Hopping the Pond:

The Normalization of North Atlantic Civil Aviation

from its Origins to the Rise of the Jumbo Jet, 1919-1970

By

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Abstract

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Flight across the North Atlantic is a routine process now, with thousands of flights carrying millions of passengers between Europe and North America every year quickly, safely, and affordably. By some measures it remains the busiest international flight corridor in the world and the most profitable for airlines. Yet there were no planes capable of making the flight a mere century ago. Aviation underwent a period of rapid development and expansion during the twentieth century that transformed the North Atlantic from a barrier into a central corridor in the global air network. This dissertation examines the development of civil aviation on the North Atlantic from 1919 to 1970, focusing on political, economic, and technological factors. Transatlantic flight was a focus of aviation but the earliest planes lacked the range needed to make the crossing. Technological improvements let pioneering aviators cross the ocean by 1919, proving that it was possible though difficult without further advances. Infrastructure also needed to be further developed since the North Atlantic was a hostile environment, with bad weather and limited facilities for aircraft in emergencies. Until 1945, the governments of the North Atlantic region thoroughly explored, studied, and built the infrastructure to make regular transatlantic possible. Postwar, governments supported their airlines through further infrastructural improvements, subsidies, by funding aeronautics, and by complex negotiations with foreign countries to open the skies to passenger travel. By 1970, transatlantic flight was a routine endeavour enjoyed by the masses and supported by systems invisible to the average traveler.

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Introduction

This dissertation focuses on the development of transatlantic flight from the first experimental flights until the time passenger travel became routine and widely available, 1919-1970. The twentieth century was a time of unprecedented technological progress, with powered flight being one of the most revolutionary sectors. Aviation embodied the popular perception that high technology could literally bring people across the world closer together, transcending traditional notions that long distance travel must be a time consuming and expensive process. By the mid-twentieth century, air travel began to offer the common man the chance to cross continents and oceans in mere hours and at a reasonable cost. The wispy patchwork of contrails on a clear day is a testament to the ubiquity of airplanes in modern society and the huge demand there is for such travel. Businesspeople travel for meetings in another city and fly home in a single day. Priority goods and mail can be delivered anywhere in the world at close to the speed of sound. Tourism has flourished as the middle classes took to the skies in ever greater numbers, seeking vacation experiences that were inconceivable a generation before. Why rent a cottage close to home for a week when Miami Beach or the French Riviera was within reach? The airplane made the world far smaller, spurring travel, trade, and tourism. As political scientist Robert Strausz-Hupé said in 1953, "The impact of aviation upon the entire economic, social, and political structure of civilization has shattered traditional concepts of space and time."[1]

Airlines were the vanguards of this new world order. Widely seen as a prestigious enterprise, combining the latest technology with expansive trade links,[2] airlines became symbols of national pride. As American musician Frank Zappa quipped, "you can't be a real country

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[1] Robert Strausz-Hupé, "Aviation and International Co-Operation," *Annals of the American Academy of Political and Social Science* 299, Air Power and National Security (May 1955), p. 134.

[2] Oliver J. Lissitzyn, "The Participation of the United States in World Air Transport: Statistics and the National Interest," *Journal of Air Law and Commerce* 28, no. 1 (Winter 1961-1962), p. 5.

unless you have a beer and an airline".[3] Fermented beverages notwithstanding, governments around the world subscribed to the notion that air travel was a quintessential component of a modern, developed economy. A country without an airline risked being seen as backward or weak. Warding off this spectre was costly but the benefit was prestige. This idea was in vogue as recently as the 1970s when international law expert Andreas F. Lowenfeld claimed:

> [I]nternational civil aviation is a serious problem in international relations, affecting the way governments view one another, the way individual citizens view their own and foreign countries, and in a variety of direct and indirect connections the security arrangements by which we live.[4]

A country with an airline might expect several direct benefits. The government could direct its airline to attract foreign revenue (often in hard currency) from flights beyond its borders, and as a reserve of planes for national emergencies or military applications (transportation, makeshift bombers, or simply to keep pilots' skills fresh). Countries might enjoy secondary benefits by fostering an airline. For example, a government could mandate its national airline to buy aircraft made by a domestic aeronautics industry, which could create a pool of skilled high tech workers to sustain the domestic aerospace sector.[5] By the 1960s, an airline's main role was to carry the growing number of passengers to places near and far. Between 1919 and 1969 commercial air travel matured from an embryonic service into a reliable, globe-spanning industry. During that time, annual passenger numbers climbed from just 3,500 to over 300 million while revenue passenger-kilometres (RPK), the total distance in kilometres flown by all passengers combined, rose from 700,000 to 350 billion. Average flight

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[3] The full quote was slightly more general but no less tongue-in-cheek: "Every major industrialized country has **A BEER** (you can't be a **Real Country** unless you have **A BEER** and an **airline** -- it helps if you have some kind of a *football team*, or some *nuclear weapons*, but *at the very least* you need **A BEER**) [emphasis in the original source]. Frank Zappa, *The Real Frank Zappa Book* (New York: Simon & Schuster, 1989), p. 231.

[4] Andres F. Lowenfeld, "A New Takeoff for International Air Transport," *Foreign Affairs* 54, no. 1 (October 1975), p. 36.

[5] A vibrant domestic aerospace sector might also benefit a country's military. Stephen Wheatcroft, *Aviation and Tourism Policies: Balancing the Benefits* (London: Routledge, 1994), p. 19-20.

distances similarly grew from about 200 to 1,170 kilometres during that time. The size of the planes reflected this growth. A passenger aircraft in 1919 might hold a single paying customer but by 1969 an average flight carried more than fifty people and the Boeing 747 "jumbo jet", which began service in 1970, could accommodate over four hundred passengers.[6]

The Holy Grail for commercial air service is the North Atlantic route between Europe and North America. Many airlines count it the most important part of their networks, and by some measures it remains the most heavily traveled international air corridor.[7] The prospect of rapid travel above the Atlantic spurred the development of bigger, faster aircraft to connect the peoples of Europe and North America. As early as 1932, J.A. Wilson, the controller of civil aviation in the Canadian Department of National Defence, wrote that:

> [The] North Atlantic crossing is by far the most important trade route in the world. It joins the greatest industrial districts of the new and the old world. On it, if anywhere, will be found traffic sufficient in volume and value to justify the addition of an air service to the transportation facilities now serving the needs of its trade and commerce.[8]

Some of the routes above the North Atlantic serve more passengers than entire airlines can carry; the New York to London route alone accounted for over 3 million passengers in 1989, with several other transatlantic city pairs counting over one million travelers.[9]

Even today, the North Atlantic is the busiest airspace in the world, as about 425,000 planes passed through North Atlantic airspace annually as of 2007,[10] and it is by far the most

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[6] John C. Leslie, "International Air Transport Association: Some Historical Notes." *Journal of Interamerican Studies and World Affairs* 13, no. 3/4 (July-October 1971), p. 324.

[7] British Airways ran fully 38% of its international traffic by RPK to the United States and Canada (British Airways accounted for about 40% of all North Atlantic air traffic by European airlines in the 1990s). Robert Espérou and Alexandra Subrémon. *La Politique communautaire de transport aérien* (Paris: Presses universitaires de France, 1997), p. 74-5.

[8] David Clark MacKenzie, *Canada and International Civil Aviation 1932-1948* (Toronto: University of Toronto Press, 1989), p. 23.

[9] Donald E. Lundberg, and Carolyn B. Lundberg. *International Travel and Tourism, Second Edition*. Toronto: John Wiley & Sons, Inc., 1993), p. 71.

heavily traveled international air corridor. Flights between Europe and North America cross through this region as they loosely trace the same path set down by the ocean liners of old. Those ships carried millions of people across the ocean and in so doing forged an indelible connection between the two continents. The United States' major airlines followed the lead of the ocean liners as expanded across the globe but they could have directed their principal route structure south into Latin America or west across the Pacific to Asia rather than east to Europe. Each region was in reach of air travel by the late 1930s but out of those three Europe offered the airlines the greatest growth prospects. Europe had the highest per capita wealth outside of North America that passenger services required to thrive. Furthermore, the peoples on both sides of the Atlantic shared a common heritage, traded heavily with one another, and sailed to visit relatives when they could afford to make the long crossing. Neither Latin America nor Asia had the close ties with the people of North America as did Europe, be it economically or genealogically. Colloquially, the North Atlantic is sometimes referred to as "The Pond" by the British or North Americans, expressing the idea that this part of the ocean represents just a small gap between the two lands and their inhabitants.

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[10] Daniel Medina, *Geographic Load Share Routing in the Airborne Internet* (Herbert Utz Verlag, 2011), p. 6. It is widely acknowledged that the North Atlantic is an extremely busy flight corridor, but there are often qualifiers attached to descriptions of whether it is the "busiest" corridor overall and how to define such assessments. For example, Park et al. calls the region the "largest intercontinental market," with 12.6% of all passengers on international flights in 1994. Jong-Hun Park and Anming Zhang. "An Empirical Analysis of Global Airline Alliances: Cases in North Atlantic Markets," *Review of Industrial Organization* 16, no. 4 (June 2000), p. 369-70. The North Atlantic is a region spanning millions of square kilometres, so the number of flights is higher than others in part because many pass through some part of the region (i.e. a route between Miami and Madrid is lumped together with a route between Montreal and Frankfurt, even though the routes do not intersect and do not include the same countries). Other regions of similar size may have higher overall flight numbers (eg. North America, Western Europe, Eastern Asia) but are not considered to be a single region in the same sense due to political (or other) divisions. Bill Carey, "North Atlantic Trials Demonstrate Fuel, Emissions Reductions," *Aviation International News*, retrieved from: http://www.ainonline.com/aviation-news/air-transport/2011-09-02/north-atlantic-trials-demonstrate-fuel-emissions-reductions (November 19, 2015). Other sources consider the region as merely the busiest *oceanic* airspace in the world: Ian MacLeod, "Canadian technology extends radar's reach over Atlantic," *Ottawa Citizen*, April 4, 2012, p. A3; Daniel Medina, *Geographic Load Share Routing in the Airborne Internet* (Herbert Utz Verlag, 2011), p. 54.

The idea of a common Atlantic community, consisting of people's shared ancestry across both sides of the ocean, emerged long before NATO subsumed the term. The American writer and political commentator Walter Lippmann expressed this idea several times, including in 1943 when he stated: "[t]he Atlantic Ocean is not the frontier between Europe and the Americas. It is the inland sea of a community of nations allied with one another by geography, history, and vital necessity."[11] The idea that the northern portion of the Atlantic Ocean is a clearly defined region is a social construct that reflects its importance to both Europeans and North Americans since there is no physical boundary that separates it from the waters to its south. Some definitions consider the North Atlantic to extend as far south as the equator while others emphasize the importance of only the waters north of about 30 degrees north latitude, where passenger ships historically plied the seas between Europe and North America. All three of the North Atlantic air routes explored for commercial service during the 1920s and 1930s lay north of 30 degrees as well, while the regular air service that emerged after the Second World War were almost entirely operated north of 40 degrees north. Historical flows of explorers and people defined the region: Christopher Columbus sailed the North Atlantic on his voyages to the New World in the late fifteenth century, the British and French built colonial empires in North America and the Caribbean by sailing the North Atlantic currents, and millions of Europeans immigrated to the United States and Canada by crossing through this region. With the beginning of the Cold War

[11] G. John Ikenberry, *Liberal Leviathan: The Origins, Crisis, and Transformation of the American World Order* (Princeton University Press, 2012), p. 186; Valérie Aubourg, Gérard Bossuat, and Giles Scott-Smith, eds. *European Community, Atlantic Community?* (Paris: Soleb, 2013). Walter Lippmann's piece in "The Defense of the Atlantic World," *The New Republic* 10, no. 120 (1917), p. 59-61, may have been the first use of the term Atlantic community in this context. The use of the term predates 1917, as noted by Sir George Edward Gordon Caitlin, *Creating the Atlantic Community* (Great Britain: Fabian Society, 1884). The idea that cultural or familial linkages were strong and spanned the ocean certainly was not new. The idea of creating new linkages between the peoples of North America and Europe through tourism, and so building a new North Atlantic Community, also gained popularity in the postwar era both as a way of balancing payments between the United States and its European allies and as a hedge against communist influence in Europe. See: Christopher Endy, *Cold War Holidays: American Tourism in France* (Chapel Hill, NC: University of North Carolina Press, 2004), p. 100-24.

and the emergence of NATO, the North Atlantic as a concept became subsumed in the military alliance; the very term NATO stands for North Atlantic Treaty Organization, enshrining the alliance's geographical importance.

A centuries-old community made the North Atlantic into a well defined space in the minds of the North Americans and Europeans who shared a common ancestry. The peoples of the countries ringing the North Atlantic were among the wealthiest in the world and could easily afford leisure travel to a degree that was unparalleled during the twentieth century, affording them the opportunity to travel to visit their kin or homelands, or simply as tourists. Even transatlantic business travel became a viable option. Americans in particular were highly mobile, eager to travel far for leisure and consequently were the biggest driving force behind passenger ship travel during the early twentieth century. But passenger ships were successful on the North Atlantic in part for a lack of alternatives. Airlines recognized the potential of this route by looking to the example set by the ocean liners and once they added planes able to make the crossing to their fleets, airlines expected a ready-made market to defect to the faster form of transportation. With a market so large and, consequently, so much money at stake, airlines and the governments that supported them did everything in their power to make the crossing not just a reality but a safe and reliable corridor, one to rival any other in the world.

The North Atlantic Ocean's transformation into a central part of the world's air travel network was a complex and multifaceted process. Crossing the ocean safely, especially by air, relied on many technological developments and a vast infrastructural network painstakingly built over decades. The end result is a seamless passageway that the average passenger will never notice during the flight. Despite the challenges posed by the distance, isolation, and poor weather typically found in that region, travelers can embark on what is today a predictably short

and safe voyage. What is most remarkable is that the situation a century ago was the exact opposite: no aircraft could conceivably manage the distance or weather, nor could it expect to get emergency support, even immediately offshore. Between 1919 and 1970 the North Atlantic was transformed from a barrier, where only the bravest pilots and engineers dared test their ingenuity and bravado, into a superhighway, bearing millions of travellers per year. How this change came about is no small matter: governments spent fortunes to allow their airlines the chance to serve that route by exploring the region, building the infrastructure, and governing the fair use of the corridor.

This dissertation will show that government efforts were paramount to making the North Atlantic safe and open for airlines. Governments, not the airlines, spent the vast majority of money to survey the North Atlantic, to study its weather and geography, to build the support infrastructure, and to manage the operation of the air routes. Many studies on the development of civil aviation regularly note the importance of government money and action in support of a particular national airline or aircraft technology. Those studies, however, do not consider how such government support for aviation proved indispensable for the safe operation of the vast and complex North Atlantic corridor, nor how well it operates or how the corridor drove the development of civil aviation.[12] This study will examine how those governments supported both their own airlines and civil aviation in general on the North Atlantic, a region that critically shaped aviation around the world.

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[12] A few books, such as James Patrick Hanlon's *Global Airlines: Competition in a Transnational Industry* (Oxford: Butterworth-Heinemann, 1996), consider the importance of government spending for aviation, but do not consider the North Atlantic region as a driver for aeronautical or airline development. In his book, Winston Bray's *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), the North Atlantic was but one important corridor for British air travel among several, whereas competition with the United States with respect to aircraft manufacturing was a more important concern. Some seminal works barely note the importance of the North Atlantic corridor as a driver for the aeronautics industry or the airlines, focusing instead on governments as a driver for aeronautical development, such as Jeffrey A. Engel in *Cold War at 30,000 Feet: The Anglo-American Fight for Aviation Supremacy* (Cambridge, Massachusetts: Harvard University Press, 2007).

The first efforts to fly across the North Atlantic were risky affairs. Spurred on by a cash prize offered in 1914 by *The Daily Mail*, a British newspaper, entirely new planes had to be built to custom specifications, special aviators had to be selected and trained for the flight, and there was little to no support during the long ocean expanse. The distance was far more modest than modern flights over the Atlantic: from St. John's, Newfoundland to the Irish coast on a "flying boat", a distance of 2,500 kilometres (about 1,600 miles), less than half the distance between New York and Paris or London. No runways existed at either end of the trip capable of accommodating such a plane at that time.[13] In fact, the true potential of transatlantic flight was far from realization and the First World War paused further developments. The experimental flights in the years that followed the war mapped out the region and permitted the establishment of airfields, harbours, weather stations, and other pieces of infrastructure critical to regular and safe operations. But it was not until 1939, nearly forty years after the advent of powered flight, that regular service across the North Atlantic began, linking the major cities of North America and Western Europe, only to be disrupted by the outbreak of the Second World War. The first part of this study will focus on the activities of both the experimental flights and the infrastructural developments during the interwar years, noting in particular the role that government involvement played in support of both.

