Piper Cubs – which between them supply more than one-half the aircraft flown – the Champion Citabrias, and the Cherokees. Boeing, Canadair, Convair, Douglas, Grumman, Hawker Siddeley, Lockheed, Nihon, and Vickers are the major heavy aircraft (over twenty-five tons) in use in the country today. The heaviest airplane on the civil registry is the Boeing 747 at almost 400 tons fully loaded. With an overall length of 232 feet, a wingspan of 196 feet, and a 400-passenger capacity, this is also the largest aircraft flying in Canada. Some of the fastest commercial planes are the Boeing 707 and 747, and the DC-8 series, all designed for speeds of 600 miles-per-hour or more. Though military jet fighters such as the Lockheed Starfighter are capable of Mach-2 speeds, such velocities will not be matched commercially until the scheduled airlines take delivery of the SST's.

FIGURE 3.1

AIRCRAFT HOURS FLOWN
(1960-1970)





Data Source: Aviation Statistics Centre

Provincially, Ontario and Quebec generally supply just under one-half of the aircraft registered in Canada, and over one-half of the hours flown. This is partially attributable to their large populations, and to the fact that Air Canada's operating figures – in addition to those of Nordair and Quebecair – are filed at their Montreal headquarters, despite the widespread geographical operating areas of these companies. For helicopter operations, the mountain provinces of British Colombia and Alberta rank second and third to Ontario; Quebec is relegated to fourth position.

Private vs Commercial Flying

A very general glance at private flying in Canada reveals that, in 1971, the private fleet was comprised of approximately 7,900 aircraft including seventy-five percent of all types of airplanes flown, and virtually one hundred percent of all gliders, autogyros, and balloons. Ontario itself had more than one-third of the privately registered aircraft, followed by British Columbia, Alberta, Saskatchewan, and Quebec. It is noteworthy that one-half of Canada's aircraft were constructed before the mid-1950's, while only about twenty percent were less than five years old. In general, twin-engine planes were newer than single-engines, a fact consistent with their relatively recent invasion of the 'light-aircraft' market. Furthermore, approximately forty percent of private aircraft owners were between thirty-five and forty-four years of age, with almost eighty-five percent aged twenty-five to forty-four.

Several other phenomena appeared on Canada's private flying scene in the 1960's: the upsurge in glider flying, the introduction of autogyros, and the revival of ballooning.

Gliding is the art of maintaining horizontal flight in an aircraft without the application of internally-produced thrust: most modern light aircraft are capable of gliding fair distances if their engines fail. Soaring, distinct from gliding because it involves continuous flight by upward movement in rising air columns, requires special aerodynamic design and lift construction.

Canadian gliding began in 1907 with the flights of Larry Lesh in Montreal, and of R.J. McCowan in Sydney, Nova Scotia. Their vehicles were bamboo and muslin biplane rigs propelled by towing, and controlled, at first, by shifts in the pilot's centre of gravity. The sport largely died out until other efforts were initiated by Norman Bruce of Medecine Hat, Alberta, in the 1920's. Founding the Cloud Rangers' Gliding Club, Bruce barnstormed his gliders throughout the country, reviving the sport and inspiring the formation of more organizations, among them the McGill and Webster Gliding Clubs of Montreal. During the 1930's, clubs sprang up throughout Canada – at Victoria, in many Prairie cities, and at Ottawa, in particular. World War II, despite its suppression of much civil aviation activity, did nothing to halt Canadian enthusiasts. On the contrary, both the inexpensiveness of the sport, and the fact that the vehicles did not demand valuable war materials for their construction, strengthened the appeal of gliding which ultimately was responsible for the training of a considerable number of pilots sent overseas. Eventually, gliders were used as troop transports on large-scale airborne troop movement operations, such as the German invasion of Crete and the Allied landings on D-Day. Today, many RCAF air cadets receive pilot training on gliders to accustom them with the "feeling" of flying.

In a move to improve training standards and organize the sport on a national scale, the Soaring Association of Canada (SAC) was formed in 1944 to become the Canadian member of the Fédération Aéronautique International (FAI) – a world gliding and soaring fraternity. Instruction and instructor-training began at Carp, Ontario, just after the war ended, and the first national meet was held at Kingston in 1949. Throughout the years, Canada has become a strong contender for international soaring awards, and has acquired many leading FAI ratings, including the 'Diamond C' certificates of which there are only 400 to 550 in the world. Moreover, Canada is renowned for sound work in glider design by such agencies as Brandlmayr and Czerwinski.

At ICAO's suggestion, MOT commenced in 1946, to register, inspect, and license all glider pilots and aircraft in Canada. During the last decade, gliders have increased in number from 100 to 250, pilots from 444 to 1,500. The majority of these aircraft, valued from $5,000 to $15,000, are imported into Canada from the United States – notable the most popular single-pilot model, the Schweizer – or from Europe, including the Schleucher, Slingsby, and Omnipal/Blamk models. Numerous gliders are assembled in Canada as well. The total for all glider hours flown in the country for recreational training, and aerodynamic research, has averaged just over ten thousand hours annually in recent years.

The year 1963 introduced to Canadians the autogyro – a rotating-wing aircraft in which the motor remains unpowered during cruising; instead, thrust is supplied by a pusher-propeller mounted behind the pilot. Virtually all the autogyros or gyroplanes in the country are produced by the Benson Company of Raleigh, North Carolina, although the Avian Company of Canada has also manufactured a few models. At present, there are eighty-four such craft in Canada, with the majority in Quebec.

Ballooning, on the other hand, predates even gliding in Canada. In 1858, an American named Lowe made an exhibition flight over Canada's newly-named capital, Ottawa. Twenty years later, the wave of ballooning enthusiasm, begun with the Paris flights of the Montgolfier brothers some years before, spread to Canada and inspired the construction of a spherical balloon by Charles Pagé of Montreal. Held aloft by city household gas — it being difficult to acquire the 70,000 cubic feet of hydrogen gas required — the craft completed a pleasant but uncontrolled five-mile flight from Montreal to St. Juneau, Quebec, on July 31, 1879. Pagé and his financier "copilot", R.W. Cowan, were acclaimed as Canada's first aviators.

Despite this feat and continued exhibitions at fairs during the next few decades, it was not until the end of World War I that ballooning was really taken seriously. At that time, Britain, impressed with the manoeuvers of the German Count von Zepplin's civil and military dirigibles, decided to initiate a round-the-world airship service. The sister-ships, R-100 and R-101, were scheduled to arrive in Canada from England in the late spring of 1930 and then return home. Extensive work began in 1927, to prepare St. Hubert's near Montreal for the airship landings. The visit of the balloons was a great success, but their lack of manoeuvrability in rough weather and the explosive nature of the buoyant hydrogen gas, made them unsafe for public use. The project was thus abandoned.

The world today, but particularly North America, is witnessing a resurrection of ballooning in its original sporting context. In Canada there are about a dozen balloons, both hot-air and light-gas driven, and the number has been increasing steadily since the revival in 1967.

With reference to commercial flying in Canada, several facts are interesting to observe. The ownership of commercial aircraft appears to be about two-thirds by private corporation, with the remainder by partnership investments. Unit-toll hours are the domain of heavy, multi-engine transports flown throughout the country. Charter and contract flying tend to be concentrated geographically in the Canadian west and north, while specialty services are undertaken in greatest number in the southern and metropolitan areas. Almost eighty percent of charter services are flown by light-weight, single-engine aircraft or helicopters, primarily Cessna 180's, Bell 47's, and De Havilland Beavers.

The branch of commercial flying termed 'specialty' is notable for the diversity and activities it involves. Flight training, by far the largest portion of specialty flying, uses light, single-engine aircraft, mostly Cessnas and Pipers. Cessna 150's and 172's as well as Piper 140's and 180's, play leading roles in recreational flying rental, while scenic aerial photography favours DC-3's and Cessna 310's. On the other hand, survey photography generally employs light, twin-engines planes, although DC-3's and Bell helicopters have high usage rates as well. Aerial application has been the subject of considerable technological development, and specialized light planes such as the Cessna Agwagon, the Grumman Ag-Cat, and the Piper Pawnee are being used more and more extensively. Many "flying farmers", however, are still using older models, and the most commonly flown individual type in this category is the Boeing Stearman biplane. Helicopters — such as the Bell 47 and Hiller 12; light planes — Cessna 172's and Piper Super-Cub's; and occasionally larger, greater-range models such as DC-4's, are all used for aerial reconnaissance. Helicopters for aerial construction work, and the amphibious Cansos and Grumman Avengers for water-bombing, are likewise finding wide-spread use.

Safety and Accidents

Canada has a good aviation safety record, especially considering the indigenous level of flying in this country (Tables 3.6 to 3.8). The stringent regulations of MOT and the research of NRC scientists have contributed largely to these developments.

MOT, through its Aeronautical Engineering, Flight Standards and Regulations, Accident Investigation, and Aviation Safety Divisions, is responsible for the maintenance of adequate safety standards, and where unfortunately necessary, the investigation of any accidents which do occur.

The Aeronautical Engineering Division ensures, in general, that aircraft flown in Canada are airworthy. When a manufacturer wishes to introduce a new type of aircraft into the Canadian market, he must first submit designs and a production model for inspection, at his own expense. All the components — structure, control, avionics, powerplant, and aerodynamic performance — are examined by experts; if the aircraft proves satisfactory, a type certificate of airworthiness is issued. After models of the plane have been sold, the owners must submit their individual aircraft — usually once a year — for inspection by an MOT certified mechanic, and for a test flight by a licensed test-pilot. If all tests are passed, a certificate of airworthiness is issued, without which it is illegal to fly in this country.

'Flight Standards and Regulations' is responsible for the standards of pilot training; examination and licensing; registration of aircraft; airport standards; and air operations surveillance, among others. Inspectors from this Division monitor pilot behaviour in all controlled airspaces, at airports, and in the operation of large airplanes. These men often fly long domestic and international routes with an air transport pilot to ensure that the commercial operators are remaining alert and precise in their navigation.

The Stearman 4EM was used in Canada during the early 1930's as a fast, efficient mail plane. The aircraft had very pleasant flying characteristics and this quality, coupled with its speed and performance, made it well liked by pilots. This airplane was restored in the markings of CF-AMB, one of the Stearmans used by the Eastern Airlines of Canadian Airways, Ltd. The restored machine was first flown in December, 1969, and subsequently presented to the National Aeronautical Collection by Mr. John Paterson of Thunder Bay, Ontario.

Photo curtesy of the Aviation and Space Division, National Museum of Science and Technology.

'Accident Investigations' determines the causes of all accidents in Canada with a view to the prevention of further casualties. Using such technological advances as the Black Box on-board flight data recorder, and with the facilities of its own sophisticated laboratory in Ottawa, the inspector of this Division can often determine the most obscure mechanical flaws responsible for malfunction, even when the wreakage of the aircraft is so complete that recognition is scarcely possible. Moreoften than not, however, it is found that pilot error or carelessness, and not a mechanical device, must be blamed.

Over the last decade, although flying hours in Canada have more than doubled, accidents have increased by only sixty-five percent. The safest segment of the industry is scheduled domestic and international services which averaged only one accident each year per one hundred thousand flying hours. There were none recorded in 1967. Private flying records the highest rate, averaging forty accidents per hundred thousand flying hours.

Although Chapter VII outlines in detail the work of the National Research Council (NRC), it is appropriate to mention here the particular studies being conducted on the bird-strike problem, that is, the number of accidents caused by collisions between aircraft and birds. Since the early 1960's, scientists have been analyzing the habits of birds with the intention of discouraging large populations from nesting near airports. International coordination has been established to create a network of observatory stations whose reports are used to prepare charts of the migration routes of various species at all times of the year. At the Uplands laboratories in Ottawa, such sophisticated equipment as the "chicken-gun" – which can fire pre-killed birds at an aircraft at over 600 miles-per-hour to duplicate in-flight collisions – assists government scientists in determining the effects of such incidents on the structures, particularly the susceptible jet engines, windshields, and tail areas of the aircraft.

The scope and diversity of aviation in Canada, indicated very sketchily by the different aspects touched upon in this chapter, are attributable to the variety of the country's vast geography and the increasing demands of its expanding population.

FIGURE 3.2

Data Source: M.O.T.

TABLE 3.1 Hours Flown by Canadian Registered Civil Aircraft, 1960-70

Class of operation	Hours flown by year					
	1970	1969	1968	1967	1966	1965
Commercial Revenue						
Scheduled:						
Domestic	262,893	274,354	289,598	281,562	238,886	214,639
International	143,179	134,305	134,311	117,485	96,483	83,259
Non-Scheduled:						
Unit-toll	103,021	80,376	63,014	48,552	41,414	37,481
Charter	671,496	598,150	527,532	509,978	481,722	431,269
Specialty(1)	468,112	525,980	574,006	550,494	456,511	296,688
Sub-totals (revenue)	1,648,701	1,613,165	1,588,461	1,508,071	1,315,016	1,063,336
Commercial Non-Revenue	65,177	56,486	58,691	60,739	59,559	44,221
Sub-Totals (Commercial)	1,713,878	1,669,651	1,647,152	1,568,810	1,374,575	1,107,557
Flying clubs	133,498	142,039	172,374	202,173	169,857	105,380
Private flying	710,000	700,000	698,201	656,054	584,886	502,992
State flying	76,000	75,000	73,320	76,000	73,600	74,400
GRAND TOTALS	2,633,376	2,586,690	2,591,047	2,422,298	2,202,918	1,790,329

	1964	1963	1962	1961	1960
Scheduled:					
Domestic	196,952	194,389	208,418	206,613	248,333
International	70,690	72,451	75,396	83,156	103,151
Non-Scheduled:					
Unit-toll	33,156	31,815	40,178	37,786	31,679
Charter	377,246	332,131	306,324	313,225	289,113
Specialty(1)	234,288	202,226	186,127	184,643	173,565
Sub-totals (revenue)	912,332	823,012	816,443	825,423	845,849
Commercial non-revenue	35,253	34,044	37,752	39,681	32,709
Sub-totals (commercial)	947,585	867,056	854,195	865,104	878,558
Flying Clubs	87,631	84,198	89,215	98,468	122,636
Private Flying	441,518	384,591	336,899	295,120	258,650
State flying	71,600	72,400	70,400	68,000	63,200
GRAND TOTALS	1,544,803	1,408,245	1,350,709	1,326,692	1,323,044

(1) Includes rental.
Source: Aviation Statistics Centre files.

TABLE 3.2. Number of Personnel Licenses in Force, 1960-70

Type of license	Number at 31 December, given year					
	1970	1969	1968	1967	1966	1965
Pilot:						
Gyrocopter	5	4	2	1	1	–
Glider	1,521	1,342	1,175	1,025	917	823
Private	25,203	23,765	23,621	21,089	18,710	16,831
Commercial	4,945	4,631	5,004	4,268	3,550	2,835
Senior commercial	734	696	550	507	405	359
Transport	2,779	2,664	2,342	2,145	1,749	1,533
Sub-totals (pilots)	35,187	33,093	32,694	29,035	25,332	22,381
Flight navigators	216	217	193	179	171	128
Air traffic controllers	1,000	931	924	865	813	782
Flight engineers	95	91	112	102	65	59
Aircraft maintenance	3,089	3,001	2,811	2,632	2,539	2,369
GRAND TOTALS	39,587	37,333	36,734	32,813	28,920	25,719

	1964	1963	1962	1961	1960
Pilot:					
Gyrocopter	–	–	–	–	
Glider	763	665	582	503	444
Private	16,159	16,393	15,979	14,597	14,701
Commercial	2,575	2,359	2,251	1,996	2,319
Senior commercial	317	368	356	381	439
Transport	1,387	1,355	1,342	1,287	1,250
Sub-totals (pilots)	21,201	21,140	20,510	18,764	19,153
Flight navigators	98	91	94	90	96
Air traffic controllers	792	814	807	788	763
Flight engineers	36	38	28	52	57
Aircraft maintenance	2,277	2,270	2,109	1,824	1,953
GRAND TOTALS	24,404	24,353	23,548	21,518	22,022

Source: MOT.

TABLE 3.3. Summary of the Civil Aircraft Registry by Type of Aircraft

	Number at 31 December, given year					
	1970	1969	1968	1967	1966	1965
Registration						
Commercial	3,161	3,069	2,840	2,486	2,253	2,073
Commercial (restricted)	100	90	90	75	76	64
State	201	200	200	214	203	200
Private	7,292	6,919	6,392	6,047	5,499	4,990
Private (restricted)	28	37	32	25	19	13
Ultra-light	496	440	399	292	240	181
Experimental	37	17	20	23	20	21
Type						
Aeroplane	10,424	9,955	9,223	8,469	7,699	6,996
Helicopter	552	502	453	435	390	354
Glider	245	229	216	202	189	170
Gyroplane	84	78	77	54	32	22
Balloon	10	8	4	2		
Number of engines						
One	9,647	9,205	8,518	7,850	7,140	6,498
Two	1,255	1,179	1,082	960	839	738
More than two	156	151	153	146	142	136
Weight (gross)						
0- 4,000 lb.	9,443	8,973	8,256	7,561	6,851	6,214
4,001- 12,500 lb.	1,350	1,318	1,254	1,171	1,069	958
12,501- 30,000 lb.	205	189	182	191	172	164
30,001-100,000 lb.	178	182	182	167	147	139
100,001-and over	139	110	99	72	71	70
GRAND TOTALS	11,315	10,772	9,973	9,162	8,310	7,542

	1964	1963	1962	1961	1960
Registration					
Commercial	1,949	1,929	1,908	1,910	1,818
Commercial (restricted)	62	64	71	60	45
State	200	191	182	207	204
Private	4,544	4,172	3,976	3,612	3,186
Private (restricted)	14	11	11	15	8
Ultra-light	152	123	93	74	53
Experimental	12	11	8	7	4
Type					
Aeroplane	6,454	6,057	5,834	5,220	4,998
Helicopter	316	294	287	216	219
Glider	151	143	128	86	101
Gyroplane	12	7			
Balloon					
Number of Engines					
One	6,002	5,639	5,433	4,827	4,608
Two	647	588	564	479	484
More than two	133	131	124	130	125
Weight (gross)					
0- 4,000 lb.	5,721	5,344	5,104	4,599	4,280
4,001- 12,500 lb.	847	789	776	620	685
12,501- 30,000 lb.	157	159	165	112	160
30,001-100,000 lb.	139	151	152	140	161
100,001-and over	69	58	52	51	32
GRAND TOTALS	6,933	6,501	6,249	5,885	5,318

(1) Including ultra-light and experimental. (2) Including state.
Source: Civil Aircraft Registry, MOT, 1960-70.

TABLE 3.4. Hours flown by Canadian Registered Aircraft, 1969

Powerplant	No. engines	Hours by weight group (lbs.)				Totals
		1,000-2,500	2,501-18,000	18,001-35,000	35,001 and over	
Commercial						
Jet	2		1,868	1,750	115,328	118,946
	4				151,389	151,389
Totals			1,868	1,750	266,717	270,335
Turbo	1		187			187
	2		19,587	5,993	19,184	44,764
	4		322		108,250	108,572
Totals			20,096	5,993	127,434	153,523
Piston	1	228,268	528,265			756,533
	2		125,349	52,853	6,111	184,313
	4				15,135	15,135
Totals		228,268	653,614	52,853	21,246	955,981
Helicopter	1	171,287	19,037			190,324
	2			874		874
Totals		171,287	19,037	874		191,198
GRAND TOTALS		399,555	694,615	61,470	415,397	1,571,037
Private						
Jet	2		3,701	8,639	883	13,223
	4				264	264
Totals			3,701	8,639	1,147	13,487
Turbo	1		507			507
	2		13,364	1,998	4,573	19,935
	4				2,717	2,717
Totals			13,871	1,998	7,290	23,159
Piston	1	203,070	345,442			548,512
	2		90,294	14,485	56	104,835
	4				627	627
Totals		203,070	435,736	14,485	683	653,974
Helicopter	1	9,403	1,268			10,671
Totals		9,403	1,268			10,671
GRAND TOTALS		212,473	454,576	25,122	9,120	701,291

Source: Aviation Statistics Centre files.

TABLE 3.5 Summary of Aircraft Registry by Manufacturer, 1967-69

Aircraft type	Manufacturer	Country of manufacturer	Model	1967		1968		1969	
				Number in Canada	Hours flown	Number in Canada	Hours flown	Number in Canada	Hours flown
Airplane	Ace	USA	Baby Ace	4	304	4	302	4	118
	Aero Commander	USA	Darter	4	403	17	1,106	12	2,473
			Commander (200)	1	42	1	143	1	180
			Commander (500)	12	2,965	15	4,239	17	4,063
			Commander (520)	2	64	1	222	3	458
			Commander (560)	5	1,478	5	935	5	972
			Super Commander (680)	24	6,313	28	7,063	28	8,858
			Alti-Cruiser	1	458	1	599	1	246
			Jet Commander (1121)	7	3,052	7	3,687	8	3,915
			Grand Commander (AC60)	3	420	4	549	4	426
	Aeronca	USA	Scout	10	594	10	607	12	770
			Super Chief	113	7,795	114	7,424	123	6,006
			Sedan (15)	26	2,138	34	2,643	33	2,368
			– (058)	1	56	1	116	1	6
	American Aviation	USA	Yankee	–	–	–	–	14	68
	AV Roe (Avro)	Canada	Anson (MKV)	5	1,776	3	989	4	1,403
			– (748)	1	412	2	959	4	2,447
	Auster	UK	– (MKVI)	10	627	15	602	13	564
			– (MKVII)	–	–				
	Aviation Traders	UK	Convair (DC4) (ATL 98)	–	–	–	–	2	1,710
	Barkley Grow	USA	– (T8PI)	1	522	1	667	1	398
	Beech	USA	Stagger Wing	5	182	4	103	5	72
			Musketeer	33	5,782	52	6,223	62	9,534
			Debonair	7	1,177	5	678	5	400
			Bonanza	71	8,851	86	9,088	93	9,100
			Mentor	–	–	–	–	1	94
			Kansan	1	211	1	25	–	–
			Expeditor	46	16,796	20	6,694	27	7,730
			Super	48	13,602	85	28,069	79	26,023
			Seminole	1	415	10	2,455	9	2,003
			Baron	22	6,694	1	536	6	740
			Duke	–	–	1	137	3	1,055
			Queen Air	13	4,611	6	1,550	6	1,139
			Queen Air (80)	4	1,540	4	1,988	14	5,037
			King Air	7	2,161	17	6,680	20	8,164
			Travelair	26	7,236	47	14,186	51	14,820
			Commuter Liner	–	–	–	–		
	Bellanca	USA	Cruisair	21	1,451	16	614	23	920
			Skyrocket	2	717	3	784	1	379
			Aircruiser	1	384	1	280	1	212
	Boeing	USA	Fortress	1	1	1	246		
			Stearman	21	4,864	18	2,168	19	1,261
			Stratoliner (707)	2	1,310	1	3,051	2	3,497
			Astrojet (727)	1	3,583	1	2,156		
			– (737)	–	–	3	145	15	26,216
			Jet Clipper (747)	–	–	–	–		
	Bristol	UK	Wayfarer (170)	2	891	3	1,399	5	2,644
	British Aircraft	UK	– (BACIII)	–	–	–	–	2	2,805
	Britten Norman	UK	Islander (BN2)	–	–	3	488	7	1,822
	Callair	USA	– (A2, A3, A4)	7	812	–	–	1	8
			– (A5-A9)	3	587	5	682	7	579
			Super Cadet (S1-B1)	–	–	4	465	4	347
	Canadair	Canada	– (CL215)	–	–	–	–	7	–
			North Star	2	494	3	692	3	962
			Yukon	4	753	–	–	–	–

See footnote(s) at the end of the table.

TABLE 3.5 Summary of Aircraft Registry by Manufacturer, 1967-69 — Continued

Aircraft type	Manufacturer	Country of manufacturer	Model	1967		1968		1969	
				Number in Canada	Hours flown	Number in Canada	Hours flown	Number in Canada	Hours flown
Airplane — Continued	Cessna	USA	Cessna (120)	51	5,208	70	3,553	75	4,525
			Cessna (140)	137	11,926	141	10,332	149	9,422
			Cessna (150)	352	190,195	511	232,766	576	221,633
			Cessna (170)	143	15,217	163	12,950	179	11,618
			Skyhawk (172)	486	118,454	615	121,646	692	122,431
			Skylark (175)	54	4,757	61	5,578	67	5,218
			Cardinal (177)	12	887	37	5,874	47	7,924
			Cessna (180)	553	136,822	628	143,305	657	162,365
			Skylane (182)	99	15,570	132	15,741	134	15,998
			Skyway M (185)	118	30,902	178	39,023	231	51,416
			Agwagon (188)	4	351	5	456	7	139
			Cessna (190)	1	46	1	72	1	57
			Cessna (195)	22	1,988	18	1,656	26	1,400
			Cessna (205)	4	527	2	507	2	758
			Super Skywagon (206)	47	12,532	59	15,020	70	15,820
			Centurion (210)	17	2,743	26	3,348	27	2,793
			Bird Dog (305/321)	1	416	1	608	3	794
			Twin Cessna (310)	43	11,171	49	9,309	56	12,104
			Skyknight (320)	9	2,635	12	3,003	13	3,211
			Skymaster (336)	2	365	3	460	4	140
			Super Skymaster (337)	17	3,515	26	5,504	34	6,621
			Cessna (401)	1	367	3	696	5	1,209
			Cessna (402)	4	2,893	7	4,616	10	5,145
			Cessna (411)	3	1,511	5	1,195	4	1,399
			Cessna (421)	2	147	7	1,522	7	2,075
			Bobcat (T 50)	3	111	1	10	2	7
	Champion	USA	Citabria	398	57,362	471	52,672	512	48,202
			Lancer	1	36	1	76	1	24
	Convair	USA	Canso	31	9,367	34	8,538	35	9,307
			Liner/Classroom	—	—	1	1	1	56
			Metropolitan (440)	—	—	1	1,666	2	7
			Super Metropolitan (640)	4	3,546	3	4,001	4	7,793
	Curtiss-Wright	USA	Commando	5	4,010	4	3,461	4	3,460
	Dassault	France	Mystère	5	1,784	5	2,128	7	2,742
	De Havilland	Canada	Chipmunk	15	1,074	13	986	14	762
			Beaver	221	110,178	259	118,644	263	127,822
			Turbo Beaver	24	7,528	—	—	—	—
			Otter	79	43,826	84	47,792	85	50,278
			Caribou	3	2,719	3	2,485	2	2,105
			Twin Otter	13	6,604	28	15,080	38	67
			Gypsy Moth (DH 60)	3	119	1	68	1	67
			Tiger Moth (DH 82)	10	226	14	245	14	271
			Dove/Devon	—	—	1	130	1	148
			Heron	2	371	—	—		
			Dominie	13	6,460	16	5,931	19	7,647
	Dornier Werke	Germany	Dornier	10	4,805	12	5,158	10	5,081
	Douglas	USA	Invader	—	—	1	151	4	55
			Dakota (DC 3)	82	55,631	86	51,907	91	52,575
			Skmaster (DC 9)	14	19,697	16	15,827	9	9,829
			Liftmaster (DC 6)	10	25,777	12	29,819	9	12,086
			Douglas (DC 76)	1	582	—	—		
			Jet Liner (DC 8)	27	106,979	37	128,160	42	143,693
			Douglas (DC 9)	18	37,694	30	65,701	33	86,307
	Fairchild	USA	Husky (F 11)	5	1,294	4	1,238	4	1,086
			Husky (F 24)	3	65	2	70	3	195
			Friendship	8	29,878	8	12,540	9	11,437
			Cornell	3	53	5	153	5	163
	Fleet	Canada	Finch	2	18	2	9	2	15
			Fleet	1	7	1	9	2	30
			Canuck	75	24,921	80	21,439	83	14,680

See footnote(s) at end of the table.

TABLE 3.5 Summary of Aircraft Registry by Manufacturer, 1967-69 — Continued

Aircraft type	Manufacturer	Country of manufacturer	Model	1967		1968		1969	
				Number in Canada	Hours flown	Number in Canada	Hours flown	Number in Canada	Hours flown
Airplane — Continued		USA	Alon/Ercoupe	107 107	11,268 11,268	136	12,343	141	8,182
	Found Brothers	Canada	Found Brothers	18	5,903	19	5,996	15	5,932
	Funk	USA	Funk	2	186	1	29	2	44
	Great Lakes	USA	Baby	—	—	1	7	—	—
	Grumman	USA	Goose	20	7,570	22	9,365	22	9,177
			SCAN	2	225	2	186	2	322
			Widgeon	12	2,461	10	2,194	10	1,338
			Mallard	6	4,127	7	4,120	6	3,844
			Gulfstream (G 159)	6	2,691	7	2,875	8	3,458
			Gulfstream II (G 1159)	1	1	2	322	2	883
			AG-Cat	2	402	2	428	3	381
			Avenger	18	2,819	20	1,673	21	3,035
	Handley-Page	UK	Herald	3	4,981	3	4,888	3	5,199
	Hawker-Siddley	UK	Argosy	—	—	—	—	3	—
			Andover	—	—	—	—	—	—
	Helio	USA	Courrier	4	840	2	403	3	507
			Super Courrier	6	1,293	8	1,123	8	1,401
	Howard	USA	Jobmaster	2	79	1	3	4	236
			Converted Ventura	2	358	1	329	—	—
	Lake-Colonial	USA	Skimmer	13	1,075	18	1,274	29	2,097
			Colonial			4	118	4	102
	Lear	USA	Learjet	3	1,288	2	721	4	328
	Lockheed	USA	Electra (10,12)	5	1,249	2	157	2	81
			Lodestar (18)	9	2,870	9	2,051	8	2,092
			Electra (188)	—	—	—	—	2	—
			Super-Constellation	3	2,039	5	3,695	—	—
			Jetstar	3	961	3	1,263	3	1,476
			Hercules	1	1,515	3	1,604	1	1,361
			Ventura	—	—	1	193	—	—
			Silver Star	2	205	2	262	2	278
	Longreen	USA	Centaur	1	60	1	21	—	—
	Maranda	Canada	Super Loisir	2	279	6	155	5	116
	Martin	USA	Mars	2	323	2	45	2	71
	Maule	USA	Beedee	16	1,875	23	2,324	25	2,203
	Mitsubiski	Japan	Mitsubiski	—	—	1	66	10	1,310
	Mooney	USA	Mite	3	22				
			Mark 20	68	8,860	78	9,567	86	8,543
			Model 21	1	661				
	Maurane Saulnier	France	Rallye Super	10	440	10	440	10	564
	Navion	USA	Rangemaster	11	726	17	936	16	663
			Recruiter	1	1	2	34	—	—
			Twin Navion	2	72	2	72	4	64
	Nihon	Japan	Nihon	1	51	2	1,533	2	4,295
	Noorduyn	Canada	Norseman (IV)	11	729	8	1,688	9	1,690
			Norseman (V)	22	10,179	38	14,479	32	12,984
			Norseman (VI)	20	6,954	10	1,586	10	3,102

See footnote(s) at the end of the table.

TABLE 3.5 Summary of Aircraft Registry by Manufacturer, 1967-69 — Continued

Aircraft type	Manufacturer	Country of manufacturer	Model	1967		1968		1969	
				Number in Canada	Hours flown	Number in Canada	Hours flown	Number in Canada	Hours flown
Airplane — Continued	North American	USA	Harvard	54	2,413	58	2,101	5	1,523
			Mitchell	2	19	2	54	2	89
			Sabreliner	1	136	2	361	2	1,048
			Mustang	1	16	—	—	—	—
	Northwestern	USA	Porterfield	1	62	1	86	—	—
	Piaggio	Italy	Royal Gull	—	—	2	60	1	87
	Piper	USA	Cub (PA 11)	72	6,244	84	5,764	86	6,258
			Super Cruiser (PA 12)	137	16,380	156	13,711	176	13,953
			Family Cruiser (PA 14)	13	972	17	2,158	18	1,213
			Vagabond PA 15	8	502	13	765	13	728
			Clipper PA 16	21	2,104	24	1,557	29	1,805
			Vagabond PA 17	7	1,366	6	623	7	433
			Super Cub (PA 18)	247	42,338	294	41,748	310	37,385
			Cub Trainer (J-2)	3	123	1	134	1	20
			Pacer PA 20	39	2,612	46	2,934	50	2,779
			Cub Trainer (J-3)	258	25,381	296	19,918	300	20,779
			Club Coupe PA 4	13	2,375	14	905	16	1,155
			Tripacer/Caribbean 22	223	44,408	264	38,373	285	31,312
			Apache/Aztec 23	179	60,860	215	65,633	227	65,424
			Comanche 24	83	14,877	90	10,513	103	11,830
			Pawnee 25	22	4,014	29	3,873	32	3,738
			Cherokee 28	184	95,826	324	124,503	394	130,378
			Twin Comanche 30	39	6,371	46	8,469	57	11,501
			Navajo 31	6	835	14	3,305	27	7,224
			Arrow 32	6	1,276	10	1,545	20	3,574
			Cruiser (J-5)	9	569	9	420	12	1,004
	Pitts	Canada	Special	1	67	1	45	3	86
	Republic	USA	Seabee	55	3,500	60	1,988	57	1,860
	Scottish	UK	Twin Pioneer	1	41	1	62	1	63
	Short Harland	UK	Skyvan	—	—	1	181	4	1,039
	Silvaire	USA	Observer	119	9,822	138	8,960	141	8,575
	Smith	USA	Miniplane	3	135	6	60	3	27
	Snow	USA	Snow Commander	4	453	7	1,136	7	574
	Stinson	USA	Stinson	12	2,082	14	2,461	12	2,200
			Voyager	178	12,234	213	12,463	214	10,589
			Reliant	1	5	2	108	—	—
	Stits	USA	Playboy, Flut-i-bug, etc.	12	572	18	870	15	729
	Superior	USA	Culver/Cadet	1	24	1	34		
	Swearingen	Germany	Merlin	—	—	—	—		

See footnote(s) at the end of the table.