The Second World War profoundly altered both aviation technology and global politics, and transatlantic aviation was shaped by the changes in both realms. Following the end of the war in 1945, the newest and fastest planes were used on and often built specifically for the North Atlantic, including the first commercial jets. But political and economic factors must be considered alongside advances in aviation technology to understand how the routes came about. Each country with an international airline cooperated to establish the infrastructure and rules for

[13] *New York Times*, "One-Day Flight Across Atlantic," p. 1, February 5, 1914.

air travel over the long Atlantic distances but did so within the framework of the emerging Cold War order. Cold War politics made the United States especially interested in building ties with Western Europe both to secure the region for its own interests as well as to isolate the Soviet Union and other communist countries from the Western world, as noted by Geir Lundestad. Lundestad argued in his book *"Empire" by Integration* that the United States asserted its economic and political power much like an empire with Western European countries parts of America's sphere of influence. The strong American influence extended to Western Europe's economic and military matters and shut out the Eastern European countries, redirecting the natural flows of airline networks and aircraft trade.[14]

Lundestad's views echo those of Michael Hogan in his book, *The Marshall Plan*, which examined how the United States used postwar reconstruction funding to firm up American ties with Western Europe. Hogan argued that America used the Marshall Plan's targeted financial aid to rebuild war ravaged economies and so earn considerable influence, trust, and meaningful economic links with West European countries. The Marshall Plan had several aims including to bring Germany into the Western fold while keeping communist influence in Western Europe to a minimum, to build strong European institutions, to reform industries badly harmed by the war, and to unite Western Europe within a capitalist-oriented America-centric sphere.[15]

The United States could have restricted sales of its aircraft to Western Europe following the war as it did with Eastern Europe[16] but the American government allowed its companies to sell to the West Europeans, reflecting the close ties they shared and the association they hoped to

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[14] Geir Lundestad, *"Empire" by Integration: The United States and European Integration, 1945-1997* (New York: Oxford University Press, 1998).

[15] Michael J. Hogan, *The Marshall Plan: America, Britain, and the Reconstruction of Western Europe, 1947-1952* (New York: Cambridge University Press, 1987).

[16] Sean Nicklin, *The Skies that Bind: The Evolution of Civil Aviation in Communist Europe and the Role of International Agreements, 1945-1970* (Master's Thesis: University of Ottawa, 2009).

exploit over the years that followed. Commercial air travel embodied the close association between the two continents, but also American pre-eminence, as American airlines dominated air service in the region throughout the Cold War era. Rapid growth in the volume of air travel over the North Atlantic also reflected the American Cold War agenda, because the economic ties America promoted fostered increased travel between North America and Europe.

Infrastructure and support systems for transatlantic flight were set up around the North Atlantic throughout the mid-twentieth century. Weather stations were deployed at strategic locations and air traffic control systems were equipped with the latest technology to support planes throughout their oceanic transit. Airlines also needed assurances that they could fly the route economically, without prohibitively restrictive fees or delays directed against them by their destination countries.[17] They also needed the best planes available: fast, reliable, and using the most sophisticated technology of the day. American historian Jeffrey A. Engel described aircraft as "the most technologically advanced products available for purchase on the world market before the computer revolution".[18] The Cold War spurred the development of civil aircraft technology, principally in the United States, where vast sums of government money directed at the big aerospace firms allowed them to finance risky long-term development projects. Only the most advanced technologies sufficed for the needs of the North Atlantic, and technological development, in turn, was spurred on to meet the needs of transatlantic flight. This study will explore the implementation of these technological systems on the North Atlantic for the benefit of air travel.

The North Atlantic corridor accommodated the largest airlines in the world during a time of significant international economic growth, spurred by the expansion of trade and tourism. In

[17] Betsy Gidwitz, *The Politics of International Air Transport*. (Lexington: Lexington Books, 1980), p. 141.
[18] Jeffrey A. Engel, "The Surly Bonds: American Cold War Constraints on British Aviation," *Enterprise & Society* 6, no. 1 (2005), p. 2.

their earliest days, most airlines began operating as domestic carriers with routes contained entirely within a single country or region. As European airlines expanded their operations, however, they needed to operate internationally due to the small geographic sizes of their host countries.[19] International expansion thus meant that airlines needed normalized standards in every country they flew to: common emergency radio frequencies and language, legal protection for passengers, weather stations, common and recognizable navigational aids, and many more. Without such standards the risks of international flight would be too great for airlines or governments to accept, particularly over the North Atlantic. National governments struck bilateral air agreements, detailed treaties to regulate flight between their countries. These agreements included safety precautions and landing sites for aircraft as well as carefully determined controls over fares and the number of flights allowed. Several international organizations also played an important role in regulating the North Atlantic. The International Civil Aviation Organization (ICAO), which became a specialized agency of the United Nations, serves as the guarantor of many bilateral air agreements. By acceding to the ICAO, a country assures all other members that it will cooperate with existing norms and standards set down by the organization.[20] In effect, any airline operating within one ICAO country could meet the requirements to fly to any other ICAO member country with ease. The North Atlantic routes were all negotiated under ICAO auspices from 1946 onwards. Additionally, the International Air Transport Association (IATA), a club of airlines closely affiliated with the ICAO, sets

[19] Many sources detail the expansion of airlines internationally. For some examples see R.E.G. Davies, *A History of the World's Airlines*. (New York: AMS Press Inc., 1983); Jacqueline Dutheil de la Rochère, *La Politique des États-Unis en matière d'aviation civile international*. (Doctorate Thesis: Université de Paris), 1971; Betsy Gidwitz, *The Politics of International Air Transport*. (Lexington: Lexington Books, 1980); Robert L. Thornton, *International Airline and Politics: A Study in Adaptation to Change*. (Ann Arbor: University of Michigan, 1970).

[20] Dumitra Popescu, *Bilateral Air Agreements of Socialist Countries and International Law: A Comparative Study*. (Master's Thesis: McGill University, 1970), p. 81.

standards and practices for its members and regulated international airfares until the 1970s.[21] Those two organizations oversee most airline operations throughout the world, making them central to any study of civil aviation. This study examines the role that international collaboration played to develop the North Atlantic and how central this region was to the organizations.

Over a dozen countries, hundreds of organizations and companies, and uncountable numbers of people had a hand in making the North Atlantic route what it is today, the cornerstone of international air travel. It spurred civil aviation's growth from early in the century. To meet the needs of the long ocean crossing, planes were built with longer ranges and greater speeds. Aerospace firms and governments alike pushed the boundaries of aircraft technology to address this, and airlines clamoured for the best planes and choice routes. Negotiating for and operating the North Atlantic routes was so important that the governments and organizations involved redefined how they concluded bilateral agreements. That it has become trivially easy for a passenger to make the trip is a testament to all those who invested their efforts over the decades before. To fully appreciate the magnitude of the accomplishment as well as the importance that bridging the ocean had on air travel as a whole, it is essential to make as broad an investigation as possible into each of the varied parties involved. Governments, airlines, aircraft companies, international organizations, and the people behind the creation and operation of the route must all be considered.

Objective

This study will explain how transatlantic air travel became routine, used by the masses rather than merely a small elite, by linking the political, economic, and technological issues

[21] J.W.S. Brancker, *IATA and What It Does*. (Leyden: A. W. Sijthoff, 1977), p. 19.

surrounding transatlantic flight's development and operation, with emphasis on the role of government support throughout. The first section of the dissertation, chapters One and Two, focus on the development of transatlantic air travel up to 1945, noting how and why the governments and industries of the countries surrounding the North Atlantic invested so much time, money, and energy in making the region a viable air corridor. Chapter One examines experimental flights across the North Atlantic and the multinational effort to explore the region in anticipation of regular air service from 1919 to 1939. It focuses on the need for and development of the critical infrastructure that civil aviation depended on for safe operations. Chapter Two moves forward into transatlantic air service in the Second World War, from 1939 to 1945. Regular military flight operations and extensive infrastructure development by the Americans, British, and Canadians marked a critical step in making the region safe for civilian flight after the war. By 1945, the work of these countries built both a valuable working knowledge of transatlantic flight and a robust infrastructure system that would serve commercial aviation throughout the twentieth century. These chapters offer an overview of the period when transatlantic air travel matured from a strictly exploratory and experimental phase into a mature air corridor, capable of handling commercial air traffic.

Between 1919, when the first experimental flights began, and 1970, when jumbo jets marked the start of permanent, large-scale travel across the Atlantic, the region underwent a near-total transformation. Many changes were implemented directly by the countries involved, mainly legal and infrastructural, while others stemmed from the evolution of aeronautical technology or the changing nature of personal travel. Both governments and airlines pressed for improvements in aircraft that led to farther travel distances and higher flight ceilings, which the North Atlantic routes required, driving aviation technology forward. The need for better aircraft

to travel across the Atlantic acted as a driving force behind these improvements. The purpose of this study is therefore to note what impact the development of the critical North Atlantic route had on civil aviation with respect to the field as a whole, as well as how much and in what ways governments shaped its development. The second section, chapters Three to Seven, covers the development of the groups, technologies, and systems that underpin transatlantic flight in the postwar era. Expanding upon the pre-1945 developments, this section notes the extensive international cooperation and collaboration among North Atlantic countries to improve the reliability and performance of commercial flight in the region.

Chapter Three traces the emergence of the ICAO and IATA late in the Second World War and their role in shaping, regulating, and planning for the future of international aviation. It also details the creation and implementation of the Bermuda Agreement, a bilateral agreement between the United States and Britain that served as the basis for air travel between the two countries and heavily influenced later air agreements. Chapter Four discusses the civilian aircraft that flew on the North Atlantic from the war up to the early 1970s, with emphasis on the American and British aviation industries that produced nearly every model used during that time. The technological innovations embodied in those planes, their strengths and weakness, and the role played by governments in both North America and Europe to further aircraft development provide insight into how important these machines were to the countries they served. Chapter Five moves onto air traffic control, a critical part of infrastructure behind air travel. The international coordination of air traffic, compounded by the difficulty of tracking aircraft over the ocean, made air traffic control on the North Atlantic dauntingly complex and so the systems assembled to reliably track planes over this distance proved vitally important. Chapter Six turns to meteorology on the North Atlantic. Forecasting and monitoring weather over the vast region

required decades of study by all countries in the region and the construction of weather stations in remote areas, all of which depended on the most sophisticated scientific models and considerable government aid. Chapter Seven follows the operation of weather ships, a fleet managed by the ICAO to observe meteorological conditions and to aid aircraft over the North Atlantic. Each of these chapters delves into the complex international networks that modern transatlantic air travel depends on; how they were conceived, built, and run so seamlessly that a passenger on a commercial flight would not notice their existence.

The countries involved in developing the infrastructure and regulating air transit rights in the North Atlantic offer insight into that which motivated their air travel sectors. The United States, which had a large and mature commercial airline system, pushed for a liberal passenger market where its own airlines could compete freely. European countries with Britain chief among them, on the other hand, preferred a more tightly controlled aviation regime that could protect their airlines from American competition. Smaller countries or those with limited presence in the North Atlantic in the postwar era such as Canada, France, the Netherlands, Belgium, Iceland, Ireland, West Germany, Italy, and the Scandinavian states, provide further context by showing what impact political, economic, and strategically useful geographic locations had over civil aviation on this vital corridor. Governments struck the bilateral air agreements that set out the terms for international air travel. Equally important, the emergence of tourism as a driving force behind the expansion of civil aviation is also a central focus of this dissertation. Civil aviation had a latent ability to offer transportation to the people of the world that went unrealized until the 1960s when ticket costs declined and larger, faster aircraft permitted larger numbers to travel vast distances rapidly. Transatlantic tourists were among the greatest beneficiaries of air travel due to the time savings they came to enjoy. This makes the

North Atlantic routes an important area of study: their growth shared a symbiotic link with expanding passenger traffic. It reflected changes in how society made use of leisure time as well as how it embraced the normalization of this emerging technological system. Through analysis of the operation of North Atlantic air travel, a greater understanding of social changes as well as economic transformation within society will be presented. The third section, chapters Eight to Ten, deals with the actual airline operations on the North Atlantic, specifically on how revenue-generating services were set up and the rapid rise of passenger traffic during the postwar era.

Chapter Eight focuses on air mail and cargo services. Government-provided air mail fees were essential for making the airlines economically viable pre-1945, offering even transatlantic services a financial fillip during uncertain times. Chapter Nine addresses the flurry of government and airline activity after 1945 as the countries of the North Atlantic struck a series of air agreements for regular commercial service. It also notes the measures countries employed to protect their airlines from what they perceived as unfair foreign competition; measures that tended to retard the free flow of passengers and increase airfares. Chapter Ten deals with the North Atlantic airfare regime and how pricing evolved from 1945. The emergence of low-cost charter services and their impact on the burgeoning tourist industry also feature prominently, as both conduits for and drivers of international travel. These chapters encapsulate the driving forces behind the airlines on the North Atlantic as both profit-driven enterprises and, in most cases, agents of government prestige. Transatlantic air services were held in high regard and, while there was a great deal of pressure to offer such services, they had to be run as sustainably as possible.

Sources and Literature Review

Government records extensively inform this study, a necessity given the overwhelming importance of governments in setting up and managing many aspects of transatlantic flight. Several national archives were consulted during the research for this study, including those in Canada, the United States, the United Kingdom, France, the countries most heavily involved in opening and developing transatlantic flight. The archives of the Commission of the European Union was similarly consulted to provide a broader picture of the desires of European countries collectively. These various archival records cover the earliest discussions regarding how and when the first test flights ought to operate up to opening additional cities to another country on well established transatlantic routes in the 1960s. In many cases, the details offered by these archival sources illuminate the deals and offers that were made behind closed doors to win air rights, or personal assessments of what officials sought to accomplish with air agreements.

The sources do not, however, provide some of the important background detail. Most of the post-1945 sources included in this study did not note the close association between Cold War politics and the direction of Western European and American aviation. American documents did not consider the prospect of air travel nor aircraft sales to Eastern Europe, which is interesting by its absence. Prior research conducted as part of my master's thesis revealed that the American authorities went to great lengths to restrict communist Eastern Europe's aviation expansion by any means,[22] which suggests that the diplomats and bureaucrats within the various departments who produced these materials were either consciously aware that communist countries were not to be dealt with or simply did not consider them to be viable partners for aviation dealings given the political restrictions. In this sense, the Cold War and America's pursuit of communist isolation beginning in the 1940s indirectly shaped the development of transatlantic flight. Communist isolation is less evident in the European archival material since Western European

[22] Sean Nicklin, *The Skies that Bind*.

countries were both more willing to associate with East European countries and since transatlantic aviation for them focused on North America and so Eastern Europe was not a factor.

The records of airlines that flew the North Atlantic routes were also considered in this study. British Airways is the British flag carrier, who, as the successor to the British Overseas Airways Corporation (BOAC) and Imperial Airways, thus inherited their records. It keeps these in the British Airways Heritage Centre in London. As BOAC and Imperial Airways were the European airlines that featured the most prominently in transatlantic air services, they are indispensable in providing a complete picture of how the continent's airlines competed with the United States. Pan American Airways, the "unofficial" American flag carrier, deposited its records at the Richter Library in the University of Miami. Pan Am's records are particularly valuable as the airline was the first to fly transatlantic service and, by most measures, had the biggest presence in the region: the most planes, the most passengers carried, the most destinations served. Both of these collections informed numerous parts of this study, including where the big airlines most wished to travel and why, how many people they flew, how much their routes cost to operate, what government support they received, and the competition they faced from their rival airlines on the North Atlantic. These records moreover are illustrative of the similarities and differences between the American and European airlines, a central part of this study. While the records of the major American transatlantic operator Trans World Airlines (TWA) are held by the TWA Museum in Kansas City, Missouri, they were not consulted for this study since they unfortunately do not contain the same breadth of detailed transatlantic operational information as was the case for BOAC and Pan Am. The corporate records were biased towards their airlines and so this study treated their material in light of this bias.

Aviation trade magazines were also used extensively. *Flight Global*, a British trade magazine, includes a wide array of data and analyses for all aspects of civil flight. It also includes summaries of the political, economic, and technological elements at play in the aviation field. *Interavia Business and Technology* is another aviation magazine with a focus on the business of flying, which includes the airlines and aircraft manufacturers. Newspapers of record from the countries under examination also proved useful: the *New York Times*, *The Times* of London, and *The Globe and Mail* provided guides to the publically available information as well as offering insights into the popular perception of air travel throughout the twentieth century.

Despite the importance of transatlantic flight to international aviation, the secondary literature on that topic rarely focuses on the importance of the North Atlantic as a driving force behind the policies, regulations, practices, and technologies that define air travel today. Most of the scholarly material regarding civil aviation considers commercial air travel from the perspective of a single country or airline, or focuses narrowly on a single new technology or support system. These tend to consider civil aviation in a strictly utilitarian sense as an industry to be organized for the safety and rapid transportation of passengers and cargo. Most of the remaining secondary literature on aviation focuses on the technology and logistics behind air travel, including the construction of aircraft, critical systems such as radar, or the implementation of safety features. This study will unite these areas of research to demonstrate how government involvement directly and indirectly shaped civil aviation in practical terms, with the North Atlantic route used as a case study. The secondary material falls broadly into six main categories: aircraft histories, infrastructure histories (notably airports), airline histories, organizational histories (e.g. of the ICAO), military and international rivalry histories, and mobility and tourist histories.

Studies about the aircraft, as the principal technological product in this study, are covered to provide insight into who was building the planes, for whom, and for what reasons. Aircraft histories note both the importance of the North Atlantic route as a driver for aeronautical innovation and the need for government support in aircraft development. Encyclopedic compendia proved useful, notably *Jane's All the World's Aircraft*[23] and *Jane's Fighting Aircraft of World War II*.[24] These reference works cover all aircraft in service in a particular year, who was using them, when the planes entered service, their performance characteristics, and various other details. Monographs about aircraft offer a broader look at the trends in aeronautics and what the innovations in the industry meant in terms of service and performance. These technological histories include Laurence K. Loftin Jr.'s *Quest for Performance: The Evolution of Modern Aircraft*,[25] Jon Proctor, Mike Machat, and Craig Kodera's *From Props to Jets: Commercial Aviation's Transition to the Jet Age 1952-1962*,[26] and *Jet Age: The Comet, the 707, and the Race to Shrink the World* by Sam Howe Verhhovek.[27]

In considering the influence of aircraft developments, the present dissertation attempts to balance attitudes often assumed – that newer aircraft or technological systems are generally superior to their predecessors – with comparisons to the reality of their implementation. Innovative new technologies were not always unqualified successes, with the de Havilland Comet and supersonic aircraft among the two most notable examples. A dispassionate examination of the merits of the changing aviation landscape backed up by the data offered in the

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[23] Various authors, *Jane's All the World's Aircraft* (Toronto: various publishers, annual).

[24] Leonard Bridgeman, ed. *Jane's Fighting Aircraft of World War II* (New York: Military Press, 1989).

[25] Laurence K. Loftin, Jr. *Quest for Performance: The Evolution of Modern Aircraft* (Washington: National Aeronautics and Space Administration, 1985).

[26] Jon Proctor, Mike Machat, and Craig Kodera. *From Props to Jets: Commercial Aviation's Transition to the Jet Age 1952-1962* (North Branch, MN: Specialty Press Publishers and Wholesalers, 2010).

[27] Sam Howe Verhhovek, *Jet Age: The Comet, the 707, and the Race to Shrink the World* (Avery, 2010).

books and studies listed above offer a useful guide to the nature of these aircraft and the dynamics of their transformation during the twentieth century.

This study is also interested in the infrastructure and technological systems underpinning transatlantic flight. Infrastructure and its development across national borders is dealt with at length in *Materializing Europe: Transnational Infrastructures and the Project of Europe*, edited by Alexander Badenoch and Andreas Fickers[28] and in *The Making of Europe's Critical Infrastructure: Common Connections and Shared Vulnerabilities* edited by Erik van der Vleuten, Arne Kaijser, Anique Hommels, and Per Högselius.[29] The development of meteorological knowledge and of systems to track and predict the weather are the subject of several works, including Robert Marc Friedman's *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology*,[30] Kristine C. Harper in *Weather by the Numbers: The Genesis of Modern Meteorology*,[31] Roger Turner in *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science*,[32] and Paul Edwards in "Meteorology as Infrastructural Globalism".[33] The early development of radar is expertly discussed by Henry E. Guerlac in *Radar in World War II*.[34] The complex integration of technological systems that

[28] Alexander Badenoch and Andreas Fickers, eds. *Materializing Europe: Transnational Infrastructures and the Project of Europe* (New York: Palgrave Macmillan, 2010).

[29] Erik van der Vleuten, Arne Kaijser, Anique Hommels, and Per Högselius, eds. *The Making of Europe's Critical Infrastructure: Common Connections and Shared Vulnerabilities* (Basingstoke: Palgrave Macmillan UK, 2013).

[30] Robert Marc Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology* (Ithaca, NY: Cornell University Press, 1989).

[31] Kristine C. Harper, *Weather by the Numbers: The Genesis of Modern Meteorology* (Cambridge, MA: The MIT Press, 2008).

[32] Roger Turner, *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science* (Dissertation: University of Pennsylvania, 2010).

[33] Paul N. Edwards, "Meteorology as Infrastructural Globalism," Osiris 21, Special issue on Science, Technology, and International Affairs: Historical Perspectives (2006), p. 229-50.

[34] Henry E. Guerlac, *Radar in World War II* (New York: American Institute of Physics, 1987)

make air traffic control work are clearly detailed in a technical study by Michael S. Nolan, *Fundamentals of Air Traffic Control*.[35]

Many of the works cited in this dissertation focus on the airlines, as they were the agents performing the flights studied here. Many works cited fall into this category, including more general books such as R.E.G. Davies' *A History of the World's Airlines*,[36] an excellent summary of the major airlines and the aircraft they used on their route networks. Indeed, Davies has written a considerable number of works that proved useful for this dissertation, including *Airlines of the Jet Age*,[37] *Fallacies and Fantasies of Air Transport History*,[38] and *Supersonic (Airliner) Non-sense: A Case Study in Applied Market Research*,[39] all of which explore different elements of air travel over the twentieth century. Davies offers a technical analysis about how and why the various countries across the world, and in the North Atlantic region in particular, established their airlines and served their routes, although he does not provide critical examinations of some of the important decisions and motivations of the airlines and their management. Noted aviation historian William M. Leary edited a highly useful guide to airline management and operations in *The Airline Industry*[40] in a complementary role to the studies written by Davies. Several non-historical works have looked more narrowly at the functioning of the airline industry, offering insights into how the North Atlantic fit into the global route network. For example, in the 1970s and 1980s, Nawal K. Taneja wrote prolifically about airlines and their management in *The Commercial Airline Industry: Managerial Practices and*

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[35] Michael S. Nolan, *Fundamentals of Air Traffic Control, 5th Edition* (Clifton Park, NY: Delmar, 2011).

[36] R.E.G. Davies, *A History of the World's Airlines* (New York: AMS Press Inc., 1983).

[37] R.E.G. Davies, *Airlines of the Jet Age* (Washington, D.C.: Smithsonian Institution Scholarly Press, 2011).

[38] R.E.G. Davies, *Fallacies and Fantasies of Air Transport History* (McLean, Virginia: Paladwr Press, 1994).

[39] R.E.G. Davies, *Supersonic (Airliner) Non-sense: A Case Study in Applied Market Research* (McLean, Virginia: Paladwr Press, 1998).

[40] William M. Leary, ed. *The Airline Industry* (New York: Facts on File, 1992).

Regulatory Policies,[41] *Airline Planning: Corporate, Financial, and Marketing*,[42] *Airlines in Transition*,[43] and *The International Airline Industry: Trends, Issues, and Challenges*.[44] A great variety of works by industry observers were used in this study, dealing with the economic and political dynamics of international airline competition and management practices including James Patrick Hanlon in *Global Airlines: Competition in a Transnational Industry*,[45] and Richard Pryke in *Competition among International Airlines*.[46] These works offer a broad and nuanced look at the competitive and sometimes collaborative way that the modern airline operators provided an affordable and efficient transatlantic flight experience for passengers while generating revenue for themselves. They are not historical studies but rather serve as guides to contemporary airline operations during the era in which they were written. This study incorporates the above studies' findings as a framework for understanding airlines, although they focus on broad trends, are not primarily historical, and tend not to provide the more human-scale details necessary to understand how a particular airline's management decided to act.

Other useful works examine individual airlines, which offer a helpful illustration of how and in what unique ways particular airlines handled international aviation. Several of the books were true scholarly histories, including R.E.G. Davies' *Lufthansa: An Airline and its Aircraft*,[47] *Pan Am: An Airline and its Aircraft*,[48] *TWA: An Airline and its Aircraft*,[49] Guy Vanthemsche's

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[41] Nawal K. Taneja, *The Commercial Airline Industry: Managerial Practices and Regulatory Policies* (Toronto: D.C. Heath and Company, 1976).

[42] Nawal K. Taneja, *Airline Planning: Corporate, Financial, and Marketing* (Lexington, MA: Lexington Books, 1982).

[43] Nawal K. Taneja, *Airlines in Transition* (Lexington, MA: Lexington Books, 1981).

[44] Nawal K. Taneja, *The International Airline Industry: Trends, Issues, and Challenges* (Lexington, MA: Lexington Books, 1988).

[45] James Patrick Hanlon, *Global Airlines: Competition in a Transnational Industry* (Oxford: Butterworth-Heinemann, 1996).

[46] Richard Pryke, *Competition among International Airlines* (Brookfield, VT: Gower Publishing Limited, 1987).

[47] R.E.G. Davies, *Lufthansa: An Airline and its Aircraft* (New York: Orion Books, 1991).

[48] R.E.G. Davies, *Pan Am: An Airline and its Aircraft* (New York: Orion Books, 1987).

[49] R.E.G. Davies, *TWA: An Airline and its Aircraft* (McLean, Virginia: Paladwr Press, 2000).

La Sabena. L'aviation commerciale belge 1923-2001: Des origins au crash,[50] Geoff Jones in *Air France*,[51] Winston Bray in *The History of BOAC, 1939-1974*,[52] Gene Banning's *Airlines of Pan American since 1927: Its Airlines, its People, and its Aircraft*,[53] R.E.G. Davies' and Robert Baehr's "America's Airlines: Unofficial Instruments of National Policy,"[54] and Sveinn Vidar Gudmundsson in "Mergers vs. Alliances: The Air France-KLM Story."[55] Other airlines are examined in several high quality works aimed at a more general audience, including Duncan Campbell-Smith's *The British Airways Story: Struggle for Take-off*,[56] and Arthur Reed, *Airline: The Inside Story of British Airways*.[57] Air Canada and its predecessor Trans-Canada Airlines are examined by several authors, all of which trace the distinct role that Canada had in transatlantic aviation, including David Collins in *Wings Across Time: The Story of Air Canada*,[58] Peter Pigott in *Air Canada: The History*,[59] and Philip Smith in *It Seems Like Only Yesterday: Air Canada, The First 50 Years*.[60] All of the major airlines studied here competed against one another in the North Atlantic skies, so where the authors' interpretations of events differ, their chief value is in demonstrating where the national interests of the airlines lay. They also serve as a helpful complement to the broader aviation industry studies by providing a narrower focus that made the airlines' drives and actions clearer.

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[50] Guy Vanthemsche, *La Sabena. L'aviation commerciale belge 1923-2001: Des origins au crash*. (Brussels: De Boeck & Larcier, 2002).

[51] Geoff Jones, *Air France* (Midland Publishers Limited, 2008).

[52] Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished).

[53] Gene Banning, *Airlines of Pan American since 1927: Its Airlines, its People, and its Aircraft.* R.E.G. Davies, ed. (McLean, Virginia: Paladwr Press, 2001).

[54] Robert Baehr, "America's Airlines: Unofficial Instruments of National Policy," *American Studies in Scandinavia* 19, no. 2 (1987), p. 71-84.

[55] Sveinn Vidar Gudmundsson, "Mergers vs. Alliances: The Air France-KLM Story," *Social Science Research Network Electronic Journal* (June 2014).

[56] Duncan Campbell-Smith, (*The British Airways Story: Struggle for Take-off* (Sevenoaks: Coronet, 1986).

[57] Arthur Reed, *Airline: The Inside Story of British Airways* (London: BBC Books, 1990).

[58] David Collins, *Wings Across Time: The Story of Air Canada* (Toronto: Griffin House, 1978).

[59] Peter Pigott, *Air Canada: The History* (Toronto: Dundurn, 2014).

[60] Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986).

International organizations were also crucial in shaping transatlantic flight, as David MacKenzie explores in *ICAO: A History of the International Civil Aviation Organization*.[61] MacKenzie outlined the history and core operations of this important institution. Other authors delved into the complex interrelationship of politics and airline operations in contemporary legal or diplomatic studies, such as Robert L. Thornton in *International Airlines and Politics: A Study in Adaptation to Change*,[62] Betsy Gidwitz in *The Politics of International Air Transport*,[63] David Corbett in *Politics and the Airlines*,[64] Christer Jönsson in "Sphere of Flying: The Politics of International Aviation,"[65] and Alan P. Dobson in *Peaceful Air Warfare: The United States, Britain, and the Politics of International Aviation*.[66] All of the latter works emphasize the central role that governments play in making air travel possible and provide a counterpoint to national studies or to studies that focus on a single entity. By examining the changing political relationship between nations and airlines, the authors here paint a picture of the complex and vibrant world of international flight that proved informative for this study, notably in portraying the power disparity between the United States and all other nations in the sphere of aviation.

While this thesis focuses on civil aviation, there is a military component that underlies aspects of transatlantic flight. The militaries of the United States, Britain, and Canada undertook much of the early work developing infrastructure throughout the North Atlantic during the Second World War, as noted by Carl A. Christie in *Ocean Bridge: The History of RAF Ferry*

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[61] David Clark MacKenzie, *ICAO: A History of the International Civil Aviation Organization* (Toronto: University of Toronto Press, 2010).

[62] Robert L. Thornton, *International Airlines and Politics: A Study in Adaptation to Change* (Ann Arbor: University of Michigan, 1970).

[63] Betsy Gidwitz, *The Politics of International Air Transport* (Lexington: Lexington Books, 1980).

[64] David Corbett, *Politics and the Airlines* (Toronto: University of Toronto Press, 1965).

[65] Christer Jönsson, "Sphere of Flying: The Politics of International Aviation," *International Organization* 35, no. 2 (Spring 1981), p. 273-302.

[66] Alan P. Dobson, *Peaceful Air Warfare: The United States, Britain, and the Politics of International Aviation* (New York: Oxford University Press, 1991).

Command[67] and Jeffrey Davis in "ATFERO: The Atlantic Ferry Organization".[68] The Cold War saw the emergence of the Marshall Plan that played a critical political and economic role in Cold War developments in Europe in the early postwar years, as noted by Michael Hogan in *The Marshall Plan*,[69] including the close association between the nations of North America and Europe that proved so vital to setting up regular aviation links between the two continents. Geir Lundestand's *"Empire" by Integration*, while not strictly a Cold War history, showed American involvement in Europe during the era as a product of Cold War politics. The United States government felt compelled to insinuate itself throughout Western Europe as a new sort of imperial power to check the influence of the communist Soviet Union.[70] Even Christopher Endy's *Cold War Holidays*, which details the growth in tourist flows between the United States and Western Europe, has a military undertone. Endy argues that the United States used tourist flows, of both people and currency, to keep the West European countries engaged in its sphere.[71]

Mobility and tourist histories were detailed in this study as well. They chronicled the unprecedented tourist flows across the North Atlantic during the postwar years as commercial air travel opened new avenues of travel, again as noted by Christohper Endy in *Cold War Holidays*. Stephen Wheatcroft's *Aviation and Tourism Policies: Balancing the Benefits*[72] and *The Management of International Tourism* by Stephen F. Witt, Michael Z. Brooke, and Peter J.

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[67] Carl A. Christie, *Ocean Bridge: The History of RAF Ferry Command* (Toronto: University of Toronto Press, 1995).

[68] Jeffrey Davis, "ATFERO: The Atlantic Ferry Organization," *Journal of Contemporary History* 20, no. 1 (January 1985), p. 71-97.

[69] Michael J. Hogan, *The Marshall Plan: America, Britain, and the Reconstruction of Western Europe, 1947-1952* (New York: Cambridge University Press, 1987).

[70] Geir Lundestad, *"Empire" by Integration: The United States and European Integration, 1945-1997* (New York: Oxford University Press, 1998).

[71] Christopher Endy, *Cold War Holidays: American Tourism in France* (Chapel Hill, NC: University of North Carolina Press, 2004).

[72] Stephen Wheatcroft, *Aviation and Tourism Policies: Balancing the Benefits* (London: Routledge, 1994).

Buckley[73] are excellent guides to the role that tourism played in spurring international flight, particularly across the North Atlantic. Entirely new forms of social mobility emerged with affordable air travel that altered the understanding of what travel and leisure meant. Where these histories were weakest was in that they rarely detailed the human side of travel, focusing instead on the raw passenger volumes or market trends rather than on personal experiences. Dallen Timothy's *Tourism and Political Boundaries* is an exception as it details the attraction that Americans had to the small size of Europe's countries and distinct cultures in close proximity, spurring passenger travel for purely personal reasons. But Timothy was one of a few such works since the literature on air travel that combines tourism as a social experience is rather limited.

This thesis also draws upon theoretical works in the field of history of technology. In *Cosmopolitan Commons: Sharing Resources and Risks across Borders*,[74] Nil Disco and Eda Kranakis put forward a theoretical model to understand how vast natural spaces like rivers, oceans, and airspace have been transformed into productive, shared economic spaces, a "cosmopolitan commons," through international agreements, collaborative networks, shared infrastructure, and a range of technologies that assist in accessing, monitoring, and regulating these spaces. In one of the book's case studies,[75] Kranakis traces how European airspace became such a commons even though it initially represented an "anti-commons". By the terms of the 1919 Convention Relating to the Regulation of Aerial Navigation (one of the Paris treaties agreed to following the First World War), each signatory nation was accorded sovereignty over its airspace, meaning that each nation was authorized to prohibit any and all foreign access to its

[73] Stephen F. Witt, Michael Z. Brooke, and Peter J. Buckley. *The Management of International Tourism* (New York: Routledge, 1995).

[74] Nil Disco and Eda Kranakis, eds. *Cosmopolitan Commons in Europe* (Cambridge, Mass.: The MIT Press, 2013), Chapters One and Two.

[75] Eda Kranakis, "'The Good Miracle': Building a European Airspace Commons, 1919-1939," in Disco and Kranakis, eds., *Cosmopolitan Commons*, p. 57-96.

airspace. However, to use airspace productively in Europe, these separate national spaces had to be transformed into a shared, collaboratively managed transnational space. Kranakis traces how this was achieved in the period leading up to the Second World War. The North Atlantic air corridor represents an analogous case: it too became a "cosmopolitan commons." Through years of aeronautical development as well as political agreements, the nations flying this route created a workable and well-regulated transit corridor that could support constantly growing levels of traffic because all parties agreed to a system of common use for mutual benefit.