TABLE 3.5 Summary of Aircraft Registry by Manufacturer, 1967-69 — Concluded

Aircraft type	Manufacturer	Country of manufacturer	Model	1967		1968		1969	
				Number in Canada	Hours flown	Number in Canada	Hours flown	Number in Canada	Hours flown
Airplane — Concluded	Laylorcraft	USA	Model B/C/D	138	9,857	153	8,933	163	8,762
			Ranch Wagon	4	192	1	26	1	21
	Temco	USA	Swift	14	1,922	—	—	—	—
			Luscombe II	1	78	2	133	3	164
	United Consultant	USA	Twin Bee	1	173	—	—	1	145
	Universal	USA	Globe	2	165	22	846	18	665
	Vickers	UK	Viscount (700)	44	118,308	43	104,023	41	77,380
			Vanguard (950)	23	69,263	23	55,909	24	31,979
	WACO	USA	WACO	4	84	5	48	4	366
	Wittmann	Canada	Tailwind	1	82	1	44	1	29
Helicopters	Air and Space	USA	A & S	5	158	23	545	18	248
	Bell	USA	Ranger/Bellarius	226	111,256	273	108,132	286	124,812
			Iroquois	9	5,996	12	8,564	16	7,662
			Jet Ranger	17	6,872	33	11,740	58	21,453
	Boeing-Vertol	USA	Shawnee	1	142	1	309	1	286
			Modified	2	437	2	721	2	674
			Chinook	1	313	—	—	—	—
	Brantly	UK	Brantly	2	254	4	984	3	49
	Fairchild Hiller	USA	Miller	9	2,845	17	3,116	8	4,201
			Raven	31	21,137	35	19,048	35	19,047
	Hughes	USA	Hughes	22	6,324	31	8,364	35	9,026
	Republic (Sud-Aviation)	France	Alouette II (SE 313/8)	6	3,522	10	4,066	15	3,952
			Alouette III (SE 3160)	4	1,502	4	1,261	4	1,400
	Sikorski	USA	Chikasaw	15	6,752	10	3,646	12	5,125
			Choctaw	2	904	2	1,261	3	1,206
			Sikorski (S-61)	1	708	1	424	3	874
			Sikorski (S-62)	1	222	1	205	—	—
Balloons	All	—	All	—	—	—	—		
Autogyros	Avian	Canada	Gyroplane (HG 18)	12	260	—	—		
	Bensen	USA	All	—	—	—	—		
Gliders	All	—	All	124	8,924	171	10,565	163	10,154

Source: Aviation Statistics Centre Service Bulletins; Civil Aircraft Registry, MOT.

TABLE 3.6 Accidents to Aircraft of Canadian Registry, 1960-70

Type of Operation	Accidents by year										
	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Commercial											
Scheduled:											
Domestic	2	3	1	0	1	3	2	2	5	1	3
International	2	0	0	0	2	0	0	1	2	1	0
Non-Scheduled:											
Domestic and contract	136	128	105	108	101	62	57	66	66	61	53
International	0	0	0	0	0	7	0	1	1	2	6
Specialty:											
Training	26	30	24	35	27	21	12	5	9	17	23
Recreational	31	31	25	22	26	24	23	13	14	19	15
Other	22	31	20	28	22	26	11	16	10	17	26
Sub-totals (commercial)	219	223	175	193	179	143	105	104	107	118	126
Non-Commercial											
Flying Clubs	20	23	35	37	29	34	21	17	9	31	31
Privately owned aircraft											
Recreational	194	163	156	176	144	115	72	89	126	114	129
Corporate-owned	56	47	39	25	34	19	31	16	12	24	18
Other	26	37	19	30	31	25	20	17	12	18	12
Miscellaneous	15	9	39	11	5	12	18	16	15	14	14
Sub-totals (non-commercial)	311	279	288	279	243	205	163	155	174	202	205
GRAND TOTAL	530	502	463	473	422	348	268	259	281	320	331

Sources: MOT; Civil Aviation, Statistics Canada, 1960-69.

TABLE 3.7 Casualties and Fatalities Sustained in Accidents with Aircraft of Canadian Registry, 1960-70

	Occurrence by year										
	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Pilots											
Killed	47	57	57	77	57	42	38	46	30	33	33
Seriously injured	45	47	32	36	28	33	32	21	28	21	23
Other crew											
Killed	8	7	2	6	10	11	1	7	8	5	1
Seriously injured	6	4	1	1	0	2	6	4	2	2	0
Passengers											
Killed	164	71	55	73	103	75	38	157	65	36	21
Seriously injured	35	34	31	39	45	31	27	24	23	19	20
Third parties											
Killed	4	1	1	1	1	2	1	1	0	0	2
Seriously injured	2	0	2	1	1	1	1	0	0	1	0
Totals, killed	223	136	115	157	171	130	78	211	103	74	57
Totals, seriously injured	88	85	66	77	74	67	66	49	53	43	43
Totals, fatal accidents	57	64	63	84	64	48	45	48	38	37	36
Totals, all accidents	530	502	463	472	422	348	268	259	281	320	331

Sources: Civil Aviation, Statistics Canada, 1960-69; MOT.

TABLE 3.8. Accident Statistics Per Hour Flown, 1960-70

	Per hundred thousand flying hours by year					
	1970	1969	1968	1967	1966	1965
Type of operation:						
Commercial scheduled	1.0	0.7	0.2	0.0	0.9	1.0
Commercial non-scheduled	17.3	18.3	14.9	17.4	18.0	18.3
Sub-total (commercial)	12.8	13.4	10.6	12.3	13.0	12.9
Flying clubs	15.0	16.2	20.3	18.3	17.1	32.3
Other private	37.0	33.0	32.8	33.1	32.5	29.6
Sub-total (non-commercial) ..	33.8	30.4	30.5	32.7	29.3	30.0
Number killed	8.5	5.3	4.4	6.5	7.8	7.3
Number injured	3.3	3.3	2.5	3.2	3.4	3.7
Totals fatal accidents	2.2	2.5	2.4	3.5	2.9	2.7
Totals accidents	19.1	19.4	17.9	19.5	19.2	19.4
	1964	1963	1962	1961	1960	11-year average
Type of operation:						
Commercial scheduled	0.7	1.1	2.5	0.7	0.9	0.8
Commercial non-scheduled	16.0	17.8	18.8	21.7	24.9	18.0
Sub-total (commercial)	11.1	12.0	12.5	13.6	14.3	13.0
Flying clubs	24.0	20.2	10.1	31.5	25.3	20.4
Other private	27.7	30.2	40.5	47.1	54.0	34.8
Sub-total (non-commercial) ..	27.3	28.6	35.0	43.8	43.0	32.2
Number killed	5.0	15.0	7.6	5.6	4.3	6.9
Number injured	4.3	3.5	3.9	3.2	3.3	3.4
Totals fatal accidents	2.9	3.4	2.8	2.8	2.7	2.8
Totals accidents	17.3	18.4	20.8	24.1	25.0	19.8

Sources: MOT; Aviation Statistics Centre files.

Chapter IV

AIRCRAFT MOVEMENTS

The rapid growth of civil aviation in Canada after World War II placed a great strain on the requirements for air traffic control facilities. The geographic location of Canada as an effective control point for aircraft flying between Europe and North America necessitated adoption of sophisticated equipment and techniques. Long-range planning became an accepted norm. In the late 1950's a statistical survey was set up by the Department of Transport to collect data on landings and take-offs of aircraft at all civilian airports with an air traffic control tower. The statistics are used by the Air Traffic Control Division of the Ministry of Transport to plan future requirements for manpower, training and equipment.

National Trends

Air traffic control towers are manned by the Ministry of Transport at forty-seven airports (at July 1971). This compares with thirty-one towers in 1961 and thirty-three in 1965; some of the overall growth in movements, therefore, can be attributed to an increased data basis. It is from the logs kept by the controllers who record the type and identity of the aircraft, the origin or destination of every flight made from their field, and the time and the runway used, that the data is obtained to compile the Aircraft Movement Statistics. These statistics (Tables 4.1 - 4.5) are broken down in numerous ways ways — by the origin and destination of the flight (domestic, transborder — that is, to or from the United States, and other international), by the weight and type of powerplant of the aircraft, and by the type of flight made — whether it be local (in which the plane does not leave the tower control zone), itinerant (in which the plane enters and/or leaves the tower control zone), or simulated approach (in which the plane makes a missed landing or a practice instrument approach).

Total movements, after a slight decrease during the period 1961-64, increased sharply from just over two million to over four million movements between 1964-67. This jump is due largely to the increase in local flights (generally recreational and training), and to a lesser extent to an increase in itinerant flights (primarily commercial and business, with some recreational). Since the centennial year, a gentle increase in all sectors has yielded a 1970 total of 4,375,000 movements. (Figure 4.1).

An examination of itinerant movements broken down by various criteria reveals an interesting picture (Table 4.5). Itinerant movements, after a practically stationary period from 1960 to 1963, have since doubled — from 900,000 to almost 1,900,000. An analysis by origin and destination shows that, while international movements (including transborder) slowly but steadily increased during the period 1964-70, domestic flights over the same period dramatically increased. Examination of breakdowns by weight-class and power-plant shows a close inter-relation between the two: a steep rise for both piston and light aircraft over the period 1964-67, followed by one stationary year, then by two years of very gradual growth. A similar trend is revealed when medium-weight and turboprop aircraft, and heavy and jet aircraft, are compared. The gradual replacement of turboprop aircraft by pure jets can be readily seen: in 1960 there were one-third as many movements by the latter as the former, but by 1968 the numbers of movements were identical, and by 1970 the turbojet was making over fifty percent more flights at Canadian airfields than was the turboprop. (This is primarily the result of Air Canada's substitution of Viscounts and Vanguards by DC-9's). Finally, a breakdown by class of operation illustrates that, while unit-toll (or major scheduled) services and private flying both rose steadily during the decade, government flying (civil and military) fluctuated around a stable axis. Moreover, non-scheduled commercial flying increased tremendously thereby shifting numerically from the least to the most extensive operation.

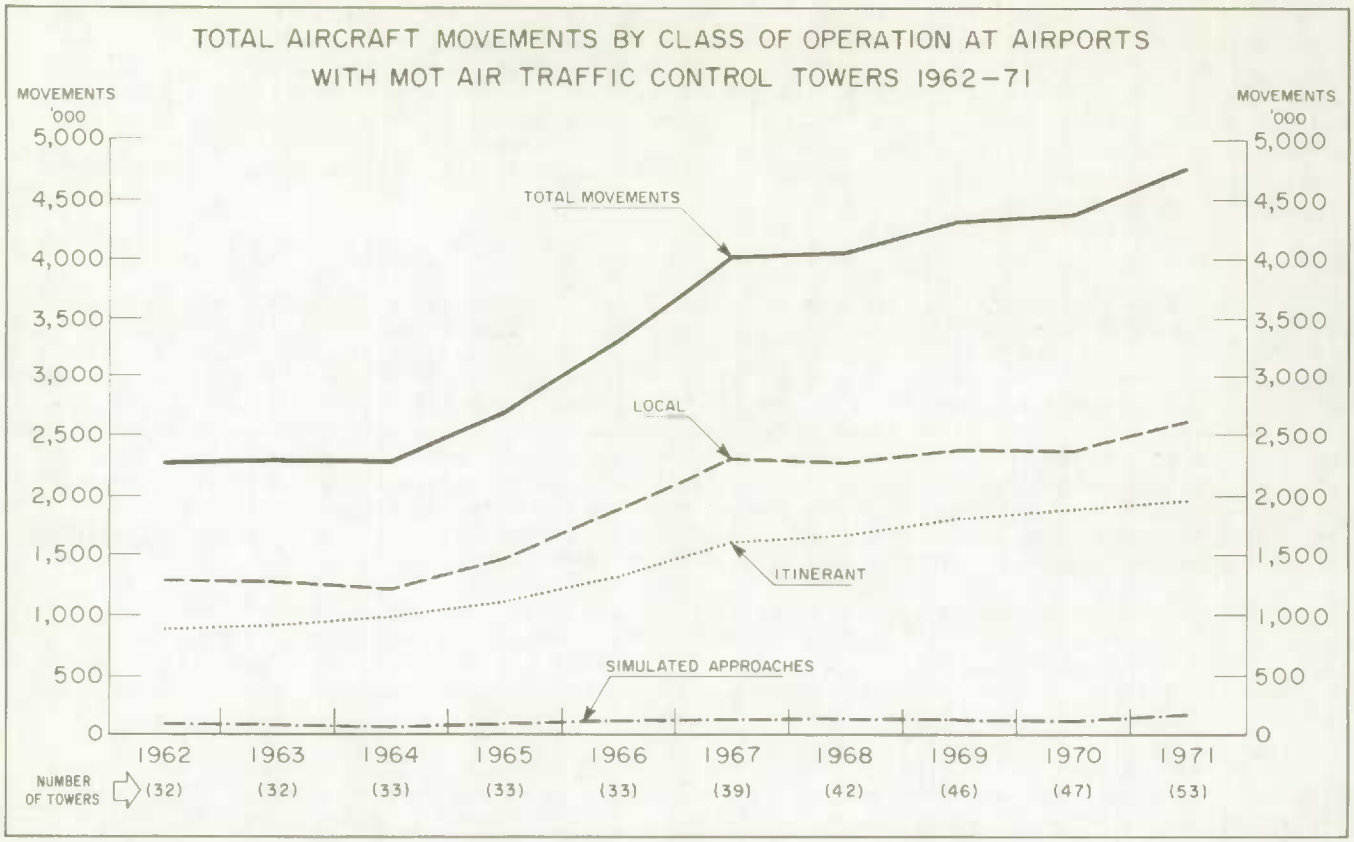
Individual Airports

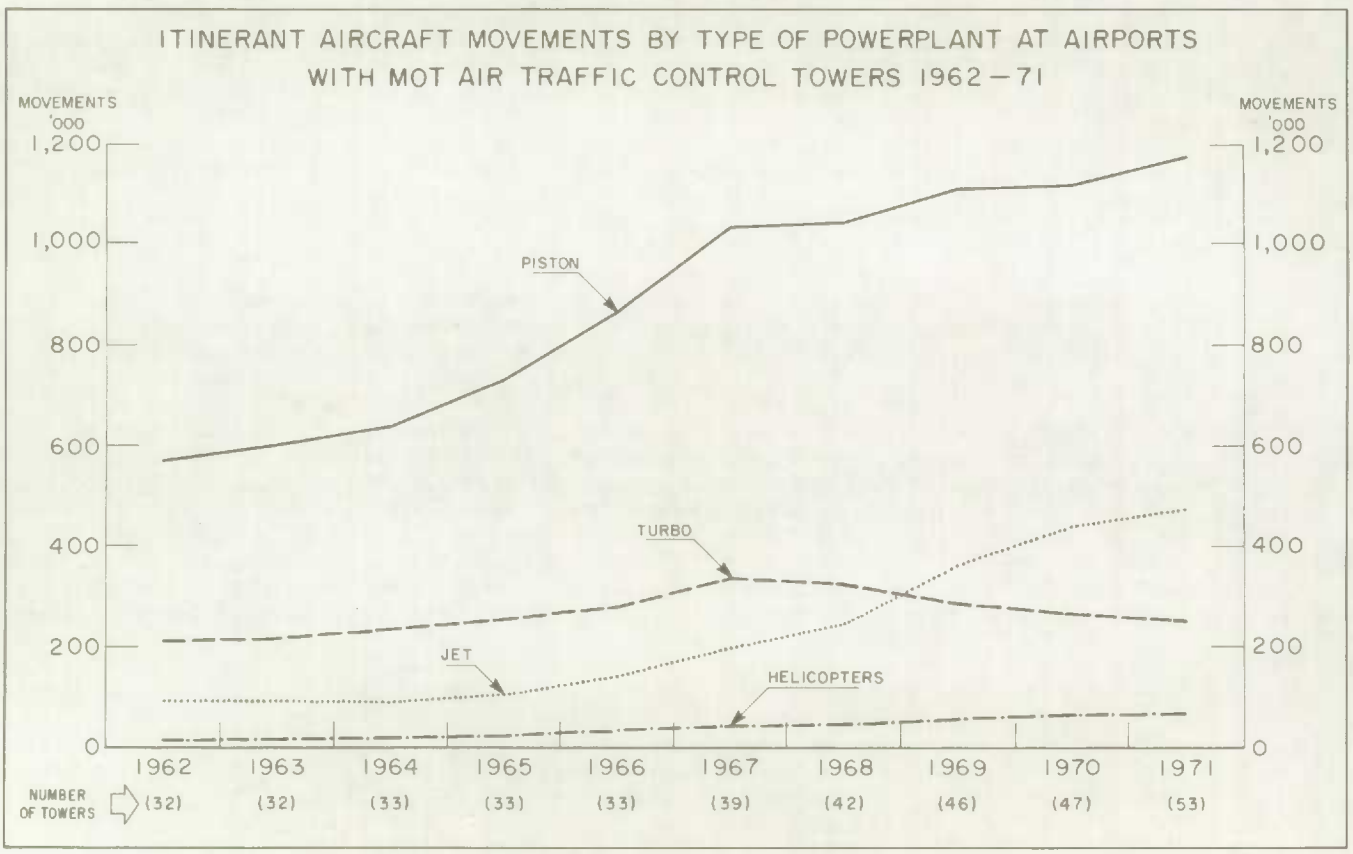
Airports in Canada can be separated into a number of categories — main and auxiliary, satellite, remote, local, developmental, and specialized (military, heliport and seaplane base). Aircraft movement figures for individual airports (Tables 4.4 - 4.5) reveal certain interactions among these categories.

Movements at main and auxiliary airports indicate that at international terminals, such as Calgary, Halifax, Edmonton, Ottawa, Montreal, Quebec, Toronto, Vancouver, Victoria and Winnipeg, the number of itinerant flights has increased consistently over the last decade with occasional fluctuations produced by such special circumstances as Expo'67 in Montreal. Nevertheless, when local aircraft movements are added to itinerant figures, a different picture emerges. For instance, total aircraft movements at Winnipeg's airport fell from 181,000 in 1960 to 140,000 in 1962, increased to 270,000 in 1966, but dropped again to 160,000 in 1970. The decrease in the first half of the decade is consistent with the trend across the country for that period, but how can we explain the second decline in total movements?

The explanation for this phenomenon which has occurred at other major centres throughout Canada as well, can be ascribed to the increasing number of new satellite airports appearing annually: St. Andrews, fourteen miles from Winnipeg, opened in 1967 and by 1970 was handling over 100,000 movements yearly. By managing most of the area's private and small commercial flights, this airport has permitted Winnipeg International to concentrate on large-scale airline operations. This pattern is

FIGURE 4.1


TOTAL AIRCRAFT MOVEMENTS BY CLASS OF OPERATION AT AIRPORTS
WITH MOT AIR TRAFFIC CONTROL TOWERS 1962–71
MOVEMENTS '000
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
TOTAL MOVEMENTS
LOCAL
ITINERANT
SIMULATED APPROACHES
1962 1963 1964 1965 1966 1967 1968 1969 1970 1971
NUMBER OF TOWERS
(32) (32) (33) (33) (33) (39) (42) (46) (47) (53)


ITINERANT AIRCRAFT MOVEMENTS BY TYPE OF POWERPLANT AT AIRPORTS
WITH MOT AIR TRAFFIC CONTROL TOWERS 1962–71
MOVEMENTS '000
1,200
1,000
800
600
400
200
0
PISTON
TURBO
JET
HELICOPTERS
1962 1963 1964 1965 1966 1967 1968 1969 1970 1971
NUMBER OF TOWERS
(32) (32) (33) (33) (33) (39) (42) (46) (47) (53)

This three-legged traffic control tower forms part of the complex air traffic control facilities at Toronto International Airport.

MOT photo.

duplicated by airports such as Pitt Meadows near Vancouver, Buttonville and Toronto Island near Malton, St. Hubert and St. Jean near Montreal, and Springbank near Calgary. In each case, satellite terminals have high total movements but lower itinerant movements when compared to the main airfields they neighbour. Thus, the activity at an airport can only be judged by considering the total activity in the economic area where it is located.

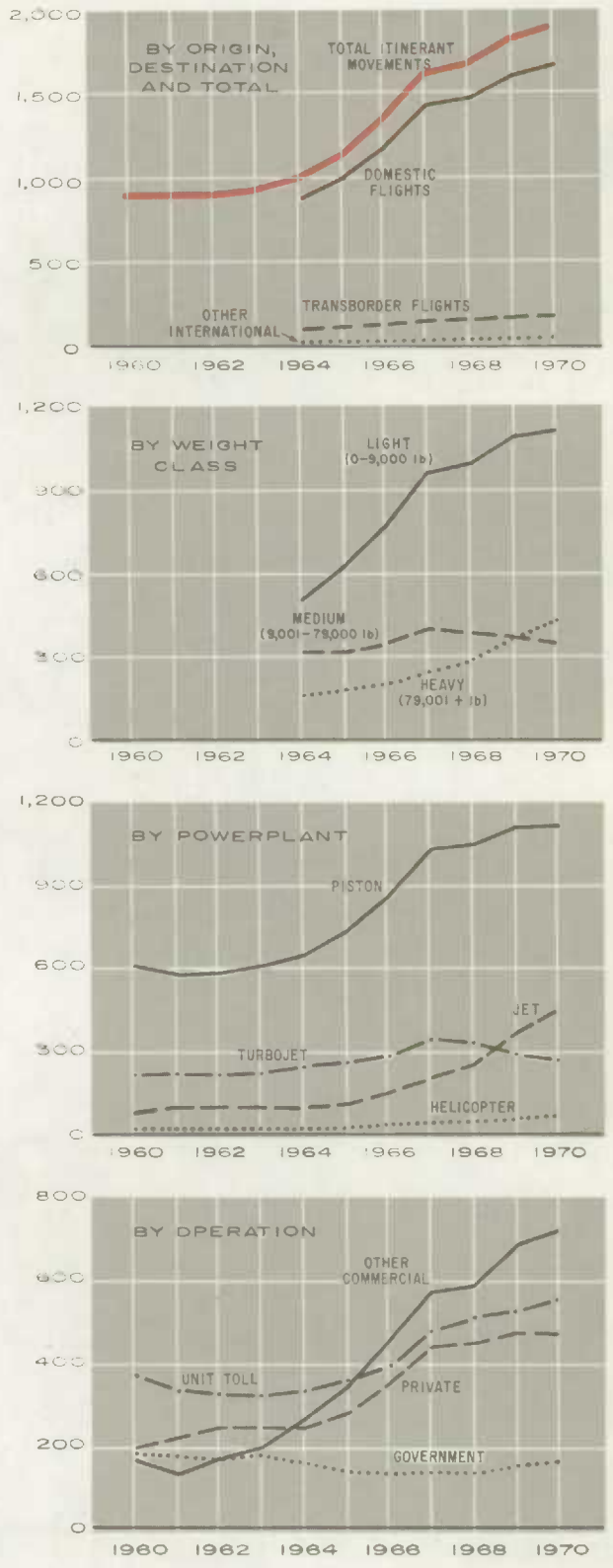
The contrast between main and satellite airports as defined by high itinerant and local movement quantities respectively, is evident in the rapid expansion of total movements at airports such as Oshawa and St. Hubert, and the equally rapid decline at such terminals as Winnipeg. The top five airports by itinerant movements in 1970 were Toronto (Malton), Montreal (Dorval), Vancouver, Winnipeg and Ottawa – all prime scheduled stops, while the most important airport according to total movements was St. Hubert; Buttonville and Toronto Island combined easily to outrank Malton; and Pitt Meadows, alone, topped Vancouver. In a 1970 analysis, Toronto International ranked first in itinerant movements, first in scheduled commercial movements, first in private movements, and first in simulated approaches, while St. Hubert was on top for total and 'other commercial' and local (civil) flying, and Ottawa International headed the list for government and military movements.

Statistics are also collected from over one hundred airports without air traffic control towers (Table 4.2). Although some of these, such as Whitecourt near Edmonton, would be classified as satellite terminals, most are local (for community use), remote (for particularly inaccessible areas), or developmental (designed for opening up areas to economic and scientific exploration). As is evidenced both by the high number of new airports (up sixty per cent from 1963) and the rate of increase in the total aircraft movements (an almost four-fold jump from the 1965 figure of 400,000 movements to the 1970 total of 1,400,000), this is a rapidly expanding field in Canadian aviation.

Aircraft movement statistics are very useful for pinpointing growth centres in aviation, and for gauging the effects of past decisions. Coupled with passenger and commodity flows (which will be dealt with subsequently), this data establishes a firm foundation for future policy and planning in Canada's airport construction and operation programs.

FIGURE 4.2

ITINERANT AIRCRAFT MOVEMENTS, (1960 – 1970)
AT CANADIAN AIRPORTS WITH M.O.T. TOWERS
(THOUSANDS)



Data Source: Aircraft Movement Statistics

TABLE 4.1. Total Canadian Aircraft Movements, 1960-70, at Airports with Air Traffic Control Towers

	Number by year (movements in '000)										
	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Itinerant movements	1,890	1,821	1,668	1,611	1,320	1,114	989	929	899	899	897
Local movements	2,374	2,381	2,266	2,313	1,893	1,483	1,211	1,281	1,289	1,435	1,806
Simulated approaches ...	112	124	115	114	104	92	89	89	95	111	135
Totals	4,375	4,326	4,048	4,038	3,317	2,688	2,289	2,299	2,282	2,446	2,838
Number of airports reporting	47	46	42	39	33	33	33	32	32	31	26

Source: Aircraft Movements Statistics, Aviation Statistics Centre, 1960-70.

TABLE 4.2. Total Movements at Small Canadian Airports, 1964-70

Year	Number of airports reporting	Total movements
1970	109	1,406,909
1969	98	1,158,688
1968	92	1,046,874
1967	84	598,376
1966	57	260,448
1965	61	399,773
1964	61	323,095

Source: Aircraft Movements Statistics, Aviation Statistics Centre, 1964-70.

TABLE 4.3. Distribution of Itinerant Aircraft Movements, 1960-70, at Airports with Air Traffic Control Towers

Category of operation	Movement by year										
	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
	('000)										
By type of operation											
Airline – unit-toll ..	550	524	511	475	391	356	330	319	322	335	366
Other commercial	718	678	586	570	455	347	262	196	169	180	163
Private	466	470	443	433	347	275	241	241	242	213	192
Government-civil	47	44	43	41	35	34	27	22	21	21	16
Government-military ..	109	105	85	91	93	101	129	151	144	151	160
By power plant											
Piston	1,119	1,111	1,045	1,034	864	730	640	600	574	576	600
Jet	441	363	248	197	144	106	93	96	96	95	72
Turbo-prop	265	287	326	336	279	255	237	215	212	212	210
Helicopter	64	57	47	42	33	22	19	18	17	16	15
Glider	1	2	1	2	–	–	–	–	–	–	–
By weight											
0- 4,000 lb.	875	845	780	755	586	456	365	–	–	)	
4,001- 9,000 "	245	252	216	206	183	166	152	–	–	) Light	
9,001- 19,000 "	74	63	51	47	46	37	40	–	–	)	
19,001- 39,000 "	108	113	110	108	104	95	92	–	–	) Medium	
39,001- 79,000 "	164	184	229	249	199	181	187	–	–	)	
79,001-159,000 "	307	254	185	161	126	112	95	–	–	)	
159,001-199,000 "	1	1	2	3	3	2	2	–	–	)	
199,001-314,000 "	71	78	77	77	72	65	56	–	–	) Heavy	
314,001 and over "	45	30	18	4	1	–	–	–	–	)	
Geographical											
Domestic	1,684	1,621	1,484	1,440	1,182	995	880	–	–	–	–
Transborder	170	167	157	146	118	102	93	–	–	–	–
International	35	32	27	25	20	17	16	–	–	–	–
GRAND TOTALS	1,890	1,821	1,668	1,611	1,320	1,114	989	929	899	899	897

Note: Columns may not total exactly due to rounding.
Source: Aircraft Movement Statistics, MOT, 1960-70.

TABLE 4.4. Total Aircraft Movements at Airports with Ministry of Transport Air Traffic Control Towers, 1960-70

No.	Airports	1960	1961	1962	1963	1964
1	Abbotsford	–	25,445	34,157	48,832	57,838
2	Baie Comeau	17,857	9,766	12,802	10,095	13,743
3	Brandon	–	–	–	–	–
4	Buttonville	–	–	–	–	–
5	Calgary International	147,075	132,679	171,121	142,066	140,133
6	Cartierville	232,344	179,955	207,620	219,967	207,453
7	Edmonton Industrial	225,676	162,622	146,292	141,196	142,191
8	Edmonton International	1,139	17,788	19,216	20,233	24,034
9	Fort St. John	14,985	9,237	13,440	17,878	27,311
10	Fredericton	20,907	22,453	21,943	24,235	29,301
11	Gander International	24,764	29,529	29,973	31,591	30,708
12	Halifax International	12,340	25,333	29,368	36,061	31,358
13	Hamilton City	–	–	–	–	–
14	Kamloops	–	–	–	–	–
15	Thunder Bay	114,007	67,174	55,169	50,656	53,138
16	Lethbridge	34,275	24,966	21,850	21,217	28,404
17	London	87,953	73,166	67,847	79,778	71,722
18	Moncton	51,165	47,663	38,453	41,533	46,832
19	Montreal International	194,612	185,469	172,233	166,117	176,055
20	North Bay	53,614	53,636	26,161	44,487	39,337
21	Oshawa	–	–	–	–	–
22	Ottawa International	233,990	189,095	163,434	156,981	145,069
23	Penticton	–	–	–	–	–
24	Pitt Meadows	–	–	–	–	–
25	Port Hardy	13,279	13,853	13,911	11,869	13,397
26	Prince George	12,778	21,809	15,440	14,326	19,639
27	Quebec	98,790	84,146	89,529	80,154	88,599
28	Regina	80,861	79,538	67,287	72,208	66,189
29	Saint John	55,620	41,167	33,559	37,433	31,677
30	St. Andrews	–	–	–	–	–
31	St. Hubert	–	–	–	–	–
32	St. Jean	–	–	–	–	–
33	St. John's	13,685	19,803	21,670	18,555	13,621
34	Saskatoon	137,569	110,963	100,852	42,950	47,547
35	Sault Ste. Marie	–	–	–	–	–
36	Sept-Iles	28,265	24,048	22,500	24,700	24,721
37	Springbank	–	–	–	–	–
38	Sydney	17,185	16,326	12,308	9,117	8,273
39	Toronto International	140,208	106,753	116,218	114,734	120,566
40	Toronto Island	182,979	212,753	189,001	186,601	191,749
41	Vancouver International	203,336	160,953	157,828	141,524	87,036
42	Victoria International	151,454	87,557	72,888	73,945	78,986
43	Wabush	–	–	–	–	–
44	Waterloo-Wellington	–	–	–	–	–
45	Whitehorse	13,849	13,466	12,822	14,045	12,069
46	Windsor	40,548	38,905	39,154	38,269	53,191
47	Winnipeg International	180,964	157,807	140,073	166,032	166,617
48	Total	2,838,073	2,445,705	2,282,119	2,299,385	2,288,504

TABLE 4.4. Total Aircraft Movements at Airports with Ministry of Transport Air Traffic Control Towers, 1960-70

1965	1966	1967	1968	1969	1970	No.
80,689	154,392	170,575	159,324	107,486	110,704	1
16,655	23,852	15,141	15,743	23,889	27,513	2
36,130	48,587	50,260	57,751	58,212	50,291	3
–	–	157,028	170,701	212,031	192,320	4
163,276	206,088	233,024	231,423	218,737	198,815	5
295,404	329,890	326,916	313,307	126,859	9,611	6
166,831	190,272	184,250	202,178	202,027	184,462	7
26,280	29,272	37,265	40,336	50,991	58,797	8
41,777	30,951	34,950	24,303	25,587	19,161	9
46,634	47,952	30,865	25,352	50,957	44,078	10
37,071	32,608	62,087	52,972	26,071	63,036	11
46,528	59,182	74,606	98,660	65,614	71,336	12
91,019	137,402	154,682	141,538	117,918	171,049	13
19,244	23,985	34,609	37,771	51,970	48,890	14
66,229	91,622	89,602	93,628	49,726	46,129	15
24,258	43,956	56,880	53,286	51,232	43,730	16
66,902	92,425	102,347	100,709	115,841	104,205	17
61,832	96,539	92,143	95,247	94,476	89,883	18
211,115	237,947	259,344	256,803	257,708	250,915	19
23,936	25,216	41,404	43,157	48,250	66,027	20
–	61,818	68,401	65,338	11,644	91,828	21
167,784	183,288	196,805	193,823	199,898	201,266	22
12,420	20,450	25,254	37,447	14,380	37,109	23
79,460	153,455	181,252	156,517	142,940	155,886	24
19,427	14,634	18,206	18,865	16,742	18,261	25
23,127	37,121	49,701	54,314	39,572	38,332	26
99,431	111,580	132,980	113,262	123,373	109,676	27
66,298	77,312	82,828	105,926	98,740	86,804	28
29,937	34,228	39,375	60,875	36,443	23,815	29
9,176	29,623	40,379	46,517	102,865	119,073	30
–	–	–	22,142	289,718	314,312	31
–	–	22,474	8,640	13,427	29,948	32
14,915	8,595	10,301	11,126	14,073	29,854	33
67,545	97,534	105,744	105,616	95,101	69,213	34
–	–	–	–	–	–	35
24,161	35,745	38,822	34,223	33,484	31,234	36
–	–	–	–	7,651	68,387	37
10,956	9,444	10,228	12,413	10,429	13,652	38
139,278	174,288	201,785	200,864	210,708	220,996	39
210,662	228,252	240,339	214,709	209,181	190,370	40
99,456	132,773	158,653	152,642	169,602	149,521	41
76,866	125,109	150,262	119,439	115,651	107,686	42
–	–	–	10,773	9,440	10,211	43
76,498	127,981	160,665	92,606	39,756	80,741	44
14,863	21,781	28,246	34,261	58,901	71,454	45
49,823	63,707	62,087	59,607	76,335	77,304	46
198,317	269,555	259,534	237,600	179,932	158,358	47
2,688,239	3,316,740	4,037,749	4,048,224	4,325,568	4,375,369	48

Source: Aircraft Movement Statistics, Aviation Statistics Centre, 1960-70.