The infrastructural globalism theory set forth by Paul Edwards is employed in this study.[76] Edwards notes that certain systems that are heavily dependent on large-scale information gathering, such as meteorology, do not merely benefit from tight integration at the global level but are almost entirely dependent on integration to provide useful services. Meteorology certainly offers great benefits to international aviation but aviation itself can be considered a case of infrastructural globalism in action. The North Atlantic became a serviceable air corridor largely because of the shared development and operation of air traffic control systems, weather stations, radio communications network, aircraft technologies, and even airport facilities by all countries in the region. Without such globe-spanning infrastructure, all of these elements of air travel would be rendered far less effectual to the detriment of the airlines and those who fly internationally.

This study also employs the transnationalist theory as explored by Erik van der Vleuten in his articles "Infrastructures and Societal Change: A View from the Large Technical Systems Field,"[77] and "Understanding Network Societies: Two Decades of Large Technical System

[76] Paul N. Edwards, "Meteorology as Infrastructural Globalism."

[77] Erik van der Vleuten, "Infrastructures and Societal Change: A View from the Large Technical Systems Field," *Technology Analysis & Strategic Management* 16, no. 3 (September 2004), p. 395-414.

Studies."[78] Van der Vleuten explains that societies react to new "large technical systems" (big pieces of infrastructure) by reshaping their behaviours to make use of the new systems: people are shaped by the new technology and, in turn, shape its use. Complex technological networks of infrastructure cause societies to evolve in new ways at the international level, as seen in several facets of transatlantic aviation. Middle class people in the nineteenth century could not afford a vacation across the Atlantic, but with the advent of cheap air travel in the 1950s and 1960s, millions could do so regularly. Airplanes represented a transformative large technical system dependent on infrastructure that operated at the international level, including meteorological, communications, and air traffic control systems: without transnational connections these technological systems would have been far les effective.

While this study explores a wide array of subjects, its aim is to explain how North Atlantic flight became routine. To that end, it was necessary to keep the scale of the dissertation manageable by focusing on the subjects that most pertinently deal with the process of routinization. Some subjects were treated briefly as a result, most of which were relevant to aviation in general and so were not representative of how the North Atlantic shaped the development of air travel specifically. Air security, for example, was left less examined in large part since regular passenger screening did not start during the period of study and was not a feature unique to transatlantic air service. Plane crashes were also discussed briefly and several incidents that influenced transatlantic flight were included in this study, but crashes are common to air travel the world over and so were not examined in detail here. All general aviation subjects are discussed briefly in the dissertation, as needed and as space permitted, and some

[78] Erik van der Vleuten, "Understanding Network Societies: Two Decades of Large Technical System Studies," in Erik van der Vleuten and Arne Kaijser, eds. *Networking Europe: Transnational Infrastructures and the Shaping of Europe, 1850-2000* (Sagamore Beach, MA: Science History Publications, 2006), p. 279-314.

subjects that remained beyond the scope of the present study, such as air crew training and certification, will hopefully become objects of historical research in the future.

Chapter One: Opening the North Atlantic Skies

The earliest planes could barely keep aloft for a few minutes. But their potential was clear even in those days: advancing technology would allow mankind to soar across continents. And if any place on earth represented the obvious apex of aviation in the early twentieth century, it was the Atlantic Ocean. Said ocean was already heavily used by steamships that conveyed passengers by the hundreds of thousands and millions of tons of cargo annually. It stood to reason that transatlantic flights would eventually follow: better planes were constantly being built, faster and bigger than those that came before. In the first decades of their existence, aircraft had evolved from primitive wood and canvas to metal bodies with powerful engines. Several potential routes stretching between Europe and North America presented opportunities for the first air crossing once planes that could manage the hop materialized. National pride and the potential of lucrative transoceanic air service beckoned aviators and airlines who turned their attention to the promise of this new frontier. The long-term challenge, however, was to transform air travel between the two continents into a safe, predictable commute rather than an arduous, risky trek.

Thousands of people invested their time, money, resources, and sometimes their very lives into this bold endeavour before a new paradigm of regular, transatlantic air travel emerged. Methodical improvements in aviation technology, thorough planning, infrastructural developments, and more than a little luck all played a role in early transatlantic flight. Aviators risked all to make the initial crossings, spurring on the aeronautics industry to develop the first planes to cross the Atlantic. The flights encouraged governments and airlines to build up the pioneer routes, bringing their extensive resources and know-how to transform the realm of daredevils into commercial “highways” of the sky. It involved a great deal of international

cooperation and, occasionally, competition at the state and commercial level to make this happen, but the drive to make transatlantic flight a reality was impossible for many countries to resist. This first phase of North Atlantic development, running from 1919 to 1939, marked the open and close of this frontier: the outbreak of the Second World War ended exploration there but marked a period of military development that made postwar commercial flight possible, creating a special but normal part of the civil aviation market.

Pioneering Transatlantic Flights

The first serious effort to fly across the Atlantic Ocean was spurred by the British newspaper *The Daily Mail* and funded by its owner Lord Northcliffe, born Alfred Harmsworth. Beginning in 1906, the paper offered cash prizes for increasingly lengthy and technically challenging flights, including one for the first flight across the English Channel and another for a circumnavigation of Great Britain.[1] Lord Northcliffe, an avid backer of new technologies, saw the potential of airplanes both for Britain's prestige and its defence.[2] He was particularly concerned that Britain lacked aircraft that might match those produced in France or Germany, especially in light of the (as yet unrealized) military potential that planes represented.[3] But the planes of the day were fragile, barely able to lift off the ground for more than a few minutes. He chose to offer the prizes "convinced of the immense future before [aircraft] as auxiliaries to our [naval] Fleet and for the protection of these islands, and in view of the vast efforts that are being made by foreign Governments in aeronautics".[4] In that spirit, in 1913 *The Daily Mail* offered a prize of £10,000 to the first group to fly across the Atlantic in less than 72 hours. Stops along the

[1] "The New *Daily Mail* Prizes," *Flight International*, April 5, 1913, p. 393.
[2] Robert Wohl, *A Passion for Wings: Aviation and the Western Imagination, 1908-1918* (New Haven: Yale University Press, 1994), p. 37-8.
[3] Percy Rowe, *The Great Atlantic Air Race* (London: Angus & Robertson, 1977), p. 24-6.
[4] "Waterplane Flights: Large Prizes Offered by the "Daily Mail," *The Times*, April 2, 1913, p. 5, col. G.

way were permitted as long as the voyage began in Canada, the United States, or Newfoundland, and ended in Great Britain or Ireland (or vice versa).[5]

As *The Daily Mail* noted, navigation was difficult for aircraft traversing the sea: long stretches without landmarks or in poor weather could send a plane far off course. If an aircraft could not find its designated refueling points along the way, it would be unable to complete the trip.[6] In addition, Britain's Aerial Navigation Acts of 1911 and 1913 required planes to alight in specially designated areas. It was nearly impossible for pilots to determine where they might set down their planes in advance as minor and inevitable navigational errors could drive a plane far from its planned course over transatlantic distances. As the official registrar of the competition, the Royal Aero Club of the United Kingdom petitioned the British government to clear some legal hurdles as it would be unfortunate for a pilot to land a plane that had crossed the Atlantic on someone's property and then have the entire organization sued for trespassing. Harold Perrin, Secretary of the Aero Club, requested that the usual flight plan requirement be waived for all flyers making the journey.[7] A combination of proper planning, use of the latest technology, and fortuitous weather conditions all improved a flight's chances of success. Lt. J.C. Porte, the pilot for one of the first transatlantic flight efforts, summarized these problems:

> My greatest concern, apart from engine trouble, was with the question of navigation. Ireland seems a big thing to miss when you look at the map, but in aerial navigation over the ocean it is quite possible. However, a few days ago I learned that a naval friend of mine had produced an instrument enabling us to take sights at any altitude, and I think that point has been settled satisfactorily. We should cross in 20 hours. If we drop into the ocean I do not think we should be able to soar again. I could not estimate how long the machine will float. It depends to some extent upon the state of the sea. We shall be as near the track of steamers as possible and shall hope to be

[5] *Ibid*.
[6] *Ibid*.
[7] TNA HO 45/10720/248608, "Home Office: Registered Papers, 1910-1919," 1914. Letter from Harold Perrin to the British Under Secretary of State, June 29, 1914.

> picked up. As to the danger of dirty weather, we shall choose our time and start in a settled calm. Once aloft we shall beat any storm.[8]

Porte touched on a wide swath of hazards awaiting transatlantic flights. The known navigational challenges could be countered with prudent planning and technological innovations to fix (or reasonably estimate) a position anywhere in the world. But North Atlantic weather was chaotic and predictable only in that it was often bad. Porte planned to begin his flight during a period with clement conditions for if a flight faced severe headwinds it might make little or no forward progress, forcing the crew to ditch in the sea once it ran out of fuel, while storms could destroy a plane. Even if a flying boat[9] set down in the water, it was designed for calm harbours with small waves. It might not last on the open ocean even under what would otherwise be considered good conditions. A safe transatlantic flight therefore relied on extremely thorough preparation and good luck during those early years.

Luck is beyond human control, but improved aircraft could reduce the need for it. Aviation technology was immature in those early days and was not immediately up to the transatlantic challenge. In 1913, French aviator Count Charles de Lambert noted some of the limitations of aircraft. Planes were not very powerful or efficient. He gave an example of a plane using conventional petrol (gasoline) engines that might weigh one ton. The necessary fuel for a transatlantic flight using such an aircraft would weigh one and a half tons even without accounting for the additional weight of the fuel tanks. As this was far from an insurmountable obstacle in de Lambert's opinion, it was only a matter of time before better engines, alternate

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[8] "Transatlantic Flight: First Formal Entry for the Contest," *The Times*, February 16, 1914, p. 10.

[9] A flying boat (also called a seaplane or waterplane) is a term for any aircraft capable of taking off and landing on water. In contrast, an airplane (alternately called aeroplane) is the term usually reserved for aircraft designed to take off and land on the ground. While minor differences between the types of aircraft exist, the main advantage of one or the other type of craft is where it can alight: a flying boat needs only a calm stretch of water and suitable dock facilities, whereas an airplane requires a runway (often paved) but can be sited closer to a final destination. The decision to use one type or the other depended on a number of advantages and disadvantages that will be discussed in detail in later sections.

fuels, or more efficient plane designs were realized. In his estimation, however, such an aircraft was likely to be a flying boat rather than a landplane since it offered flexible landing options in the event of trouble.[10]

So many technical, technological, logistical, and professional issues stood in the way of the first transatlantic flight that the Royal Aero Club acknowledged that "even supposing the [*Daily Mail*] prize to be won, the man behind it will find himself out of pocket at the end."[11] Only very well-funded groups could even attempt to enter the competition in any event. Research work, testing, and developing the airframe required cutting-edge skills and technologies plus countless man-hours of labour. The £10,000 award was merely a trophy of sorts for the victor; recognition for the accomplishment rather than a paycheque.[12]

In spite of these challenges, several groups entered the running to be the first across the Atlantic. Among the most promising initial candidates was the group organized by American newspaperman Rodman Wanamaker. His group had many technical obstacles to overcome in its planning. An entirely new plane was to be built to highly advanced and precise specifications, and special aviators were to be selected and trained for the flight. Glenn H. Curtiss was commissioned to construct the new aircraft with an 80-foot wingspan, a 200 horsepower engine, and fuel capacity sufficient for 30 hours of flying. A wireless telegraph was envisioned for radio communication with ships along the route, although the crew would have to track all ships' positions through their own reckoning.[13] The decision to make use of radio equipment was unusual and expensive for a plane at that time but its potential value on a flight of such importance and difficulty made the case for its inclusion.

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[10] "$50,000 for Flight Across Atlantic," *New York Times*, April 1, 1913, p. 1.
[11] "Editorial Comment," *Flight International*, February 14, 1914, p. 158.
[12] *Ibid*., p. 157-8.
[13] "The Atlantic Flight: 'Week-End Visits' to New York and London," *The Times*, February 6, 1914, p. 6.

Wanamaker's team's proposed over-ocean flight distance was modest by modern standards: only from St. John's, Newfoundland, to the Irish coast.[14] This represented a distance of about 3,000 kilometres, which was significant for aircraft at the time but still less than half as far as the distance between the major cities of New York and Paris or London. As no runways existed at either end of the trip capable of accommodating such a plane at that time, which was obviated by the use of a flying boat. The team planned the final craft's airspeed to be in excess of one hundred miles per hour (161 km/h) with an additional push provided by a westerly tailwind. Optimistically, this could see the trip completed during the daylight hours of a single day. Although a *New York Times* article suggested that a daylight trip could be completed, the aircraft was far too slow to manage the feat on an eastbound transatlantic flight without gale-force tailwinds to push it along. Since the sun rises and sets earlier as one travels east, there is a smaller window for a plane to cross the ocean without running into the night. For example, when it is dawn in Newfoundland, the sun has already been up in Ireland for over three hours.[15] Wanamaker's plans were suspended by the outbreak of the First World War, however. Lt. John C. Porte, the pilot in charge of designing the plane, was a member of the British military and returned to his home country.[16]

All other transatlantic flight efforts were similarly shelved for the war's duration. *The Daily Mail*'s prize in any event was taken off the table. However, no private group sought to achieve the goal as it would certainly have been in poor taste to attempt such a feat while the war in Europe continued. Almost immediately following the cessation of hostilities in November,

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[14] Since it was impossible to reasonably expect a flight crew to find a particular point in Ireland under the time and fuel restrictions the long flight imposed, the mere fact of having reached the island was considered sufficient for the terminus. "One-Day Flight Across Atlantic," *New York Times*, February 5, 1914, p. 1.

[15] "One-Day Flight Across Atlantic," *New York Times*, February 5, 1914, p. 1.

[16] The *Daily Mail* prize was likewise suspended for the duration of hostilities. "America's Flight Halted," *New York Times*, August 5, 1914, p. 13.

1918, however, the contest was re-launched. Several new entrants registered for the prize over the month that followed, hoping to be the first to cross the North Atlantic by air.[17] Perhaps surprisingly, the first transatlantic air trip was not completed by a group competing in the contest at all, but by the United States Navy (USN).

In 1917, just after the United States joined the First World War, the USN began work on an anti-submarine aircraft capable of carrying depth-charges and bombs for long-duration patrol flights. The 'Navy-Curtiss Number One' or NC-1, named after Glenn Curtiss and his aircraft production team, was ready to fly too late to be of use in the war. The Navy recognized the value in using long-range planes (which could be used for observation and reconnaissance even without any offensive capabilities) and continued to support their development even after the war concluded in 1918. Aircraft with transatlantic range were considered valuable assets.[18] The actual cost of the experimental transatlantic flight, including all aircraft work and support infrastructure, came to about £200,000.[19]

By May 1919, Curtiss had built three more planes: the NC-2, NC-3, and NC-4. All were flying boats rather than landplanes.[20] The small fleet hopped from New York to Halifax and then on to Quidi Vidi Lake near St. John's, Newfoundland. The NC-1, NC-3, and NC-4 set out from Newfoundland on the transatlantic trip on May 16, 1919, bound for the Azores some 1,900

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[17] The armistice that ended hostilities came on November 11, 1918, and the prize was officially opened again on November 14. The first entry to register came one day later, on November 15. Rowe, *The Great Atlantic Air Race*, p.65.

[18] Ted Wilbur, *The First Flight Across the Atlantic: May, 1919* (Washington, D.C.: NC-4 50th Anniversary Committee, Smithsonian Institution, 1969), p. 7-11.

[19] The figures were: £100,000 for the destroyer escort that guided and supported the crossing, £12,000 for each of the four planes built in the program, £20,000 for research and development work, plus about £32,000 in additional unnamed expenses. The article bemoaned the lack of similar support from the British government for its own transatlantic efforts. "The U.S. Airmen," *The Times*, May 21, 1919, p. 14.

[20] The NC-2 was not finished but parts of it were used to repair the NC-1 following a fire that also damaged the NC-4. All three active aircraft used a four-engine configuration that could fly at 75 mph. *Ibid*., p. 13-5. According to Percy Rowe in his book *The Great Atlantic Air Race*, however, the top speed of the plane was 90 mph. Rowe, *The Great Atlantic Air Race*, p. 89.

kilometres (1,200 miles) away.[21] The flight was carefully timed so that the weather would be as favourable as possible: several of the ships supporting the crossing reported a period of good conditions after days of wind and cloud. With poor weather, the flight would have been nearly impossible to conduct safely.[22] A series of 21 navy destroyers lined the path at 80 kilometre (50 mile) intervals to guide the planes as highly visible navigational aids. Each ship had an illuminated number as identification and fired star flares at five minute intervals for the night portion of the voyage.[23] Yet more ships were deployed along the routes between the Azores and the Portuguese coast, and even more between Portugal and England. In all, 66 ships were used in support of the crossing.[24]

Such precautions were considered crucial to assure that the planes could find their way. Yet they proved to be insufficient as the NC-3 lost its way when its crew mistook another ship for one of the destroyers and veered far off course. It lost too much time to find its destination and put down at sea.[25] The NC-1 likewise ditched at sea after its crew could no longer keep their plane aloft: the wings were not properly weight-balanced, forcing the crew to struggle constantly to stay righted.[26] Only the NC-4 soldiered on to the Azores even as its crew lost sight of the

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[21] Wilbur, *The First Flight Across the Atlantic*, p. 25-7.