TABLE 4.5. Itinerant Aircraft Movements at Airports with MOT Towers, 1960-70

No.	Airports	Itinerant movements				
		1960	1961	1962	1963	1964
1	Abbotsford	–	4,820	7,422	12,112	18,864
2	Baie Comeau	12,910	8,388	8,341	8,012	10,248
3	Brandon	–	–	–	–	–
4	Buttonville	–	–	–	–	–
5	Calgary International	46,841	49,823	51,915	57,674	59,012
6	Cartierville	32,384	36,182	39,235	44,277	51,489
7	Edmonton Industrial	57,796	45,650	46,810	49,489	49,483
8	Edmonton International	1,035	14,662	14,560	14,262	14,769
9	Fort St. John	5,507	6,078	7,055	8,420	11,800
10	Fredericton	8,311	13,856	11,954	11,969	15,246
11	Gander International	21,696	23,225	20,595	19,419	18,976
12	Halifax International	7,441	15,938	17,985	19,454	20,884
13	Hamilton City	–	–	–	–	–
14	Kamloops	–	–	–	–	–
15	Lakehead/Thunder Bay	17,491	16,057	16,757	17,061	17,619
16	Lethbridge	9,656	9,217	8,662	8,822	10,071
17	London	15,666	18,118	23,655	27,684	25,579
18	Moncton	19,439	20,319	19,773	19,695	20,294
19	Montreal International	87,104	84,364	82,541	80,821	95,186
20	North Bay	22,744	21,540	12,512	19,009	17,118
21	Oshawa	–	–	–	–	–
22	Ottawa International	60,035	55,515	58,469	61,555	57,538
23	Penticton	–	–	–	–	–
24	Pitt Meadows	–	–	–	–	–
25	Port Hardy	13,000	13,667	13,642	11,614	12,938
26	Prince George	3,914	5,726	5,104	6,162	9,506
27	Quebec	19,917	20,925	22,240	24,720	35,723
28	Regina	26,751	27,828	29,721	29,457	28,768
29	St. John	15,713	14,372	14,644	14,800	16,190
30	St. Andrews	–	–	–	–	–
31	St. Hubert	–	–	–	–	–
32	St. Jean	–	–	–	–	–
33	St. John's	7,828	10,006	8,968	8,813	7,064
34	Saskatoon	29,457	28,722	24,854	17,866	18,180
35	Sault Ste. Marie	–	–	–	–	–
36	Sept-Iles	15,836	14,131	13,172	13,737	13,621
37	Springbank	–	–	–	–	–
38	Sydney	8,654	8,816	8,195	7,645	7,156
39	Toronto International	95,388	91,764	89,376	86,012	89,205
40	Toronto Island	56,719	44,363	36,563	35,448	36,838
41	Vancouver International	59,671	60,251	67,237	72,881	73,763
42	Victoria International	32,273	29,795	31,295	30,694	31,228
43	Wabush	–	–	–	–	–
44	Waterloo-Wellington	–	–	–	–	–
45	Whitehorse	7,104	7,463	8,265	8,314	8,039
46	Windsor	9,704	11,470	15,299	16,034	17,872
47	Winnipeg International	69,186	66,213	61,740	64,763	68,724

TABLE 4.5. Itinerant Aircraft Movements at Airports with MOT Towers, 1960-70

Itinerant movements						
1965	1966	1967	1968	1969	1970	No.
25,380	43,572	51,829	49,372	40,339	41,193	1
10,176	11,367	11,632	11,488	11,554	17,476	2
6,008	5,918	4,729	8,297	17,360	15,328	3
–	–	34,450	22,506	20,188	35,898	4
66,948	62,588	57,197	64,849	70,060	73,456	5
73,170	95,540	98,064	91,527	43,515	4,893	6
59,464	68,942	75,521	82,652	86,388	81,416	7
15,524	17,206	20,250	21,929	23,538	26,737	8
16,053	16,147	19,067	15,637	16,510	13,673	9
17,879	17,730	17,122	16,755	23,713	24,964	10
18,654	17,933	22,715	22,972	25,854	21,256	11
28,982	30,627	34,260	34,871	36,566	37,640	12
686	903	4,759	9,009	27,437	39,321	13
5,730	7,234	12,410	19,613	26,686	27,751	14
19,520	22,087	23,622	27,501	21,968	19,529	15
8,434	14,873	20,166	18,054	17,452	15,335	16
24,708	31,588	37,455	37,654	42,820	38,352	17
22,785	29,324	29,841	30,330	28,020	28,098	18
107,255	125,756	151,502	140,511	148,027	152,342	19
12,470	14,061	17,260	17,008	20,674	27,786	20
–	3,850	4,876	6,133	7,110	25,135	21
62,845	76,121	82,705	87,359	93,194	89,169	22
6,304	7,003	7,208	8,467	11,551	16,994	23
6,837	14,885	48,328	56,451	52,995	48,477	24
13,969	13,669	15,944	15,987	14,499	12,698	25
12,826	14,793	20,403	21,500	20,751	19,111	26
40,291	43,222	46,918	48,851	52,032	55,014	27
29,098	32,494	33,810	36,957	36,061	33,088	28
16,335	17,507	17,813	23,771	18,480	16,284	29
208	182	8,087	10,215	18,566	22,193	30
–	–	–	5,459	74,936	86,569	31
–	–	11,074	4,310	5,922	9,878	32
7,836	7,326	8,288	8,544	9,473	12,166	33
19,934	23,987	31,276	34,103	35,063	31,284	34
–	–	–	–	–	8,436	35
13,555	16,647	19,590	21,664	24,650	22,689	36
–	–	–	–	1,253	12,000	37
8,413	7,754	7,919	8,836	7,982	9,367	38
99,958	119,493	141,477	153,336	165,426	176,611	39
42,315	49,762	53,760	59,406	61,532	54,143	40
84,879	106,930	124,748	129,730	142,120	132,606	41
31,565	43,906	53,637	49,701	51,787	50,935	42
–	–	–	5,850	6,676	8,025	43
–	–	2,614	2,661	14,552	27,677	44
9,469	12,440	15,607	18,703	20,830	23,149	45
18,030	21,406	23,847	22,735	23,063	25,602	46
74,787	96,619	106,776	109,268	114,161	117,949	47

Source: Aircraft Movement Statistics, Aviation Statistics Center.

Chapter V

PASSENGER AND CARGO TRAFFIC

The analysis of passenger and cargo flows through and between airports is the second major statistical source for air terminal planning, and a major factor in determining the allocation of routes among airlines. Figures are compiled through surveys of the eight largest Canadian and approximately thirty foreign airlines licensed to service Canada. These surveys can be divided into two sections – airport activity measuring the flow of passengers, cargo, and mail at individual air terminals; and passenger origin and destination (O and D) depicting the community of interest of travellers between cities, either domestic (totally within Canada), or between Canada and the United States. International O and D involving travel on the scheduled services of Canadian airlines is not published, although international charter statistics are available.

Due to the nature of the skein of paths formed by all the individual passenger and cargo movements, careful definition of what constitutes airport activity and O and D is necessary. Before using the Tables relevant to this chapter, readers should consult the glossary for such terms as enplaned, deplaned, arriving, departing, directional origin and destination (DOD), and ticket origin and destination (TOD).

Airport Activity

Figure 5.1 and Table 5.1 indicate that the passenger flow at major Canadian airports has expanded rapidly during the last decade, with growth rates of up to 30 percent per year at certain terminals during the years 1966 to 1970. This growth can be attributed to numerous factors. The savings of travel time inherent in jet journeys exceeding three hundred miles in length is a prime cause of the upsurge. Modern innovations – baggage carousels, moving passenger sidewalks (Montreal), and modular passenger/cargo facilities (Toronto) – have greatly increased airport efficiency, while the well-publicized technical improvements in aircraft – pressurized cabins, higher speeds, stronger and lighter materials, larger size – have enhanced the public image of commercial aviation in terms of safety, glamour, and comfort. The result? – a more air-minded and air-travelling public. Moreover, flying has become the forté of the time-conscious businessman, and a substantial portion of all business trips are today made by air. And finally, the rising income level of Canadians, coupled with a growth in special fares such as charter, senior citizen, group and standby, have lowered average world fares measured in uninflated dollars in the postwar years.

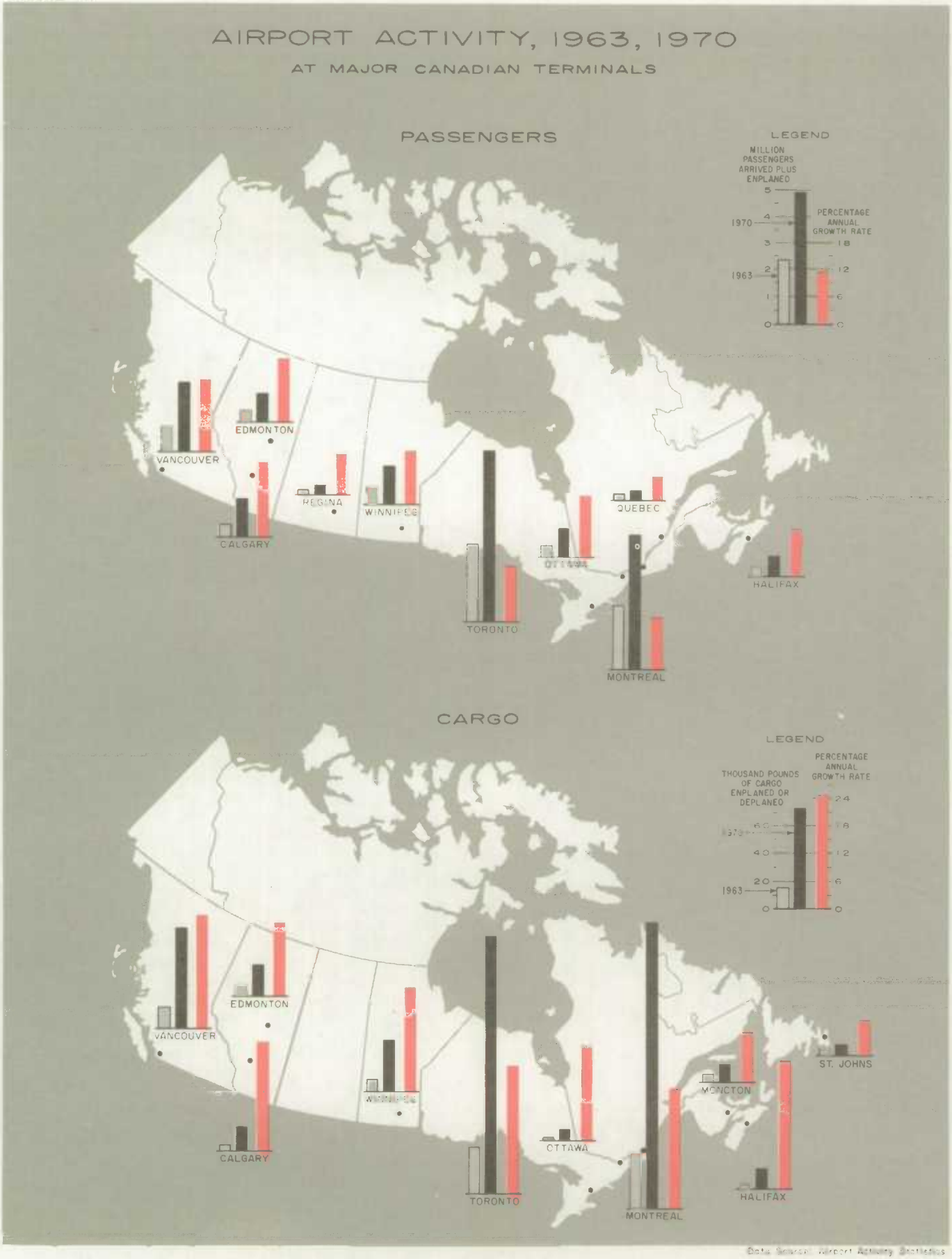
Until recently, most airlines had set their domestic fares according to a system whereby charges were less per mile for routes with a heavy traffic density than for those less frequently travelled. However, certain carriers have introduced a new flat scale schedule of $10 plus 5.7 cents per mile for all routes. Generally, fares in the Prairies and the Maritimes have been reduced, but those in the central provinces raised, and the net increase of the fare charge has been approximately five percent overall (Table 5.2).

As previously noted, international fares are usually negotiated and agreed on by the member airlines of IATA. Since the last round of fares was set for the North Atlantic route in 1964, numerous special rates, increased aircraft operating efficiency, including the reduction of the number of seating classes, and the popularity of European vacationing, have extended the interest and profitability of these flights. However, scheduled services have felt the pressure of the lower-priced charter operations, and rate-cutting proposals are now being considered for increasing the scheduled airlines' share of the North Atlantic market.

Cargo activity (Table 5.3) has expanded even more rapidly than passenger traffic – annual growth of 20 to 25 percent is common for the top airports. Airline companies are now financially able to offer all-cargo scheduled services where before they flew only contract or mixed passenger-cargo operations. Nonetheless, in spite of frequent ability to lower "total distribution" costs, air cargo still contributes less than one percent of all the goods movements in Canada. This is due in part to the obstacles to the widespread use of such service: notably the high unit cost necessitated by the small quantities, the high price of containerization (which, however, lowers the damage rate involved in stowage, and allows standardization of transit facilities and equipment), the difficulties of ground transportation to and from airports, and to the fact that, despite the higher speed of delivery, most companies do not yet regard air cargo as a 'normal' mode for shipping their goods. Cargo flown is usually restricted to items of high value-density or perishability such as drugs, poultry, cut flowers, and gemstone, among others, or to situations where rapid delivery over long distances is vital and where, as in the Canadian north, inaccessibility necessitates air transportation.

With reference to individual airports, 1970 scheduled service rankings for the leading terminals by passenger and cargo flows correspond closely to each other – Montreal's Dorval (2.5 million passengers, 210 thousand tons of cargo), Toronto's Malton (three million passengers, 190 thousand tons of cargo), Vancouver (1.25 million passengers, ten thousand ton of cargo), Winnipeg (800 thousand passengers, 38 thousand tons of cargo), and Calgary (800 thousand passengers, 17 thousand tons to cargo).

FIGURE 5.1



Data Source: Airport Activity Statistics

The growth rates, in terms of passenger activity, from 1963 to 1970, show that all the leading 25 airports except Moncton have expanded at rates ranging from 50 to 300 percent. For the top airports taken together, the flow has doubled or tripled yielding an average annual growth rate of nine to 18 percent. Particularly noticeable is the surge in passenger traffic through western terminals — of the twelve airports with the most recent five-year average annual growth rates of ten percent or more, only three are situated east of the Lakehead. Furthermore, the three most rapidly expanding airfields in Canada are Thunder Bay, Saskatoon, and Edmonton Industrial.

Cargo growth patterns are somewhat more variable. While the five leading air terminals sustained growth rates of 19 to 24 percent, most other airports display lower figures. Negative growth rates at three of the top twenty-five airfields reflect the fluctuating nature of air cargo services in developing areas (Windsor's −.7 figures is attributed to the abnormal increase in the base year 1966), while generally higher figures reflect the more rapid overall growth of cargo over passenger transport. Finally, the growing need for flying supplies into the far north is reflected in the positions and growth rates of the relatively small cities of Yellowknife, Inuvik, and Frobisher in the Northwest Territories.

Passenger Origin and Destination

While airport statistics record the total passenger flow through an airport including stopovers and connecting passengers, (TOD) Ticket Origin and Destination figures measure the number of passengers who actually commence their journeys at a given airport, thereby facilitating the airport planner in estimating the air-travelling population of the geographical area, or air hub.

Examination of Table 5.4 shows that ticket originations average approximately one-third to one-half of passenger departures at the ten leading airports. Toronto assumes first place with 22.9 percent of total originations, and is followed by Montreal (15.3 percent), Vancouver (9.7 percent), Calgary (6.1 percent), Edmonton (5.9 percent), and Winnipeg (5.0 percent), of a 1970 total TOD figure of 5,320,741. In general, the top few terminals which serve as focal points for connecting passengers, and entry/departure centers for international passengers, show slower growths for TOD than for total passenger flows. Other airports, on the other hand, indicate the reverse trend, as well as their increasingly important positions as passenger sources, and as sources of transfer passenger for the larger air terminals. Notable as well are such airports as Victoria, St. John's, Windsor, London, and Sept-Isles, whose considerably higher ranking on the TOD over the total-flow scale indicates their comparatively minor role as transfer points. This is due to their geographical location on the continent and to their relationship with larger urban centers.

Data compiled on route traffic densities (Table 5.5, 5.6, and Figure 5.2), indicate that the heaviest linkages in Canada — Toronto/Montreal, Toronto/Ottawa, and Calgary/Edmonton — account for over one million passengers per year, totalled for both directions. This figure has more than doubled since 1960. For most of the other routes ranked, the increase has been threefold or more, with the exceptions of Victoria/Vancouver, Toronto/Windsor, and Montreal/Quebec. These shuttle-runs are affected by the higher cost per mile of flying short routes with the new jet aircraft, and the improvements in surface transportation. The Tables also emphasize the role of certain terminals as distribution points for passengers — in the 1970 ranking of twenty-five pairs, Toronto (approximately two million passengers) appears eleven times, Vancouver (900 thousand passengers) eight times, Montreal (over one million passengers) seven times, Calgary (more than 500 thousand passengers) and Winnipeg (almost 400 thousand passengers) four times each, and finally, Edmonton (450 thousand passengers) three times. Many of the routes represent short shuttle runs between these centers and other airports — Toronto to Thunder Bay, Windsor, Sault Ste Marie, and Sudbury; Montreal to Quebec; Vancouver to Victoria, Kelowna, and Prince George — or between the centers of Edmonton/Calgary, Winnipeg/Toronto, Toronto/Ottawa/Montreal and Montreal/Halifax. Other linkages represent the segments of the transcontinental services — Vancouver/Calgary/Winnipeg/Toronto/Montreal.

Canada-United States' O and D figures show the heaviest densities to lie between New York City and Toronto/Montreal — a figure of approximately one million passengers in 1969. Once again, Toronto maintains the dominant position with eleven of the top twenty-five pairs, followed by Montreal with seven, and Vancouver with five. The favourite American partners include California (Los Angeles and San Francisco) with five, Florida (Tampa and Miami) and Boston with three each, and Chicago, Philadelphia, and Washington/Baltimore with two each, in addition to New York.

The 1970 movement of international passengers into and out of Canada is depicted in Table 5.7. Of the total of six million passengers entering or leaving Canada by air, over two-thirds crossed the

Canada/United States' border; and of the remaining one-third, more than 66 percent were going to Europe, the remainder departing to or leaving from Central and South America, Asia, Africa, or the Pacific Islands. It is interesting to note that in all cases more persons entered into than departed from Canada. Some remained in the country while others crossed into the United States or journeyed to other countries by land or water transport.

Origin/destination detail is not available for passengers travelling on scheduled services to and from foreign countries other than the United States. However, information is published on the 15 percent of international passengers who flew on charter flights in 1970. These travellers accounted for over 30 percent of the total Canada/European journeys, flew approximately three percent of the Canada/United States trips, and captured about 20 percent of the air markets involving other world areas. The statistics involved will, therefore, be weighted somewhat more in favour of European flights than is true for all international services, but they will serve to indicate the degree of interest and range.

Table 5.8 ranks seven Canadian airports by international charter passengers flown into and out of these terminals. Toronto shows approximately 450 thousand persons in 1970 or 50 percent of the total, leading Vancouver with 125 thousand passengers — just under ten percent, and Montreal with 90 thousand persons — just over ten percent. Only one of the seven leading airports makes this ranking very different from any of the others mentioned previously — Windsor, as Canada's southern-most major airport, is the departure point for many of the popular Caribbean charters.

Table 5.9 indicates the heaviest-density routes for international charters. The predominance of European charter origins and destinations is evident: only two out of the seventeen city pairs — Vancouver/Tokyo and Toronto/Tokyo — are from or to Asia, even in the year of Osaka's Expo '70; another two — Windsor/Freeport and Toronto/Bridgetown — involve the Caribbean; but over two-thirds are European links, and none are from or to Africa, Australia, South America, or the Pacific Islands. Points in the United Kingdom dominate the top seventeen pairs, with 300 thousand of the world total of 850 thousand passengers travelling to or from Manchester, London, or Glasgow. Amsterdam is second with 80 thousand passengers, followed by Paris, Rome, and Frankfurt.

Table 5.10 shows some of the leading air carriers in international charter service. In terms of passengers, the largest operator — foreign or domestic — is the Edmonton centered Wardair operation. This company evolved in 1952 from Max Ward's Polaris Charter Company which, since 1946, had been supplying and transporting for mining firms in the Northwest Territories. Today it continues these bush operations in addition to charter services throughout Canada and the world. Its fleet includes Boeing 707's and 727's Bristol 170 freighters, and De Havilland Otter and Twin-Otter aircraft (Table 6.7).

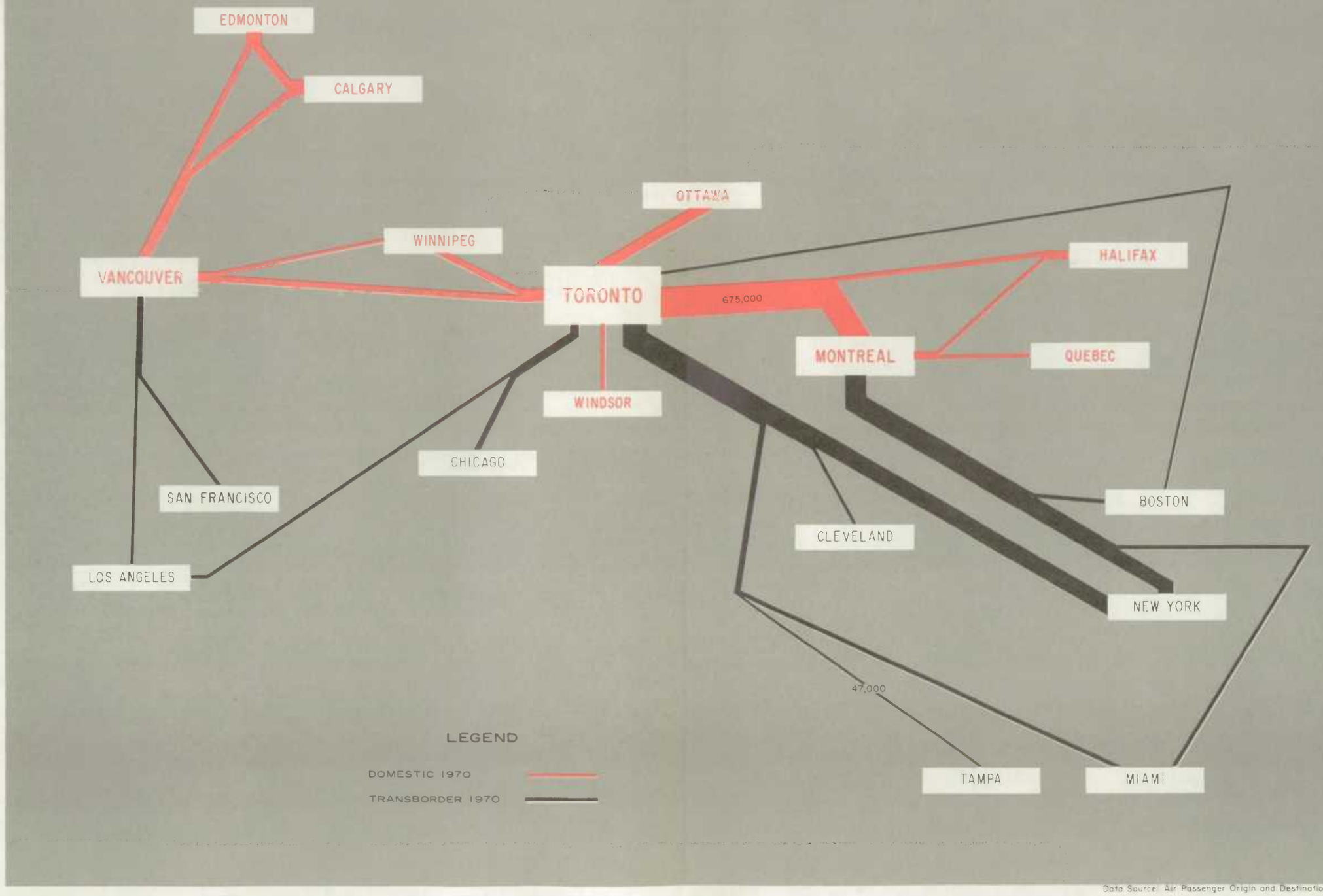
Second to Wardair as far as international charter passengers and revenue is concerned, but first in international charter, air cargo and overall commercial operations, is Air Canada, followed by Pacific Western, CP Air, and the remaining regional carriers. Although foreign-based charter operators do not fly as many passengers or as much cargo as do Canadian-based firms, airlines such as BOAC, KLM, Caledonian, and British United Airways capture about 40 percent of total international charter services flown to or from Canada.

A cumulative total by geographical area and by a number of indicators sums up the international charter picture for 1970 (Table 5.11). The importance of European O and D's is emphasized — 75 to 80 percent of the total passenger flow and revenue is involved. The figure of 648 thousand passengers can be further subdivided into four categories — British Isles with approximately 414 thousand, Western Europe with 220 thousand, Communist nations with about 14 thousand, and the Middle East with less than one thousand. Approximately 73 thousand passengers travelled in 1970 to Central and South America (more than 80 percent to the Caribbean), almost the same number journeyed to the continental United States and Alaska, nearly 28 thousand persons flew charter to Asia (primarily Japan and Hong Kong), with a somewhat smaller number departing to the Pacific Islands of Fiji and Hawaii. Six African countries received only 177 charter passengers, although the 500 tons of air cargo shipped proved comparatively more substantial. On the European routes, almost two thousand tons of cargo was flown by charter, about one-half each way. However, the shipments to the South Americas and to Africa almost completely originated in Canada, while the greater portion of the 800 tons of goods shipped between Canada and the United States was flown north.

It has been clearly demonstrated that the position of air transportation has undergone extensive alteration in Canada's transportation network — the vital importance acquired by aviation particularly within the last decade cannot be disputed. Although the reluctance to shift to air cargo by private industry would appear a limiting factor for extensive growth of the sector in the very near future, the rapid technical improvements in cargo aircraft, air terminals and linking ground transportation systems will offer more widely acceptable and profitable services and facilities within the next decade. On the other hand, the incredible growth of passenger air travel in the last ten years seems likely to to continue as the industry itself technically expands and economizes, and the expeditious and convenient nature of air travel is brought within the grasp of an even greater number of Canadians.

FIGURE 5.2

TOP CITY-PAIRS BY PASSENGER ORIGIN AND DESTINATION



Data Source: Air Passenger Origin and Destination Statistics

TABLE 5.2. Great Circle Mileages and One-way Economy Fares Between Selected Cities in Canada, Summer, 1971

No.	City – Ville	Calgary		Edmonton		Halifax		London		Montreal		Ottawa	
			$		$		$		$		$		$
1	Edmonton	172(1)	20										
2	Halifax	2,327	149	2,283	149								
3	London	1,628	111	1,636	111	884	69						
4	Montreal	1,867	120	1,845	120	500	41	403	35				
5	Ottawa	1,789	116	1,771	116	593	46	314	30	94	14		
6	Quebec	1,929	129	1,895	129	402	35	543	44	145	19	229	25
7	Regina	412	36	430	37	1,926	126	1,218	87	1,459	97	1,379	92
8	Saint John	2,211	142	2,174	142	119	18	772	57	382	39	475	40
9	St. John's	2,691	179	2,626	179	549	44	1,410	94	1,009	70	1,101	76
10	Toronto	1,670	109	1,671	109	800	58	88	14	315	30	226	25
11	Vancouver	426	37	503	41	2,752	174	2,030	135	2,287	145	2,207	140
12	Victoria	426	39	535	43	2,774	176	2,045	138	2,307	147	2,226	142
13	Winnipeg	741	55	738	55	1,600	106	878	68	1,129	77	1,049	73

(1) Edmonton Industrial. – Edmonton Industriel.

Source: Aviation Statistics Centre files.

TABLE 5.1. Arriving Passengers on Scheduled Domestic and International Services at 25 Canadian Airports, 1963-70

Airport	Rank								5 year growth rate 1966-70	Cargo rank 1970
	1970	1969	1968	1967	1966	1965	1964	1963	%	
Toronto International	1	1	1	1	1	1	1	1	10.9	2
Montreal International	2	2	2	2	2	2	2	2	9.7	1
Vancouver International	3	3	3	3	3	3	3	3	14.7	3
Calgary International	4	5	5	5	5	5	5	5	16.1	5
Winnipeg International	5	4	4	4	4	4	4	4	11.3	4
Ottawa International	6	6	6	6	6	6	7	6	17.8	10
Halifax International	7	7	8	7	7	7	6	7	7.6	7
Edmonton International	8	8	7	8	8	8	8	8	11.4	6
Quebec	9	10	9	10	10	10	10	10	5.5	15
Regina	10	9	11	12	12	12	12	11	9.7	14
Thunder Bay	11	21	22	22	23	22	21	22	30.7	17
Edmonton Industrial	12	12	15	16	17	20	23	29	18.9	9
Saskatoon	13	11	13	14	19	19	17	15	19.0	23
St. John	14	14	12	11	11	11	11	12	2.1	22
Victoria International	15	15	14	13	14	17	16	19	10.0	31
Moncton	16	13	10	9	9	9	9	9	− 6.4	8
Gander International	17	19	19	20	15	14	13	16	5.5	25
Sydney	18	18	16	15	18	13	15	13	7.3	29
Fredericton	19	16	17	17	13	16	19	17	1.9	27
London	20	17	18	18	16	15	14	14	4.5	20
St. John's	21	22	20	21	21	21	20	20	9.2	11
Windsor	22	20	21	19	20	18	18	18	4.3	13
Prince George	23	23	23	25	24	23	25	25	13.3	43
Fort St. John	24	24	28	26	26	25	24	24	8.5	55
Sept-Îles	25	29	26	30	30	27	26	26	14.7	16

	1970	1969	1968	1967	1966	1965	1964	1963
	Thousands of passengers arriving (including terminating, stopover, and transfer)							
Toronto International	3,257	2,889	2,678	2,633	2,150	1,869	1,621	1,519
Montreal International	2,662	2,409	2,224	2,534	1,836	1,661	1,420	1,289
Vancouver International	1,270	1,145	975	886	733	598	499	453
Calgary International	801	694	605	551	441	355	294	268
Winnipeg International	799	763	742	682	520	459	402	381
Ottawa International	608	514	462	441	316	288	240	255
Halifax International	421	372	351	358	314	287	244	233
Edmonton International	415	366	353	319	270	248	209	217
Quebec	217	182	190	184	175	159	159	153
Regina	205	199	154	158	142	120	114	122
Thunder Bay	194	89	83	87	67	63	52	49
Edmonton International	188	145	122	108	94	68	48	24
Saskatoon	184	156	133	115	92	81	79	86
St. John	156	128	150	159	144	124	121	117
Victoria International	149	124	131	120	102	89	82	74
Moncton	149	131	177	197	195	171	186	180
Gander International	122	90	94	96	99	99	95	83
Sydney	122	104	117	115	92	116	84	100
Fredericton	118	112	105	107	109	92	73	78
London	117	107	94	102	98	95	86	87
St. John's	109	87	94	91	76	67	64	64
Windsor	107	90	88	100	90	84	74	77
Prince George	105	82	70	78	63	53	42	34
Fort St. John	81	80	56	63	58	51	45	39
Sept-Îles	78	63	63	57	45	37	37	34

Source: Aviation Statistics Centre files.

TABLE 5.2. Great Circle Mileages and One-Way Economy Fares Between Selected Cities in Canada, Summer, 1971

Quebec		Regina		Saint John		St. John's		Toronto		Vancouver		Victoria		Winnipeg		No.
	$		$		$		$		$		$		$		$	
																1
																2
																3
																4
																5
																6
1,526	105															7
284	29	1,809	114													8
878	67	2,316	155	647	51											9
454	28	1,259	85	686	52	1,322	89									10
2,353	153	828	61	2,635	167	3,116	203	2,078	133							11
2,374	155	849	63	2,657	169	3,143	205	2,094	135	38	13					12
1,199	86	330	31	1,483	100	2,006	136	934	73	1,158	66	1,778	81			13

TABLE 5.3. Cargo Enplaned/Deplaned on Scheduled Domestic and International Services at 25 Canadian Airports, 1963-70

Airport	Rank								5 year growth rate 1966-70	Passengers rank 1970
	1970	1969	1968	1967	1966	1965	1964	1963		
Montreal International	1	1	1	1	1	1	1	1	22.7	2
Toronto International	2	2	2	2	2	2	2	2	23.3	1
Vancouver International	3	3	3	3	3	3	3	3	20.5	3
Winnipeg International	4	4	4	4	4	4	4	4	19.6	5
Calgary International	5	5	7	7	7	10	10	9	21.6	4
Edmonton International	6	6	6	6	6	7	9	8	15.5	8
Halifax International	7	8	8	11	11	11	11	11	31.0	7
Moncton	8	7	5	5	5	5	5	5	7.3	16
Edmonton Industrial	9	9	11	9	10	6	8	10	9.0	12
Ottawa International	10	10	12	12	13	12	12	12	16.9	6
St. John's	11	11	9	10	9	8	7	7	8.2	21
Frobisher	12	–	–	–	–	–	–	–	–	75
Windsor	13	12	14	14	12	13	13	13	– 0.7	22
Regina	14	13	15	15	14	14	15	17	4.1	10
Quebec	15	15	16	17	16	15	14	15	11.3	9
Sept-Îles	16	16	18	18	19	16	16	19	16.3	25
Thunder Bay	17	17	20	19	18	19	19	21	12.9	11
Goose Bay	18	14	10	8	8	9	6	6	– 21.1	40
Inuvik	19	18	25	45	–	–	–	–	80.7	78
London	20	25	21	21	21	21	21	22	9.7	20
Stephenville	21	20	19	16	15	–	–	–	– 6.8	35
St. John	22	19	22	23	20	17	17	16	7.5	14
Saskatoon	23	23	17	27	22	22	23	23	12.3	13
Yellowknife	24	33	28	31	–	–	–	–	26.1	45
Gander International	25	22	13	13	17	20	22	14	– 0.8	17

	1970	1969	1968	1967	1966	1965	1964	1963
	Pounds of cargo handled (including originating, transfer and stopover)							
Montreal International	208,508	187,019	148,794	99,900	91,983	67,532	52,458	40,893
Toronto International	186,862	156,876	126,467	80,301	80,847	56,418	44,537	33,763
Vancouver International	72,673	64,207	56,614	40,060	34,417	25,836	19,783	15,590
Winnipeg International	37,753	34,410	30,022	20,042	18,424	13,608	10,549	8,000
Calgary International	17,494	14,618	11,522	8,746	8,005	5,497	4,558	3,986
Edmonton International	15,121	13,027	13,518	9,898	8,488	7,048	4,687	4,523
Halifax International	15,039	11,859	10,070	5,728	5,110	4,187	4,167	2,691
Moncton	13,163	12,534	14,996	10,218	9,936	9,772	7,438	6,444
Edmonton Industrial	7,811	7,106	6,058	6,247	5,531	7,248	4,844	3,580
Ottawa International	7,810	6,024	5,721	4,657	4,175	2,868	2,277	2,121
St. John's	7,612	5,588	6,732	5,785	5,556	6,568	5,136	4,536
Frobisher	6,546	–	–	–	–	–	–	–
Windsor	4,236	3,534	4,433	3,754	4,350	2,559	2,027	1,744
Regina	3,860	3,445	3,975	3,350	3,293	2,461	1,544	1,200
Quebec	3,820	3,310	3,015	2,346	2,485	1,895	1,947	1,378
Sept-Îles	3,197	2,893	2,289	1,951	1,745	1,630	1,468	1,029
Thunder Bay	3,033	2,589	2,069	1,929	1,864	1,317	1,015	783
Goose Bay	2,746	3,445	6,444	7,267	7,095	6,156	6,279	5,062
Inuvik	2,615	2,156	1,494	443	–	–	–	–
London	2,448	1,515	2,031	1,693	1,688	1,198	948	745
Stephenville	2,386	2,097	2,134	2,558	3,163	–	–	–
St. John	2,283	2,138	1,929	1,524	1,712	1,536	1,429	1,212
Saskatoon	2,272	1,976	2,353	1,393	1,426	1,021	839	697
Yellowknife	1,881	1,115	1,303	938	–	–	–	–
Gander International	1,822	1,934	4,433	4,040	1,880	1,263	894	1,462

Source: Aviation Statistics Centre files.