[22] Rowe, *The Great Atlantic Air Race*, p. 98-101.

[23] At one point, a flare nearly exploded close underneath the NC-3. The flares were set to detonate at 4,000 feet elevation on the northern side of the ships, while the planes were supposed to pass on the southern side to avoid such a collision. The NC-3 was slightly off course as it flew at 4,500 feet when one of the flare shells burst near enough to badly frighten the crew. The NC-3's navigator knew in advance that the shot's timing would be close but chose not to alter course south of the ship since he believed that the ship was the one out of position. Wilbur, *The First Flight Across the Atlantic*, p. 25-7.

[24] Robert Wohl, *The Spectacle of Flight: Aviation and the Western Imagination, 1920-1950* (New Haven: Yale University Press, 2005), p. 13.

[25] The NC-3's crew managed to put down somewhat safely in the sea and sail their flying boat backwards over 205 miles before being spotted near Ponta Delgada in the Azores. Wilbur, *The First Flight Across the Atlantic*, p. 27, 30-1.

[26] One of the NC-1's wings was salvaged from the NC-2 and so was not properly weight-balanced with NC-1's other wing. It was therefore impossible for the crew to leave the controls alone for any length of time. *Ibid*., p. 28.

destroyers in fog and cloud. The NC-4 arrived in Lisbon on May 27 after the weather improved and finally reached England after another brief hop.[27]

The sheer amount of effort behind the NC-4 crossing was monumental. While the flight proved that aircraft could cross the North Atlantic, doing so in this manner was far from practical or affordable. Regular air travel could not depend on dozens of ships sailing along the route to give guidance and support. And the project had just a one-in-three success rate. While the NC-4 made the North Atlantic crossing, it failed to meet the *Daily Mail* requirement of doing so in under three days. Not until June of 1919 did two Britons, John Alcock and Whitten Brown of the Royal Air Force, successfully make the crossing and win the prize.[28]

Nearly every detail about Alcock and Brown's crossing was meticulously planned. Their plane was a Vickers Vimy, a new model of British bomber aircraft built for long-range flights. It was modified to carry 865 imperial gallons (3,900 L) of fuel, providing a theoretical range of 2,440 miles (3,900 km).[29] Selecting the shortest practical transatlantic route was equally important. They departed from St. John's, Newfoundland, near the easternmost point of North America, and headed for Galway on the west coast of Ireland, 1,900 miles (over 3,000 km) away rather than the shorter route to the Azores used by the navy crossing. Since the *Daily Mail* prize paid out for a trip that ended in the British Isles, this route presented fewer complicating factors (a longer overall voyage plus an additional stopping point) even if it was technically more difficult.[30] Thanks to the precautions taken and modest exertion, the plane crossed the North

[27] Another 14 ships were arranged to guide the plane on its final transatlantic leg. *Ibid*., p. 29-33.
[28] "Atlantic Prize Won: British Air Victory," *The Times*, June 16, 1919, p. 13, col. F.
[29] "New Aero to Try Feat," *Washington Post*, June 2, 1919, p. 3.
[30] *Ibid*., p. 1.

Atlantic with about one third of its fuel remaining and while this left room for changes to the flight plan, Alcock landed as soon as he spotted what appeared to be suitable landing ground.[31]

The prevailing winds in the North Atlantic blow from west to east. Since a flight intended to push a plane to the limits of its range must have the most favourable winds possible, the first transatlantic flight had to travel eastwards. These winds would carry the plane towards its destination, reducing the flight time and saving fuel.[32] A plane should fly the most economical route based on the wind rather than the most direct route. This is especially true for slower aircraft such as the Vickers Vimy used by Alcock and Brown. Faster modern jets need to make only minor deviations from the great circle route[33] between their point of origin and destination due to the wind. But as a general rule the slower the flight speed the greater the impact of wind and air pressure. Except in unusually calm conditions, a slower flight must veer farther from the great circle to follow prevailing winds and realize the fastest route.[34]

Bearing out this point, Alcock and Brown's plane was "throttled down" to 90 miles per hour (145 km/h), well below its top operational speed. This lower speed was selected for its economical fuel consumption for it was safer for the crew to take its time rather than rush the

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[31] "The Transatlantic Flight," *Flight International*, June 19, 1919, p. 804.

[32] William Warntz, "Transatlantic Flights and Pressure Patterns," *Geographical Review* 51, no. 2 (April 1961), p. 195-6.

[33] The term 'great circle' refers to the curved appearance of long-distance routes when drawn on a conventional map. In reality, the route is a straight line between two points on the surface of the earth that is distorted when displayed on a 2D map. For example, a flight departing London for New York will head northwest despite the fact that London is farther north than New York. The plane's straight path around the curvature of the earth towards New York means that its heading will gradually shift towards the west and then southwest even though the plane does not actually turn at any point. Voyages longer than about 1,000 miles that do not account for this curvature introduce increasingly large navigational errors. Direct lines that do not deviate towards the shortest great circle path when drawn on a map are called Rhumb lines. Sir John Alcock and Sir Arthur Whitten Brown, *Our Transatlantic Flight* (London: William Kimber, 1969), p. 15-6.

[34] Following the winds rather than the most direct path often also comes with an associated fuel savings if the trip takes less time. This has the advantage of giving the flight crew extra time to find a suitable landing spot if the planned landing site proves unsuitable. Warntz, "Transatlantic Flights and Pressure Patterns," p. 201-3.

plane and exhaust their reserves.[35] The plane retained about one third of its fuel upon landing, validating the economical approach. The actual groundspeed, accounting for the tailwind, was about 120 miles per hour (192 km/h) over 16 hours and 12 minutes of flight.[36] This tailwind carried the plane 800 km farther with no additional demand on the engines. Conversely, a flight in the opposite direction would have faced an equally strong headwind that would have cut the groundspeed by the same amount, requiring longer range and greater fuel capacity to traverse the same ground distance.

Safety was considered at all planning stages: experts following the flight effort claimed that the group had taken every precaution short of "having a destroyer chain stretched beneath them, as in the case of the American Navy's seaplane flight."[37] Even with all the precautions, it was impossible to eliminate all potential hazards. Much of the flight took place in thick cloud or fog that lasted for hours at a time. With no horizon or fixed points to ascertain up and down, the airmen at times accidentally inverted the plane and inadvertently performed aerial stunts including loop-de-loops and barrel rolls that Alcock described as "comic 'stunts'".[38] At one point, the disoriented crew barely managed to right their plane after accidentally going into a steep spiral dive and dropping from 6,000 feet to just above the ocean's surface.[39] Icy weather blocked the airspeed indicator at times while the thickest fog forced the flight down to 200 feet above the sea for visibility.[40] Finally, upon reaching Ireland, the airmen put the plane down on what they initially assumed was a level field but was instead a bog that badly damaged the plane

[35] Vehicles have speeds at which they achieve the greatest fuel economy, typically slower than their top speed. By keeping a plane flying at this economical speed and sacrificing a short flight for a fuel efficient flight, Alcock and Brown extended their maximum flight range and so gave themselves a better chance to find a safe landing spot. "New Aero to Try Feat," *Washington Post*, June 2, 1919, p. 3.

[36] "How I Flew The Atlantic," *Daily Chronicle*, June 16, 1919, p.1.

[37] "Canadians Confident of Alcock's Success," *New York Times*, , June 15, 1919 p. 1.

[38] "How I Flew The Atlantic," *Daily Chronicle*, June 16, 1919, p.1.

[39] Wohl, *The Spectacle of Flight*, p. 13.

[40] "How I Flew The Atlantic," *Daily Chronicle*, June 16, 1919, p.1.

and slightly injured both of them.[41] No single problem proved to be a fatal but the flight showed that even the best prepared transatlantic effort still had serious obstacles that could not be solved by planning alone.[42]

One of the more mundane elements of the first nonstop transatlantic flight, Arthur Whitton Brown noted that he found it difficult to wake up at 7 a.m. in what appears to be the first case of jet lag. Brown remarked:

> This difficulty of adjustment to the sudden change in time lasted for several days. Probably it will be experienced by all passengers travelling on the rapid trans-ocean air services of the future – those who complete a westward journey becoming early risers without effort, those who land after an eastward flight becoming unconsciously lazy in the mornings, until the jolting effect of the dislocation wears off, and habit has accustomed itself to the new conditions.[43]

These first flights were daring and pushed the boundaries of aviation technology to their limits. None of them had the same impact in the public mind as the 1927 flight by Charles Lindbergh.[44] This crossing from New York to Paris won him the Orteig Prize: a $25,000 award in the same spirit as the earlier *Daily Mail* prizes.[45] His flight did not revolutionize aviation, nor did it usher in a transformation in aircraft technology. The plane he used, the *Spirit of St. Louis*, was unconventional mainly in that it was stripped of weight to maximize room for additional fuel (including a navigator). That alone made the plane impractical for regular flight, although it made the crossing all the more sensational as Lindbergh had no one present to help him over the

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[41] *Ibid*.

[42] Terry Gwynn-Jones, *Farther and Faster: Aviation's Adventuring Years, 1909-1939* (Washington: Smithsonian Institution Press, 1991), p. 86-9.

[43] Newfoundland Time is three and a half hours ahead of British Time, and so 7 a.m. feels like 3:30 a.m. to air travelers. Slower moving ship travel avoids such problems by virtue of gradual acclimatization to the changing local time: a transatlantic sea voyage takes several days, diminishing the impact of the change in time zones by spreading out the adjustment. Alcock and Brown, *Our Transatlantic Flight*, p. 104.

[44] Lindbergh's Atlantic flight has been thoroughly documented elsewhere, the details of which are only tangentially relevant to this study and so will not be discussed at length here. For more on the his flight and its impact on the public imagination and on aviation, see: Thomas Kessner, *The Flight of the Century: Charles Lindbergh & the Rise of American Aviation* (Toronto: Oxford University Press, 2010). For background on the flight in Lindbergh's own words, see: Charles A. Lindbergh, *The Spirit of St. Louis* (New York: Simon & Schuster Inc., 1981).

[45] "Puts Up $25,000 For Paris Flight," *New York Times*, May 30, 1919, p. 1.

ocean. But Lindbergh's flight had the virtue of crossing not between remote stretches of coast but from one major North American city to a major European city. Perhaps most importantly for aviation, the flight utterly captured the public imagination. The aviator was celebrated in France and the United States, given parades and parties, and his deed shifted perceptions of what flight might mean for the common man.[46] This fact set Lindbergh's effort apart from his predecessors by bringing home the idea that transatlantic travel was not just possible but might one day become practical.[47] It was an incremental achievement that built on the work before while setting the stage for future accomplishments. Perhaps the most important legacy of Lindbergh's transatlantic flight was that it spurred on a period of investment and spending on aviation technology. In 1928, just after the historic flight, sales of the Ford company's 4-AT jumped to 38 from just 13 in 1927.[48]

Further landmark flights marked North Atlantic history. On September 2, 1930, Dieudonné Costes and Maurice Bellonte flew the first nonstop flight westbound between Paris to New York. A layman might not appreciate the importance of flying the same route as Lindbergh had done three years prior. The true value was that the flight was against the strong westerly headwinds. From a technical standpoint this was indeed a notable milestone in that it proved aviation technology had advanced considerably during those three years. Lindbergh's plane was barely up to the challenge of flying that distance with a tailwind. Flying into the winds meant that the plane contended with a longer flight and potentially unexpected adverse weather.[49]

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[46] Many works detail Charles Lindbergh's exploits and his impact on the zeitgeist. For more, see: Richard P. Hallion, "Daniel and Harry Guggenheim and the Philanthropy of Flight," in William M., Leary, ed. *Aviation's Golden Age: Portraits from the 1920s and 1930s* (Iowa City: University of Iowa Press, 1989), p. 26-7; Wohl, *The Spectacle of Flight*, p. 9-46.

[47] Edward P. Warner, "Atlantic Airways," *Foreign Affairs* 16, no. 3 (April 1938), p. 467.

[48] William M. Leary, "Henry Ford and Aeronautics during the 1920s," in Leary, *Aviation's Golden Age*, p. 10.

[49] "La conquête de l'atlantique nord," *France Aviation*, October 11, 1955, p. 1.

These pioneers proved that it was indeed possible to fly across the North Atlantic. Their experience paved the way for regular air service by spurring the development of new and more powerful aircraft suited for long flights as well as the associated aviation technologies needed to operate the route safely and, more importantly for future aviation, they demonstrated the need for infrastructure to support transatlantic flights. Weather had to be tracked, predicted, and transmitted rapidly throughout the North Atlantic region so departing flights could plan the most efficient and safest track. Radio transmitting stations needed to be situated at strategic locations to broadcast weather updates as well as listen for distress calls, or to offer a position fix with radio beacons and, in later years, radar. Airfields had to be built to serve the new planes. But before all of those things could be done, the governments of the North Atlantic most invested in aviation partnered with airlines to study where and how to ready the region for regular civil air travel.

Airships on the North Atlantic

Air travel was not always dominated by planes, and for a time there was a role for airships on the North Atlantic. A British airship, the R-34, made a crossing both west and east in July, 1919, shortly following the first transatlantic voyages by the NC-4 and Alcock and Brown. Brown, despite having just flown the Atlantic in an airplane, believed that passenger traffic would only be practical in the near future using airships. He tabulated the costs and detailed a series of plans for how such a program might be developed for future use, claiming that passengers might have to spend just £48; less than a first class berth on an ocean liner. Part of the cost was offset by the conveyance of large quantities of high priority air mail. Brown was not dismissive of the potential of planes, he merely saw them as a technology too immature for

affordable, near-term transatlantic service. Airships of the day, as with the R-34, had far greater range than any plane and could supplement paying passenger service with air mail at a rate of £425 a ton. Brown believed such an airship service could be realized with just four airships in service, providing two flights weekly between London and New York. Planes, on the other hand, would require a fleet of nearly thirty to offer comparable service and cost well over twice as much at that time.[50] Airships certainly boasted far greater carrying capacity than airplanes even in that first crossing. The R-34 had a crew of 30 with fully 25 tons of supplies and fuel as it embarked.[51] No plane of the day even came close to that scale.

Detailed information about the R-34 was compiled in a report and released for public consumption: publicity was an important element of the first transatlantic round-trip flight. American news agencies were targeted in particular for these press releases as the British authorities assumed that their own press would cover the details without any encouragement.[52] A change of plans, to have R-34 fly to St. John's and back to Britain as a shakedown, was vetoed from a publicity standpoint. The Air Ministry was so conscientious about losing public interest in the first transatlantic airship flight that it would only accept the initial plan of flying to its New York area terminus. Bringing the airship back quickly and with the fewest further complications trumped any possible benefits from the extra stop.[53] Ironically, the British government did not sponsor publicity with public funds or resources. Any celebration for the R-34's crossing was

[50] Alcock and Brown, *Our Transatlantic Flight*, p. 121-37.

[51] John Duggan and Henry Cord Meyer, *Airships in International Affairs, 1890-1940* (New York: Palgrave, 2001), p. 63-4.

[52] Collecting promotional photos was considered important enough to merit an 8-point itemized list about what to include and how to distribute them upon the flight's conclusion. TNA AIR 2/725, "R. 34 Transatlantic flight July 1919: Narrative of voyage and official log 2/7/1919-6/7/1919." Minute 2, "Written and pictorial publicity of trans-Atlantic voyage of R.34," June 6, 1919.

[53] TNA AIR 2/726, "R. 33 and R. 34 transatlantic flight: home publicity, 1919." Notes of an Air Ministry Meeting, "General Groves outlined the position regarding R.34's Trans-Atlantic Flight," June 2, 1919.

left to the public at large, but even then there was only mild interest in the airship's accomplishment.[54]

The press packages showed that the R-34 flight faced similar challenges as the preceding long-distance airplane flights. Its crew carefully monitored fuel consumption, tracked position, and made the best use of weather data through observations and reports from strategically stationed ships along the route. A sophisticated wireless telegraph system was installed with a range of up to 1000 miles (1600 km), and the Marconi Wireless Telegraphy Company offered the use of its transmitting stations for support.[55] The radios were included in part to help with weather reports. Two British battle cruisers were stationed at points in the mid-Atlantic specifically to assist with the crossing. Further assistance was provided by the network of stations set up in advance of the transatlantic flights already carried out in 1919.[56] While radio equipment was considered mission-critical, the wireless direction-finding was not. If it failed prior to takeoff, Deputy Chief of the Air Staff General Robert Groves stated that the flight would proceed. The Royal Navy would then have to dispatch additional ships to provide sufficient direction-finding support.[57]

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[54] The British Treasury may have been far more concerned with the difficulties in demobilization than in celebrating the third Atlantic crossing in as many months. The R-34 followed the NC-4 and the Alcock and Brown crossing, so even if it represented a major aviation accomplishment, it was not as momentous as it might have been a few months earlier. Duggan and Meyer, *Airships in International Affairs*, p. 64.

[55] TNA AIR 2/725, "R. 34 Transatlantic flight July 1919: Narrative of voyage and official log 2/7/1919-6/7/1919." Lt. C.P. Robertson, "Notes on the Trans-Atlantic Voyage of R.34," (no date) 1919.

[56] No specific location for the ships was given. A route map showed the R-34's flight path following the great circle route from East Fortune, Scotland, to St. John's, Newfoundland, before heading onwards to points in North America proper. The ships were likely stationed on or near the course at strategic intervals to maximize radio coverage and offer weather updates. TNA AIR 2/725, "R. 34 Transatlantic flight July 1919: Narrative of voyage and official log 2/7/1919-6/7/1919." Air Ministry Press Release, "Air Ministry News Story no. 28, Notes on the Trans-Atlantic Voyage of R-34," (undated) 1919, p. 7-8.

[57] It should be noted that the airship was originally used as a bomber and transferred to the Air Ministry, but was still operating with the support and assistance of the Royal Air Force. As such, there was a great deal of cooperation between the two organizations. TNA AIR 2/726, "R. 33 and R. 34 transatlantic flight: home publicity, 1919." Notes of an Air Ministry Meeting, "General Groves outlined the position regarding R.34's Trans-Atlantic Flight," June 2, 1919.

The R-34 crossing pointed to the need for support infrastructure for airship operations, even for experimental flights. Much of this already existed over land in Europe and North America by 1919, built during and after the First World War to aid plane operations. Airships could use the same navigational aids as planes, but ground support was almost entirely different. The mass produced planes that airfields could support used different types of fuel, often had distinct tool requirements, and needed much smaller hangars. The network of airfields often lacked amenities that could accommodate airships unless they were specifically built and if there was room for them. European countries and the United States both put emphasis on the faster airplanes through support of these airfields and, in most cases, through lucrative air mail contracts designed with the faster planes in mind.[58] Partly because of the heavy investment in the proven (and cheaper) airplane technology, official airship spending was relatively limited: there was little appetite among governments to support a second, similar technological sector.[59]

Innovative technologies and aviation practices were conceived to support airships, some of which became the cornerstone of modern aviation. Some early meteorological maps were designed to track air currents specifically for airships, giving detailed summaries of weather conditions. Compared to planes, airship's slow speeds required extremely close scrutiny of air pressure, wind speeds, and wind direction. An airship could cut travel time by as much as half on a transatlantic flight by following the optimal winds. For example, an airship could manage a speed of about 50 knots (90 km/h) under normal conditions in the 1920s, which was comparable to the highest typical wind speed along much of the North Atlantic. A pilot that took no heed of

[58] A handful of similarities existed between the airplane and airship facilities. They both had to keep a staff of skilled workers, both needed good connections to ground or water transportation, and both had to have facilities for handling passengers (once passenger service became more common). These paled in comparison to the differences between how the two operated. Helmut Braun, "Lighter-than-air vs. Heavier-than-air: How Can Network Effects Explain the Failure of Airship-Technology?" *The Journal of European Economic History* 38, no. 2 (Summer 2009), p. 375-81.

[59] *Ibid*., p. 386-7.

the weather and set a course along the direct great circle route from Europe to North America could encounter winds that might counter all forward motion at full speed at times, lengthening a voyage from 2.5 to 5 days when compared to more favourable winds farther south.[60] Airplane pilots made use of maps in this style in later years to find favourable winds and reduce their travel times, albeit to a smaller degree than their lumbering airship counterparts.[61] It is worth noting that Zeppelins[62] were much slower than airplanes. In 1933, they averaged airspeeds of about 70 miles per hour compared to planes flying at 165 mph. Zeppelin speeds of perhaps 100 mph were conceivable but not for some time yet.[63]

While planes could fly into a strong headwind in the 1930s, airships were far too susceptible to the wind to ignore any detail of weather forecasts. But thanks in part to their slow speeds they could employ technologies that airplanes could not. The *Hindenburg* used an echolot, a "sonic altimeter", to find its altitude when the ground was obscured. This was effectively a form of sonar that relied on airships' slower speeds and quieter conditions to listen for the echo from a loud pinging sound.[64] Even with the best information available, airships could not fly at all unless the weather was generally agreeable. In the 1930s, German company Graf Zeppelin operated its prestigious route between Germany and South America only between

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[60] Warntz, "Transatlantic Flights and Pressure Patterns," p. 196.

[61] Ibid., p. 195-7.

[62] Zeppelin is often used interchangeably with airship in both the literature and modern parlance, taking its name from the Graf Zeppelin company of Germany. The term 'zeppelin' refers to any rigid-bodied airship that retains its shape even when the lifting gas is not present, as opposed to a blimp that simply inflates a single large gasbag to lift the airship. Technically, an airship may be either one of these types or even other semi-rigid-bodied craft. Since the term airship predated the term zeppelin, the latter word will be used here only to refer to those airships in use after the term became popular in the 1930s and not to those that predated it.

[63] Only modest increases in airship speeds were actually foreseen in the years to come. Unlike streamlined planes, airships present a far larger surface area to the wind and so it is more difficult to travel faster before wind resistance becomes impossible to overcome. Airships could, however, cover very long distances without needing to refuel. Over the shorter distances planes could already travel, 500-600 miles depending on the type of aircraft, it was much more practical and economical to use them than airships. TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." Royal Airship Works, "Memo on Trans-Atlantic Airship Service," May 30, 1935, 2B.

[64] Harold G. Dick and Douglas H. Robinson. *The Golden Age of the Great Passenger airships, Graf Zeppelin & Hindenburg* (Washington: Smithsonian Institution Press, 1985), p. 134.

May and November when conditions were most suitable in a corridor that was considered among the best in the world for airships. The United States suspended the use of its own airships along its Atlantic coast altogether following the crash of its airship *USS Macon* in 1935 in only mildly adverse conditions.[65] In fact, airships had a comparatively strong commercial record compared to planes, which had been involved in fatal crashes numerous times. Until the 1937 crash of the Hindenburg, there had not been a single fatality on a revenue-generating zeppelin flight.[66]

A study from 1930 by the Air Transport Engineering Corp. of the United States suggested that, until airplanes could be designed with sufficient range, airships ought to be used to complement the faster planes. This relationship was analogous to fast railroads conveying goods to long-haul steamships for overseas voyages already in widespread practice in the United States. Airships, specifically the rigid-bodied zeppelins, were capable of carrying heavy loads over transatlantic distances by 1930 and had already flown between Europe and the Americas. The study suggested that regular service by both Germany and the United States was considered possible as early as 1933.[67]

P.B. Collins, of the British Air Ministry, shared a similar view. In 1935, Collins noted that the German experience with regular flights to South America proved that airships were viable for long-haul, transatlantic flights, and that "British or American service must be very seriously considered." He conceded that this potential arrangement was predicated on several unlikely assumptions: that flying boat service would remain much more expensive than airship

[65] While the note here did mention that the North Atlantic could be traversed at that time with existing airships, it was considered to be prohibitively expensive to do so. The worse weather found on the North Atlantic was not considered to be insurmountably challenging for an airship, although it was far more burdensome to overcome when compared to the South American service then in operation. TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." A.E. Slater, Minute 8, September 11, 1935.

[66] It is worth noting that airships had a comparatively small number of flights and proportionately fewer passengers flew on them compared to planes by 1937. As a ratio of all passenger flights, the number of fatalities were not as daunting as might first be assumed. C. Michael Hiam, *Dirigible Dreams: The Age of the Airship* (Lebanon, NH: ForeEdge, 2014), p. 6-7.

[67] p. 5-7.

travel for a prolonged period;[68] and that Germany would render technical assistance to Britain to develop a competitive airship program. Collins knew that the former was unlikely to persist long into the future while the latter was politically unpalatable for both the British and Germans.[69] Henry Self, also of the Air Ministry, expressed greater pessimism about the future of Zeppelins. In his 1935 estimate, Imperial Airways overestimated flying boat costs by over half in the reference document Collins used. Self also pointed out that Germany was abandoning Zeppelins as the vehicle to carry air mail bound for South America. He reasoned that if the country at the forefront of Zeppelin technology was cutting back on its use, perhaps airships were not worth pursuing.[70]

It is important to note that air travel did not occur in a vacuum. Despite the apparent advantages Zeppelins offered in the 1920s and early 1930s, they were barely competitive with steamships. It took an airship three days on average to cross the Atlantic westbound (into the prevailing winds) compared to four days for a ship. At roughly $3 million apiece for a zeppelin in 1930 compared to $18,000 per plane, Zeppelins were extremely expensive to build.[71] Even docking zeppelins proved pricey. Huge hangars were needed to store each fragile airship after

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[68] At the time of writing in 1935, transatlantic costs for an airship were calculated to be 2s 8d per ton-mile against an estimated 23s 9d for the flying boats that Imperial Airways used for their reference data. This was preliminary information dependent upon flying boats that were then in use by Imperial to be put on the transatlantic routes, but they were not intended for that purpose. The note here pointed out that improved aircraft were in production that would reduce the costs for flying boats considerably, so the costs listed were preliminary only and would not be representative of the near future of aviation. TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." P.B. Collins, Minute 4, July 4, 1935.

[69] *Ibid*.

[70] Self believed that the figure of 23s 9d for a ton-mile was erroneous and that 15s was probably more accurate, though he did not explain how he arrived at this figure. As with Collins, advances in aviation technology were predicted to cut the costs of flying boats in the near future (landplanes were not mentioned) and so would be a far better investment for Britain going forwards. TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." A.H. Self, Minute 7, August 30, 1935.

[71] The figure of $18,000 represents not the transoceanic variety of airplane or flying boat but a general average of all types of plane. Any plane built to cross the North Atlantic cost far in excess of a conventional aircraft designed only for a regional hop or domestic flight. Nevertheless, transatlantic-capable planes of any type were less expensive than a Zeppelin. Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 42-43.

landing[72] and large tracts of land had to be set aside for mooring: even slow winds meant that the airship might not align with a fixed dock. Catching mooring cables required scores of people at once, a cost in manpower that was unjustifiable if those same people were busy only for the tiny fraction of the time necessary to grab and affix those cables.[73] Telescoping mooring masts alone cost up to £50,000 in 1935 but even these could not tie off a zeppelin in winds of over 50 miles per hour.[74] And helium, the alternative lifting gas, was only commercially produced in the United States at that time. Other countries that wished to use non-flammable helium rather than flammable hydrogen could not: in 1927, the American government passed an export ban on helium.[75]

The only saving grace for airship travel was that it was nearly as luxurious as ocean liner service.[76] Airplanes, for their faster speed and greater operational flexibility, were never as opulent as the transatlantic Zeppelins. This alone did not justify their existence, of course, as the airships failed to continue service after the 1930s.[77] The countries most heavily invested in airship development, Britain, France, the United States, and even Germany, pursued airplanes simultaneously to airships for North Atlantic travels. Those who backed aviation were not exclusively partial to a single mode of transportation. As powered flight was still a young and

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[72] Zeppelins were also called "rigid airships" but this term does not mean that their frames were durable or resistant to damage, merely that they were able to hold a fixed shape. In reality, zeppelins were vulnerable to even slight impacts with other objects and had to be housed in a hangar nearly any time they were not in use. Helmut Braun, "Lighter-than-air vs. Heavier-than-air: How Can Network Effects Explain the Failure of Airship-Technology?" *The Journal of European Economic History* 38, no. 2 (Summer 2009), p. 372.

[73] R.E.G. Davies, *Fallacies and Fantasies of Air Transport History* (McLean, Virginia: Paladwr Press, 1994), p. 65-72.

[74] TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." Royal Airship Works, "Memo on Trans-Atlantic Airship Service," May 30, 1935, 2B.

[75] Hydrogen had greater lifting power than helium, so as long as a zeppelin builder was reasonably assured that there was little risk that the gas would ignite it was actually advantageous to use it. Guillaume de Syon, *Zeppelin!: Germany and the Airship, 1900-1939* (Baltimore: The Johns Hopkins University Press, 2002), p. 197.

[76] Berths were small by comparison to ocean liners but were far larger than those on planes of the day. There were also lounges and walkways for the passengers, and showers were available. *Ibid*., p. 193.

[77] John Christopher, *Riding the Jetstream: The Story of Ballooning: From Montgolfier to Breitling* (London: John Murray, 2001), p. 53-4.

developing technological sector at that time, all avenues were considered worth exploring until it could be conclusively shown which one was best for regular commercial service. Airships had a head start as the R-34 had carried 30 people across the Atlantic in 1919 when no plane could make the crossing for another two years to follow. But in 1936, Juan Trippe ordered Boeing 314s with room for more passengers than the Hindenburg could carry.[78] The race for aviation supremacy was nearly at an end.

While Germany operated what amounted to the only regular zeppelin service in the world in the 1930s, it faced political restrictions on where and how often it could operate internationally. The United States limited Germany to "experimental" Zeppelin operations only rather than permitting regular service, forcing the Germans to seek permission for a pre-specified number of flights.[79] The United States granted Germany twelve landing permits in 1935, each covering one round-trip voyage into American airspace. Germany's LZ-129 Hindenburg was the primary vehicle for the crossings,[80] while experimental flying boats were also used.[81] Germany approached the British at the same time for the right to use Bermuda on the southern route and the various British Empire points along the direct route. The Germans sought landing permits for twelve trips as part of the same experimental flight series. The British government believed that the southern route should be open to the Germans since Britain only controlled Bermuda on that route, increasing its need to work with other powers, provided that Germany respected

[78] Duggan and Meyer, *Airships in International Affairs, 1890-1940*, p. 215.

[79] Warner, "Atlantic Airways," p. 469-70.

[80] The airship had a capacity of 48 passengers, so the permits gave Germany clearance for a total of 576 in each direction across the Atlantic. The article also noted that the Germans would carry mail on the airship at a discounted rate that effectively gave the United States Post Office a profit on each run, perhaps offered as a concession to earn additional rights in the future. "Vidal Promises Two Atlantic Flights a Week," *New York Herald Tribune*, March 10, 1936, p. 16.

[81] The flying boats departed Horta in the Azores by catapult launches from Lufthansa's steamship *Schwabenland*. German reports were pessimistic about the chance of a flying boat successfully taking off from Horta without the assisted launch due to uneven seas much of the time. The flights proved successful in that they traveled the distance between Horta and New York (including a stop in Bermuda in one case) with fuel to spare. TNA AVIA 2/1978, "Trans-Atlantic Air Service: German Proposals." Letter from Eric Phipps to Anthony Eden, September 30, 1936, 108B.

reciprocal aviation rights with Britain on the North Atlantic. The northern route, in contrast, was not open to Germany or indeed any other country than those within the British Empire and the United States per the terms of air agreement talks over the previous year.[82] These permits only applied to the southern route, however: Germany was refused the right to use the direct route through Ireland, Newfoundland, and Canada on the grounds that it was reserved for Imperial Airways and Pan Am.[83]

Only a dozen Zeppelin trips traversed the North Atlantic before the Hindenburg disaster on May 6, 1937 put an end to German airship travel.[84] This is not to say that the Germans focused all their energies on zeppelins to the exclusion of planes for transatlantic flight: by 1935 Lufthansa was operating planes across the South Atlantic to Brazil.[85] The reality of airship travel was that it was too slow, too vulnerable to the weather, too expensive, and too impractical for regular air travel. If the Germans, the foremost experts on airship technology, were turning towards planes, then the Zeppelins' time had passed. All nations involved on the North Atlantic turned what energies they had spent on airships and redirected it entirely at heavier-than-air craft. There was still much to do before cumbersome airplanes or flying boats could cross those rough seas in those days.

Determining the Best Transatlantic Route

As the early flights indicated, there was a vast disparity between the shortest route and the one with the most clement weather. To create a reliable air route between Europe and North

[82] TNA AVIA 2/1978, "Trans-Atlantic Air Service: German Proposals." Draft of a letter to the Canadian and Irish governments from Downing Street, April 28, 1936, 52A.

[83] The Germans had asked the Irish government for permission to use Galway Bay, Ireland, as a refueling depot for their long-range flying boats. Following the Irish refusal, the Germans planned instead on flying via the southern route. "N. Atlantic Air Route," *Evening News*, October 16, 1936.

[84] Warner, "Atlantic Airways," p. 479-80.

[85] TNA AVIA 2/1923, Part 1, "Trans-Atlantic Air Service: French Proposals." Folio 59A, Extract from "Modern Transport," undated (circa 1935).

America, it was first necessary to determine which path presented the greatest benefit with the most manageable challenges. Veering from the direct route to either the north or south offered potential landing sites on several strategically useful islands but a longer trek overall. Airfields or safe harbours on those islands would be crucial as planes could not assuredly overfly the ocean in a single hop. The governments of the North Atlantic region therefore began a period of extensive studies in the 1930s to learn about this new frontier and determine whether it was worthwhile to add the extra distance as well as the cost of building entirely new infrastructures.