TABLE 5.4. Top 25 Canadian Cities by Ticket Origination, 1968-70

City	Passenger Activity rank 1970	TOD rank			Ticket originations		
		1970	1969	1968	1970	1969	1968
					'000		
Toronto	1	1	1	1	1,475.2	1,293.4	1,162.8
Montreal	2	2	2	2	935.6	847.6	762.1
Vancouver	3	3	3	3	590.0	525.8	453.6
Calgary	4	4	4	4	351.8	316.7	254.4
Edmonton	8	5	5	5	312.7	285.3	244.0
Winnipeg	5	6	6	6	285.9	259.7	217.3
Ottawa	6	7	7	7	263.4	212.4	189.3
Halifax	7	8	8	8	167.1	137.0	122.7
Quebec	9	9	10	9	84.1	69.9	66.9
Regina	10	10	9	11	77.7	70.2	60.0
Victoria	15	11	11	10	75.6	62.2	60.9
St. John's (Nfld)	21	12	12	12	71.3	59.7	58.2
Windsor	22	13	14	13	69.0	54.2	50.1
Saskatoon	13	14	13	14	63.2	55.2	47.2
London	20	15	15	15	62.8	52.9	45.0
Thunder Bay	11	16	16	16	57.8	47.5	42.5
Moncton	16	17	17	17	43.8	37.6	38.5
Sydney	18	18	20	20	40.1	31.7	30.8
St. John (N.B.)	14	19	18	18	39.8	33.5	35.0
Fredericton	19	20	21	21	37.2	29.1	27.5
Sept-Îles	25	21	19	19	37.1	31.9	32.5
Sudbury	–	22	24	26	32.5	23.6	22.0
Prince George	23	23	22	23	32.1	28.8	22.9
Sault Ste. Marie	–	24	23	22	31.9	24.3	23.0
Kelowna	–	25	27	31	24.6	19.0	15.0

Source: Air Passenger Origin and Destination Statistics, Domestic Report, Statistics Canada, 1968-70.

TABLE 5.5. Top City-Pairs by Origin and Destination of Canadian Domestic Passengers, 1960-70

City-pair	Rank			Thousands of passengers by year			
	1970	1969	1968	1970	1969	1968	1967
Toronto – Montreal	1	1	1	674.8	586.1	547.3	580.3
Toronto – Ottawa	2	2	2	305.6	251.5	227.7	202.7
Calgary – Edmonton	3	3	3	234.8	212.9	173.2	157.1
Toronto – Winnipeg	4	4	4	170.9	146.3	125.8	109.2
Vancouver – Calgary	5	5	6	166.0	141.9	111.2	93.4
Toronto – Vancouver	6	6	5	163.0	143.0	117.1	97.1
Vancouver – Edmonton	7	7	7	139.3	122.0	102.0	86.5
Toronto – Halifax	8	8	10	98.7	84.2	70.8	63.3
Toronto – Windsor	9	13	9	93.0	71.9	74.3	72.2
Montreal – Quebec	10	11	11	92.7	78.3	69.5	80.1
Vancouver – Winnipeg	11	9	15	90.3	81.8	62.8	54.1
Montreal – Halifax	12	10	12	89.9	80.0	69.0	75.0
Toronto – Thunder Bay	13	15	14	84.5	70.0	63.0	56.7
Toronto – Calgary	14	12	13	83.0	75.7	64.7	52.2
Vancouver – Montreal	15	14	16	78.0	71.5	55.7	69.8
Toronto – Edmonton	16	16	17	70.1	63.4	52.2	44.5
Victoria – Vancouver	17	17	8	67.3	57.7	76.1	67.8
Winnipeg – Montreal	18	18	18	61.2	55.5	49.3	64.5
Sault Ste. Marie – Toronto	19	21	19	61.1	49.1	48.6	44.9
Calgary – Winnipeg	20	20	21	61.0	50.2	42.7	33.3
Montreal – Ottawa	21	22	22	60.5	46.6	38.3	37.0
Sudbury – Toronto	22	23	24	59.3	43.4	35.1	33.4
Prince George – Vancouver	23	19	20	57.8	53.3	43.2	43.5
Kelowna – Vancouver	24	24	26	48.1	39.0	32.4	26.8
Hamilton – Montreal	25	80	–	46.1	14.4	–	–
	1966	1965	1964	1963	1962	1961	1960
	Thousands of passengers by year						
Toronto – Montreal	458.9	444.8	396.8	386.8	368.6	338.2	312.2
Toronto – Ottawa	168.8	152.8	132.4	132.4	124.6	122.1	106.7
Calgary – Edmonton	125.8	102.4	78.9	64.1	57.5	59.1	65.9
Toronto – Winnipeg	95.9	79.5	69.2	70.7	65.5	63.0	46.5
Vancouver – Calgary	75.9	62.6	53.2	46.8	51.1	57.3	44.1
Toronto – Vancouver	87.2	73.2	59.6	56.5	51.7	48.5	34.1
Vancouver – Edmonton	71.5	57.3	48.5	46.4	50.4	54.4	35.1
Toronto – Halifax	54.1	47.5	40.7	37.7	36.2	33.0	25.3
Toronto – Windsor	77.2	74.1	70.0	72.0	65.5	70.4	64.8
Montreal – Quebec	81.9	82.3	88.1	89.5	78.2	69.5	64.6
Vancouver – Winnipeg	47.3	37.2	30.2	33.5	31.8	31.7	22.1
Montreal – Halifax	53.0	48.2	40.4	35.7	36.2	37.1	31.5
Toronto – Thunder Bay	48.3	40.5	32.3	31.1	30.7	29.5	21.0
Toronto – Calgary	44.9	38.0	31.4	27.5	27.9	28.4	19.1
Vancouver – Montreal	41.2	33.1	26.2	25.2	24.7	23.1	16.7
Toronto – Edmonton	38.8	32.9	24.9	26.1	26.5	23.4	17.0
Victoria – Vancouver	48.1	48.3	44.5	40.5	50.7	65.8	68.9
Winnipeg – Montreal	37.0	30.6	25.5	27.0	25.4	24.4	19.2
Sault Ste. Marie – Toronto	38.4	33.0	26.6	25.8	26.3	20.4	17.8
Calgary – Winnipeg	27.6	23.9	19.3	18.5	16.5	18.0	12.7
Montreal – Ottawa	30.6	27.0	25.4	28.8	28.5	30.3	35.2
Sudbury – Toronto	23.7	18.9	13.4	15.4	16.9	17.0	15.5
Prince George – Vancouver	43.4	31.7	20.8	14.4	11.2	10.1	9.7
Kelowna – Vancouver	20.0	14.7	10.0	8.1	6.7	7.3	3.7
Hamilton – Montreal	–	–	–	–	–	–	–

Source: Air Passenger Origin and Destination Statistics, Domestic Report, Statistics Canada, 1968-70

TABLE 5.6. Top 25 Canadian/US City-pairs by Passenger Origin and Destination, 1968-70

City-pair	Rank			Passengers by year		
	1968	1969	1970	1968	1969	1970
				000's		
Toronto — New York	1	1	1	366.7	435.7	450.1
Montreal — New York	2	2	2	331.7	373.9	381.5
Toronto — Chicago	3	3	3	109.6	133.0	139.6
Montreal — Boston	4	4	4	80.1	88.3	89.1
Vancouver — San Francisco(1)	7	5	5	66.0	85.4	80.7
Toronto — Miami	5	6	6	76.1	85.2	80.0
Montreal — Miami	6	7	7	69.3	75.5	79.6
Toronto — Los Angeles(2)	9	8	8	54.9	70.5	69.9
Toronto — Boston	12	11	9	42.7	55.9	62.7
Vancouver — Los Angeles(2)	8	9	10	58.7	59.9	61.4
Toronto — Cleveland	10	10	11	50.6	56.3	60.6
Montreal — Chicago	13	13	12	39.3	48.6	55.1
Toronto — Tampa(3)	11	12	13	47.7	49.2	47.1
Toronto — Detroit	14	14	14	34.6	43.8	47.0
Toronto — Philadelphia(4)	17	16	15	28.8	36.4	40.1
Vancouver — Honolulu(5)	20	21	16	27.2	31.5	38.6
Toronto — Washington/Baltimore	22	15	17	26.3	36.5	35.9
Montreal — Los Angeles(2)	16	17	18	30.2	35.8	35.1
Vancouver — Seattle	15	18	19	32.1	34.5	35.0
Montreal — Washington/Baltimore	18	19	20	27.3	34.1	32.7
Ottawa — New York	21	23	21	27.0	27.6	32.0
Toronto — San Francisco(1)	25	22	22	23.7	30.4	31.1
Halifax — Boston	23	24	23	26.1	25.6	30.3
Montreal — Philadelphia(4)	19	20	24	27.3	32.4	28.7
Victoria — Seattle	24	26	25	24.6	21.3	24.3

(1) Includes Oakland, Berkeley, Sausolito, and Walnut Creek.
(2) Includes Anaheim, Burbank, Downey, Glendale, Long Beach, Newport Beach, Pomona, Santa Ana, VanNuys, and Whittier.
(3) Includes St. Petersburg.
(4) Includes Camden, N.J.
(5) Includes Hana, Hilo, Hoolehau, Kahulai, Kailua, Kanuela, Lanei, and Lihua.

Source: Air Passenger Origin and Destination Statistics, Canada-US Report, Statistics Canada, 1969; Aviation Statistics Centre files.

TABLE 5.7. Revenue Passengers Entering and Leaving Canada by Air, 1970

By area and type of carrier	Revenue passengers		
	Entering Canada	Leaving Canada	Totals
United States of America	2,097,724	2,071,514	4,191,743
Unit-toll	2,051,537	2,024,052	4,098,094
Charter	46,187	47,462	93,649
Europe	926,298	878,770	1,804,789
Unit-toll	605,301	551,639	1,156,670
Charter	320,997	327,131	648,128
Other	293,970	277,298	571,268
Unit-toll	245,729	222,815	468,544
Charter	48,241	54,483	102,724
Totals	3,317,992	3,218,312	6,545,304
Unit-toll	2,902,567	2,789,236	5,700,803
Charter	415,425	429,076	844,501

Sources: Air Carrier Operations, Statistics Canada, 1970; International Air Chartes Statistics, Statistics Canada, 1970.

TABLE 5.8. Total International Charter Passengers, 1970 Enplaned/Deplaned at Seven Leading Airports

Airport	Passengers by area of service						
	Africa	Asia	Europe	Pacific	Southern	US	Total
Toronto	130	9,537	383,051	177	31,153	25,827	449,865
Vancouver		8,789	102,636		3,059	11,640	125,944
Montreal	318	2,536	54,256		11,084	22,119	90,313
Edmonton		1,193	37,510		663	8,547	47,913
Calgary	105	4,129	29,264		476	5,792	39,766
Windsor			12,203		22,746	1,031	35,980
Winnipeg		341	11,586		2,385	7,791	22,103

Source: International Air Charter Statistics, Statistics Canada, 1970.

TABLE 5.9. Total International Charter Passengers, 1970, Leading 17 City-Pairs

Rank	City-Pair	Passengers		
		To Canada	From Canada	Total
1	Toronto – London	87,363	88,131	175,494
2	Vancouver – London	29,099	31,399	60,489
3	Toronto – Glasgow	28,525	27,745	56,270
4	Toronto – Amsterdam	25,834	25,731	51,565
5	Toronto – Manchester	10,845	10,739	21,584
6	Vancouver – Amsterdam	9,902	10,160	20,062
7	Montreal – Paris	9,527	9,332	18,859
8	Edmonton – London	8,007	8,186	16,193
9	Montreal – London	7,472	7,899	15,371
10	Calgary – London	6,907	8,107	15,014
11	Windsor – Freeport	5,873	6,127	12,000
12	Toronto – Bridgetown	5,146	5,677	10,823
13	Toronto – Rome	3,967	6,188	10,155
14	Toronto – Frankfurt	4,957	4,639	9,596
15	Edmonton – Amsterdam	4,740	4,715	9,455
16	Toronto – Tokyo	4,210	4,561	8,771
17	Vancouver – Tokyo	4,095	4,454	8,549

Source: International Air Charter Statistics, Statistics Canada, 1970

TABLE 5.10. Canadian and Foreign Charter Operators, 1970 – International Flights

Carrier	Number flights	Passengers	Cargo	Revenue
			tons	$'000
Canadian Operators				
Air Canada	1,185	126,057	2,233	14,272
CP Air	340	57,209		6,341
Eastern Provincial	21	2,070		107
Nordair	475	46,018	44	3,005
Pacific Western	562	74,450	179	8,470
Quebecair	176	11,101	7	750
Transair	55	3,900	4	233
Wardair	1,048	167,359	136	17,148
Others	250	2,343	314	283
Sub-totals	4,112	490,507	2,917	50,610
Foreign Operators				
BOAC	252	38,586	275	3,687
KLM	169	24,256	451	2,631
Caledonian	432	78,352	266	7,289
British United	178	23,657		2,149
Martins	116	20,135	4	2,113
Capitol International	92	19,370		1,729
World Airways	96	16,643		1,617
Laker	111	16,062		1,566
Trans International	63	15,275		2,361
Donaldson	92	11,468		937
Others	847	90,190	815	9,311
Sub-totals	2,448	353,994	1,809	35,390
GRAND TOTALS	6,560	844,501	4,726	86,000

Note: Columns may not add exactly due to errors of rounding.
Source: International Air Charter Statistics, Statistics Canada, 1970

TABLE 5.11. Total International Charter Traffic, 1970, by World Area, Flights, Passengers, Cargo, and Revenue

World area	Flights	Passengers	Cargo	Revenue
			tons	$'000
Africa				
To Canada				
From Canada	27	643	502	807
Total	27	643	502	807
Asia				
To Canada	81	13,064	94	120
From Canada	93	15,330	86	5,438
Total	174	28,394	180	5,558
Europe				
To Canada	2,043	320,997	995	20,966
From Canada	2,049	327,131	1,003	46,755
Total	4,092	648,128	1,998	67,719
Pacific				
To Canada	5	177	80	184
From Canada				
Total	5	177	80	184
Southern				
To Canada	341	35,000	34	184
From Canada	419	38,510	1,043	5,545
Total	760	73,510	1,077	5,727
USA — Continental				
To Canada	683	34,997	659	1,409
From Canada	650	36,784	231	2,778
Total	1,333	71,781	890	4,188
USA — Hawai				
To Canada	88	11,190		
From Canada	81	10,678		1,815
Total	169	21,868		1,814
Total to Canada	3,241	415,425	1,862	22,863
Total from Canada	3,319	429,076	2,865	63,138
GRAND TOTAL	6,560	844,501	4,727	86,000

Note: Columns may not add up exactly due to rounding.
Source: International Air Charter Statistics, Statistics Canada, 1970.

passenger flow and therefore revenue, is low in the winter (poor flying and vacation weather) and high in the summer, peaking in August. On the other hand, flights to the Southern Hemisphere and to the United States (including extensive services to Florida and the Caribbean) both run at their highest continuous level in the winter months of January through March.

The fluctuations can also be correlated with holiday patterns: peaks can be noted during the summer at all destinations of services, but particularly in trans-Atlantic flights; peaks at December (Christmas) and March (Easter) are also found in the southern and transborder flight records. Revenues reflect this pattern, with highs in mid-summer and minor peaks in early spring and at the year's end.

Other variations may be caused by special circumstances. The decrease in revenue shown for the spring of 1969, which runs counter to the pattern shown in 1968 and 1970, is traceable to the Air Canada strike from April 21st to May 20th of that year.

This overall view can be faceted to show the economic trends for special segments of Canada's airline industry. Only 30 out of 360 foreign (Table 6.10), and seven out of 547 domestic carriers offer scheduled service along a fixed route; all the remaining airlines offer either charter or specialty services, flying a few passengers or loads of cargo under specific instructions, or otherwise specializing in aerial photography or flight-training, among others (Figure 6.2).

Charter operations comprise much more than the ferrying of large numbers of passengers to foreign countries at low cost. The typical Canadian charter operation probably flies fewer than five planes, none larger than ten-passenger aircraft, and it may fly only one or two light airplanes. Charter services by Canadian operators have grown phenomenally during the 1960-70 decade, showing a five-fold increase in operating revenue to $125 million in 1970, compared to a three-and-one-half fold increase in other revenue sources. Correspondingly, the share of charter revenues in total receipts rose from ten to eleven percent in the early 1960's and to 15.2 percent in 1970.

International services are flown by both Canadian and foreign operators (Tables 6.8 – 6.10). Of all the foreign airlines licensed to operate in Canada, only thirty offer scheduled services – eleven from the United States and nineteen from other foreign countries. Of the Canadian operators, Air Canada and CP Air provide the most important international scheduled services, although other firms fly international scheduled and/or charter operations.

Table 6.8 illustrates the remarkable increase in the amount of Canadian international passenger traffic assumed by foreign operators in the last decade. At the beginning of the 1960's, foreign operators transported approximately one-third of these passengers on scheduled services and charters combined, but in 1969 they flew more Canadians transborder and overseas than did Canadian airlines. According to IATA figures, international charters have increased much faster since 1964 than have scheduled international services. As Mr. Knut Hammarskjold, Director General of IATA pointed out at the June 1971 ICAO assembly, "...non-IATA charter traffic increased at an average rate of 58.1 percent between 1964 and 1970, compared with 15.3 percent for the scheduled airlines".

Foreign carriers are also challenging Canadian services in international air cargo transport.

Table 6.9 details the 1970 international air traffic in Canadian passengers, and indicates the approximately equal status of foreign and Canadian airlines handling both charter and scheduled operations. This Table also reinforces the concept of the seasonal nature of international traffic; during the July to September period about 1.67 times as many people flew to foreign countries as during the period October to December.

As Table 6.10 shows, Montreal is Canada's busiest international airport – nineteen foreign airlines discharge passengers at its terminal including three from the United States – while Toronto's Malton receives the largest number of American airlines (six), and Vancouver, naturally enough, is the terminus for the two major Pacific foreign airlines, Quantas and JAL (Japan Air Lines).

Specialty services (Table 6.11) provide revenues for many small firms, particularly in the group of approximately 400 operators with incomes less than $150 thousand per year (Table 6.4). Specialty flying includes numerous areas (see Chapter III as well). Flight training, according to the 1967 MOT study, accounts for approximately 64 percent of all specialty flying, with rentals for recreational purposes adding another seven percent. Aerial photography – both scenic and survey – involves another four percent, while aerial inspection, reconnaisance, and advertising (forestry, pipeline and power-cable patrol, ice reconnaisance, and wildlife studies) contributes five percent. The remaining twenty percent involves three fields which generally fall to the small operators, accounting for the majority of their revenue sources and for about 50 percent of the flight training hours; "aerial application and distribution" includes agricultural flying (seeding and pest control), and aerial forestry and

fishery cultivation; "aerial control" constitutes forest fire patrol and fighting, and cloud seeding services; "aerial construction", primarily a helicopter operation, is comprised of the laying of such communication and transportation systems as pipelines, cables, and tramlines, in areas where access roads are costly to build.

Generally speaking, specialty flying boomed from 1960 to 1968, expanding from 173 thousand to 574 thousand hours during the decade. Since 1968, however, largely as a result of the cessation of grants-in-aid for pilot training, specialty hours have declined to just over 400 thousand hours per year.

One of the fastest growing sectors of the aviation economy has been helicopter operations. These carriers undertake many kinds of work including considerable photographic and agricultural services, in addition to transport operations and aerial construction in areas inaccessible by ordinary airplanes, or at projects where the ability to hover is necessary — from the depths of mountains to the concrete jungles of the cities. Table 6.13 outlines the strong growth of the industry during the last ten years — the four-fold increase in hours flown, and the five-fold increase in operating revenue. Canada today maintains one of the highest per capita levels of helicopter cargo transport in the world, even in the absence of any scheduled services.

The oldest and largest of Canada's fifty helicopter operators, and one of the world's leaders of civilian helicopter services, is Okanagan Helicopters of Vancouver. This company, formed in 1946 by Carlyle Agar of British Columbia, pioneered in helicopter-based construction with its work of laying the enormous power lines for the Kitimat-Kemano aluminum smelter in record time and at a very low cost for this type of operation. Today, flying over forty Bell, Hiller, and Sikorsky aircraft, it handles extensive business in western Canada, contracts in such widely separated areas as Pakistan and the United Kingdom, and provides international consulting services.

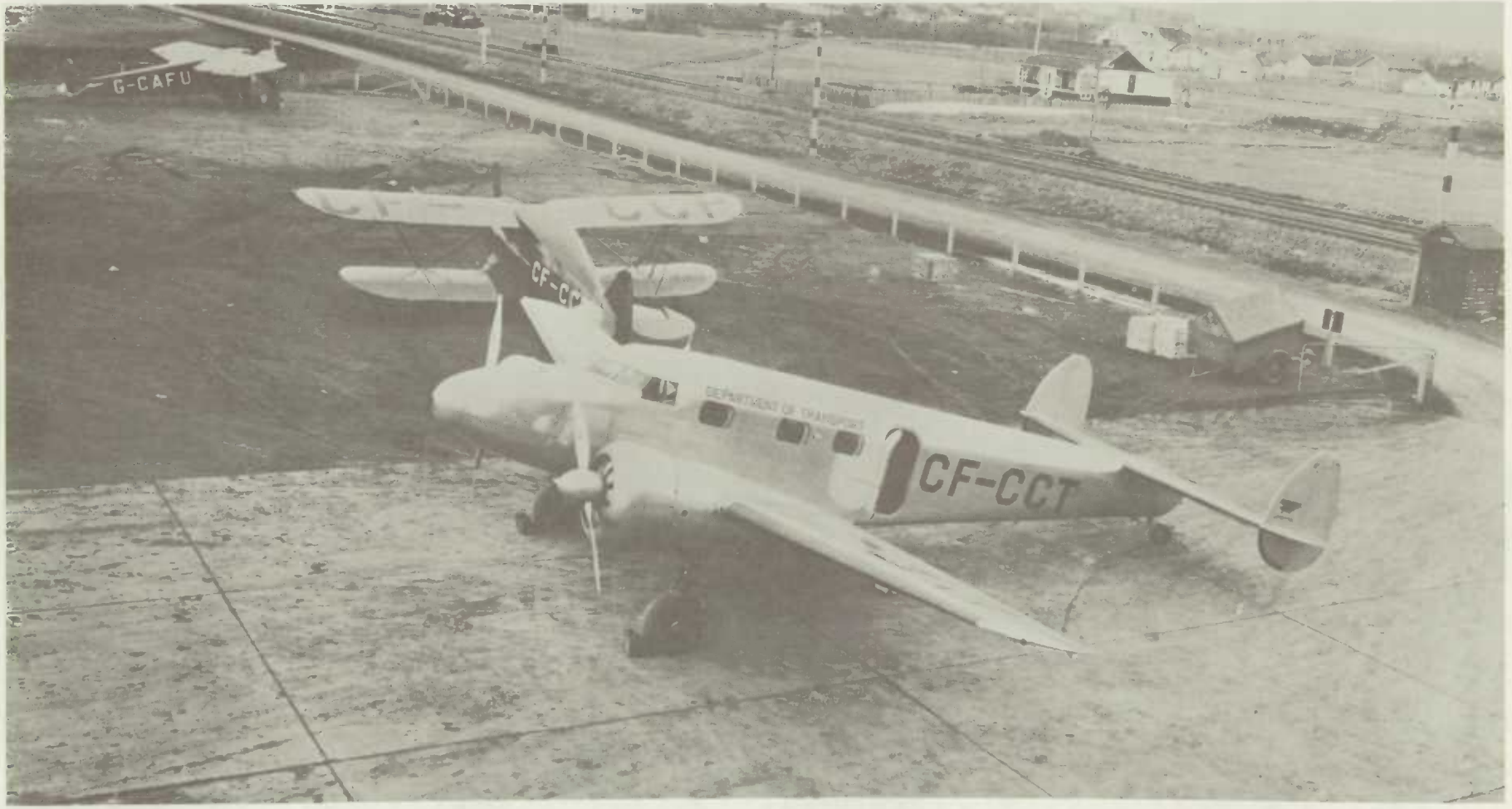
Although vastly outnumbered by the smaller aircraft operators, the seven scheduled air carriers are not only the most familiar "names" to the public, but also contribute about 85 percent of the total operating revenue acquired by the industry (Tables 6.13 and 6.14).

During the last decade, Air Canada has consistently flown more hours carrying more passengers and goods than all the other scheduled air carriers put together. Indeed, 1970 revenues of almost half a billion dollars from all services earned on its many domestic and international routes, comprise over half of the industry's total of $800 to $850 million. On the other hand, it has also had years since 1960 in which it lost more money than any other airline, with the exception of CP Air, interspersed with periods of prosperity — the years 1965-68, when profits after taxes averaged $4.7 million. Currently, Air Canada's high-revenue position is again being offset by the purchase of such aircraft as the stretched DC-8-60's and the Boeing 747's among other factors. The increase in total assets from a steady 1960-65 figure of about $270 million to over $700 million in 1970 indicates that the fleet of Viscounts, Vanguards, DC-8's, and DC-9's, which forms Air Canada's extensive operations, have made necessary a very heavy and probably continuing capital expenditure.

CP Air, Canada's other major international airline, has grown steadily during the decade as well — to a 1970 total of 75 thousand flying hours, one and a half million passengers, and $150 million in revenues, or to about eighteen percent of the industry's total. With the surge in international and transcontinental traffic experienced in the last half of the decade, CP Air, which operates regional services as well, has returned the highest ten-year profit of the seven scheduled operators. Similar to Air Canada, however, the company has felt the need to expand and modernize its aircraft fleet of Boeing 727's, 737's and DC-8's, a policy which is reflected in the declining income and sharply rising total assets over the period 1960 to 1970.

Approximately ten percent of all airline revenues are received by the five regional operators. In general, these companies began as post-war "bush" operators, developed through charter work into remote areas, and have, since their classification as regional carriers, tended to concentrate on scheduled services and to purchase larger jet aircraft appropriate for these operations.

Pacific Western Airlines (PWA), the largest of the group, was founded by bush pilot Russell Baker as Central British Columbia Airways Limited. From its 1946 beginnings, it expanded through contract work for the Kitimat dam, the Dew Line, and the McKenzie airlifts, among others. Today it flies bush operations out of Edmonton, international charter services from its Vancouver head office, and scheduled services between many points in western and north-western Canada including such shuttle-runs as Vancouver-Victoria and Calgary-Edmonton.



The first all-metal monoplane produced by Lockheed Aircraft Company was the model 10 Electra which could accomodate ten passengers. It was such a success that a smaller, six-passenger version, the 12A, was put into production and flown for the first time in 1935.

Now a part of the National Aeronautical Collection in Ottawa, this aircraft, the CF-CCT, was acquired by the Department of Transport in 1937. During its early life it was employed mostly for testing the newly developed trans-Canada airway system. On the 30th of July, 1937, it flew from Montreal to Vancouver, completing the first dawn-to-dusk transcontinental flight in Canada.

Photo curtesy of the Aviation and Spece Division, National Museum of Science and Technology.

Chapter VI

COMMERCIAL AIR SERVICES

The world's first aircraft passenger was Henri Farman, a French manufacturer who flew with Lion de la Grange in 1908. Although Canadian air passenger service took somewhat longer to develop, with the first modern passenger services appearing in the late 1920's, air transport had become a respectable and prosperous Canadian enterprise by the late 1950's. The rapid advance of aviation technology and administrative innovation over the last decade has significantly altered the structure and level of operations of Canada's commercial air carriers. Statistics compiled from Statistics Canada and Ministry of Transport reports for the past ten years serve to illustrate the growth and fluctuation in such indicators as financial position, operating statistics, and total assets (primarily fleet) for all the subdivisions of commercial aviation — domestic and foreign-based operations; domestic and international flights; scheduled and charter services; flag carriers, helicopter operations, specialty, and regional carriers.

In preparing the statistics, a system of "levels" for financial operations has been developed. Since this is a highly specialized classification and subject to periodic change, it will not be used in this chapter. However, as most of the Tables prepared use the system, Table 6.1 sets it out in some detail. All that need be noted here is that Air Canada and CP Air complete Level 1, the regional carriers (Pacific Western Airlines, Transair, Nordair, Quebecair, and Eastern Provincial Airlines), fill Level II, and all other operators are placed in Levels III to V according to their annual gross revenue.

Overall Trends in Financial and Operating Data

As Table 6.2 points out, the total number of carriers operating in Canada has sharply increased since 1960 — the number of Canadian carriers has risen from 292 to 547 in this period. The number of foreign-based carriers licensed to fly into Canada but not between points in Canada, has also risen steeply — from 197 to 365 in the same period.

Tables 6.3 to 6.6 illustrate the significant trends in financial and operating statistics of the major Canadian commercial services over the 1960 to 1970 period.

Passengers carried, miles covered, and hours flown have all practically doubled, to 11.8 million, 217 million, and 1.3 million respectively, in 1970. Sharpest increases are noted during the period 1964 to 1968, with jumps of 81 million miles, 3.5 million passengers, and over half a million hours. Goods carriage has expanded even more sharpely, approximately two and one-half times in the decade — doubling to 305,000 tons in the last five years alone.

Airlines have extended their flight and ground operating staffs over the period, from 19,000 in 1964 to 29,500 in 1970. Salaries have increased more than proportionately — from $130 million to $283.5 million.

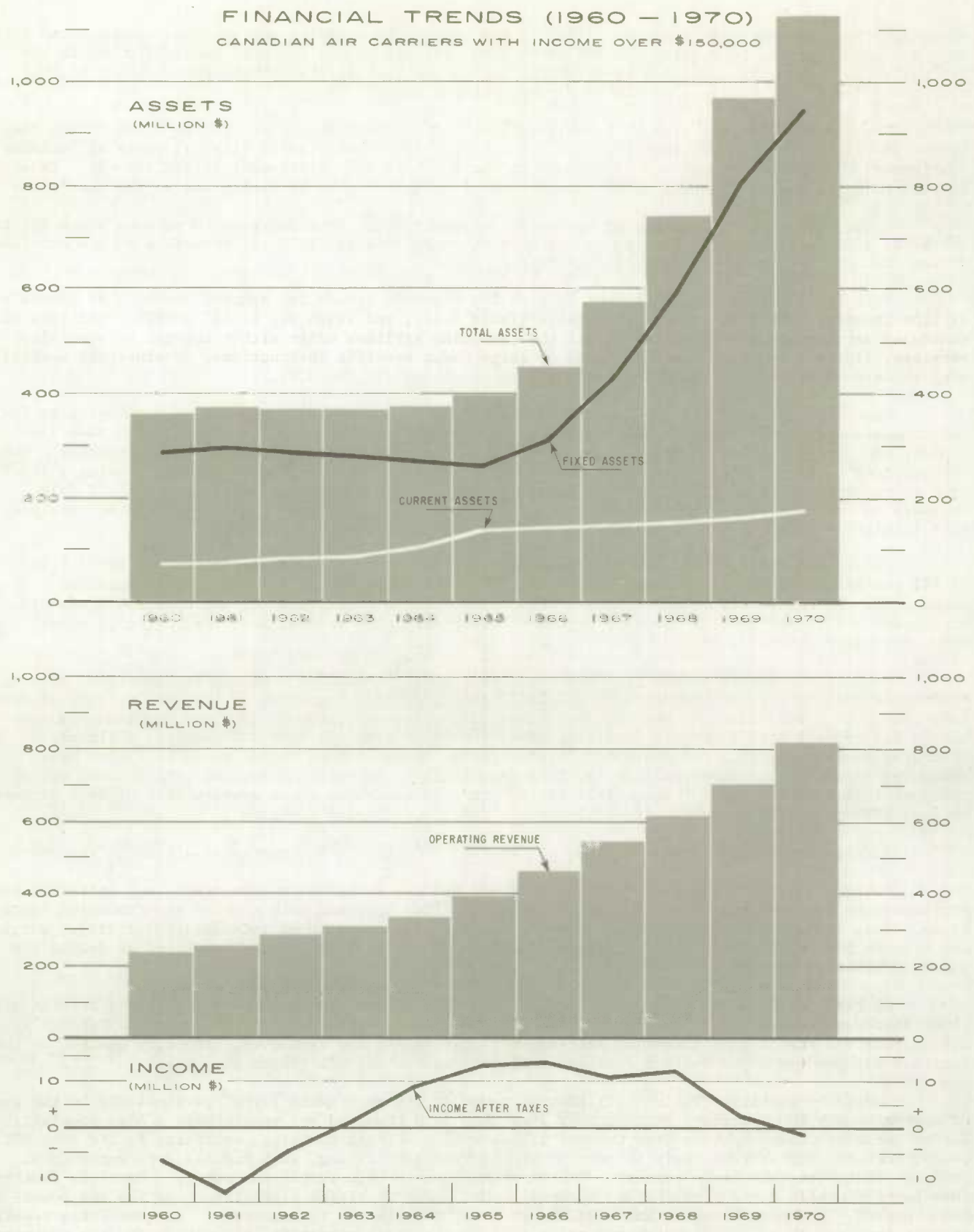
Operating figures reflect this upswing in activity (Figure 6.1). Revenue has increased by a factor of three and one-half during the decade to a 1970 total of over $800 million, with operating profit rising from a deficit position in the early 1960's to an average $3.6 million surplus during the five years 1966-70. Net income after taxes, however, following a 1966 high of $16 million, currently threatens to return to its earlier deficit position — 1970 combined profits for all 122 firms was only $1.3 million, and numerous large and small operators fell into the red.