Broadly speaking, aviation planners in both Europe and North America examined three North Atlantic routes, each with unique merits and shortcomings. The first of these was the direct route, the shortest path between North America and Western Europe. This followed the great circle and offered convenient landing sites in Eastern Canada, Newfoundland, and Ireland, albeit with a very long ocean step and regularly bad weather in Newfoundland. The second option was the northern route along the coasts of Labrador, Greenland, Ireland, and on to Britain. While this last had the useful advantage of short jumps across the ocean, little was known about the region's suitability for development or its weather. Construction costs for airports or harbours in such remote and unwelcoming reaches could be prohibitively expensive. Although weather data was sketchy at best, the consensus in 1930 was that the northern route would be nearly impassable except during short periods in warmer seasons. The third and final option, the southern route, was the longest option. Stretching from the American coast through Bermuda and the Azores before reaching Europe, it featured a long ocean stretch that was only just shorter than the direct route's ocean jump. Where this route shone was its predictably clement weather, a major asset when aircraft could not overfly bad weather and forecasts could not reliably predict

it. Determining which of these routes was most practical for aeronautical development was a major focus throughout the 1930s.[86]

Several nations conducted surveys of the North Atlantic at that time, with the United States performing some of the most extensive test flights and studies. One of the earliest thorough analyses was conducted by the Chicago-based Air Transport Engineering Corp. in 1930. Its investigation pointed to a high volume of cargo traffic that would benefit from rapid transatlantic transportation, once it became viable: 74 million pounds of valuable goods and priority mail. While this represented under 0.1% of all goods shipped in 1925, the year that was analysed, it nevertheless proved that there was a market for speedy delivery.[87] Additionally, over one million people traveled from Europe to the United States in that same year. This was a considerable volume of passenger traffic, even ignoring the additional passengers travelling in the opposite direction. As the study suggested that paying passengers inevitably would seek out faster air travel on the North Atlantic once it became available, it emphasized the need to develop transatlantic flight and to find the most expedient route.[88]

The Air Transport Engineering Corp. study found that the technical solution to developing transatlantic air travel depended on which route was being considered. As aircraft in 1930 were not capable of flying above the foul weather commonly found in the northernmost reaches of the Atlantic, flying a southerly route could mitigate this hazard. The first transatlantic airship flights followed this route since they were highly susceptible to bad weather, and unable

[86] Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986), p. 26-7.

[87] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 3.

[88] *Ibid*., p. 4

to land in strong winds. Airplanes, however, lacked the range necessary for such lengthy hops that were longer than the other routes under consideration.[89]

-The Southern Route

Politics shaped the southern route as much as geography as the Portuguese authorities required that all aircraft using the Azores as a stopover point (a Portuguese island chain) were required to stop in Lisbon on any route into Europe. While this demand meant an unnecessary detour for airlines that preferred to fly directly on to the larger capitals of the continent, they recognized this situation was temporary. Airlines would eventually fly a direct route across the ocean without the need for a stop to refuel as more advanced aircraft became available, thereby removing this or any other gratuitous condition.[90] Britain gained similar leverage in the North Atlantic through its control over Bermuda and Newfoundland too, influence that likewise was expected to fade once planes no longer needed to use those islands as stopping points.[91]

Portugal was in a weaker position than Britain, France, and America. It lacked the resources to develop or exploit transatlantic air travel itself. But it controlled the Azores, an indispensable stopping point on the southern route. Its government tried to exploit this control by approaching the airlines testing the southern route, principally Imperial Airways and Pan Am, to form a pooled airline company with Portugal. Alternately, Portugal proposed that the airlines ought to pay a share of their revenue equal to the share of the Lisbon to New York route running

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[89] *Ibid*., p. 5-7.

[90] The assumption that planes would be able to make the transatlantic crossing in a single direct step was a logical conclusion even at that time. Newer models regularly entered the market with greater range than their predecessors, so in time the only planes stopping in the Azores would be those bound solely for that island chain. The detour to Lisbon was also sufficiently minor (being near the direct route between the Azores and many European cities) that it would be difficult for an airline to justify ignoring the route solely due to this. Warner, "Atlantic Airways," p. 477-8.

[91] *Ibid*.

between Lisbon and the Azores (just over a quarter of the total).[92] Imperial Airways refused on the grounds that doing so represented a subsidy to a foreign company, which was against British policy. The airline believed that it ought to push for technical stopping rights (landing only for fuel or safety reasons) while excluding commercial ones (exchanging passengers, mail, or cargo) at all Portuguese territories. Further, Imperial was willing to offer minor concessions to Portugal for a percentage of revenue generated on the route, from one percent for the first five years up to three percent.[93] A major economic commitment to Portugal made little sense to countries with transatlantic ambitions, especially when they had alternative routes to consider.

France and Britain both developed some of the infrastructure along the southern route during the 1930s. The British Aviation Ministry built radio facilities in Bermuda with both communication and direction-finding capabilities in 1936. Bermuda's radio development came at a time when the French planned similar stations in both Brest and at its overseas territory of St. Pierre and Miquelon adjacent to Newfoundland, the latter of which was of considerable value for the direct route.[94] Bermuda's wireless station was built with traffic to and from New York in mind despite near-term plans for transatlantic flight using the island. By 1939, with France planning regular use of Bermuda on its tentative North Atlantic air route, the British Air Ministry stressed that it was uncertain that the station could accommodate French flights or any volume of Azores-bound air traffic.[95]

The British and Americans enjoyed a collegial if competitive partnership in the North Atlantic air market, but both were open to having the French participate as well. Admiral Ernest

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[92] TNA CO 323/1327/3 (Part 1), "Trans-Atlantic Air Service." Letter from H. Burchall, Imperial Airways, to Lt. Col. Shermerdine, "Re: Portuguese Negotiations," July 8, 1935, 63.

[93] *Ibid*.

[94] TNA AVIA 2/1923, Part II, "Trans-Atlantic Air Service: French Proposals". Letter to L. Vivent, November 5, 1936, 29A.

[95] TNA AVIA 2/1923, Part III, "Trans-Atlantic Air Service: French Proposals". Minute 39, January 7, 1939.

King, Chief of the American Bureau of Aeronautics, expressed only minor reservations to British aviation officials on the subject. He felt that the French sought to "butt in" on the southern route but that direct route service was acceptable. G.R. Macfarlane Reid, Air Attaché at the British Embassy in Washington, expressed his belief that "the French are merely very anxious to avoid being left out of any scheme for an Atlantic service." Admiral King informed the British that he felt Anglo-American cooperation was not only the most beneficial partnership for both their countries but also the best guarantee of "world peace", although he did not elaborate upon why this might be. His views with respect to France were less hostile than merely unenthusiastic about a partnership. King said he informed the French that the United States would not move forward on talks until French officials approached the British about using the direct route stopping points, as they had done with the Americans recently.[96] France did not participate in Anglo-American aviation talks in 1935 that emphasized the direct route since French aviation officials were far more focused on the southern route through the Azores and Bermuda. British representatives expressed their concerns that press leaks may have erroneously given the French the impression that the Americans and British were seeking to shut out the French from transatlantic flight altogether. Correcting this misapprehension was important to those representatives, who feared that France might take offence. They did acknowledge that the air agreement between the United States and United Kingdom would not include France but that there was no drive to shut the French out of the Azores or Bermuda as the French believed.

[96] TNA AVIA 2/1923, Part I, "Trans-Atlantic Air Service: French Proposals". Letter from Air Attaché G.R. Macfarlane Reid to A.R. Boyle, Directorate of Air Intelligence at the Air Ministry, February 28, 1935, 4A.

Indeed, the British wished to affirm that the French would enjoy access to Bermuda under an existing agreement between the British and French once transatlantic air service began.[97]

France and Britain were in more or less friendly competition on the North Atlantic, and they had a history of collaboration when their interests aligned.[98] In a discussion between the British Air Attaché in Paris and several French civil air officials, the French supported a common series of rules and regulations on tariffs, radio procedures, airport facilities, and direction finding. Most importantly, they wished to present a common front towards the United States to strengthen their bargaining position. And despite British fears of losing total sovereign control over their airline, the French stopped short of proposing an air pool. The French officials, Director of Civil Aviation Louis Couhé and Senator Amaury de la Grange, were specifically tasked with seeking out the terms of test flights to the United States.[99] Pooling agreements were common in Europe as they protected a national airline from competition, guaranteeing each partner a carefully determined share of a route's revenue.[100] The British, however, preferred free competition in this instance. British aviation officials, however, were keen to work with France on meteorology and infrastructure along the southern route. France was sinking money and resources into the Azores to develop the islands into a viable link in the transatlantic chain,

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[97] TNA AVIA 2/1957, "Trans Atlantic Air Service Discussions in Ottawa & Washington, Nov/Dec 1935." Telegram from the Secretary of State for Dominion Affairs to the British High Commissioner in Canada, December 2, 1935. 16A.

[98] Indeed, both the air ministries of both countries met regularly and formally cooperated in a number of capacities. For more, see: Eda Kranakis, "European Civil Aviation in an Era of Hegemonic Nationalism: Infrastructure, Air Mobility, and European Identity Formation, 1919-1933," in Alexander Badenoch and Andreas Fickers, eds. *Materializing Europe: Transnational Infrastructures and the Project of Europe* (New York: Palgrave Macmillan, 2010), p. 290-326.

[99] TNA AVIA 2/1923, Part I, "Trans-Atlantic Air Service: French Proposals". Letter from Roger to Archie, January 7, 1936, 87A.

[100] Bilateral agreements outlining pooling arrangements were only possible after a country consolidated its airlines into a single national carrier, which simplified pooling arrangements. Pools eliminated potentially unaffordable competition, which was a serious problem for airlines in European countries since these lacked the financial resources that American airlines often possessed. Eda Kranakis, "The 'Good Miracle': Building a European Airspace Commons, 1919-1939," in *Cosmopolitan Commons: Sharing Resources and Risks across Borders*, ed. Nil Disco and Eda Kranakis (Cambridge, Mass.: The MIT press, 2013), p. 70-3.

saving the British from similar efforts if an arrangement between the two countries could be struck.[101]

France did not commit its efforts exclusively to the development of the southern route. Compagnie Air France Transatlantique, the airline France founded to test flights across the North Atlantic, sent its fleet of flying boats through the Azores in its 1939 series of test flights and also made use of landplanes. However, since there were no airfields in the Azores at Horta, the planned stopping point, the landplanes had to use the direct route to North America.[102] British facilities in England, Bermuda, and Newfoundland were open to the French aircraft. Radio support was also provided to the French. Compagnie Air France Transatlantique gave a detailed itinerary to the British stations well in advance to ensure that minimal problems arose.[103]

It behoved the British to work with France to avoid wasteful competition and also for pragmatic diplomatic reasons. British Air Ministry officials looked to France for air rights through the extensive French colonial holdings across Africa and Asia; potential stepping stones on its own imperial transportation network.[104] America, on the other hand, was interested in granting France transatlantic air rights for strictly commercial reasons. America gained permission to operate an equal number of flights to each country with which it held a bilateral air agreement. As the United States struck agreements with more European countries, it added to

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[101] TNA AVIA 2/1957, "Trans Atlantic Air Service Discussions in Ottawa & Washington, Nov/Dec 1935". Telegram from Foreign Office to Sir R. Lindsay, December 4, 1935, 27A.

[102] Prior to this announcement, all of the 1939 French flights were planned to use the direct route. The flying boats were redirected to the southern route at a late stage. Whether this was to take advantage of better weather or simply to test the advantages of the two routes against one another was not made clear. TNA AVIA 2/1923, Part III, "Trans-Atlantic Air Service: French Proposals". Telegram from J.J.W. Herbertson to Col. G.C. Crawley, March 2, 1939, 62B.

[103] TNA AVIA 2/1923, Part III, "Trans-Atlantic Air Service: French Proposals". Translated letter from Louis Couhé to the Directorate General of Civil Aviation at the British Air Ministry, April 7, 1939, 88C.

[104] TNA AVIA 2/1923, Part I, "Trans-Atlantic Air Service: French Proposals". Notes on a meeting, "French participation in a trans-Atlantic Air Service," April 1, 1935, 22A.

the total number of flights it could operate to the continent.[105] This was a central point of contention between the United States and European countries in the postwar era and is discussed in Chapter Three.

The southern route was dominated by the Americans, British, and French, but they were not the only ones pursuing air travel there. Germany's Lufthansa energetically pursed North Atlantic flight tests, principally along the southern route including stops at New York and Horta, often skipping Bermuda. The German airline flew a combined 50 flights between 1936 and 1938, 28 of which happened in 1938 alone.[106] Other countries developing transatlantic air travel lagged behind this in terms of raw flight numbers. Air France Transatlantique managed just one test flight in 1938 while the British, who had planned 15 crossings, also managed one. Pan Am refrained from all test flights that year pending the arrival of the Boeing 314 flying boat.[107] The 314 was purpose-built for long distance flights, capable of carrying 35 passengers across the Atlantic Ocean. The American airline was so confident in the new plane that it ordered 12 of them at a total price of $4.8 million, by far the highest ever paid for a commercial aircraft. With it, however, Pan Am won the race to offer the first paid air service between North America and Europe, which it began in 1939.[108]

Test flights and infrastructural developments on the southern route showed that it was feasible by the late 1930s but remained difficult. Several solutions to the technical challenge it represented were considered. These included the elimination of aircraft's external landing gear in favour of a more aerodynamic, buoyant hull for water landings, greater emphasis on reducing

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[105] *Ibid*.

[106] "Germany: North Atlantic 1938," *Interavia*, no. 587, October 22, 1938.

[107] Pan Am enjoyed such a favourable air mail contract with the United States Post Office that its absence on the North Atlantic in 1938 was considered irrelevant. It was widely recognized as the frontrunner in building an economically viable regular air service in light of the income it was guaranteed once operations began. *Ibid*.

[108] Robert J. Serling, *Legend and Legacy: The Story of Boeing and its People* (New York: St. Martin's Press, 1992), p. 38-41.

wind resistance on the plane through better designs,[109] and even the semi-permanent assignment of refueling ships at designated points along the route. Such ships would broadcast their position to facilitate navigation when visibility was limited. This came with an unfortunate hazard: putting a flying boat down on the open ocean. Even small swells in protected harbours were severe challenges for the safe operation of a plane during takeoff and landing.[110]

-The Direct Route

The direct route between North America and Europe, or the great circle route, presented its own set of challenges. While the first transatlantic flights followed this path, it featured a very long overwater section, more than 3,000 km, that was notorious for bad weather most of the year. Preliminary information suggested that impassable storms were present at nearly all times during the winter and that fog was a regular feature near the Grand Banks of Newfoundland during the rest of the year.[111] Only with advances in technology including radio beacons for navigation, the use of pressurized cabins to permit the overflight of bad weather, and the introduction more powerful engines was this route expected to be operational for commercial purposes.[112] Incidentally, similar criticisms were lodged against the southern route despite its better weather. R.H. Mayo, an engineer consulting with Imperial Airways, argued that radio beacons would be critical for navigation across the southern route. But as beacon range fell far

[109] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 10-14.

[110] *Ibid*., p. 14-19.

[111] Fog was particularly hazardous around the Grand Banks. Conditions there often produced a continuous fog bank from sea level up to and above 3000 feet. Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 14-5.

[112] *Ibid*., p. 22-29.

short of the transoceanic distance, he averred in 1931 that significant technological advances were needed to make even that route practical.[113]

Criticism of the direct route usually stemmed from the fact that aircraft could not overfly the harsh conditions there. The route carried the advantage of requiring the least additional infrastructure of the three paths, with suitable airfields and harbours already in use around the British Isles and parts of Eastern Canada. Into the early 1930s, Newfoundland lacked a suitable airfield to support transatlantic flight, and so the British Ministry of Civil Aviation's Deputy Chairman Henry Self suggested that a "land aerodrome" might be worth building on the island. In 1936, when he made the proposal, there was little in the way of air traffic between Newfoundland and other places. Any airport built at that time would mainly exist to serve the transatlantic air market.[114] Despite the generally poor weather, the direct route had an important benefit to the British as both ends were effectively under their control. Newfoundland was a part of the British Empire while Ireland, at the other end, was a British partner in Atlantic aviation endeavours. So while the British planned on covering nearly all of the costs to construct an airport in Newfoundland[115], they relied upon the Irish to build an air base that Britain would be

[113] British Airways Heritage Centre, AW/1/6161, Part I "Atlantic Services, Services, 1930-35." Draft letter from R.H. Mayo to the British Director of Civil Aviation, "Navigation by Radio Over the Atlantic Route," October 23, 1931.

[114] Self's proposal suggested that Hattie's Camp be the location for the airport. McClure rejected this since its remote location would impose an additional eight hours of rail travel on those visiting Newfoundland who intended to reach the capital, St. John's. McClure recommended instead that some other site be used and, for the meantime, Newfoundland be served by seaplanes during warm weather and planes equipped with skis in the winter. TNA AVIA 2/1943 Part I, "Survey of Newfoundland for suitable air base for Trans-Atlantic Service." 1935. Letter from I. McClure to A.H. Self, Esq., March 30, 1936, 54A.