The combination of high operating revenue and low profit can partially be attributed to the high costs of replacing obsolete aircraft in the last few years. Examination of the airlines' balance sheets (Table 6.4) shows the high debt position (almost $300 million in long-term loans and current notes in 1969 compared to only $43 million as recently as 1963), and the large value of fixed assets (over one billion dollars before depreciation in 1969, from $400 million in 1963) of Canada's operators.

Two trends demonstrative of this rapid turnover in capital equipment are those with respect to load factors and fuel consumption. In the first place, between 1966 and 1970, passenger load factors for Canadian scheduled services fell from 63 to 56 percent, and cargo load factors from 52 to 46 per cent; since totals transported in both sectors have risen over the period, total available space (that is, the number and capacity of aircraft) rose even faster. Secondly, while consumption of turbo (jet) fuel has jumped by a factor of 3.5 (to 500 million gallons annually) in the period of 1961 to 1970, over the same time span consumption of regular gasoline (piston-engine fuel) has actually declined by almost two thirds. This reflects the replacement on scheduled routes generally, of piston powerplant aircraft by turbo props in the first half of the decade, and by pure jets in the latter half.

In Canada, the operations of commercial services are not constant throughout the year. This might be expected in a country with great differences between winter and summer climates, and indeed much of the variation can be traced to the fluctuations in Canadian weather. Generally speaking,

FIGURE 6.1



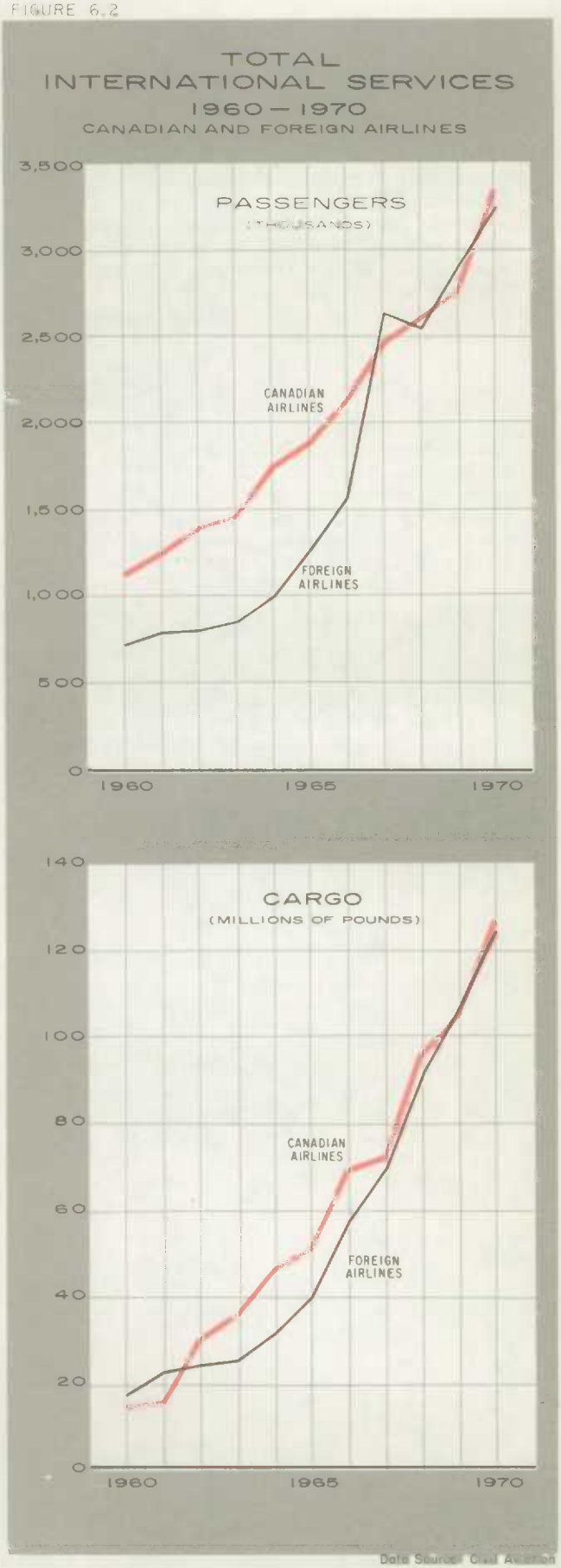
Data Source: Civil Aviation

Characteristic of the regional carriers, PWA's relatively short flights prohibit the use of larger jets which are economical to fly only on longer routes due to high operating costs involved in takeoff and landing. The company, therefore, maintains a sizeable fleet of short and medium-range aircraft — Boeing 737's, Convairs, Electras, DC-3's, 4's and 6's, Grummans, and Nords most of which are easily convertible from passenger to cargo service, and one Boeing 707 for its international charters. Over the decade its growth in passenger traffic has been four-fold — to 250,000 in 1970 — while cargo traffic has risen from three thousand tons in 1960, to 46,000 in 1970, placing it second only to Air Canada in the transport of goods. In terms of international charter revenue, PWA in third only to Wardair and Air Canada. Despite the fact that its program of building a jet fleet has drawn heavily on its profits, the airline has had fewer deficit years than any other regional carrier, generally sharing in the economic "boom" of Western Canada.

Transair, the regional air carrier for the Prairies and the central Arctic, began in 1947 as Central Northern Airways, and developed through a 1955 merger with Arctic Wings Limited. In 1969 it bought out Midwest Air Lines and is currently in the process of amalgamation. The joint company owns considerable medium-range jet aircraft including two 737's, six Hawker-Siddeley models, one Viscount, and two Japanese Nihon YS-11's, but operates many more piston aircraft ranging from Pipers to DC-6's in addition to fifteen helicopters. Originally engaged in numerous types of flying, Transair has closed out most of its unprofitable bush and international charter services since 1965, concentrating on its scheduled Prairie services, and on its contracts as chief carrier for the Canadian section of the Dew Line. Expansions in both passenger and cargo transport have generally been consistent, but revenues have not risen fast enough to cover the costs of the expensive, short "milk runs".

Nordair is the newest of the five regional carriers, founded in 1957 with the merger of Mont Laurier Aviation of Roberval, and Boreal Air Services of St. Felicien, Quebec. Augmented in 1960 with the acquisition of certain Arctic routes and some holdings of Wheeler Airlines, Nordair was recognized as a regional carrier in 1969. Nordair operates scheduled services from Montreal to Frobisher, Resolute, and Hall Beach in the high Arctic, grossed $3 million in 1970 for international charters to Europe, the United States, the Caribbean, and South America, and supplies the northern sector of the Dew Line from Greenland to Alaska, in addition to undertaking considerable oceanic

FIGURE 6.2



and geological aerial surveys. It has a reputation for inventiveness in its equipment — its 737's are specially built for landing on gravel or unimproved bush runways, and the DC-3's are often ski-equipped for snow landings.

Quebecair, the result of a 1953 merger between Rimouski Airlines and Gulf Aviation, serves a large number of points in the St. Lawrence Valley and Gulf of St. Lawrence regions, including routes connecting Montreal, Chicoutimi, Gaspé, Quebec City, Sept-Isles, Northern New Brunswick, and southern Labrador. The company is known for its aggressive acquisition of aviation firms, having absorbed Northern Wings, Northern Wings Helicopters and Matane Air Services since 1960. Quebecair maintains its own two-story terminal at Montreal and was the first regional airline to offer jet services. In addition to the 1958 turbo-props — Fairchild F-27's — its fleet includes BAC III's, a Curtis C-46, and a Douglas DC-3. Like Eastern Provincial Airways which also operates in the Maritimes/Eastern Quebec region, its growth in terms of passengers and cargo transportation has been slow compared to the other scheduled operators.

Eastern Provincial Airways (EPA), based in Gander, Newfoundland, serves the five Atlantic provinces including Quebec with all forms of scheduled, bush, and contract services. Founded in 1949, EPA grew through such activities as supply and construction transportation for the Pine Tree Line and Mid-Canada Corridor radar defense lines, exploration of the rich inaccessible Labrador interior leading up to the Churchill Falls and related projects, and both ice patrols and photographic survey of Greenland for the Danish government. In 1963 it absorbed Maritime Central Airways, another old and major firm. EPA has recently gone through considerable purchase of new equipment under a pooling agreement with Nordair, and currently manages a fleet of Boeing 737's, Heralds, many STOL aircraft and helicopters, DC-3's and Beechcraft. Its relatively short routes, however, combined with the necessity of maintaining thirty ground radio stations for navigation and communication, have retarded much growth in operating revenues.

As shown by Table 6.15, the scheduled carriers, which provide by far the largest portion of the industry's total operating revenues, have experienced a fairly steady growth over the last decade. Other air carriers which supply a total of 15 percent of the operating revenues, experience slow increases in the period 1960-64, but have since expanded threefold during the 1964 to 1970 period, outstripping the scheduled carriers (two-and-a-half-fold over the same time span). This is in accord with the upsurge in non-scheduled commercial aircraft movements noted in Chapter IV.

Overall, the statistical material displayed in this chapter points out the continued, rapid expansion in most sectors of the commercial aviation industry. With this foundation, future growth projections can be extrapolated with considerably greater accuracy.

TABLE 6.1. Financial Classification of Canadian Commercial Aircraft Operators

Level I Air Canada and CP Air.

Level II Regional Air Carriers (Eastern Provincial Airways, Nordair, Quebecair, Pacific Western Airlines, and Transair).

Level III Canadian Air Carriers (excluding those in Levels I and II) with either: (a) UNIT-TOLL Revenues of $150,000 (or over) per annum; or (b) UNIT-TOLL and CHARTER/CONTRACT (excluding specialty flying) revenues of $500,000 (or over) per annum;
From 1960-68 condition (a) was excluded, and from 1960-63 the ceiling with regard to condition (b) was $400,000.

Level IV Canadian Air Carriers (excluding those in Levels I, II, and III) with annual gross flying revenues of $150,000 (or over) per annum:
From 1964-68 the ceiling was $100,000 per year; from 1960-63 gross flying revenues were $60,000 or over; during this period carriers with unit-toll revenues of less than $60,000 per year were also classified in this Level.

Level V Canadian Air Carriers with gross flying revenues of less than $150,000;
from 1964-68 the ceiling was $100,000; from 1960-63 — $60,000.

Note: Many of the statistics presented in the following financial tables pertain only to Levels I to IV, due to a different reporting procedure used for Level V. This is not a serious lapse since Level V carriers account for less than 3 % of the total operating revenues of Canadian commercial services.
Source: Air Transport Committee of the CTC.

The following table will give an idea of the data-base for all following tables:

Year	Number at domestic Levels(1)					Total domestic carriers reporting	USA carriers	Other foreign carriers	Total foreign carriers reporting
	1	2	3	4	5				
1960	2	6	15	63	203	289	10	8	18
1965	2	4	19	60	278	363	10	10	20
1966	2	4	25	66	302	399	10	11	21
1967	2	4	31	76	275	388	11	11	22
1968	2	4	29	88	325	448	11	11	22
1969	2	4	36	77	304	423	11	12	23
1970	2	5(2)	40	75	340	462	10	14	24

(1) In 1968 the financial qualifications were raised at each Level in accord with higher operating costs brought about by cumulative inflation.
(2) Nordair Ltée, which is classified as Level II by the Air Transport Committee, has been included in Level III up to 1969, for statistical purposes.

TABLE 6.2. Number of Canadian and Foreign Operators Licensed to Operate in Canada, 1957-70

Year	Operators licensed		
	Canadian	Foreign	Totals
1957	225	150	375
1958	239	162	401
1959	277	175	452
1960	292	197	489
1961	331	224	565
1962	384	251	635
1963	411	262	673
1964	410	261	671
1965	401	275	676
1966	395	269	644
1967	403	311	714
1968	437	355	792
1969	454	390	844
1970	547	365	912

Sources: DOT Annual Reports, 1957-69; Directory of Canadian Commercial Air Services, CTC, August, 1970.

TABLE 6.3. Selected Operating Statistics of Canadian Air Carriers Group I to IV, 1960-70

		1970(1)	1969	1968	1967	1966	1965
Number of airlines reporting			119	123	113	97	85
Financial							
Operating revenue	$'000,000	821.8	701.2	616.4	543.6	460.7	392.8
Operating expenses	"	787.0	667.3	576.5	516.1	431.4	368.2
Operating income (loss)	"	34.8	33.8	39.8	27.5	39.3	24.6
Net income	"	1.3	2.5	11.9	11.1	13.9	13.2
Other:							
Revenue: operations all services							
Miles flown	$'000,000	217.3	199.3	181.5	160.5	135.1	117.2
Passengers carried	"	11.8	10.3	9.3	8.9	7.5	6.6
Passenger-miles	"	11.6	9,477.2	8,169.6	7,327.2	5,983.3	5,196.1
Goods ton-miles	"	341.8	315.6	226.1	170.1	147.9	123.5
Hours flown	'000	1,252.6	1,196.3	1,158.4	1,125.0	940.4	781.8
Cargo carried	'000 tons	270.6	244.0	194.2	155.7	154.0	128.0
Goods carried	"	305.2	276.2	224.3	183.4	178.6	153.2
*Passenger load factor		56.0	55.0	55.6	62.2	62.5	–
*Weight load factor		45.9	46.7	47.5	48.3	52.4	52.1
Fuel consumed							
Turbo fuel	qty. '000,000 gal.	490.9	417.5	366.3	316.5	262.5	222.3
Turbo fuel	cost $'000,000	78.8	66.9	52.9	42.2	35.8	30.7
Gasoline	qty. '000,000 gal.	19.3	25.9	31.3	31.9	30.5	27.0
Gasoline	cost $'000,000	8.6	11.1	12.1	12.0	111.2	9.9
Totals turbo fuel and gasoline	qty. '000,000 gal.	510.2	443.4	397.6	348.4	323.0	249.3
Employers							
Pilots and co-pilots	'000	3.1	3.1	2.9	2.6	2.2	1.8
Pilots and co-pilots	$'000,000	51.8	45.9	39.9	33.6	27.2	22.7
Totals employees	'000	29.5	28.6	26.6	24.7	21.4	19.0
Totals employees	$'000,000	283.1	245.4	214.6	186.9	151.1	129.8

See footnote(s) at end of table.

TABLE 6.3. Selected Operating Statistics of Canadian Air Carriers Groups I to IV, 1960-70 — Concluded

		1964	1963	1962	1961	1960
Number of airlines reporting		74	95	89	86	83
Financial						
Operating revenue	$'000,000	334.9	308.8	284.6	254.9	236.0
Operating expenses	"	315.6	294.1	277.3	257.4	237.7
Operating income (loss).....	"	19.4	14.7	7.3	Dr. 2.6	Dr. 1.7
Net income	"	8.4	1.4	Dr. 4.6	Dr. 13.1	Dr. 6.5
Other						
Revenue: operations all services						
Miles flown	$'000,000	103.5	102.6	99.3	97.6	104.2
Passengers carried	"	5.8	5.4	5.3	5.0	4.7
Passenger-miles	"	4,408.9	—	—	—	—
Goods ton-miles	"	105.8	—	—	—	—
Hours flown	'000	661.6	630.6	626.3	631.4	694.9
Cargo carried	'000 tons	111.8	104.6	98.4	96.2	101.2
Goods carried	"	135.2	125.5	118.3	114.0	119.0
*Passenger load factor		—	—	—	—	—
*Weight load factor		51.7	—	—	—	—
Fuel consumed						
Turbo fuel	qty. '000,000 gal.	195.3	187.2	171.1	143.8	83.1
Turbo fuel	cost $'000,000	27.7	27.4	24.6	20.1	12.2
Gasoline	qty. '000,000 gal.	22.7	20.2	20.3	31.4	56.3
Gasoline	cost $'000,000	8.5	7.5	7.4	10.9	17.7
Totals turbo fuel and gasoline	qty. '000,000 gal.	218.0	214.4	191.4	175.2	139.4
Employers						
Pilots and co-pilots	'000	1.6	—	—	—	—
Pilots and co-pilots	$'000,000	19.8	—	—	—	—
Totals employees	'000	17.8	17.6	17.8	17.7	17.1
Totals employees	$'000,000	116.5	108.5	105.6	102.2	95.7

(1) Preliminary figures.
* Scheduled services only.
Dr. Indicates debit.
Sources: Air Carrier Operations, Statistics Canada, 1970; Civil Aviation, Statistics Canada, 1960-69.

TABLE 6.4. Statistical Summary of Level V Operations, 1960-70

		Quantity by year										
		1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960
Revenue passengers	'000	272	231	216	218	225	223	213	172	157	151	102
Revenue goods	'000,000 lb.	—	22	15	15	16	24	17	12	10	10	7
Revenue hours flown:												
Unit-toll and bulk ...	'000	127	120	100	112	106	111	119	81	76	70	58
Specialty	"	225	296	330	295	269	191	137	121	103	109	92
Totals	'000	352	416	430	407	375	302	251	202	179	179	150
Operating revenues	$'000,000	—	20	18	16	18	15	12	10	8	9	7
Net income after taxes	$'000	—	367	— 46	417	2,345	168	— 21	— 249	— 518	— 311	— 165

Sources: Air Carrier Operations, Statistics Canada, 1970; Civil Aviation, Statistics Canada, 1960-69.

TABLE 6.5. Balance Sheet, Canadian Airlines Groups I-IV, as at December 1st, 1960-69

	1969	1968	1967	1966	1965
Assets	thousands of dollars				
Current assets:					
Cash and special deposits	17,402	20,322	37,357	50,142	57,434
Notes and accounts receivable	96,772	83,636	71,021	53,616	51,340
less: reserves for uncollectible accounts	2,309	2,141	2,072	1,773	1,497
Materials and supplies	38,210	34,157	28,128	27,743	24,845
Short term prepayments	7,369	6,841	3,512	3,853	2,413
Other current assets	2,591	5,129	2,934	4,203	1,221
Totals current assets	160,035	147,944	140,880	137,785	135,756
Fixed assets:					
Investments and special funds	32,080	37,361	28,176	27,444	17,783
Property and equipment:					
Operating	1,071,508	819,019	654,820	500,694	417,644
less: accumulated depreciation	320,773	276,537	259,547	220,613	178,780
Non-operating	8,579	24,305	2,285	1,583	5,439
less: accumulated depreciation	6,564	22,569	562	381	3,135
Totals fixed assets	752,750	544,217	396,996	281,283	241,157
Other assets – deferred charges:					
Long term prepayments	15,686	7,407	1,242	251	269
Other deferred charges	7,614	5,314	3,587	2,679	2,480
Totals other assets	23,300	12,721	4,830	2,930	2,749
Totals asset	968,165	742,244	570,882	449,442	397,446

	1964	1963	1962	1961	1960
Assets					
Current assets:					
Cash and special deposits	23,656	16,003	10,921	4,706	10,105
Notes and accounts receivable	46,882	38,715	34,662	33,676	32,991
less: reserves for uncollectible accounts	1,203	800	805	532	465
Materials and supplies	25,242	28,131	31,179	30,868	23,265
Short term prepayments	2,376	2,099	2,219	1,989	1,816
Other current assets	4,012	754	562	701	746
Totals current assets	100,964	84,902	78,738	71,408	68,458
Fixed assets:					
Investments and special funds	12,657	14,017	15,354	15,604	11,500
Property and equipment:					
Operating	403,472	383,668	374,296	368,598	353,466
less: accumulated depreciation	149,560	125,618	111,621	100,744	105,559
Non-operating	903	736	5,771	11,356	3,480
less: accumulated depreciation	493	5,452	4,775	9,163	3,425
Totals fixed assets	254,321	259,961	263,671	270,046	247,962
Other assets – deferred charges:					
Long term prepayments	277	191	76	7,086	4,985
Other deferred charges	2,845	4,660	5,979	2,108	3,145
Totals other assets	3,123	4,851	6,055	9,194	7,130
Totals asset	371,065	363,731	363,818	366,252	335,050

TABLE 6.5. Balance Sheet, Canadian Airlines Groups I-IV, as at December 31st, 1960-69 — Concluded

	1969	1968	1967	1966	1965
Liabilities and other equities	thousands of dollars				
Current liabilities:					
Notes and accounts payable	105,353	49,773	59,442	50,924	45,898
Current portion of long term debt	19,120	7,001	5,702	4,178	2,643
Accrued taxes	6,546	6,046	5,086	4,473	950
Other current and accrued liabilities	57,010	81,114	39,326	32,501	25,596
Totals current liabilities	188,029	143,935	109,557	92,076	75,087
Non-current liabilities:					
Long term debt	194,846	74,401	44,057	28,261	15,626
Other non-current liabilities	441,969	395,868	314,357	241,310	241,795
Totals	636,815	470,269	358,414	269,571	257,422
Deferred credits	24,929	19,066	8,682	4,088	819
Reserves	14,878	16,627	9,690	12,690	7,269
Capital stock and retained earnings stock issued and outstanding:					
Preferred	22,001	21,238	22,152	19,338	17,423
Common	34,208	31,365	29,045	26,416	26,691
Other paid-in capital	3,971	2,479	1,578	1,436	1,132
Retained earnings	43,334	37,265	31,764	23,827	11,604
Totals stockholders equity	103,514	92,346	84,539	71,017	56,851
Totals liabilities	968,165	742,244	570,882	449,442	397,446
	1964	1963	1962	1961	1960
Liabilities and other equities					
Current liabilities:					
Notes and accounts payable	37,696	28,051	30,286	40,503	30,767
Current portion of long term debt	2,492	2,955	2,029	2,107	3,109
Accrued taxes	498	851	474	495	832
Other current and accrued liabilities	18,943	15,818	16,713	13,406	12,157
Totals current liabilities	59,630	47,676	49,502	56,511	46,866
Non-current liabilities:					
Long term debt	16,400	15,821	13,529	13,624	12,756
Other non-current liabilities	246,120	257,910	259,980	250,622	244,906
Totals	262,521	273,731	273,508	264,246	237,662
Deferred credits	414	614	322	282	475
Reserves	5,839	8,536	11,091	14,718	14,250
Capital stock and retained earnings stock issued and outstanding:					
Preferred	16,683	17,065	13,969	13,669	13,174
Common	24,954	22,114	22,118	21,466	21,110
Other paid-in capital	1,818	1,148	1,568	1,273	725
Retained earnings	794	Dr. 7,153	Dr. 8,261	Dr. 5,914	787
Totals stockholders equity	42,661	33,174	29,394	30,494	35,796
Totals liabilities	371,065	363,731	363,818	366,252	335,050

Source: Civil Aviation, Statistics Canada, 1960-69.

TABLE 6.6. Average Number of Employees, and Salaries and Wages Paid Levels I to IV and Foreign Air Carriers, 1964-70

Category	1970	1969	1968	1967	1966	1965	1964
	average number of employees						
CANADIAN AIRLINES							
Pilots and co-pilots	3,058	3,113	2,934	2,648	2,191	1,831	1,609
Other flight personnel	2,868	2,625	2,315	2,016	1,563	1,271	1,117
General management	958	857	765	692	599	545	508
Maintenance labour	6,561	6,027	5,877	5,298	4,895	4,489	4,255
Aircraft and traffic servicing	9,406	8,904	8,152	7,682	6,448	5,614	5,258
Other personnel	7,843	7,099	6,507	6,350	5,744	5,257	5,010
Totals	30,694	28,625	26,550	24,686	21,440	19,007	17,757
US AIRLINES							
Totals	632	663	646	544	327	281	239
OTHER FOREIGN AIRLINES							
Totals	841	818	798	776	711	693	733
GRAND TOTALS	32,167	30,106	27,994	26,006	22,478	19,981	18,729
	salaries and wages paid $'000						
CANADIAN AIRLINES							
Pilots and co-pilots	51,766	45,937	39,928	33,556	27,176	22,731	19,825
Other flight personnel	22,321	17,778	15,201	12,055	8,799	7,352	6,278
General management	13,002	10,917	9,306	7,751	6,279	5,428	4,903
Maintenance labour	66,165	49,062	45,306	38,969	32,182	28,980	25,759
Aircraft and traffic servicing	82,330	65,217	56,019	49,807	39,316	33,137	30,262
Other personnel	65,145	56,522	48,882	44,763	37,385	32,119	29,408
Totals	300,729	245,434	214,643	186,902	151,138	129,748	116,435
US AIRLINES							
Totals	5,942	5,422	4,766	3,860	3,642	1,905	1,553
OTHER FOREIGN AIRLINES							
Totals	7,145	6,981	6,004	5,435	4,660	4,220	4,234
GRAND TOTALS	313,816	257,747	225,412	196,197	159,440	135,873	122,268

Sources: Civil Aviation, Statistics Canada, 1963-69; Air Carrier Operations, Statistics Canada, 1970.

TABLE 6.7. Fleets of Major Canadian Air Carriers, 1971

Aircraft	Number by air carrier								
	Air Canada	CP Air	Nord-air	Trans-air and Midwest	Quebec-air	Eastern Provincial	Pacific Western	Okanagan Helicopters	Wardair
Beech 18				1		1			
Boeing — 707							1		2
727		3							1
737		7	3	2		3	4		
747	2								
Bristol 170									2
BAC 111					3				
Catalina (PBY-5)				4					
Cessna				1		1			
Convair							4		
Curtiss (46)			3		1				
De Havilland Otter (DHC3)									2
Twin Otter (DHC6)			1	2		1			2
Douglas — DC 3		1	5	5	1	5	2		
DC 4			1	1		3	3		
DC 6				1			3		
DC 8	38	11							
DC 9	36								
Fairchild F27					4				
Grumman				3			2		
Hawker Siddeley AWK — 650				2					
748				4					
Herald						3			
Lockheed Electra							5		
Nihon YS-11				2					
Nord							4		
Piper				6					
Short Skyvan			1						
Vicker — Vanguard	12								
Viscount	31			1					
Bell				15				26	
Hiller								6	
Sikorsky								4	

Note: Aircraft listed here are only those with valid certificate of airworthiness at time of compilation and may not comprise entire airline fleet.
Source: Aircraft fleet Record, MOT, April, 1971.

TABLE 6.8. Number of Passengers and Pounds of Goods Carried on International Services of Domestic and Foreign Carriers, 1969-70

Year	Passengers carried		Goods carried	
	Domestic-operators-foreign		Domestic-operators-foreign	
			pounds	
1960	1,119,683	712,706	14,465,630	16,783,286
1961	1,238,671	789,680	15,935,233	21,991,694
1962	1,385,921	795,175	30,245,887	23,541,980
1963	1,443,725	850,954	35,514,612	24,841,141
1964	1,739,280	994,653	46,058,272	31,068,617
1965	1,876,446	1,268,090	50,722,617	39,784,137
1966	2,118,762	1,562,004	69,115,523	57,143,039
1967	2,469,905	2,648,252	71,880,417	69,215,552
1968	2,597,097	2,552,223	95,307,984	91,277,330
1969	2,742,423	2,911,294	104,486,148	105,801,368
1970	3,332,308	3,272,387	126,798,688	124,028,016

Sources: Civil Aviation, Statistics Canada, 1960-69; Air Carrier Operations, Statistics Canada, 1970; Aviation Statistics Centre files.

TABLE 6.9. Passengers on International Flights by Quarter in 1970

Services	Number of passengers by quarter				
	First	Second	Third	Fourth	Total
Scheduled services					
Canadian carriers	755,219	695,877	844,422	546,283	2,841,801
Foreign carriers	613,060	741,930	905,446	639,957	2,918,393
Sub-totals	1,386,279	1,437,807	1,749,868	1,186,240	5,760,194
Charter services					
Canadian scheduled carriers	16,691	55,331	94,972	16,272	183,266
Canadian non-scheduled carriers	51,768	77,672	119,856	57,945	307,241
Foreign carriers	22,241	74,049	228,426	29,278	353,994
Sub-totals	90,700	207,052	443,254	103,495	844,501
Totals Canadian carriers	823,678	828,880	1,059,250	620,500	3,332,308
Totals foreign carriers	653,301	815,979	1,133,872	669,235	3,272,387
GRAND TOTALS	1,476,979	1,644,859	2,193,122	1,289,735	6,604,695

Source: International Air Charter Statistics, Statistics Canada, 1970.

TABLE 6.10. Foreign Airlines Licensed to Operate Scheduled Services in Canada, 1971

Airline	Nationality(1)	Services at Canadian airports						
		Calgary	Whitehorse	Montreal	Ottawa	Toronto	Vancouver	Winnipeg
Aerlinte (Irish Airways)	F			x				
Aeroflot (Soviet Union)	F			x				
Aeronaves de Mexico	F			x		x		
Air France	F			x				
Alitalia	F			x				
Allegheny Airlines	US					x		
American Airlines	US					x		
BOAC	F			x		x		
BWI (West Indies)	F					x		
Czechoslovak Airlines (CSA)	F			x				
Eastern Airlines	US			x	x	x		
El Al (Israel)	F			x				
Iberia Airlines (Spain)	F			x				
Japan Airlines	F						x	
KLM (Dutch)	F			x				
Lufthansa (German)	F			x				
Mohawk Airlines	US			x		x		
North Central	US					x		
Northeast Airlines	US			x				
Northwest Airlines	US							x
Olympic Airways	F			x				
Qantas (Australia)	F						x	
Sabena (Belgium)	F			x				
SAS (Scandinavia)	F			x				
Swissair	F			x				
TAP (Portugal)	F			x				
United Airlines	US					x	x	
Wein Consolidated	US		x					
Western Airlines	US	x					x	
Hughes Air West	US	x						

(1) F: foreign origin; US: United States. Source: Aviation Statistics Centre files.

TABLE 6.11. Number of Specialty Flying Hours flown by Canadian Carriers (Levels I-IV) by Type of Service, 1960-70

Operation	Flying hours by year					
	1970	1969	1968	1967	1966	1965
Flight training	98,192	116,160	134,823	145,398	100,201	57,844
Recreation	12,794	17,630	18,000	19,244	16,049	16,273
Aerial survey	18,578	16,013	17,347	22,372	22,524	22,522
Scenic photography	1,346	2,905	1,064	867	572	2,064
Aerial inspection	36,336	37,140	33,996	30,060	21,638	21,951
Aerial distribution	1,637	6,146	3,633	5,667	6,473	3,167
Aerial control	4,682	6,298	4,886	8,346	1,476	618
Aerial construction	1,767	28	281	510	223	79
Aircraft rental	18,780	21,925	24,796	19,944	17,046	1,136
Other	–	5,403	5,183	3,286	1,425	824
Sub-totals	194,112	229,675	244,009	255,694	187,627	126,469
Totals including Level V(1)	419,000	525,000	574,000	550,000	479,000	317,000

	1964	1963	1962	1961	1960
Flight training	35,145	35,782	34,371	31,922	43,506
Recreation	12,238	12,678	10,909	9,598	7,180
Aerial survey	19,542	12,586	16,078	11,198	14,280
Scenic photography	2,972	1,603	663	922	1,606
Aerial inspection	18,587	14,068	14,214	14,629	11,643
Aerial distribution	5,519	2,558	4,265	4,733	2,069
Aerial control	–	–	–	–	–
Aerial construction	–	–	–	–	–
Aircraft rental	858	415	–	–	–
Other	2,078	2,840	2,882	2,806	775
Sub-totals	96,939	82,530	83,382	75,808	81,059
Totals including Level V(1)	234,000	204,000	186,000	185,000	173,000

(1) Nearest thousand hours.

Sources: Civil Aviation, Statistics Canada, 1960-69; Air Carrier Operations, Statistics Canada, 1970.

TABLE 6.12. Canadian Helicopter Operations, 1960-70, Selected Indicators

Year	Carriers reporting	Number of helicopters	Revenue hours flown	Operating revenues	Net income	Total assets
1960	–	102	44,388	5,807,399	451,113	6,533,775
1961	–	109	48,763	6,492,312	280,586	6,971,240
1962	–	117	49,078	6,713,045	283,401	6,755,299
1963	16	136	53,350	6,119,506	518,473	6,937,629
1964	21	175	78,527	7,570,070	847,100	10,143,995
1965	22	203	107,663	11,724,261	1,050,816	12,617,523
1966	27	243	129,039	14,702,053	1,450,959	14,391,122
1967	32	261	140,042	17,125,844	1,306,026	18,717,697
1968	31	309	148,950	19,976,613	1,550,905	22,722,894
1969	31	300	168,958	21,626,229	1,023,229	26,661,484
1970*	29	263	189,832(1)	29,795,049	2,537,744	–

(1) Levels I-V – all other figures Levels I-IV. * Preliminary data.
Sources: Civil Aviation, Statistics Canada, 1960-69; Air Carrier Operations, Statistics Canada, 1970.

TABLE 6.13. Operating Statistics, Canadian Scheduled Carriers – All Services, 1960-70

Indicator	Year	Airline						
		TCA/Air Canada	CPAL/CP Air	Eastern Provincial(1)	Pacific Western	Quebec-Air	Trans-air	Nord-air(2)
Revenue hours flown	1960	260,153	46,457	10,492	41,753	11,984	15,193	–
	1961	201,755	47,163	10,589	35,298	8,245	18,311	–
	1962	186,702	45,523	9,730	29,502	10,485	21,291	–
	1963	178,531	47,441	25,405	29,990	10,422	23,813	–
	1964	180,428	42,457	25,555	35,330	10,647	22,048	–
	1965	201,526	46,789	23,023	41,467	11,455	22,275	–
	1966	228,837	50,109	26,361	32,937	14,952	21,665	–
	1967	281,676	57,588	29,657	29,575	15,870	17,537	–
	1968	301,521	63,221	27,475	25,577	19,393	17,532	–
	1969	281,329	68,788	28,114	33,851	17,660	22,896	–
	1970	299,689	76,797	23,615	34,106	15,239	21,054	16,687
Revenue passengers carried	1960	3,433,155	343,382	61,169	149,167	119,617	48,526	–
	1961	3,705,179	380,919	64,587	140,897	108,910	55,956	–
	1962	3,856,041	461,761	62,016	146,939	102,777	65,930	–
	1963	3,943,839	498,245	120,024	158,600	105,756	79,670	–
	1964	4,166,453	541,014	133,698	224,106	106,875	75,901	–
	1965	4,733,670	630,816	103,738	280,426	121,280	85,022	–
	1966	5,270,484	738,857	120,560	339,525	168,664	116,348	–
	1967	6,379,870	885,275	131,480	401,207	185,481	118,937	–
	1968	6,440,686	1,036,341	136,377	427,135	189,264	134,135	–
	1969	6,527,843	1,374,739	159,798	701,255	210,828	179,804	–
	1970	7,398,224	1,453,235	256,694	866,454	223,864	261,206	143,860
Revenue goods carried '000 lb.	1960	70,287	6,922	18,607	5,957	6,796	46,104	–
	1961	70,887	8,033	16,881	14,372	4,491	11,080	–
	1962	85,580	6,651	13,553	16,863	3,940	13,605	–
	1963	95,184	10,114	14,557	18,950	3,680	13,001	–
	1964	115,404	12,904	12,543	18,825	2,889	11,851	–
	1965	140,602	16,725	11,384	29,566	3,334	10,880	–
	1966	168,477	21,374	13,662	27,998	5,102	11,107	–
	1967	117,985	23,833	14,694	23,313	4,135	8,220	–
	1968	216,062	31,070	14,705	30,830	5,541	8,874	–
	1969	217,638	38,256	14,590	60,227	48,639	19,097	–
	1970	265,612	43,464	15,197	92,787	6,762	19,276	22,803

(1) Maritime Central Airways before 1963. (2) Classified as Level III until 1970.
Sources: Civil Aviation, Statistics Canada, 1960-69; Transcontinental and Regional Air Carriers, Statistics Canada, 1970.

TABLE 6.14. Revenue, Income and Assets – Canadian Scheduled Carriers – All Services, 1960-70

Indicator	Year	By airline						
		TCA/Air Canada	CPAL/CP Air	Eastern Provincial(1)	Pacific Western	Quebecair	Transair	Nordair(2)
Operating revenue .... $'000	1960	148,987	36,152	3,245	8,628	3,603	2,861	–
	1961	165,436	38,301	2,987	6,781	3,254	4,202	–
	1962	183,473	48,642	2,660	5,942	3,697	5,238	–
	1963	199,390	56,141	5,647	6,291	3,654	5,645	–
	1964	213,910	61,493	5,755	8,870	3,679	5,039	–
	1965	250,126	72,177	5,307	11,537	4,119	5,054	–
	1966	289,943	83,160	6,311	12,256	5,399	6,011	–
	1967	345,611	95,770	7,513	14,933	5,499	5,736	–
	1968	387,628	106,698	9,147	17,618	6,277	6,254	–
	1969	404,652	133,717	11,405	31,574	8,534	8,501	–
	1970	478,259	149,583	12,733	40,605	8,867	11,483	12,718
Net income after taxes $'000	1960	– 2,607	– 4,824	466	– 412	– 146	45	–
	1961	– 6,450	– 7,612	248	10	– 923	110	–
	1962	– 3,541	– 1,198	– 193	– 317	130	193	–
	1963	528	347	– 1,094	115	– 46	197	–
	1964	1,406	4,819	– 309	331	151	180	–
	1965	3,990	7,184	– 690	601	– 153	233	–
	1966	2,910	8,525	– 383	1,425	– 770	– 257	–
	1967	3,547	3,395	– 611	642	– 585	– 187	–
	1968	8,184	2,375	76	285	– 630	– 652	–
	1969	1,548	3,495	– 350	562	– 970	– 2,057	777
	1970	– 1,072	1,003	– 419	– 217	– 895	– 56	579
Total assets ..... $'000	1960	248,607	33,660	5,744	5,601	7,811	3,151	–
	1961	276,728	33,542	6,110	4,994	7,413	4,153	–
	1962	274,311	33,791	6,036	5,253	3,518	3,886	–
	1963	269,342	33,806	13,535	5,559	3,562	3,892	–
	1964	275,361	28,288	12,733	6,095	4,782	3,876	–
	1965	287,928	33,790	11,317	6,776	4,883	3,804	–
	1966	306,468	43,659	11,172	13,891	8,069	4,629	–
	1967	387,450	45,268	11,354	21,226	11,307	3,943	–
	1968	508,391	71,111	13,519	23,222	11,242	8,796	–
	1969	594,912	156,348	25,724	36,964	17,716	9,384	–
	1970	707,900	176,637	28,525	37,048	18,344	14,202	22,875

(1) Maritime Central Airways before 1963. (2) Classified as Level III until 1969.
Sources: Civil Aviation, Statistics Canada, 1960-69; Air Carrier Operations, Statistics Canada, 1970; assets from Air Carrier Financial Statements, Statistics Canada.

TABLE 6.15. Scheduled Air Carriers Operating Revenue, 1960-70

	Operating revenue		
	Scheduled carriers(1)	Other carriers	Total carriers
	millions of dollars		
1960	203.5	32.5	236.0
1961	221.0	33.9	254.9
1962	249.7	34.9	284.6
1963	276.8	32.0	308.8
1964	298.7	36.2	334.9
1965	348.3	44.5	392.8
1966	403.1	57.6	460.7
1967	475.1	68.5	543.6
1968	524.6	91.8	616.4
1969	598.4	102.0	702.7
1970(2)	714.2	107.6	821.8

(1) 1970 – preliminary figures. (2) Nordair, prior to 1970, was included in Group III carriers.
Sources: Civil Aviation, Statistics Canada, 1960-69; Transcontinental and Regional Air Carriers, Statistics Canada, 1970.

Chapter VII

AIRCRAFT TECHNOLOGY

Although Canadian aviators are famed more for their flying skills and creativeness than for the design and manufacture of aircraft, this country has made substantial contributions to aviation research and development, both in its pure scientific form, and in the application of theory to practice. In examining national trends in aircraft technology against the background of world development, a pertinent, if imprecise division can be made according to the areas of concentration — the early years (1909-19), bush flying (1920-38), commercial airliners (1939-56), and the jet age (1957 to the present).

Early Development

World development of the airplane was rapid before the First World War, possibly because there was so much to be improved. By 1914, the Wright Brother's unstreamlined and awkward-looking biplane was clearly outmoded by such British, French, and German designs as the Nieuport, Deperdussin and Ponnier monoplanes and the Dornier, Handley-Page, and SE-4 biplanes. Igor Sikorski, the Russian aviator who later invented the helicopter, had developed a four-engine passenger liner, which looked like a collision between a cable car and a barn roof, in 1913, and planes existed which could fly at 130 miles per hour, a respectable cruising speed for any present-day light plane.

This development was largely based on trial-and-error experimentations, for scientific research principles had not yet been applied on a large scale to aircraft design. A particular stumbling-block in the search for a higher-speed/engine-power ratio was the lack of streamlining — the early aircraft were inevitably cumbersome and festooned with struts, wires, and other air resistant protuberances. This improper designing restricted aircraft during WWI to speeds of about 150 miles per hour, despite the introduction of more efficient and reliable water-cooled engines with three times the power of pre-war models and a decreased tendancy to "seize" from overheating.

Canada, during this period, produced an aviation researcher whose name ranks with the most famous in the field. Wallace Rupert Turnbull, a man of considerable private means, a broad education in engineering, and a highly original mind, contributed theoretical and practical knowledge to many fields of flying. He built Canada's first wind tunnel at Rothesay, New Brunswick in 1902, and in 1906 published his first paper on aerodynamic stability in which he pioneered in the concepts of dihedral wing angles, "ground effect", and aerofoil construction, thus paving the way for the incorporation of aerofoils in the work of the Aerial Experiment Association. Turnbull's 1908 paper on airplane efficiency won the prized medal of the prestigious Aeronautical Society of Great Britain. His experimentation on many different forms of flight, from "flapping-wing" ornithopters, to helicopters, airscrews and paddle wheels, led him to the discovery that the efficiency of any device designed to produce "lift" increased as the amount of air disturbed went down. He subsequently concluded that the propeller was the best means of propulsion for the aircraft as it was then being designed. It is in this area that Turnbull made his most lasting contributions.

Turnbull's initial work on propellers during the years 1908-10 was concerned with the design of an efficient, rigid airscrew. Varying the "forward speed" of the "aircraft" in his wind tunnel, and the diameter and pitch of his propeller models, he produced designs with a very modern figure of eighty percent efficiency in thrust. However, he also noted that this figure could only be reached in level flight when the aircraft was moving at its cruising speed — the same propeller was much less efficient and useful at low landing and take-off velocities. During World War I, Turnbull decided on the practicality of a propeller in which the pitch could be altered mechanically during flight to compensate for changes in speed. On the basis of his subsequent design work he applied for a Canadian patent in 1919. Although his invention was not original — such propellers were being developed simultaneously in Great Britain and the United States — Turnbull's was one of the more significant contributions and with modifications, was the basis of a successful and useful production model developed in later years.

Across the country, other inventive and far-sighted aviators were likewise making developments. A western equivalent to Turnbull in practical accomplishment was Saskatchewan-born William Wallace Gibson who had made considerable money in mining and settled at Vancouver to pursue his hobby, flying. His production in 1909 of a 210-pound, 60 horsepower engine, and in 1910 of a twin-engine biplane whose propellers, by rotating in opposite directions, resulted in zero "torque" (or twist), are Canadian "firsts". Undoubtedly, his use of battery ignition was probably a world premier as well. Certainly the use of such a starting mechanism was absent for several decades after Gibson relinguished his hobby, years during which such methods as propeller-spinnings, crank-turning, air-pumping, and even shotgun-blasting were attempted and discarded as too difficult or too dangerous for putting an aircraft into motion.

While these personal experimentations in aircraft design were being conducted, other individuals were pursuing airplane manufacture and paving the way for the founding of Canada's aircraft industry during World War I.

Baldwin and McCurdy had formed the Canadian Aerodrome Company in the same year as the flight of the Silver Dart; nonetheless, despite the fact that the firm did manufacture several aircraft and even export some to the United States, the failure to gain federal support for the venture led to the company's early demise. Glenn Curtiss, another member of the original Aerial Experiment Association, was responsible for the formation of the Curtiss Aeroplane and Motor Company at Toronto in 1915, which was taken over the following year by the Imperial Munitions Board company, Canadian Aeroplanes Limited. This factory turned out more than 1,200 complete planes and the equivalent of 1,600 others in spare by the end of the war. Although it manufactured a few twin-engine machines, by far its most important product was a modification of the Curtiss JN-4 "Jenny" – the Canadian "Cannuck", which was used by barnstormers for many years after hostilities had ceased, and which served as the testing vehicle for the world's first aircraft skis.

At the end of the war, Canada's civil aircraft fleet consisted primarily of these JN-4 trainers – two-seated biplanes with a top speed of approximately eighty miles-per-hour and a range of 250 miles. In ensuing years, this fleet was augmented by numerous surplus war planes donated by the American and British governments in gratitude for Canada's wartime assistance. The Curtiss HS-2L flying boats remaining from the RCNAS operations with their powerful Liberty engines and crew capacity of four or five, were extensively used by the Government for mercy missions in isolated areas, for forest-fire patrols, and for customs searches – rum-running on the east coast, oriental opium in the west. These craft displayed the versatility and usefulness of seaplanes in Canada, a nation surrounded by water and riddled with lakes.

The British post-war gift of approximately one hundred aircraft included Bristol Fighters, SE5's, De Havilland DH9's and DH4's, and Avro 504K's. The Bristols and "Scout Experimentals" (SE5's) – biplane fighters by design – were used primarily for training although a few were adapted for aerial photography. The de Havilland bombers, generally more powerful and with a longer range, proved useful for aerial survey and for the initial flights of the CAF in the transcontinental airmail routes. The bulk of the gift, the Avro 504's served not only as flight trainers for many years but also as test aircraft for Turnbull's variable-pitch propellers, and, with the mounting of a more powerful engine, were used on forest fire patrols in the Rockies during the early 1920's.

Although important in the development of Canadian aviation, these aircraft by and large pointed out the uselessness of trying to apply military aircraft, with their emphasis on manoeuvrability and speed regardless of capacity or engine life, to civilian aviation tasks, where slower but more dependable planes were needed. In the decades following the War, world designers struggled to produce effective, commercial aircraft, while in Canada, the fledgling aircraft industry turned to the peculiar problems of flying in the northern wilderness.

Bush Flying

Immediately after the war, commercial airlines sprung up throughout Europe, flying for the most part converted bombers such as the DH4 Junkers, Fokker, Handley Page, and Farman models. These warplane derivations, however, proved uneconomical in their new roles and designers were sent back to the drawing boards with instructions to produce aircraft which cost less to fly.

As a result, the 1920's saw rapid development in aircraft technology. The work of Prandtl and Junkers in aerodynamics led to the invention of the high-wing cantilever monoplane, whose structural supports were inside the wing, increasing the streamlining considerably. The German designers also took an early lead in the use of sheet metal as a high-strength, low-resistance skin for aircraft, while American firms led in the introduction of braced-wing monoplanes and cowled engine mounts, all of which improved airflow. Not only did the variable-pitch propeller and the slotted wing-flap increase takeoff and landing performance but also the installation of newer radial engines – often air cooled, sometimes with the popular trimotor layout, and using higher octane gasoline – produced aircraft whose economy and dependability were finally up to public standards.

Meanwhile in Canada, aviation research and manufacture were becoming firmly established. In 1919, the Air Board asked a progenitor of the National Research Council (NRC) to organize an Associate Air Research Committee to foster aeronautical research in Canada, and to advise the Board on technical matters. The first work of the committee was done through the universities in the areas both of general scientific interest, and of particular concern to Canadian aviators – meteorology, aerial survey techniques, radio interference, and wind tunnel studies, in the former category; low-temperature effects on engines, lubricants, batteries, and rubber fixtures, as well as the stabilities of aircraft equipped with skis and floats, in the latter. The NRC itself became interested in aviation in 1929 and proceeded to build a wind tunnel which could simulate speeds of up to 225 miles per hour, an extensive plant for testing engines, chemistry facilities for research into fuel and lubricant properties, and an

electronics shop for instrument development. Even after the depression cut off funds for basic research, NRC continued to do valuable work in the practical problems of landing devices and engine performance for the RCAF and commercial operators.

By 1925, Wallace Turnbull, working on a $1,500 grant from NRC, had perfected his improved-version electrically-operated, variable-pitch propeller — the world's first — and it was subsequently built and successfully tested at Camp Borden in 1927. The patent was licensed to Curtiss-Wright of the United States the following year, and after a sluggish development phase entered active service in the 1930's on the Curtiss flying boats, of which the PBY-5 Catalina is the most famous. The patent made so much money for Turnbull during the war that, for a short time in 1943, the American Government ordered Curtiss-Wright to stop paying royalties because of the extensive drain on capital.

The obsolescence of the First World War aircraft had produced a demand for aircraft in Canada and led to the establishment of a civil aircraft industry. The British manufacturing firm of Vickers started an aviation branch in Montreal in 1923, which quickly designed and sold a series of aircraft that suited local needs and often incorporated the latest research improvements from the NRC and global designers. Among the more popular Vickers models of the 1920's were the Vedette, a patrolling, single-engine seaplane which was not, however, adaptable to transport work; the Varuna, another larger flying boat; the Vanessa, a cabin biplane with interchangeable floats, wheels and skis; the Velos, a specialilized photographic biplane; and the Vista, the first Canadian-built monoplane. These designs could not compete, however, either in quantity or in quality with the American braced-wing monoplanes, or the similar European models. Vickers, by the end of the decade, had given up its original work and was producing Fokker Universals on license.

By the year 1929, four companies were at work assembling one million dollars worth of aircraft in Canada (Table 7.1). In addition to Vickers, Fairchild Aviation had established a branch plant at Longueuil to produce the "Razorback" FC-2's, the first cabin monoplane in Canada; Curtiss had re-formed at Cartierville as Curtiss-Reid and was producing the only Canadian designed aircraft of the year — a light, two-seater biplane with folding wings designed with the newly-organized flying clubs in mind, called the Reid Rambler; and De Havilland, another English firm, was producing various "Moth" aircraft at Toronto, including the "Gypsy Moth" biplane trainers which replaced the Aero 504's. Also in competition in the aircraft market were United States imports such as the Bellanca Pacemaker, the Ford Trimotor, and the Douglas Seaplane, as well as the venerable JV-52 Junkers "flying boxcars" from Germany. The Ottawa Car Company distributed for both A.V. Roe of Great Britain and the Consolidated Aircraft Company of Boston, while numerous air engine manufacturers maintained repair and assembly bases across the country.

All in all, the Canadian aircraft industry produced a total of 135 aircraft in the 1920's, about two-thirds land planes, and the remainder seaplanes or amphibious craft. This represents over twenty percent of the aircraft flown in Canada at the time. In addition, 162 engines were produced and numerous foreign aircraft were converted or modified to Canadian needs.

Despite the depression and even before the financial and creative surge of the war years, the aviation industry expanded and diversified in grand style during the 1930's. Between 1933 and 1938, the number of producing firms rose from five to thirteen, with sales in the latter year of almost seven million depression dollars. Between 1934 and 1938, the industry produced 677 aircraft (Table 7.2) almost five times as many as were brought out in the entire preceeding decade; by 1939 gross sales were an appreciable .4 percent of the Gross Domestic Product. For the first time, too, the export market became a factor in Canadian aviation production, with a final pre-war figure of forty percent of total sales and an entrée into fifteen foreign countries.

Some of the aircraft produced, such as the Fleet "Fawn" put out by Fleet aircraft of Fort Erie, and the Avro "Tutor", were training biplanes built along traditional lines. Others were aircraft designed and built specifically for Canadian "bush" needs, a welcome return to the Vickers practice of the 1920's. Some represented design modifications by foreign branch operations — one good example is the Fairchild "Super 71". The Fleet 50K "Freighter", developed on the verge of the war, was a two-engined biplane cargo model based on design criteria developed through a survey of bush operators. Probably the most famous aircraft in this class, a Canadian design and execution which found a world-wide market, is the Noorduyn "Norseman" a prototype of the pre-war bush plane.

The designer, Robert Noorduyn of Montreal, consulted a large number of bush operators before commencing the project, and the 1935 first model was indicative of his research. While the Norseman had no unique features it was almost perfectly adapted to the Canadian scene. A single-engine, high-wing monoplane, it would carry seven passengers or almost a ton of cargo. It was convertible to a landplane, a seaplane, or a ski-equipped snowplane, and had the short take-off and landing features needed for improvised airstrips. The construction was particularly rugged and the engine — a Pratt

and Whitney Wasp – was modified for cold weather flying. It could cruise at 150 miles-per-hour up to 17,000 feet over a range of 1,150 miles, or more with special reserve fuel tanks. In its time, it was used as a military trainer, a passenger liner, a cargo transport, a flying ambulance, and a survey platform. It saw war service throughout the world and is still flown in an estimated twenty countries. Furthermore it has the unique distinction of being a Canadian-designed aircraft licensed for manufacture in the United States.

The Norseman was probably the epitome of the successful "bush plane" and as such was not superseded until the advent of the De Havilland STOL aircraft in the 1950's. It was, however, the end of one particular line of design development. In the 1930's, and accelerated by the wartime experience, the mainstream of commercial and military design lay with the low-wing multi-engine monoplane best typified by the Douglas DC-3 of 1936.

Commercial Airlines

The surge in design in the Twenties resulted in the development of the all-metal, low-wing monoplanes which have dominated commercial passenger services since their introduction in the early 1930's. Earlier designs, such as the Northrop Alpha and the Boeing Monomail and 247 models, were superseded in 1934 by the DC-2, and later, in 1936, by the DC-3. It is interesting to mention here that 'DC' stood for 'Douglas Commercial', since prior to the DC-1 prototype Douglas had built only military aircraft.

The design of the DC-3 had few original components, but it was built on the good points of a decade of predecessors. By reducing wing-size – using flaps to increase the area for takeoff and landing – and by streamlining, drag was reduced so that the plane could fly fifty percent faster than earlier liners with the same engines. This factor, plus higher-octane fuels, better engine design, and the variable-pitch propeller, reduced fuel consumption by forty percent; the higher cruising speed, plus the incredible durability of the construction – resulting because designers, unsure of structural fatigue at the new, high speeds, over-built – both reduced maintenance costs sharply and increased aircraft life. From the airlines' point of view, the most important improvement was in operating efficiency – costs per seat-mile for the DC-3 were just under half those of the Ford Trimotor or the Lockheed Vega, or two-thirds those of the Boeing 247.

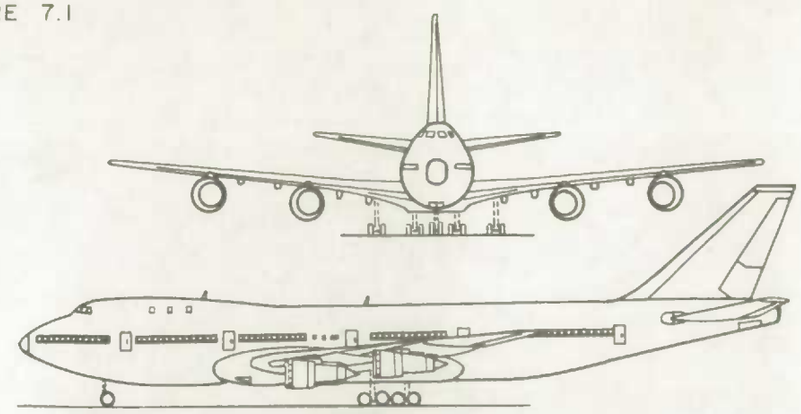
Few improvements in design were introduced between the DC-3 of 1936 and the jet aircraft of the late 1950's. Under war pressures, a number of modifications were made to the DC-3, chiefly to increase its range, but the designs of civilian aircraft in North America at least, were not greatly influenced by military needs. In fact, the reverse was often the case. During and after the war, four engines on airplanes became the rule; aluminum alloys allowed lighter yet stronger frames; and the supercharger resulted in higher and faster flights due to the reduced air density, and therefore reduced air resistance at higher altitudes. Douglas produced a series which showed improvements in the DC-3 in some respects, but never succeeded in replacing it, although the DC-4, DC-6, and DC-7 were successful modifications. Martin and Convair entered the field, and Boeing, whose B-17 bomber of 1935 had pioneered the four-engine layout, introduced pressurized cabins in its 307 model. Lockheed placed the Constellation and Super-Constellation on the market, providing Douglas' major competition in the piston design throughout the 1940's and 1950's. The speed, range, and capacity advantages of the newer models are evident in the fact that the operating costs per seat-mile decreased – making the cost per passenger for the DC-6 for example, approximately sixty percent that of the DC-3.

Advances in aircraft operating efficiency were effected at this time, by the refinements in engine design – superchargers, and the use of 100-octane gasoline for reduced fuel costs at high cruising altitudes, were two of the innovations made by manufacturers, among whom Wright, and Pratt and Whitney in the United States, and Bristol and Rolls-Royce in Great Britain, were leading names. Despite these improvements, it was becoming obvious that piston engines were reaching their limit as aircraft propulsion units. They were heavy, complicated, unsuited to the generation of high power, and their vibration both reduced durability and annoyed passengers. Something new was definitely needed.

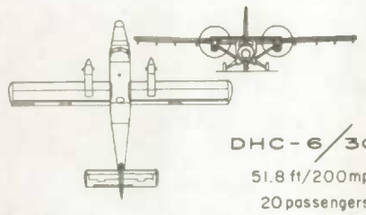
Research and manufacture were both increased in Canada during the war years, and the growth and establishment of large-scale airlines such as TCA and CPAL, opened up more markets for new airliners.

NRC had concentrated its war efforts on the practical aspects of keeping the planes flying while continuing work on low-temperature and Artic navigational aids. Structural research was undertaken in the investigation of fatigue problems in untested military trainers and fighters. At the same time, scientists attempted to design aircraft which conserved metal sheeting and other scarce materials. The result was the plywood construction of the successful De Havilland "Mosquito".

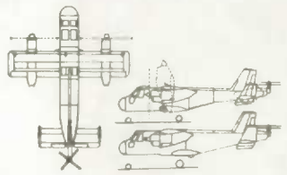
FIGURE 7.1



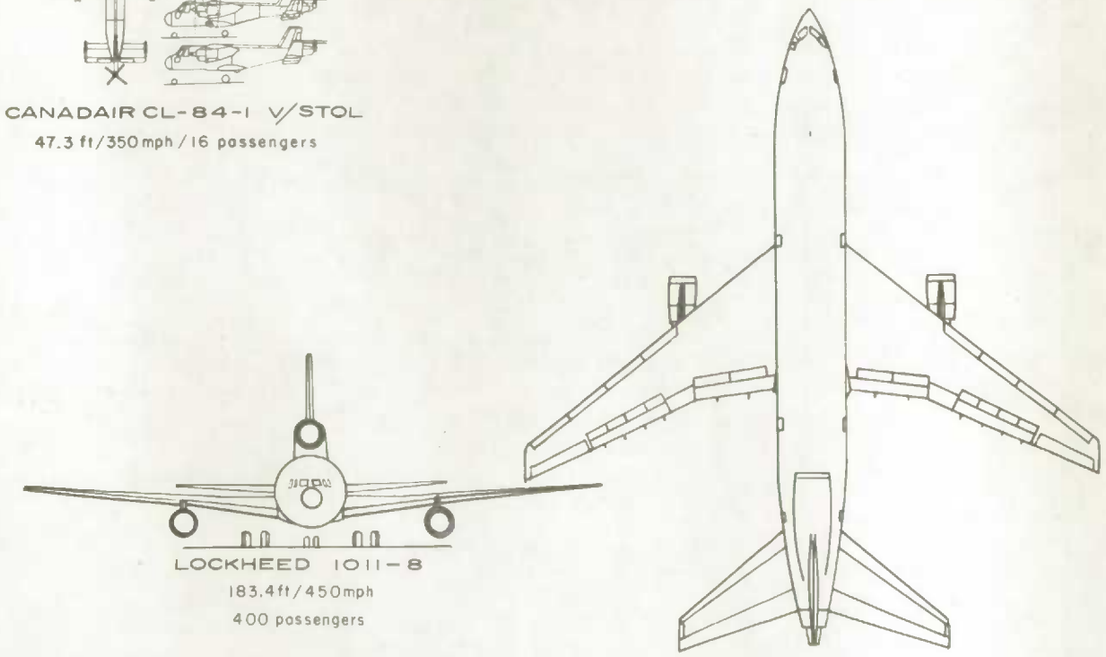
BOEING 747
231.3ft/600mph
490 passengers



DHC-6/300
51.8 ft/200mph
20 passengers



CANADAIR CL-84-1 V/STOL
47.3 ft/350mph/16 passengers

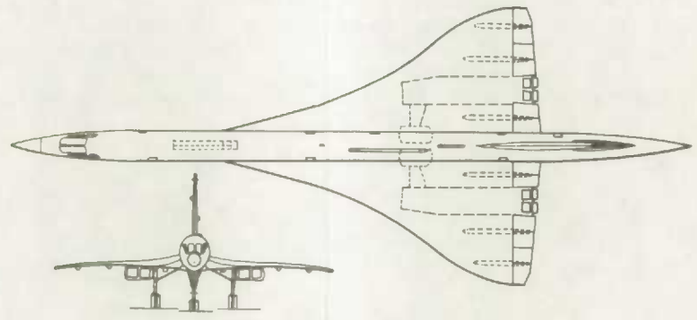


LOCKHEED 1011-8
183.4ft/450mph
400 passengers

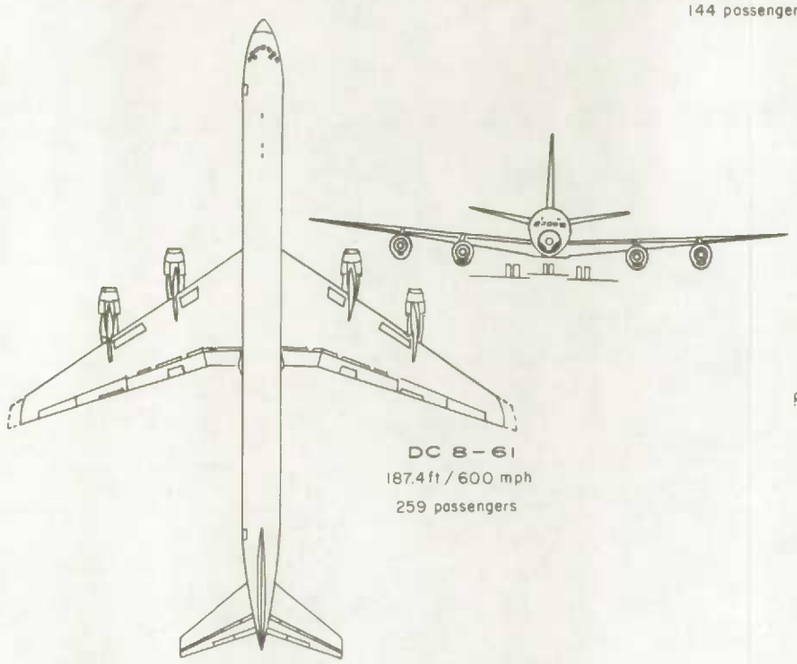
CESSNA 207
31.8 ft/140 mph
6 passengers

PIPER PA-31P
34.5ft/250mph
8 passengers

BAC 111-500
107.3ft/550mph
119 passengers



CONCORDE SST
203.7ft/1450mph
144 passengers



DC 8-61
187.4ft/600 mph
259 passengers

HS 125-400A
47.4ft/500 mph
12 passengers

Manufacturing skyrocketed during the war years, with aircraft production approximating 17,000 planes, worth $1.3 billion, between 1939 and 1945. Many models produced during the war included the Lancaster and Avian bombers by the Crown corporations of Victory and Federal Aircraft, the De Havilland Mosquito and Tiger Moth, the Catalina flying boats by the Vickers and Boeing (Vancouver) companies, the famous Hawker Hurricane by Canadian Car and Foundry, the Fairchild Bolingbroke, the Cornell and Fleet, and the Howard by Norduyn. In total, twenty-four models were designed, 6,500 airframes produced, and 30,000 engines overhauled.

In post-war years, research became more fundamental in nature. The jet engine, developed experimentally by both the Allied and Axis powers in the waning years of the war, needed to be tested and refined, and the consequent problem of supersonic speeds, probed. Cooperation between NRC and the RCAF was reinforced, leading to the establishment of the Defense Research Council in 1947. A contract for the development of both military and jet aircraft was let to A.V. Roe of Canada, which had taken over Victory Aircraft from the federal government. Special post-graduate laboratories were built at the Universities of McGill and Toronto, and the first Canadian supersonic wind tunnel was installed near Ottawa in 1951.

Research was also conducted in many other areas of aircraft design and operating efficiency. A specially-equipped North Star aircraft flew into ice-storms to test de-icing systems for airplanes. Of the two subsequently produced, the first involved alcohol seepage through pinholes in wings and propellers, the second – the expansion of a rubber "balloon" under ice sheaths on the leading edges of all aerofoils. The Institute for Aviation Medicine was created and began work in such fields as high-acceleration effects, sudden decompression, and the prevention of airsickness. Avionics, or aviation electronics, was developed as well, and NRC scientists, in conjunction with Canadian industry, have been successful in developing several electronic devices – an aerofoil that detaches from a crashing plane to preserve flight data and indicate the position of the downed craft through the transmission of a radio signal, and flight simulators, among other inventions.

Post-war manufacturing, naturally enough, decreased markedly. Between 1945 and 1946, the number of aviation firms fell from forty-five to sixteen, total employees from 62,000 to 11,000, and sales from $199 million to $36 million. However, the availability of skilled labour, design technology, and plant equipment, enabled the Canadian aircraft industry to expand rapidly to full production at the advent of the Korean hostilities in 1950. By 1953, production was $400 million annually, a level which has remained constant to this day. Moreover, while Government involvement in Canadian aviation increased considerably during this period, growth in the 1950's led also to the concentration of aviation in several large airframe and engine manufacturing firms. Between 1951 and 1959, total production amounted to $3 billion, including approximately $1.2 billion in aircraft themselves.

The aircraft used most extensively in the 1950's in Canada continued to be the lighter planes of the 1930's and the post-war years. The market for larger, newer airliners was restricted to the Government primarily – especially to the RCAF – and to TCA and CPAL. Air Canada began in 1939 with a Boeing Stearman biplane, but soon purchased Lockheeds – L10 Electras, L14 H's, and L-18 Lodestars. In later years the company switched to DC-3's and 4's, notably the North Stars, and replaced the Lancaster bombers of CGTAS with Super-Constellations and DC-6's for its overseas routes. CPAL, on the other hand, purchased North Stars, then DC-6's and Curtiss Commandos.

As the turbo-supercharger developed into the turbo-compound engine, pure turboprop engines became a possibility. Air Canada purchased the Vickers Viscounts in 1955, and added the Vanguards in 1960. CPAL, after a brief spell on the disastrous Comets, switched to Bristol Brittanias. Quebecair became the first regional carrier to offer jet service when it introduced the turbojet Fairchild/Fokker F-27 on its routes. Turboprop engines are still widely used today, particularly in medium and short-range aircraft, and STOL vehicles. According to ICAO statistics, these engines constitute just over twenty percent of all powerplants in world commercial use. Nevertheless, on the long passenger trunk-routes in the 1950's, turboprops were but the last extension of the propellor aircraft, economical only while the pure jets were being developed.

The Jet Era

The one major contribution of the Second World War to the aviation industry was the jet engine. The idea was actually invented independently by two men – the Briton, Sir Frank Whittle in 1929, and the German, Hans von Obain in 1934. By the beginning of the war, projects were underway in Germany, Great Britain, and the United States. The results were such aircraft as the De Havilland Ghost, and the initiation of the predominance of Rolls-Royce in jet engine manufacture with the 1944 Dart-Turboprop. The American firms of Pratt and Whitney, and General Electric, produced several models as well.

However, successful jet airliners could not appear until aerodynamic design had caught up with engine potential. The swept-back wing, which German theoreticians had pointed out was necessary for control at near-sonic speeds, was first introduced on a large scale in the Boeing B-47 piston-engine bomber of 1947. It was later added to the Boeing B-52 bomber of 1952 as well. Gradually, British engine design was combined with German/American structural aerodynamics to produce a successful jet airliner – the De Havilland Comet of 1952.

This design appeared five years before any major competitors, and showed at once the advantages of the jet-liner. Speed was sufficient to impress passengers, and the vibration-free ride also added years to the life of the sensitive electronic systems. Later designs have also shown that, on routes over three hundred miles and with a minimum of fity passengers, jet aircraft are cheaper to operate by twenty to twenty-five percent than piston planes. The major savings are found in lower fuel consumption, simple maintenance-free construction compared to propeller aircraft, and higher power/weight ratios.

Though the Comet I had to be withdrawn from service in 1954 as a result of structural difficulties which ensued after severals years use, the foresight in design and the advancements in aircraft technology of this plane formed the basis of the subsequent expansion and success of jetliners in the remaining years of the 1950's. By 1958 the Americans were ready to introduce the Boeing 707 and Douglas DC-8 – sophisticated jets boasting increased passenger capacities and the more powerful fanjet, axially-compressed engines.

Since the introduction of the first jets, numerous improvements have been tested. Not only have smaller jet aircraft proven more economical for medium-length runs, but rear-mounted engines have also been found to reduce cabin noise and increase takeoff performances in these planes. Such engines were used in the BAC 111, DC-9, Sud Caravelle, Boeing 727, and De Havilland Trident models.

Meanwhile, attempts made to produce larger aircraft resulted in several innovations: the "stretched" DC-8-60 series had an additional twenty-foot section of fuselage mounted behind the wings; the Boeing 747 was designed rather than stretching the B-707. This decision was made because the 707 had a steeper takeoff angle than the DC-8 and "stretching" would have caused the tail to scrape the ground on liftoff. Range has also been improved substantially, and speed has more than doubled the previously established 600 miles-per-hour mark with the advent of the Mach 2, 1,400 miles-per-hour SST.

Canadian airline companies were eager buyers in the jet market. Both purchased DC-8's, but Air Canada subsequently added DC-9's and Boeing 747's, while CP Air turned to Boeing 727's and 737's. All regional carriers fly various large and small jets, including Boeing 707's, Hawker Siddeleys, BAC 111's, and Nihon YS-11's. Since 1960, jet hours flown by the scheduled carriers (Table 7.4) have increased from 8,000 to 340,000 hours.

During the 1950's, an independent beginning in jet production had been inaugurated by A.V. Roe – 'Avro' or 'Hawker Siddeley Canada' after 1962. However, for a great number of reasons including financial considerations, in general, Canada's aviation firms have become subcontractors of the American aviation industry, specializing in such specific areas as avionics and engines. Keypoints in the development of this structure were the Defense Production Sharing Program of 1959, followed by the Defense Industry Development Sharing Program of the same year, and the Defense Industrial Research Program of 1962. These agreements served to stabalize Canada's industry and increase exports, while producing a favourable balance of trade (Table 7.7).

A 1966-67 Department of Industry study reveals a cross-section of the Canadian aviation industry in the mid-1960's. Canada ranked behind only the United States, Great Britain, France, West Germany, and Italy in the aviation output of the free world, while contributing fifty percent of the total STOL manufacture, and over ten percent of all military trainers. Of the approximately eighty Canadian firms in operation, only about nine produce more than five million dollars per year on a value-added basis, seventeen to nineteen between one and five million dollars annually, and roughly twenty contribute $50 thousand or less in overhauls and repairs (Table 7.6). Fifty-six percent of all firms surveyed were fifty percent or more foreign-owned and had over ninety percent of all assets and profits made. Of the total sales averaging $400 million in both 1966 and 1967, approximately sixty to sixty-five percent were for military orders. Exports to the United States, Great Britain, and West Germany, in particular, accounted for fifty to sixty percent of all sales. Profits tended to be about zero to five percent of sales from 1959 to 1965, with assets amounting to $400 million.

The major firms in the industry included some aircraft manufacturers undertaking original design – De Havilland and Canadair – others serving as outlets for foreign manufacture – Hawker Siddeley, Douglas, and Boeing – and a number specializing in engines – United Aircraft, Orenda, Bristol Aviation, and Rolls-Royce.

MOT maintenance facilities at Ottawa International Airport.

Photo by E.A. Crombie McNeill, MOT Information Services.

Since 1946, De Havilland of Canada has become a world leader in the production of STOL aircraft, including the Chipmunk, the Beaver, the Otter, the Cariboo, and the turbine-powered Turbo-Beaver, Twin Otter, and Buffalo aircraft. The DHC-2 Beaver has proved particularly popular in world markets and an estimated sixty-five countries now have these planes on their registry.

The first such vehicles were produced to satisfy the need for light utility aircraft in the Canadian north, and designs were based on surveys taken from experienced bush pilots. These planes vary from 4,100 to 5,100 pounds in weight and have the ability to clear fifty-foot obstacle after a fully-loaded run of only 350 yards. Such STOL aircraft need much smaller, and therefore less expensive, airports than conventional aircraft, thus offsetting their somewhat higher operating costs. For commuter shuttles and cargo transfers, STOL aircraft cannot yet match the vertical performance of the helicopter, but their cruising speed and range are considerably more extensive.

Canadair, a subsidiary of General Dynamics, was established in the latter part of the war to convert DC-4's into new aircraft with cold-weather equipment and a capacity of fifty-five passengers in pressurized cabins. These 'North Stars' were among the most advanced aircraft of the day, and created a Canadian 'first' by flying non-stop from Halifax to Vancouver in 1945 in only eight and one-half hours. Following World War II, Canadair continued to work primarily on military contracts, including the Sabre-jet interceptors and the T-33 jet trainers, but the firm also built PBY's on license for civilian markets. Later, they expanded into large cargo transports — the CL-44, the CL-215 "water-bomber" for forest-fire fighting, and the CL-84 "dynavert" V/STOL aircraft whose wings, tail, and engines can tilt ninety degrees for vertical liftoff, then return to the horizontal for level flight. Canadair also maintains facilities involved with missile systems, electronics, and aerospace research.

Douglas Aircraft of Canada manufactures structural units for the DC-9's, while United Aircraft of Canada, Limited, (UACL), a ninety percent owned subsidiary of the American United Aircraft Corporation (UAC), has the world license for spare parts for all Pratt and Whitney reciprocating engines. UACL, which was 'Canadian Pratt and Whitney' until 1963, had 1968 sales amounting to twenty-percent of the total Canadian aviation industry. It manufactures as well, a number of highly successful turboprop and turbofan engines, among them the PT-6 series used in many De Havilland and Grumman turboprop aircraft.

Orenda Limited, a corporation owned sixty percent by Hawker Siddeley and forty percent by UAC, produces aircraft engines, notable turbine jets, and parts. The company was founded in the 1950's to produce an engine for the CF-105 Arrow. Rolls-Royce Canada does much of the North American overhaul work for the extensive and long-lived series of its parent company. Its engines fly about forty percent of all civil time on the continent. This firm also produced fifty engines for the Canadian T-33 trainers.

The Canadian government's interest in aviation research in the late 1960's was extended considerably to include aerospace probing along with its other aviation studies. The program was initiated by the 1959 creation of the National Aeronautical Establishment (NAE) as a branch of NRC. Taking over all the wind tunnels and other engineering and testing facilities from the Government, NAE now can provide the facilities for theoretical and applied research in Canadian aviation; it also supplies and funds research teams in industrial establishments. Furthermore, some of the most marked developments of this body have been in the fields of rocketry and satellites.

A collaboration of NRC and De Havilland's Special Products and Applied Research Division produced the first satellites built outside the United States and the USSR — the Alouette series launched from Cape Canaveral or Cape Kennedy initially in 1962. These spacecraft, designed basically for ionosphere studies, contributed important design features to many later satellites. The Alouette group was followed, commencing in the centennial year, by the ISIS series (International Satellites for Ionosphere Studies).

Ionospheric and other electro-atmospheric studies are also conducted by NRC with the use of such rockets as the Black Brants produced by Bristol Aerospace (1968) Limited of Winnipeg. These devices — solid-fueled and eighteen to thirty-seven feet in length — have an international market because of their simplicity and dependability. Many Canadian rocketry tests, both for fuel research and for high-altitude studies, are fired from the Churchill Research Range in northern Manitoba, acquired from NASA in 1966.

Total expenditures on aerospace research and development in Canada reached approximately $100 million per year in the latter years of the 1960's, of which almost one-half went into structure and materials investigation. The active research and development carried on today by industrial, Governmental, university, flying club, and airline circles is providing a firm base for the continued expansion of a truly Canadian aviation technology.

TABLE 7.1. The Canadian Aircraft and Parts Industry, 1933-70

Year	Firms	Employees	Payroll	Sales	Imports	Exports
			thousands of dollars			
1933	5	147	169	345	177	–
1934	6	162	192	484	270	–
1935	7	294	328	881	639	–
1936	7	416	522	1,348	1,411	–
1937	8	606	692	1,731	1,565	429
1938	13	1,617	2,094	6,927	2,538	3,005
1939	13	3,596	4,652	12,638	5,205	549
1940	19	10,348	13,733	26,568	15,286	6,135
1941	24	26,661	39,942	81,368	40,873	20,341
1942	42	44,886	76,334	151,555	45,286	27,618
1943	45	69,529	126,827	246,029	82,929	45,352
1944	45	79,572	161,055	426,982	92,506	108,851
1945	38	37,812	84,231	278,653	18,252	109,253
1946	16	11,405	24,459	36,211	11,845	11,245
1947	12	9,374	21,422	44,304	18,130	10,114
1948	11	8,049	19,830	45,600	13,008	14,018
1949	14	10,725	27,443	61,099	23,156	27,274
1950	15	10,549	30,175	55,268	19,668	6,678
1951	23	19,198	59,558	117,188	41,438	7,524
1952	38	33,356	108,667	277,131	95,212	37,503
1953	43	38,048	142,376	464,015	111,803	40,247
1954	47	35,095	135,683	343,010	100,397	28,442
1955	52	33,036	130,269	354,315	138,091	19,906
1956	52	35,563	146,428	354,510	91,308	49,545
1957(1)	70	41,616	179,699	424,443	93,691	39,910
1958	75	39,932	182,277	462,331	94,820	109,274
1959	78	28,516	142,485	372,534	76,745	24,960
1960	83	27,056	131,453	308,190	116,494	20,745
1961	80	28,689	143,333	348,245	216,964	80,127
1962	83	27,665	137,981	381,234	201,741	111,420
1963	88	26,417	139,806	360,594	127,422	109,293
1964	86	28,643	159,150	403,776	137,249	248,784
1965	85	27,738	159,443	394,370	206,711	207,037
1966	84	33,833	211,543	533,345	227,229	210,188
1967	91	37,235	247,428	610,210	361,064	313,611
1968	85	35,143	257,734	653,899	437,034	369,417
1969	96	34,174	273,505	649,465	400,781	324,535
1970	–	–	–	–	384,450	429,205

(1) Repair and overhaul companies first included.

Sources: Aircraft and Parts Manufacturers, Statistics Canada; Trade of Canada, Statistics Canada, Volume II and III.

TABLE 7.2. Aircraft Produced in Canada, 1934-50

Year	Number of aircraft produced	Value
1934	18	117,470
1935	58	479,614
1936	109	1,210,910
1937	110	1,461,626
1938	282	4,001,622
1939	252	4,177,555
1940	875	13,859,625
1941	1,466	35,348,343
1942	3,409	70,274,104
1943	3,792	119,432,707
1944	4,095	269,879,520
1945	1,822	211,861,554
1946	308	3,700,453
1947	199	20,305,382
1948	65	11,816,393
1949	117	22,931,615
1950	85	2,666,348

Note: Series discontinued after 1950.
Source: Aircraft and Parts Manufacturers, Statistics Canada.

TABLE 7.3. Characteristics of Selected Commercial Aircraft flown in Canada, 1936-70

Aircraft	Year of entry into world service	Direct characteristics(1)			1969 direct operating cost(2) (c/seat-miles)
		Maximum passenger capacity	Range (miles)	Currency speed (Mph)	
Piston					
Douglas DC-3	1936	32	1,500	185	4.7
Douglas DC-4	1939	86	2,140	228	–
Curtess C-46	1941	62	1,800	195	–
Lockhead Lodestar	1942	99	1,000	170	–
Lockhead Constellation	1945	64	2,500	313	5.0
Douglas DC-6	1947	107	2,810	311	2.8
North Star	1947	86	3,880	267	–
Convair 240	1948	40	1,800	270	–
Convair 440	1952	44	2,000	285	–
Lockheed Super-Con.	1952	94	4,000	304	–
Douglas DC-7	1953	95	4,635	349	–
Turboprop					
Vickers Viscount	1953	70	2,000	330	3.5-5.2
Bristol Brittannia	1956	139	5,334	355	–
Fairchild F27	1958	52	1,180	258	3.3-6.5
Lockheed 188	1958	99	2,500	400	3.3
Vickers Vanguard	1960	139	2,000	420	–
Hawker-Siddeley 748	1962	62	1,100	273	–
Pure Jet					
Boeing 707	1958	189	5,000	525	1.1-1.7
Comet 4	1958	102	4,030	460	–
Douglas DC-8	1959	189	4,000	521	1.3-1.6
Boeing 727	1963	189	2,050	605	1.3-2.0
Hawker-Siddeley 121	1963	179	2,450	600	–
B.A.C. 111	1965	79	1,240	507	2,3-3.8
Douglas DC-9	1965	105	1,397	561	1.5-3.1
Boeing 737	1967	125	2,080	573	1.7-2.9
Douglas DC-8-60	1967	250	4,000	579	0.4-1.2
Boeing 747	1969	490	4,600	640	–
Fairchild F28	1969	65	1,162	519	–
Concorde	Future	144	4,020	1,450	–
Lockheed 1011	Future	345	4,000	625	–

(1) Usually an averaged figure for earlier models – later modifications, especially of Douglas aircraft, tended to have increased range and speed.

(2) See glossary for definition. These costs are expressed in US cents per available seat-mile (i.e., the costs per trip divided by the product of the trip length and the number of available seats). It should be borne in mind that operating costs vary with the airline, with distance flown, with seating configuration, and with time (depreciation and maintenance costs are heaviest in the first few years); thus, these costs will have varied since the mid-1960's, especially for relatively new aircraft models.

Sources: Aviation Statistics Centre files; C.A.B. Aircraft Operating Cost and Performance Report, August 1970.

TABLE 7.4. Jet Aircraft Hours Flown by Canadian Carriers, 1960-70

Year	Hours flown by carriers and year(2)							
	Air Canada		CP Air		Pacific Western		Transair	
	Jet(1)	Totals	Jet	Totals	Jet	Totals	Jet	Total
1960	8,016	266,359						
1961	28,518	208,311	7,858	50,046				
1962	34,506	190,515	15,835	47,137				
1963	42,473	181,642	19,658	48,825				
1964	45,337	183,671	23,212	43,523				
1965	55,466	206,482	24,904	48,054				
1966	74,993	238,467	30,938	53,171				
1967	109,370	292,272	36,508	61,152	103	31,612		
1968	152,318	308,454	43,469	66,117	2,493	27,355		
1969	183,125	287,182	68,602	71,834	8,898	35,722		
1970(3)	221,010	304,472	82,836	79,523	14,194	35,332	3,552	21,801

Year	Hours flown by carriers and year(2)						Total hours(2) scheduled carriers		Jet of totals
	Nordair		Quebecair		Eastern Provincial				
	Jet	Totals	Jet	Totals	Jet	Totals	Jet	Totals	
									%
1960							8,016	266,359	3.0
1961							36,376	258,357	14.1
1962							50,341	237,652	21.2
1963							62,131	230,467	27.0
1964							68,549	227,194	30.2
1965							80,370	254,536	31.6
1966							105,931	291,638	36.3
1967							145,981	385,026	37.9
1968	1,063	–					199,343	401,926	49.6
1969	5,715	–	3,540	18,129	2,612	29,716	272,492	442,583	61.6
1970(3)	8,551	17,244	4,975	15,641	6,509	24,951	341,627	498,964	68.5

(1) Pure jet only – turboprops not included.
(2) Revenue plus non-revenue. Total hours given only for those airlines showing jet hours in a given year.
(3) Preliminary estimates for jet hours.
Sources: Civil Aviation Statistics Canada, 1960-69; Aviation Statistics Centre Service Bulletins; Air Carrier Operations, Statistics Canada, 1970.

TABLE 7.5. Operating Specifications and Costs of Major Canadian Commercial Aircraft 1969

No.	Aircraft type	Aircraft make	Manufacturer	Overall length	Passenger accommodation	Recommended cruising speed
						m/hr
	Fixed Wing:					
1	Single Engine	Beaver (DHC2)	De Havilland	30- 33	7	125
2		Cessna 172	Cessna	27	4	97-117
3		180	Cessna	26- 28	1- 6	88-105
4		185	Cessna	26- 28	1- 6	101-129
5		Norseman	Noorduyn	32	7- 9	135-141
6		Otter (DHC2)	De Havilland	42	9	121
	Fixed Wing:					
7	Bimotor	Beech (BE18)	Beech	35	7- 9	175-185
8		Canso (PBY-5A)	Convair	64	22	130
9		Douglas (DC3)	Douglas	64	28- 32	185
10		Grumman Goose	Grumman	43	21	150
11		Piper Apache	Piper	27	4- 5	173
12		Aztec	Piper	30	6	204-210
13		Twin Otter	De Havilland	52	20	190-210
	Fixed Wing:					
14	Multi-Engine	Boeing (707)	Boeing	144-152	181-189	521-557
15		(737)	Boeing	94-100	103-125	573
16		Douglas (DC4)	Douglas	94	44- 86	228
17		(DC6)	Douglas	107	52-107	311
18		(DC8)	Douglas	150-187	105-259	471-521
19		(DC9)	Douglas	104-126	56- 90	561-565
20		Vickers Vanguard	Vickers	123	119-139	420
21		Viscount	Vickers	81- 86	32- 70	330-362
22	Helicopter	Bell 47	Bell	43	3	83- 89
23		204	Bell	53	6- 11	143
24		206	Bell	39	5	131-140
25		Hiller FH1100	Fairchild Hiller	40	4- 5	122
26		UH-12E	Fairchild Hiller	41	3	90

(1) Approximations only — price varies with time, condition and custom equipment.
(2) Data collected only from the scheduled carriers' unaudited financial statements. See glossary for definitions.

TABLE 7.5. Operating Specifications and Costs of Major Canadian Commercial Aircraft (1969)

Design range, full	Approximate purchase price(1)	Average operating cost per block-hour(2)				No.
		Flying	Main-tainence	Rental or depreciation	Totals	
miles		dollars				
480- 780	59- 100,000	30.93	22.39	4.37	57.69	1
530- 640	10- 15,000	22.64	7.32	3.14	33.10	2
620- 695	15- 20,000	27.17	14.70	5.72	47.59	3
580- 660	20- 25,000	29.93	12.12	7.59	49.64	4
140- 404	—	31.43	30.12	2.63	64.18	5
875	75- 125,000	44.41	32.74	12.07	89.22	6
1,500	170- 200,000	59.94	37.73	18.29	115.96	7
650	—	100.92	90.10	22.21	213.23	8
1,500	App.- 50,000	78.17	73.74	6.39	158.30	9
1,000	App.- 50,000	60.89	29.47	22.02	112.38	10
980-1,180	50- 100,000	28.88	11.16	9.85	49.89	11
800-1,200	50- 100,000	31.71	17.18	9.24	58.13	12
745	400- 600,000	77.78	59.00	51.77	188.55	13
3,217-6,608	7- 9,000,000	—	—	—	1,039.66	14
1,840-2,135	4- 5,000,000	297.96	111.16	150.29	559.41	15
2,140	100- 150,000	129.49	139.76	32.40	301.65	16
2,810	300- 400,000	202.71	183.82	64.81	451.34	17
3,750-6,100	7-12,000,000	495.12	280.82	105.65	971.59	18
995-1,484	4- 5,000,000	255.37	146.45	148.71	550.53	19
2,000	—	248.30	349.16	105.20	702.66	20
1,150-2,000	—	154.05	161.73	8.47	324.25	21
250- 259	40- 50,000	40.38	37.88	14.71	92.97	22
286- 382	—	109.79	94.56	63.34	267.69	23
392- 460	—	50.81	60.29	18.07	129.17	24
348	—	53.20	58.17	14.88	126.25	25
440- 500	—	48.38	45.40	6.55	100.33	26

Note: As some aircraft were issued in many models, data are averages and may not be accurate for specific planes.

Source: Aviation Statictics Centre Service Bulletins: Civil Aircraft Registry, MOT, 1971

TABLE 7.6. Aircraft Firms in Canada, 1963-66, Classified by Size Group on the Basis of Manufactured Value Added

Value added	1964		1964		1965		1966	
	Firms	Total value added	Firms	Total value added	Firms	Total value added	Firms	Total value added
		$'000		$'000		$'000		$'000
0- 10	7	54	3	20	6	31	20	307
10- 24,999	5	102	11	159	11	195		
25- 49,999	15	530	8	321	5	174	5	199
50- 99,999	6	401	9	635	12	539	11	864
100- 199,999	12	1,710	14	2,028	11	1,781	9	1,405
200- 499,999	8	2,501	11	3,751	4	1,295	11	6,249
500- 999,999	10	71,553	6	5,153	11	7,974		
1,000-4,999,999	18	36,089	17	37,678	17	35,489	19	44,701
5,000 and over	7	137,778	7	160,165	8	167,059	9	238,000

Source: Aircraft and Parts Manufacturers, Statistics Canada, 1963-66.

TABLE 7.7. Canadian Exports and Imports of Aircraft and Aircraft Parts, 1960-69

Year	Components	Value of exports/imports					
		All countries		United States of America		United Kingdom	
		Exports	Imports	Exports	Imports	Exports	Imports
		thousands of dollars					
1969 ..	Complete aircraft ..	66,027	202,649	18,322	191,610	381	10,418
	Engines and parts ..	102,718	85,850	84,281	72,832	1,304	12,033
	Other parts	159,665	112,282	139,943	102,240	1,131	3,993
	Totals	328,410	400,781	242,546	366,682	2,816	26,444
1968 ..	Complete aircraft ..	62,388	233,704	18,411	226,537	6,561	2,886
	Engines and parts ..	107,288	87,386	88,486	71,886	1,028	15,104
	Other parts	199,751	115,944	178,950	107,911	564	5,428
	Totals	369,427	437,034	285,847	406,334	8,153	23,418
1967 ..	Complete aircraft ..	35,992	147,509	14,307	138,955	–	938
	Engines and parts ..	94,307	103,590	77,283	80,505	1,352	23,002
	Other parts	183,312	109,965	167,048	103,179	549	5,873
	Totals	313,611	361,064	258,638	322,639	1,901	29,813
1966 ..	Complete aircraft ..	19,440	73,037	5,419	70,546	335	695
	Engines and parts ..	72,658	70,842	57,514	51,136	1,140	19,665
	Other parts	118,090	83,350	104,080	75,301	594	7,347
	Totals	210,188	227,229	167,013	196,983	2,069	27,707
1965 ..	Complete aircraft ..	105,266	76,780	81,374	71,087	–	4,960
	Engines and parts ..	48,251	60,698	37,849	41,468	667	18,572
	Other parts	53,250	69,233	44,728	61,916	467	7,007
	Totals	206,767	206,711	163,951	174,471	1,134	30,539
1964 ..	Complete aircraft ..	152,134	18,327	116,893	17,872	–	20
	Engines and parts ..	43,664	50,252	33,321	36,702	309	13,535
	Other parts	52,986	68,760	36,262	63,862	474	4,705
	Totals	248,784	137,339	186,476	118,436	783	18,260
1963 ..	Complete aircraft ..	32,640	22,123	25,940	21,283	–	760
	Engines and parts ..	31,485	47,766	23,253	29,439	233	18,290
	Other parts	44,168	90,060	27,549	84,255	698	5,558
	Totals	108,293	159,949	76,742	134,977	931	24,608
1962 ..	Complete aircraft ..	69,361	–	63,043	–	780	–
	Engines and parts ..	34,460	–	20,808	–	1,629	–
	Other parts	43,069	–	23,141	–	406	–
	Totals	146,890	259,251	106,992	229,420	2,815	29,633
1961 ..	Totals	100,914	312,552	76,030	210,141	3,217	101,540
1960 ..	Totals	50,172	167,009	14,699(1)	126,398	876(1)	39,836

(1) Aircraft and parts only. Source: Exports by Mode of Transport, Statistics Canada, 1960-69.

Chapter VIII

THE FUTURE AND CANADIAN AVIATION

Canada's air transport system during the decade of the 1970's and beyond is expected to differ from its present form as technology and developments in all sectors stimulate further expansion and improvement. From terminals and their operations, to aircraft design and control procedures among others, changes will occur. It is, therefore, particularly interesting to examine some of the forecasts and projections of air transport industry executives and planners for future developments in Canadian aviation. (Sources for the subsequent analysis are indicated by an asterisk in the bibliography.)

MOT forecasts for overall aviation activity to 1980 (Table 8.1) predict that the numbers of both aircraft registered and hours flown in Canada between 1967 and 1980 will approximately double. Expansions in commercial aircraft and services will be about seventy-five percent of present figures, with charter and specialty operations and scheduled domestic services growing the most rapidly.

Few changes are expected in the rankings of leading air terminals, as illustrated in Tables 8.3 to 8.5 and Figure 8.1, although some of the lower-ranked airports do show some alteration. Of these leading terminals Toronto, Vancouver, and Calgary have overall growth projections of threefold or more.

In passenger forecasts, Toronto, Montreal, and Vancouver are expected to retain their current ranking with a total combined passenger flow of fifty-three million by 1990; Calgary overtakes Winnipeg for fourth position — as happened in 1970; and Halifax captures sixth place. Important regional centres are projected to develop at the Lakehead, Moncton, Quebec, Regina, Saskatoon, Victoria, and Windsor. For cargo, in which a very rapid increase of fiftyfold is projected at some terminals within the next two decades, the pattern remains somewhat similar: Montreal is expected to handle the most goods — approximately three million tons annually by 1990, followed by Toronto, Vancouver, Winnipeg, Edmonton, and Calgary, with strong maritime centres at Moncton, St. John's (Newfoundland), and Halifax, as well.

In general, activity should continue to grow fastest in the extensive and largely undeveloped geographical areas of northern and western Canada.

Besides technological factors, many other considerations will account for future developments in Canada's air transportation. The current emphasis on socio-economic elements — from noise and pollution to building a healthy psychological atmosphere — foreshadows much more stress on designing and producing future transportation systems that fit into the total environment in which they must operate. The necessity for the integration of air and surface transport systems into the entire community is illustrated by the fact that by 1995 the world's population is estimated to be sixty to seventy-five percent greater than the present 3.5 billion — Canada's numbers will grow proportionately. ICAO forecasts that, should air transport fares and rates in current money value continue to decrease by two percent per year, the annual rate of growth of passenger-miles will be fourteen percent annually for the period up to 1980.

The rapidity of expansion, the financial burden of transport, and even more so, the technological development involved in aviation will depend much more in the future, upon the Government's commitments to the industry — in terms of capital investment, and regulatory, promotional, and fiscal policies. The redefining of federal and municipal responsibilities in airport operation, and the increase in airport planning based on regional and urban priorities, have become prominent features of air terminal policy. Already a geographical analysis of air needs has led to the classification of air hubs based on community or metropolitan projections for a possible multiciplicity of airports in a given area (Table 8.2).

Airports, both main and satellite, will have to be carefully designed to meet present and future needs in terms of aircraft and commodity movements, while remaining flexible enough in conception to be adaptable to advances in aviation technology. Suggested designs relegate the ticketing, and passenger and cargo processing to urban "nodes", which would also serve as V/STOL ports, possibly some distance from the landing strips. Computerized ticket, baggage, and passenger and cargo loading data control, and numerous servicing devices — refuellers, large cargo loading tractors, elevatable body trucks, underground trains, piers, and mobile lounges — are among the devices that are likely to become commonplace in future years.

Air traffic control will necessarily be updated and Instrument Flight Rule (IFR) capacity extended at major terminals to permit all-weather, all-instrument landings. In addition to the communications traffic relating to traffic control, there will undoubtedly be an increase in the data flow concerned with functions not directly related to the ATC system — airline commercial reports; meteorological information; customs, immigration, and health functions; and the reporting of aircraft status. Knowledge of the status of the aircraft and its load prior to its arrival will allow proper preparation to be made of passenger, cargo, and maintenance facilities at the terminal, thereby reducing the time required for servicing.

It is interesting to note numerous design trends suggested for aircraft in the next few decades. Drag is expected to be reduced through better aerodynamic lift surfaces — swept and variable wings, "total-body" lift design, aerofoils, and skin surfaces. Engines should show improved thrust to allow acceptably short takeoff runs for heavier aircraft, better fuel consumption at cruise speeds, and greater temperature tolerance — through improved materials technology — thereby permitting the generation of more power at the same engine volume. Structural design should work towards a higher strength/weight ratio through the use of new materials — aluminum and/or titanium alloys, composite materials, new bonding techniques, honeycomb, and fibre production methods. Designers must, at all times, keep in mind the problems of exhaust and sonic pollution, runway length and strength, and terminal handling facilities.

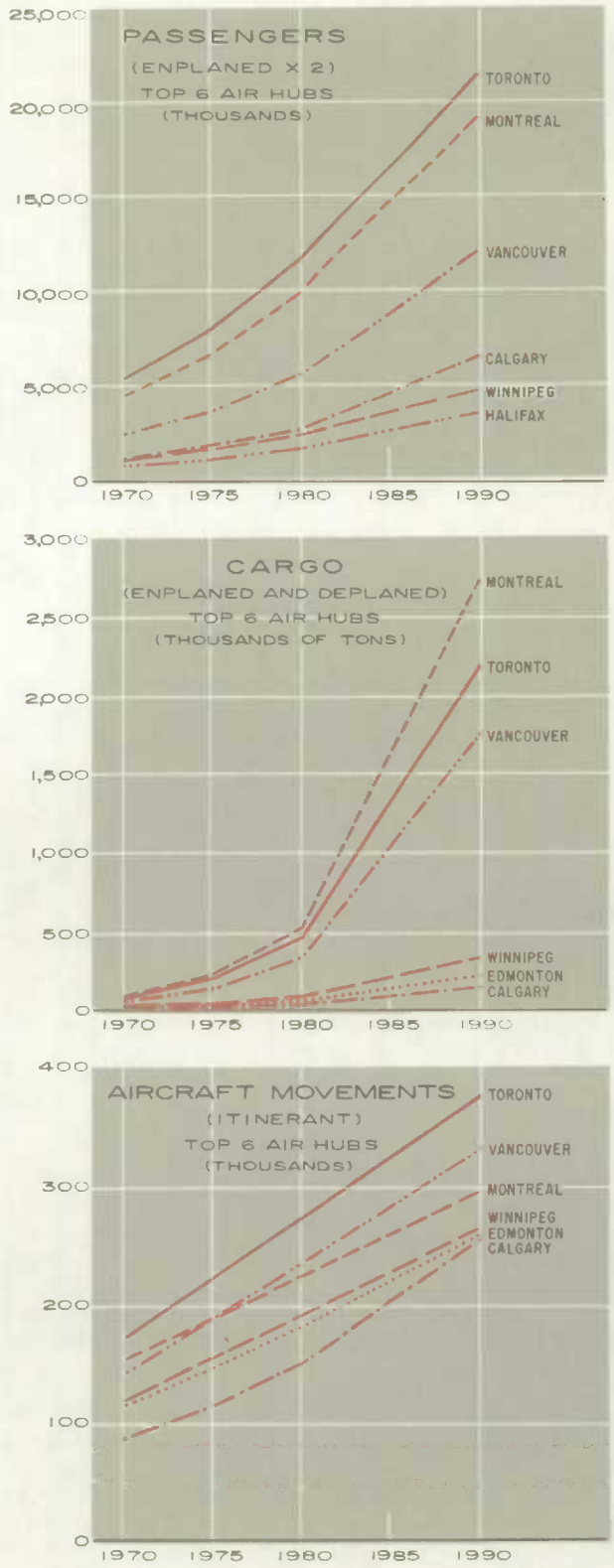
The execution of these general trends will probably be increasingly specialized for the various kinds of services offered. In the long-range projection for international flights and such domestic services as Toronto/Vancouver, speeds of subsonic models will remain in the 500 to 650 miles-per-hour range they now occupy, with a specialized high-speed market catered to by the SST's.

Medium-range aircraft with increased efficiency expressed in operating cost per seat-mile can be achieved by "stretching" current wide-bodied aircraft. Such planes could probably find economical service along the densely-populated "corridors" of the country — particularly in Quebec, southern Ontario, and the Calgary/Edmonton/Vancouver triangle. Capacities of 500 passengers for aircraft on such specialized runs are not out of the question for the 1980's but markets will undoubtedly remain for planes carrying 100 to 250 persons, such as the DC-8, DC-9, and Boeing 727-737 models.

Economical short-range aircraft, possible VTOL and/or STOL, could serve both to link urban centres too small or too close together for current jet linkage, and to act as "shuttles" between modular passenger/cargo facilities scattered throughout an air hub and the main landing/takeoff area. However, large-scale VTOL/STOL services seem unlikely to develop before the end of the decade, even with the developments on the drawing boards of De Havilland, Canadair, Breguet, and many helicopter manufacturers.

FIGURE 8.1

M.O.T. FORECASTS
AIR HUB ACTIVITIES
TO 1990



Data Source: M.O.T. Air Transportation Statistics/Forecasts

There will also be an expanded market for smaller, light aircraft — executive jets; transports such as the F27, the DC piston series, and the Beech aircraft; bush craft — piston and turboprop, STOL and CTOL — of the De Havilland/Norseman variety; helicopters of all descriptions; and many light pleasure and business planes such as the Cessna and Piper series.

If the cargo market grows as rapidly as expected — the ICAO world projection is sixteen percent per year through to 1980, or a doubling every five years — pure freighter airplanes will be widely used by the 1980's. This in turn will necessitate considerable modification in terminal facilities for goods handling, particularly if the planes reach their anticipated 500-ton capacity by the 1990's. At any rate, the expected decrease in operating costs to two cents per ton-mile for full aircraft by the late 1970's, should stimulate shippers to use air transport, thus further extending the market.

Department of Industry forecasts suggest that Canada's share of the free world's aircraft production will remain about one percent — the United States alone builds eighty-five percent. During the 1970's, Canada, with an anticipated production of 2,400 aircraft of all kinds, is expected to remain among the top seven producers along with the United States, Great Britain, France, Italy, Japan, and West Germany. Though Canada is forecast to specialize in VTOL and STOL planes, there is expected to be a heavy demand for parts manufacture — large piston, turboshaft, and turboprop engines; engines parts and components; landing gear, autopilots, and navigation instruments.

It should be emphasized that none of the forecasts in this chapter are intended as guidelines: it is but a collection of the opinions of those experts best qualified to suggest the coming trends. Both the foundation laid by Canadians in the past, and the technical and innovative advancement currently underway, foreshadow an interesting and progressive future in the complex field of air transportation in Canada.

TABLE 8.1. MOT Forecasts – Civil Aviation Fleet and Hours Flown to 1980

Item forecast	Quantity by year				
	Base 1967	Forecast 1970	Actual 1970	Forecast 1975	Forecast 1980
Private aircraft	6,277	7,488	7,853	10,015	13,071
Commercial aircraft	2,614	2,786	3,261	3,383	4,105
State aircraft	207	218	201	242	271
Totals aircraft	9,098	10,492	11,315	13,071	17,447
Private hours ('000)	603	686	710	851	1,056
Commercial hours "	1,503	1,775	1,649	2,474	3,321
State hours "	77	88	76	108	132
Totals hours "	2,183	2,549	2,435	3,433	4,509
Unit-toll hours "	448	464	409	578	717
Charter hours "	510	619	671	838	1,102
Specialty hours "	545	692	468	1,058	1,502

Source: Canadian General Aviation 1967-80, Ottawa: Queen's Printer, 1970.

TABLE 8.2. MOT Air Hub Classifications

Classification	Hub	Airports included
Major air hubs	Montreal	Beloeil, Bromont, Cartierville, Drummondville, Grantham, Granby, Granby Ouest, Joliette, Lachute, Montreal (Dorval), St. Antoine, St. Hubert, St. Hyacinthe, St. Germain, St. Jean, St. Jerome, (Ste. Scholastique), St. Thérèse, Sorel, Sweetsburg.
	Toronto	Brampton, Brantford, Buttonville, Downsview, Guelph, Hamilton, St. Catharines, Toronto Island, Toronto International (Malton), Toronto Maple, Waterloo/Wellington, Welland.
	Vancouver	Vancouver International, Pitt Meadows, Langley, Abbotsford.
Large air hubs	Calgary	Calgary International, Springbank
	Edmonton	Edmonton International, Edmonton Industrial.
	Halifax	Halifax International
	Ottawa	Ottawa International, Carp, Rockliffe
	Winnipeg	St. Andrews, Winnipeg International.
Other air hubs (medium) (small) (non-hubs)		Other airports, one per hub

Source: MOT.

TABLE 8.3. MOT Forecasts — Itinerant Aircraft Movements to 1990

Airport or air hub	Itinerant movements (1000) by year				
	Base 1968	Forecast 1970	Forecast 1975	Forecast 1980	Projection 1990
Montreal air hub	248	268	358	454	703
Toronto air hub	263	309	441	571	832
Vancouver air hub	233	261	409	642	1,620
Calgary	65	89	114	149	255
Edmonton air hub	105	114	147	181	249
Halifax	35	43	59	75	98
Ottawa	87	104	133	164	222
Winnipeg air hub	119	140	178	220	312
Baie Comeau	11	11	20	35	71
Fredericton	17	21	27	32	42
Gander	23	27	34	42	57
Lakehead	28	25	32	40	63
London	38	44	59	73	103
Moncton	30	32	39	46	59
Prince George	22	23	33	43	66
Quebec	49	58	78	99	140
Regina	37	38	45	52	66
Saint John (N.B.)	24	23	28	34	50
St. John's (Nfld.)	9	9	11	13	16
Saskatoon	34	37	49	61	84
Sault Ste. Marie	7	8	10	13	18
Sept-Îles	22	23	31	40	70
Sydney	9	8	9	12	16
Victoria	50	54	68	82	110
Windsor	23	29	37	45	61

Source: Air Transportation, Statistics/Forecasts, MOT, 1969.

TABLE 8.4. MOT Forecasts — Passenger Flow to 1990

Scheduled Services Only

Airport	Passengers enplaned X 2 (1000) by year				
	Base 1968	Forecast 1970	Forecast 1975	Forecast 1980	Projection 1990
Montreal(1)	3,736	4,348	6,687	9,817	19,300
Toronto(1)	4,808	5,250	8,037	11,647	21,550
Vancouver	1,959	2,225	3,494	5,627	12,148
Calgary	913	1,077	1,733	2,545	6,602
Edmonton	768	867	1,167	1,582	2,963
Halifax	546	626	1,008	1,621	3,500
Ottawa	659	718	1,105	1,622	3,200
Winnipeg	1,044	1,072	1,637	2,383	4,860
Baie Comeau	58	82	106	128	190
Fredericton	90	103	142	190	320
Gander	76	102	151	211	380
Lakehead	153	171	250	352	650
London	129	135	175	223	360
Moncton	183	212	286	383	625
Prince George	89	88	108	132	196
Quebec	233	282	377	504	900
Regina	234	263	355	450	670
Saint John (N.B.)	131	134	168	202	230
St. John's (Nfld.)	196	200	247	301	445
Saskatoon	184	195	273	380	680
Sault Ste. Marie	82	90	132	185	330
Sept-Îles	88	88	126	169	330
Sydney	99	117	166	211	310
Victoria	228	230	300	382	565
Windsor	161	187	267	355	580

(1) Includes present and planned international terminals.
Source: Air Transportation, Statistics/Forecasts, MOT, 1969.

TABLE 8.5. MOT Forecasts — Cargo Flow to 1990

Airport	Cargo enplaned plus deplaned(1)				
	Base 1968	Forecast 1970	Forecast 1975	Forecast 1980	Projection 1990
			tons		
Montreal(2)	75,000	92,000	219,000	522,000	2,730,000
Toronto(2)	63,000	81,000	193,000	460,000	2,200,000
Vancouver	29,000	50,000	135,000	336,000	1,758,000
Calgary	5,760	8,058	17,665	37,075	150,000
Edmonton	9,789	12,177	27,824	60,990	226,000
Halifax	5,035	5,095	11,642	25,519	94,600
Ottawa	2,860	4,142	9,470	20,750	76,000
Winnipeg	15,009	18,195	41,575	91,132	340,000
Baie Comeau	200	740	1,682	3,688	16,200
Fredericton	706	986	1,706	2,426	3,866
Gander	2,854	3,799	4,220	9,250	34,300
Lakehead	1,034	1,840	4,270	9,220	34,200
London	1,015	1,690	3,860	8,470	31,300
Moncton	5,316	10,050	22,960	50,330	186,000
Prince George	416	1,040	2,372	5,206	19,300
Quebec	1,508	2,244	5,241	11,486	42,600
Regina	1,987	3,644	8,304	18,202	67,500
Saint John (N.B.)	964	1,707	3,900	8,548	31,700
St. John's (Nfld.)	3,366	6,609	15,102	33,100	122,700
Saskatoon	1,177	1,410	3,217	7,059	26,200
Sault Ste. Marie	486	787	1,798	3,941	14,600
Sept-Îles	1,144	2,811	6,423	14,079	52,200
Sydney	806	858	1,960	4,296	15,900
Victoria	791	1,300	2,968	6,506	24,100
Windsor	2,098	4,244	9,697	21,255	78,800

(1) Scheduled services only
(2) Includes present and planned international terminals
Source: Air Transportation, Statistics/Forecasts, MOT, 1969.

GLOSSARY

AASR. — Airport and Airway Surveillance Radar. Long-range radar used in the ATC network.

AITA. — Air Industry and Transport Association. In 1961 AITA split to form ATAC (Air Transport Association of Canada) and AIAC (Air Industries Association of Canada). ATAC is an association of airlines forming the Canadian component of IATA, while AIAC is an association of Canadian aerospace manufacturers with headquarters in Ottawa.

ASR. — Airport Surveillance Radar. Short-range radar used by airport traffic control tower personnel for ATC within a 30-mile radius.

ATAC. — Air Transport Association of Canada. See also AITA.

ATB. — Air Transport Board. This was superseded in 1967 by the Air Transport Committee of the Canadian Transport Commission.

ATCA. — Air Traffic Controllers' Association. An association of Canadian controllers.

ATFERO. — Atlantic Ferry Scheme initiated by the Allies for shipping aircraft manufactured in North America to the European theatre during World War II.

AERODYNAMIC FORCES. — The four forces which must balance for an aircraft to maintain level forward flight. In the vertical direction, gravity forces must balance the lift force produced by the Bernoulli effect on the wings. The thrust produced by the propellers or jet exhaust must be sufficient to overcome the drag or air resistance. Streamlining refers to the design which produces the least drag, or by reducing the number of protuberances, disturbes the airflow the least. Some drag is unavoidable through friction between air molocules and the skin of the aircraft.

AERODYNAMIC STABILITY. — The ability to maintain stable, level flight, and to manoeuvre in a controlled fashion. There are three components to stability: roll, pitch, and yaw. Stability in 'roll' is maintained and controlled by the ailerons; 'pitch' is maintained by the dihedral angle of the wings, and controlled by the elevators; 'yaw' is maintained by the keel effect of the fuselage, and controlled by the rudder.

AIR CARGO. — All commercial air express and air freight exclusive of airmail and air parcel-post.

AIR CARRIER. — Aircraft operators licensed by CTC to transport by air, persons, property, and mail.

AIR CARRIER OPERATIONS. — Revenue and operating activities of all Canadian licensed air carriers.

AIR EXPRESS. — Generally a package goods service operated within the United States and Canada only. The rates cover door-to-door service, with the exception of some northern points. Because Air Express shipments are carried on all unit-toll flights and take priority over Air Freight and because Express shipments receive priority on the ground as well, higher-than-air freight rates are charged.

AIR FREIGHT. — Property other than express and passenger baggage transported by air, for which a standard tariff rate is charged per unit of weight or volume.

AIR TRAFFIC. — Aircraft in operation anywhere in the airspace or on that area of an airport normally used for the movement of aircraft.

AIR TRAFFIC CONTROL (ATC). — A service operated by MOT authorities to promote the safe, orderly, and expeditious flow of air traffic.

AIR TRAFFIC CONTROLLER. — A duly authorized person providing ATC service.

AIR TRAFFIC HUB. — A hub is the city and standard metropolitan statistical area requiring aviation services. It may include more than one airport.

AIR TRANSPORT COMMITTEE. — Part of the Canadian Transportation Commission. It is responsible for the economic regulation of commercial air transportation in Canada.

AILERONS. — A moveable part of an airplane wing usually on the trailing edge used to create a rolling motion.

AIRCRAFT ACCIDENT. — An incident involving serious injury or substantial damage. It also includes a missing aircraft. 'Substantial damage' is defined as that which effects the structural strength of the airplane necessitating major repair or replacement. It does not include all damage. A 'serious injury' is considered to be one involving hospitalization or a minimum five-day incapacity, and consisting of such things as unconsciousness, major fracture, severe bleeding, internal injuries, or extensive or deep burns. A 'fatal accident' is one in which death occurs within thirty days of an accident and is attributable to it.

AIRCRAFT INCIDENT. — Any occurrence causing damage to the plane or injury to persons on the plane, which occurs between the time the first person boards the plane with the intent to fly, and the time the last person deplanes at the destination.

AIRCRAFT MOVEMENT. — A takeoff or landing including simulated approaches by an aircraft.

AIRCRAFT OPERATING COSTS (TOTAL). — Operating costs consist of flying costs (salaries, wages, personnel expenses, fuel, oil, aircraft supplies, landing fees, etc.), maintenance costs (labour and materials, maintenance service purchased, overhaul provisions, and applied maintenance burden), and depreciation or rental.

AIRCRAFT OPERATING COSTS (DIRECT). — Total cost of flying the aircraft including fuel, oil, maintenance, depreciation, crew, rental, insurance, and damage reserve.

AIRCRAFT TYPE. — A term used in grouping aircraft by basic configuration, for instance, fixed wing, helicopter, glider, gyrocopter, balloon, etc.

AIRFOIL. — Any surface which can be used to control the airflow around an aircraft including wings, rudders, and ailerons.

AIRLINE. — Refers to a company involved in aerial transportation.

AIRPORT. — An area of land or water that is used or intended to be used for the landing or takeoff of aircraft, including buildings and facilities, if any.

AIRSCREW. — Propeller of an aircraft.

AIRSHIP. — A dirigible, motor-driven balloon, usually cigar shaped.

ARRIVING. — passengers, mail or cargo. The total passengers, mail, or cargo arriving on an aircraft at an airport. It includes traffic remaining on board aircraft as well as traffic deplaned.

AUTOGYRO. — A propeller-driven aircraft with a helicopter-like rotating wing, unpowered in flight, which may be powered for VTOL.

AVIATION FUEL. — Piston engines used in airplanes generally fly on high-octane gasoline. (The octane rating is a measure of fuel performance expressed as a percentage of the performance of iso-octane). Modern jet engines use refined kerosene or other light hydrocarbons which are generally cheaper than piston fuel.

AVIONICS. — Airborne electrical and electronic equipment, and avionic training aids.

BCATP. — British Commonwealth Air Training Plan. A World-War II plan for Allied pilot training in Canada.

BVD. — Beacon Video Digitizer. A new computerized flight data system being implemented in Canada.

BALLOON. — A lighter-than-air aircraft.

BLOCK HOURS. — Refers to the duration of a flight along a specific route from the time the blocks are removed at a terminal and the aircraft commences taxiing to the time the blocks are set in place at the airplane's destination.

CAT. — Clear Air Turbulence.

CGTAS. — Canadian Government Trans-Atlantic Air Service. A World War II service flying mail and passengers across the Atlantic.

CPI. — Crash Position Indicator. A device carried by airplanes, capable of emitting 40-mile radio signals to indicate to search vehicles with receivers, the position of a downed aircraft.

CTC. — Canadian Transport Commission, responsible to the Minister of Transport.

CTOL. — Conventional Takeoff and Landing aircraft. Most of the commercial planes now in service fall into this category.

CANTILEVER CONSTRUCTION. — A system of internal aircraft support based on overlapping surfaces. Essentially it relieves the necessity for external braces, struts etc., thus increasing the stream lining of the aircraft.

CERTIFICATE OF AIRWORTHINESS. — In Canada there are two different certificates of airworthiness issued by the MOT: one, at the manufacturer's expense, approving the type design of an aircraft; the other must be applied for annually by the owner of each aircraft, and involves a mechanical inspection of the aircraft by a certified mechanic, and a test flight by a specially certified pilot.

CHARTER TRANSPORTATION. — Public transport of passengers or goods from a designated base at a toll per mile or per hour for the hire of all or part of the capacity of an aircraft.

CITY-PAIR. — A method of presenting statistical data which is used to show the volumes of traffic flown between specific cities.

CIVIL AIRCRAFT. — General term covering all non-military aircraft.

CIVIL AVIATION. — All flying performed by civil aircraft.

CLASS OF SERVICE. — Refers to the license authority under which a carrier is authorized by the CTC to provide a service.

CONTROLLED AIRSPACE. — A portion of airspace assigned for special use by the ATC.

DBS. — Dominion Bureau of Statistics — The name was changed in summer, 1971, to Statistics Canada.

DOD. — Directional Origin and Destination. Passenger itineraries other than one-way trips, are broken into one-way journeys. Itineraries are broken at the farthest point from the origin, for example, a trip Montreal-Toronto-Vancouver-Toronto-Montreal is thus counted as two trips, one originating in Montreal with destination Vancouver and one trip originating in Vancouver with destination Montreal.

DOT. — Department of Transport, now known as the Ministry of Transport (MOT).

DEFENSE AEROSPACE PROGRAM. — A program jointly undertaken by Canada and the United States for the co-operated research, design, and manufacture of military aircraft. It involves the Defense Production-Sharing Program of 1959, the Defense Industry Development Sharing Program of 1959, and the Defense Industrial Research Program of 1962.

DEPARTING. — passengers, mail or cargo. The total passengers, mail, or cargo aboard an aircraft departing from an airport. It includes traffic remaining on board aircraft as well as traffic enplaned.

DEPLANED. — passengers, mail, or cargo. The total passengers, mail, or cargo off-loaded from an aircraft at an airport. It includes interline and intraline transfers, and traffic stopping over, as well as traffic terminating at an airport.

DESTINATION. — The last point in the itinerary and the last point at which the passenger is to deplane at the completion of the journey. In round trips, the destination and the origin are the same.

DEVELOPMENTAL AIRPORT. — Refers to a landing area specifically used for remote development and exploration purposes.

DOMESTIC. — Refers to traffic beginning and terminating in the provinces and territories of Canada, and to traffic flown between city-pairs in Canada.

DOMESTIC OPERATIONS. — In general, commercial air services within or between the provinces and territories of Canada.

ENPLANED. — passengers, mail, or cargo. The total passengers, mail, or cargo put onto an aircraft at an airport. It includes interline and intraline transfers, and traffic that has stopped over, as well as traffic originating at an airport.

EXCESS BAGGAGE. — Baggage which, in terms of weight, number of pieces or size, exceeds the free baggage allowance stated in the air carrier's tariffs and for which a charge is levied.

EXPORTS. — Include both goods which are wholly produced in Canada and goods previously imported which have been changed in form by further processing in Canada, then exported, as well as re-exports consisting of goods previously imported and being exported in the same form.

FIXED-WING AIRCRAFT. — Aircraft having wings fixed to the airplane fuselage and outspread in flight — that is, non-rotating wings.

FLIGHT SIMULATOR. — An apparatus designed for training and research purposes — as accurate a working model of an aircraft in flight as possible without actually taking off.

FOREIGN AIR CARRIER. — Airlines with headquarters outside Canada.

GLIDER. — Any airplane without an engine.

GOODS. — Air cargo (freight and express) plus mail and excess baggage.

HELICOPTER. — A heavier-than-air aircraft that derives lift from one or more revolving "wings", or blades, engine-driven about an approximately vertical axis. A helicopter does not have conventional fixed wings, nor in any but some earlier models is it provided with a conventional propeller for forward thrust.

HELICOPTER CARRIERS. — Air carriers employing helicopter aircraft for their primary operations.

HELIPORT. — An area of land, water, or any structure approved by the MOT for the landing and takeoff of helicopters.

IATA. — International Air Transport Association. An international association of airlines responsible for coordinating international air fares. Its decisions are subject to approval by the governments of the countries that would be affected by IATA air fares.

ICAN. — International Convention for Air Navigation. The international organization of 1919 which was the forerunner of ICAO.

ICAO. — International Civil Aviation Organization. A specialized agency of the United Nations responsible for developing a standardized system for matters such as air navigation, licensing, safety, and landing procedures. Its headquarters are in Montreal.

IFR. — Instrument Flight Rules. These are rules controlling the altitude and flight path of an aircraft wholly or in part by reference to instruments.

ILS. — Instrument Landing System. A landing approach made without visual reference to the ground by using instruments and/or radio guidance.

INSTRUCTIONAL FLYING. — Any use of an aircraft for the purposes of formal instruction with the flight instructor aboard, or with the manoeuvers on the particular flight specified by the flight instructor.

INTERLINE TRANSFERS. — Traffic interchanged at an airport between one airline and another.

INTERNATIONAL. — Refers to traffic originating or terminating in Canada destined to or originated from foreign countries, and traffic flown between Canadian and foreign airports.

INTERNATIONAL MOVEMENTS. — Movements at a Canadian airport departing to or arriving from a point outside Canada. International movements are subclassified into 'transborder' (to or from a point in the United States), and 'other international' (to or from points in other countries). Note that as aircraft movements are reported on the basis of "place arrived from" or "departed to", an arrival at Montreal airport from London, England, would appear under 'international other'. If the same aircraft moved on to Toronto, both the departure at Montreal and the arrival at Toronto would be shown as 'domestic'.

INTERNATIONAL SERVICES. — Relate to commercial air services involving transportation between a point or points in Canada and a point or points outside of Canada.

INTRALINE TRANSFERS. — Traffic interchanged at an airport between one flight of an airline with another flight of the same airline.

ITINERANT MOVEMENT. — One in which the aircraft enters or leaves the airport tower control zone.

ITINERARY. — All points in the passenger journey, beginning with the origin, followed by the routing, and ending with the destination, in the sequence shown in the fare ladder section of the coupon. The 'coupon' is each of the component parts of a ticket containing separate travel authority for the different trip segments of the total travel covered by the passenger ticket.

JET ENGINE. — A turbine utilizing the energy from its internal gas stream to provide direct propulsion. A 'fan-jet' engine or turbofan is a modified turbojet engine capable of producing much more thrust by expelling a greater volume or weight of cooler gas. This more efficient jet is the result of cold air being added by a turbine-driven, ducted fan, to the jet of hot gas produced by the engine.

LOCAL AIRPORT. — Serving for a community's purposes only, for instance, private and recreational flying, flight training, etc.

LOCAL MOVEMENT. — One in which the aircraft remains at all times within the airport tower control zone.

MOT. — Ministry of Transport.

MAINLINE SERVICE. — A unit-toll operation usually having a considerable degree of regularity, and one in which the service is generally listed in a published timetable and performed according to a filed service pattern. The term 'mainline' was developed for internal use by the Government to permit classification of air traffic. In determining whether a service falls within the mainline concept, consideration is also given to the overall frequency of flights at the airports concerned and the type and degree of surface transportation serving the points.

NAE. — National Aeronautical Establishment. The body primarily responsible for space research in Canada.

NASA. — National Aeronautics and Space Administration of the United States of America.

OPERATING REVENUE. — Revenues from the performance of air transportation and related incidental services. It includes (1) transport revenues from all classes of traffic and (2) non-transport revenues consisting of payments under the National Transportation Act (where applicable) and the net amount of revenues less related expenses from services incidental to air transportation.

ORIGINATING LOAD. — Revenue passengers, mail, express, freight, and excess baggage which entered the carrier's system for the first time at the reporting station. This will include the true originations that is, point at which the person's journey commenced with the scheduled airlines, as well as traffic connecting from other airlines.

ORNITHOPTER. — A flying device using a flapping wing effect. As yet no effective ornithopter has been developed.

PAR. — Precision Approach Radar. A precision approach is an instrument approach conducted in accordance with directions issued by a controller referring to the surveillance radar display until the aircraft is turned onto final approach, and thereafter, to a precision approach radar display.

PASSENGER. — Refers to revenue passengers only, and includes passengers paying half-fare or more, but does not include infants in arms.

PASSENGER DESTINATION. — The last point in an itinerary in the case of one-way trips. Usually it is the furthest point from origin in round trips.

PASSENGER LOAD FACTOR. — The number of revenue passengers on board an aircraft compared to the total seats available for sale. Usually it is expressed in percentage form.

PASSENGER-MILE. — A passenger-mile represents the carriage of one passenger for one mile. Passenger-mile figures are obtained by totalling the number of miles flown by each passenger.

PASSENGER ORIGIN. — The point where the passenger first boards an an airline at the beginning of his itinerary.

PEAK DAY. — The day with the greatest number of occurences in any given period.

PEAK HOUR. — The hour with the greatest number of occurrences in any given period.

PISTON-ENGINED AIRCRAFT. — An aircraft operated by engines in which pistons moving back and forth work upon a crank shaft or other device to create rotational movement.

PITCH. — The angle of the blades of a propeller to the airstream. A 'Variable Pitch Propeller' has its blades pivoted to the hub so that the pitch can be changed in flight either automatically or by manual control.

PLANE-MILE. — The miles (computed in airport-to-airport distances) for each inter-airport flight actually completed, whether or not performed in accordance with the scheduled pattern.

POINT. — A city or airport.

POWERPLANT. — The source of propulsion, for example, piston engines, jet-turbine-driven propellers, jet engines without propellers.

RCFCA. — Royal Canadian Flying Clubs Association, the Canadian Flying Clubs Association (CFCA) until the end of World War II.

RCNAS. — Royal Canadian Naval Air Service, disbanded after World War I.

RADIAL ENGINE. — An engine having stationary cylinders arranged radially around a common crankshaft.

REGIONAL CARRIER. — Any Canadian airline designated by the Ministry of Transport as a "regional carrier". The regional carriers are Pacific Western Airlines, Transair, Nordair, Quebecair, and Eastern Provincial Airways, as of the summer, 1971.

REVENUE HOURS FLOWN. — The aircraft hours of flights, inclusive of all cargo flights, performed in revenue service. Aircraft hours are the airborne hours computed from the moment an aircraft leaves the ground until it touches the ground at the end of the flight.

REVENUE PASSENGERS. — A person receiving air transportation from an air carrier for which remuneration is received by the air carrier. Infants in arms and air carrier employees or others receiving air transportation for which standard tickets are not issued, (for example, non-contingent passes issued to airline employees, and persons from whom no fare is collected), are considered as non-revenue passengers.

ROTARY ENGINE. — One in which the cylinders revolve around a fixed crankshaft in order to produce a cooling effect. The propeller rotates around the crankshaft and is driven by attachment to the crank case.

ROTARY-WING AIRCRAFT. — Helicopters and autogyros.

ROUTE (OF AN AIRCRAFT). — The path taken by an aircraft from its flight origin to flight destination including all intermediate points of landings and takeoffs, whether to deplane or enplane traffic, or for technical reasons.

SAC. — Soaring Association of Canada.

SSR. — Secondary Surveillance Radar. An auxiliary radar used for ATC.

SST. — Supersonic Transport. This is a transport plane capable of flying faster than the speed of sound, that is, faster than 760 miles per hour at sea level, in standard atmosphere, or faster than 660 miles per hour at an altitude of 40,000 feet.

STOL. — Short Takeoff and Landing. Fixed-wing aircraft utilizing aerodynamic augmentation devices to achieve short takeoff and landing are known as STOL aircraft.

SAILPLANE. — A glider that can soar.

SCHEDULED AIR CARRIERS (DIRECT). — Air carriers which offer public transportation of persons, mail, and/or goods by aircraft, serving specific points in accordance with a service schedule, and at a toll per unit.

SCHEDULED MILES AND HOURS. — This term relates to the number of miles and hours scheduled but not necessarily flown on unit toll services according to the carrier's operating schedule.

SEAT-MILE. — Product of the number of available seats times the length of the trip, in miles.

SIMULATED APPROACH. — A practice instrument approach without a landing.

SOARING. — Sustained flight in a glider through periodic risings in updraft aircolumns.

SOUTHERN SERVICES. — Services between Canada and the rest of the Western Hemisphere excluding the United States.

SPECIALTY FLYING. — Consists of activities such as sightseeing, flight training, aerial photography, and survey, etc., or other types of flying which do not involve the transport of passengers or goods from one place to another.

STOPOVER. — For the purposes of this handbook, an intermediate stop in an itinerary where the passenger arrives and departs from a point on different days.

STREAMLINING. — See AREODYNAMIC FORCES

TACAN. — Tactical Air Navigation. A military radio beacon.

TOD. — Ticket Origin and Destination. The complete record of a passenger's itinerary showing all cities where a stopover or connection was made. The volume of traffic originating at Canadian cities is obtained by accumulating all the first points of itineraries.

TOPS. — Trans-Oceanic Plane Stop. A plan designed to increase business at Canadian airports by attracting fuel/maintenance stops of trans-oceanic flights enroute to the American west coast from Europe.

TON-MILE. — One short ton (2,000 pounds) transported one statute mile (5,280 feet). Ton-miles are computed by multiplying the aircraft miles flown on each inter-airport flight by the number of tons carried on that hop.

TONNE-KILOMETER. — A metric measurement used by ICAO. It is one metric ton (1,000 kilograms or approximately 2,200 pounds) moved one kilometer (.6214 statute miles).

TORQUE. — The rotational effect produced by a piston engine which tends to turn the entire airplane in a direction opposite to the one in which the propeller is turning.

TRANSBORDER SERVICES. — Services between points in Canada and Alaska, and Canada and the continental United States.

TURBOJET. — Turbine-powered aircraft. Aircraft operated by jet engines incorporating a turbine-driven air compressor to take in and compress the air for the combustion of fuel, the gases of combustion (or the heated air) being used both to rotate the turbine and to create a thrust-producing jet.

TURBOPROP. — Turbine-powered aircraft. Aircraft operated by turbine-propelled engines. The propeller shaft is connected to the turbine wheels which operate both the compressor and the propeller.

TURBO SUPER-CHARGER. — A super-charger is a device for compressing air before it is introduced into an engine — useful in high-altitude flying. In a turbo super-charger, the compressor is driven by a turbine which is in turn driven by the exhaust gases. This was the direct forerunner of the turbine-compound, and the indirect forerunner of the turboprop, engines.

UNDERCARRIAGE. — The skiis, floats, wheels, etc., on which an aircraft lands, along with associated braces. The invention of the retractable undercarriages did much to improve streamlining, while the introduction of tricycle landing gear (providing a strong, three-point support for wheels on many large aircraft) allows designers to combine the advantages of retractable landing gear with the strong construction needed for hard breaking.

UNIT-TOLL. — The public transportation of persons, mail, and/or goods at a toll per unit.

VFR. — Visual Flight Rules. Standard rules governing flying without reference to instruments.

VOR. — Very High Frequency Omni-Directional Ranges. An updated, directional radio range.

V/STOL. — Vertical Short Takeoff and Landing aircraft.

VTOL. — Aircraft capable of Vertical Takeoff and Landing.

VALUE-ADDED. — That portion of the value of a manufactured product which is added by the process of manufacturing, that is, the difference between the final selling value and the cost of the materials which went into the product.

WEIGHT CLASS. — The normal, maximum gross takeoff weight of the aircraft type in thousands of pounds, rounded upwards. Thus, 2,200 pounds would be classed as 3,000 pounds.

WEIGHT GROUP. — The classification of weight classes in groups for statistical purposes.

WEIGHT LOAD FACTOR. — Total revenue ton-miles (passengers and goods) performed, expressed as a percentage of available ton-miles. The numbers of passengers are generally converted to pounds by a multiplication factor of 200 pounds per person, including allowance for free baggage accompanying the passenger.

WIND TUNNEL. — A device for producing an airflow at aircraft speeds in which airplane models or parts of aircraft are tested for efficiency and serviceability.

WING FLAPS. — Hinged sections on the trailing edge of the wing between the fuselage and the aileron, used to slow the speed in landing and sometines to improve lift for STOL week.

WING LOADING. — The gross weight of the plane fully loaded divided by the total area of the lift-producing surface.

BIBLIOGRAPHY

General

Ashley, C.A., The First Twenty-Five Years, Toronto: The MacMillan Company of Canada Ltd., 1963.

Canadian Regional Air Carriers, Long Beach, California: Douglas Aircraft Company, November, 1969.

Civil Aeronautics Board, Aircraft Operating Cost and Performance Data, Washington: United States' Government Printing Office, vol.IV, August, 1970.

Conoley, Ken, Airlines, Airports, and You, Don Mills: Longmans, 1968.

Cotterell, Howard C., The Regional Air Carriers' Problem, Ottawa, February, 1967.

Currie, A.W., Canadian Transportation Economics, University of Toronto Press, 1967.

FAA Statistical Handbook of Aviation, Washington: DOT, 1969.

Gentle, Ernest J. ed., Aviation and Space Dictionary, Los Angeles: Aero Publishers, Inc., 1961.

Gordon, John, Winged Sentries, Ottawa, 1963.

*International Transport Association, Operations and Economics in the 1970's, London: British Air Pilots' Association, November 24th, 1964.

*Financial and Economics Sub-Committee, Economics of Air Cargo Carriage and Service, Montreal, IATA, 1969.

International Civil Aviation Organization, Airport Traffic, 1969, Montreal, ICAO Digest No. 153.

Financial Data, 1969, Montreal: ICAO.

*A Review of the Economic Situation of Air Transport, 1960-1970, Montreal: ICAO, April, 1971.

Institute for Aerospace Studies, An Assessment of STOL Technology, University of Toronto, July, 1970.

McNally, Rand ed., World Atlas, Chicago: Rand McNally, 1968.

Main, J.R.K., Voyageurs of the Air, Ottawa, Queen's Printer, 1967.

Manchester, Lorne, Canada's Aviation Industry, New York: McGraw-Hill Company of Canada Limited, 1968.

*Miller, Ronald and David Sawers, The Technical Development of Modern Aviation, London: Routledge and Kegan Paul, 1968.

Munson, Kenneth, Civil Airlines Since 1946, London: Blandford Press, 1967.

National Aeronautical Collection, Ottawa: Queen's Printer, 1967.

*Research Analysis Corporation, Cost Analysis of Supersonic Transport in Airline Operation, vol. III, McLean, Virginia: Research Analysis Corporation, December, 1966.

*Schriever, Bernard A. and William W. Seifert, cochairmen, Air Transportation 1975 and Beyond: A Systems Approach, Cambridge, Massachusetts: The M.I.T. Press, 1968.

Sealy, Kenneth R., The Geography of Air Transport, London: Hutchinson University Library, 1966.

Straszheim, Malton R., The International Airline Industry, Washington: Brookings Institute, 1969.

*Stratford, Alan H., Air Transport Economics in the Supersonic Era, New York: Martin's Press, 1967.

Taylor, John W.R. ed., Jane's All the World's Aircraft, Scarborough, Ontario: McGraw-Hill Company of Canada, 1966-71 editions.

Urquhart, M.C. ed., Historical Statistics of Canada, Toronto: The MacMillan Company of Canada Limited, 1965.

* Indicates sources used in Chapter VIII projections.

*Wallace, R.S., A Domestic Multi-Modal Goods Distribution Model with Emphasis on Air Cargo, Waterloo, Ontario: Transport Group, Department of Civil Engineering, University of Waterloo, February, 1971.

World Survey of Civil Aviation, Canada 1970, Washington: U.S. Government Printing Office, June, 1970.

Government Publications

*Canadian General Aviation 1967-1980, Ottawa: Queen's Printer, 1970.

Department of Energy, Mines and Resources, Canadian Aerodrome Directory, Ottawa: Queen's Printer, annual reports, 1967-70.

Canadian Transport Commission, Directory of Canadian Commercial Air Services, August, 1970.

Department of Industry, Inventory of Capabilities and Resources of the Canadian Aerospace Community, Ottawa, August, 1967.

*The World Market for Aerospace Products, 1965-75, Ottawa, June, 1966.

Ministry of Transport, Ottawa, Air Traffic Control, quarterly reports, 1967-71.

--, Air Transportation, Statistics and Forecasts, 1969.

--, Aircraft Movement Statistics, monthly and annual reports, 1960-70.

--, Aviation Statistics Centre Fleet Reports, quarterly reports, 1970-71.

--, Annual Reports, 1936-70.

--, Canadian Civil Aircraft Registry, quarterly reports, 1960-70.

--, Air Transport Board, Airline Passenger Origin and Destination Statistics, annual and domestic reports, 1960-70, transborder reports, 1968-69.

--, Air Transport Committee, Research and Special Projects Section of the Economics Division, Aircraft Movements and Traffic in the Northwest Territories, 1968, February, 1970.

*--, Board of Transport Commissioners for Canada, Economics and Accounting Branch, Transportation in the Year 2000, January 31st, 1967.

--, J.A. Wilson. Development of Aviation in Canada, 1879-1948, n.d.

Public Accounts of Canada, Ottawa: Queen's Printer.

Statistics Canada (1), Ottawa, Air Carrier Financial Statements, annual reports, 1960-70, cat. no. 51-206

--, Air Carrier Operations in Canada, 1970, cat. no. 51-002.

--, Air Passenger Origin and Destination, Domestic Reports, 1968-70, cat. no. 51-204; Canada-US Report, 1969, cat. no. 51-205

--, Aircraft and Parts Manufacturers, annual reports, 1960-68, cat. no. 42-203.

--, Canada Year Book, 1969, cat. no. 11-205.

--, Civil Aviation, 1936-69, cat. no 51-202.

--, Exports by Mode of Transport, 1960-69, cat. no. 65-206.

(1) Prior to Summer, 1971, 'Statistics Canada' was the 'Dominion Bureau of Statistics'.

--, International Air Charter Statistics, 1970, cat. no. 51-003.

--, Trade of Canada, vols. I and II, cat. nos. 65-202, 65-203.

--, Transcontinental and Regional Air Carrier Operations, monthly reports, 1960-70, cat. no. 51-001.