[115] The total for preparing suitable land and constructing an airport in 1936 were estimated at £263,462. Development of a site was expected to take about nine months but would be spread over two summers since winter conditions made such work impractical. Landplanes were favoured over flying boats for transatlantic (and general) flights since they did not rely on very calm and ice-free weather for takeoffs and landings, making it possible to conduct operations far more easily and frequently than flying boats. TNA AVIA 2/1943 Part I, "Survey of Newfoundland for suitable air base for Trans-Atlantic Service," 1935. Note by the Air Ministry, "Trans-Atlantic Air Service: Land Aerodromes in Newfoundland and the Irish Free State," March 21, 1936, 52A.

permitted to use. Doing so guaranteed transatlantic air access to Imperial Airways and Pan Am thanks to an association agreement.[116]

Canada emphasized the advantages of the direct and northern routes. Owing to its strategic position, any transatlantic flights not using the southern route had to pass through Canadian airspace, use Canadian airports or harbours, and rely on Canadian infrastructure. In 1931, Canadian General Staff Major-General McNaughton stressed that the long open-ocean stretch along the southern route was too long for aircraft of the day. Perhaps more importantly, flights using the longer southern route would barely outrun ocean liners over the Belle Isle-Ireland route. McNaughton appealed to British imperial pride, arguing that Canadian routes would keep mail and passenger air traffic within the Empire, perhaps even making Montreal a more important hub than New York for transatlantic purposes. McNaughton was dismissive of weather hazards in the North Atlantic. He focused on boosting the idea of Canada as a vital part of transatlantic air travel rather than presenting a critical analysis of the pros and cons of the routes under consideration. It is interesting to note that the Canadian authorities planned to prohibit foreign aircraft from operating within Canadian airspace on transatlantic routes at that time while pushing for a bigger place in the international air network.[117]

The Canadian government supported the construction of air bases in Newfoundland but strongly pressed the British to grant Canada administrative power over their operations. George Vanier, Secretary at Canada's High Commission in London, pointed out that, per the terms of a transatlantic aviation conference in St. John's in 1933, Canada and Britain were to be partners in such a program. Vanier, claiming that the Canadian climate was similar to that in

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[116] TNA AVIA 2/1943 Part I, "Survey of Newfoundland for suitable air base for Trans-Atlantic Service," 1935. Note by the Air Ministry, "Trans-Atlantic Air Service: Land Aerodromes in Newfoundland and the Irish Free State," March 21, 1936, 52A.

[117] TNA AVIA 2/1885, Transatlantic Air Route Via Belle Isle and Ireland – Investigation of, "Trans-Atlantic Air Routes", 1931. Draft of a conversation with Major-General McNaughton, March 10, 1932, 20B.

Newfoundland, favoured the use of Canadian workers and airbase operators rather than British ones. Additionally, Canada already had an extensive civil aviation network immediately adjacent to Newfoundland that could expand easily into the island territory. Vanier believed that a single country would run the Newfoundland facilities more effectively given the unique characteristics of North American aviation. Vanier did not go into detail regarding how the North American situation differed from other points to which British aviation already operated, and so it is a matter of speculation as to what specific problems he believed that Canadian experience was better suited than the British. He did point out that winter conditions were harsher, and that Canada had managed this while building a transcontinental airline. His letter contained a hint of defensiveness on the subject when he said that the Canadian government had not made its air presence felt in Newfoundland much prior to that point since it was so busy finishing its domestic network.[118]

Indeed, by 1935 Newfoundland looked to Canada to extend "grant-aided air service" into its territory since "the Newfoundland Government could not be expected to find the funds for subsidising any such service." As Trans-Canada Airways was eager to run a route into Newfoundland at that time, the Canadian government was more than willing to work with the Newfoundlanders on the matter.[119] As Shediac, New Brunswick, was selected as the Canadian site for flying boats operating the transatlantic route, a Newfoundland stopping point was needed to bridge the gap. Botwood was chosen since its position on an inlet far from the open sea protected it from the regular fogs that plagued most Newfoundland locales. Foynes, on the

[118] TNA AVIA 2/1943 Part I, "Survey of Newfoundland for suitable air base for Trans-Atlantic Service," 1935. Letter from George P. Vanier to British Dominions Office High Commissioner R.A. Wiseman, August 20, 1935, 22A.

[119] TNA AVIA 2/1943 Part II, "Survey of Newfoundland for suitable air base for Trans-Atlantic Service," 1935. "Minutes of a meeting held at Ariel House on Friday April 14th at 11a.m. to discuss matters connected with Newfoundland Airport," 113A.

Shannon River in Ireland, was chosen for the same reasons.[120] Landplane infrastructure was simultaneously developed. The British, looking to build a major airport on Newfoundland and using the recommendation of Canadian aviation analysts, settled on Hattie's Camp near the shore of Gander Lake. The site was a relatively short distance east of Botwood and boasted good approaches for planes and tolerably little fog cover by Newfoundland's standards.[121] Construction began in 1936 and the airport went into service in 1938 before the work was finished. Upon completion, the Gander airport, as it was known, provided facilities suitable for landplanes that could make the transatlantic jump. At that time, however, Gander was designed with the sole purpose of carrying air mail and not passenger traffic.[122] As discussed below, this airport became integral to transatlantic air travel soon after.

-The Northern Route

A third and final option for North Atlantic crossings was a northern route that made use of the strategic locations of Newfoundland, Greenland, Iceland, and several other islands ringing the Atlantic's far north. Opening up this route entailed the construction of a series of sheltered harbours[123] on those islands. Aircraft that set down at these islands would not have any single hop farther than 900 kilometres, well within the flight range of existing planes in 1930. But using the northern route came with a critical caveat: the weather rendered the route impossible

[120] P.D. MacTaggart-Cowan, "Transatlantic Aviation and Meteorology," *The Journal of The Royal Astronomical Society of Canada* XXXII, no. 5 (May-June 1938), p. 218-9.

[121] Carl A. Christie, *Ocean Bridge: The History of RAF Ferry Command* (Toronto: University of Toronto Press, 1995), 18-9.

[122] Warner, "Atlantic Airways," p. 476.

[123] This Pan Am study focused primarily on the use of flying boats rather than land-based airplanes. While the material requirements for such aircraft differ from airplanes, the development of infrastructure in remote arctic and subarctic areas is the most relevant for this study.

for flight most of the year and by 1930 there was far too little weather data to state whether the route could be rendered practical.[124]

Variations on the exact stopping points along the northern route were studied to find the shortest practical route. Test flights had to avoid unreliable weather and account for safety above the then-unexplored wilderness of the interior of Quebec, Labrador, and Greenland. All of these had huge expanses of land and few or no settlements useful as staging points. Technological advances were cited as the key to overcoming these obstacles. Weather data was useful while it was still good but observations made at ground stations could only report on conditions they could see, or that might change before a plane arrived. A fast aircraft could make use of the data and rapidly traverse the gap between landing points before conditions could change.[125]

The Aviation Division of the British Meteorological Office assessed the relative weather-related challenges along both the northern and direct routes in 1931. Its report stated that fog was widespread in Newfoundland at altitudes up to 500 feet and that it could occasionally reach 1,500 feet. Belle Isle, Newfoundland, averaged 114 foggy days per year, mainly in the summer. Such conditions would hamper takeoffs and landings but would not present a problem for flights at altitude even in the 1930s. Snow presented a hazard and could fall as early as October or as late as May. Meanwhile, winds were consistently strong enough to slow a westbound flight with 100 mph (161 km/h) airspeed such that it would take up to 32 hours to cross the North Atlantic depending on the season. Eastbound flights conversely would take no more than 16 hours in similar conditions.[126] Seriously adverse conditions along the northern and direct routes,

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[124] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 31-34.

[125] *Ibid*., p. 34-42.

[126] TNA AVIA 2/1885, Transatlantic Air Route Via Belle Isle and Ireland – Investigation of, "Trans-Atlantic Air Routes", folio 2A, 1931.

including heavy rains and unstable winds, were tied to depressions (low pressure systems), according to the Aviation Division report. Depressions, which created storms in the worst cases, were found to track eastwards fast enough to potentially impact all westbound air traffic. Adding to that, some unfavourable conditions formed out to sea, which was beyond ground based stations' forecasting ability. Any North Atlantic flights therefore required weather forecasting and observation infrastructure beyond that which existed in 1931.[127]

Juan Trippe, president of Pan American Airways, turned to Charles Lindbergh to scout northern route coasts to find suitable locations for future flying boat terminals and airports. Lindbergh flew throughout the summer of 1933 and found a number of suitable sites along the coasts of Greenland and Iceland that could be improved to handle regular flights between North America and Europe. Furthermore, he stated that prior claims of poor weather did not match the fair conditions he found in his survey and was certainly not severe enough to preclude regular flight. According to Lindbergh's final report, written in 1934, the North Atlantic could soon be developed for regular seaplane use.[128]

Lindbergh's conclusion was not universally shared within the aviation community. Edward P. Warner, a founding member of the United States' Civil Aeronautics Board (CAB), wrote in 1938 that transatlantic air travel by flying boat across the northern route was undesirable. He cited a United States Army global aerial circumnavigation conducted in 1924 that was forced to take extremely long layovers in Greenland and Labrador harbours due to adverse conditions. Warner doubted that the stopover points would even be needed in the near

[127] The southern route was longer both overall and had a longer single stretch for aircraft to traverse in a single hop, between Bermuda and the Azores. Its weather, however, was far more clement than that found along the northern route. Depressions formed at all times of the year with minimal seasonal change, but were far more common between 55-60 degrees north (19-21 per season) than between 50-55 degrees north (14-15 per season). The southern route latitudes, in comparison, were nearly storm-free, with no more than one depression per season between 30-35 degrees north and perhaps as many as five between 35-40 degrees north. TNA AVIA 2/1885, Transatlantic Air Route Via Belle Isle and Ireland – Investigation of, "Trans-Atlantic Air Routes", folio 2A, 1931.

[128] R.E.G. Davies, *Pan Am: An Airline and its Aircraft*, (New York: Orion Books, 1987), p. 40.

future, thus precluding the need to develop coastal sites. Aircraft could travel ever-greater distances thanks to technological improvements. Regular flights across the North Atlantic could therefore be conducted on a direct seaplane hop between Newfoundland and Ireland without the need for landings in the farther reaches of the north.[129]

While it did not participate in actual transatlantic flights during the prewar era, the Soviet Union planned a test flight in 1939. The British furnished the Soviet Ambassador with a wide range of technical details regarding aviation infrastructure in Newfoundland and Canada. The exact location of the airport at Gander and length of its runways were listed, radio frequencies and coordinates of transmitters noted, and even a mention that there were no areas off limits for planes.[130]

All possible avenues for crossing the North Atlantic, in fact, were pursued simultaneously by governments and air companies. Trippe sought a suitable harbour in the Azores for flying boats on the southern route while he also expected the direct route to be viable in the coming years with new and better planes. He therefore sought to establish routes through the Canadian Maritime provinces and Newfoundland, sound out the Irish government for landing rights and air transit permission, and even contemplated air agreements with Iceland and Denmark, as the country in charge of Greenland, should the Arctic northern route prove a useful alternative. A Canadian with whom Trippe spoke noted that bad weather remained a concern for the direct route, but that Trippe did not treat this as a serious problem.[131]

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[129] Warner, "Atlantic Airways," p. 473-4.

[130] TNA FO 371/23697, "Political – Northern: Soviet Union, files 1285-1459, 1939". "Particulars required by the Soviet Ambassador regarding Land Aerodromes in Newfoundland," 18-19.

[131] Trippe actively considered that the direct route, using flying boats with sufficient range, might not even require a stop in Newfoundland at all. The Memo countered that this was unlikely to be feasible for some time since a stopover in Atlantic Canada without Newfoundland would add at least 400 miles to the overall route even if it offered the advantage of skirting the bad weather in Newfoundland. Agreements with Iceland and Denmark, however, were not being actively pursued at that time. The northern route was not believed to be as practical or useful in its own right and so was given a low priority. TNA AVIA 2/1885, Transatlantic Air Route Via Belle Isle

Aviation Organizations and Institutions

The year 1919 was a watershed for civil aviation. Regular international flight, let alone transoceanic flight, did not exist until then. For the first time it was possible to take a scheduled plane between the capitals of two countries: France and Britain,[132] followed shortly by France and Belgium.[133] This came in the same year as the Paris Convention, part of the broader Paris Peace Conference after the First World War. It was at Paris that the first permanent international aviation organizations were conceived; groups that would provide a common framework for cooperation and safe operation of civil aircraft around the world. These international groups played a pivotal role in transatlantic flight as they standardized the often divergent national aviation regimes that otherwise would have complicated even simple procedures, such as navigation protocols or communication procedures, when a flight from one country flew into another's airspace. They also built a framework designed to prohibit exploitive behaviour, such as charging foreign airlines excessive rates, albeit to less success. Transatlantic flight was shaped in large part by the policies and decisions of these organizations.

Prior to the 1919 Paris Convention, European leaders had conflicting interpretations on how best to deal with airspace sovereignty. Eighteen European countries had attended the International Air Navigation Conference in 1910 in Paris to resolve frequent border violations by balloon travelers. The French and German delegations backed a plan that would open the upper altitudes to international travel in the same vein as 'innocent passage' in sea travel. Lower altitudes would remain the sole jurisdiction of nations, with no specific point of demarcation set

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and Ireland – Investigation of, "Trans-Atlantic Air Routes". Memorandum of a conversation with Juan Trippe, J.C. Cooper, and Dr. V. Stefansson, May 10, 1935.

[132] The first passenger flight took place on August 25, 1919, in a converted First World War bomber that took two hours and twenty minutes to make the trip. There was a single paying passenger. Arthur Reed, *Airline: The Inside Story of British Airways* (London: BBC Books, 1990), p. 7, 23.

[133] P.P.C. Haanappel, "Bilateral Air Transport Agreements," *International Trade Law Journal* 5, no. 2 (Spring-Summer 1980), p. 241.

out in those early proposals.[134] The British delegation, by contrast, advocated for absolute sovereignty above its territory at all altitudes.[135] The Conference ended without a final agreement but set out all of the major areas in which countries would seek standardization in future. This included aircraft registration and licences, customs, common rules of the air, etc.[136] This and subsequent conferences failed to achieve consensus on one critical issue: sovereignty. In practice, most countries enforced sovereignty over their airspace vigorously through legislation in the years before the First World War. Airspace, in short, became the sole preserve of the country below.[137] The close association between military and civilian aviation (and aircraft) made the decision to impose absolute national sovereignty over airspace all but inevitable.[138] The First World War validated this view by the use of airplanes for bombing, surveillance, and espionage. Even pilots flying in foreign airspace during peacetime could represent a threat: there was a real danger that those same pilots would use their knowledge of the landscape in a future war to the detriment of the trusting country below.[139]

While planes had extremely limited range prior to 1914, but the situation changed rapidly. It was necessary to ensure that international flight would be peaceful for civil aviation to prosper. To that end, the Paris Convention was designed to tackle sovereignty and safety

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[134] Christer Jönsson, "Sphere of Flying: The Politics of International Aviation," *International Organization* 35, no. 2 (Spring 1981), p. 276-7.

[135] Britain's fears may have stemmed from their relative weakness in 1910: their aviation technology lagged that of both France and Germany. Keeping out foreign aircraft may have been a crude method of retaining air superiority at that time. David Clark MacKenzie, *Canada and International Civil Aviation 1932-1948* (Toronto: University of Toronto Press, 1989), p. 6.

[136] Edmund Wilhelm Faller, *Germany and International Civil Aviation: A Policy-Oriented Historical Study* (Master's Thesis: McGill University, 1965), p. 48-50.

[137] The concept of bomber aircraft was clearly not yet on the minds of those proposing tiered airspace sovereignty. Jönsson, "Sphere of Flying," p. 276-7.

[138] Civil aircraft could easily be converted for military purposes and military pilots often flew civil aircraft in peacetime. Countries might also see value in retaining a pilot corps in civil positions to keep their skills fresh, or even to familiarize themselves with lands they might fly above in war. *Ibid*., p. 279.

[139] Warner, "Atlantic Airways," p. 468-9.

concerns by ensuring that all member states met a common set of standards.[140] In principle, as passenger ship travel, it allowed for adhering countries to fly any number of planes to any other participating country. In practice, governments were not amenable especially once air travel became common, and the realities of international competition soon superseded the Paris Convention's idealism. The Paris Convention enshrined national sovereignty over airspace,[141] and rejected the idea of the air as a commons to be used by any or all parties freely: foreign aircraft would need permission before using a nation's airspace. Airspace became an "anticommons"; that is to say that it was nationalized and regulated. The Paris Convention spelled out the rights and privileges a country would enjoy under the new system, including commercial monopolization and the right to permit or refuse foreign aircraft access. The establishment of common rules for aircraft markings and registration were included in Convention material as well.[142] Bilateral air service agreements,[143] a form of treaty, were struck that set strict limits on the number of flights permitted by each partner country, typically on a reciprocal basis.[144] These agreements also outlined the conditions by which each country could

[140] For a summary of how airspace was conceptualized and regulated in the Paris Convention, see: Eda Kranakis, "The 'Good Miracle': Building a European Airspace Commons, 1919-1939," in *Cosmopolitan Commons: Sharing Resources and Risks across Borders*, edited by Nil Disco and Eda Kranakis (Cambridge, Mass.: The MIT press, 2013).

[141] Nawal K. Taneja, *The Commercial Airline Industry: Managerial Practices and Regulatory Policies* (Toronto: D.C. Heath and Company, 1976), p. 257-8. Recognition of absolute sovereignty over airspace was included in Articles 1-4 of the Convention. This "represented a break from maritime tradition, which usually allowed free access to ports by vessels of friendly foreign nations." A key difference between the maritime and aviation here is that aircraft do not merely dock at a port along the coast but fly far into a country's borders and above potentially sensitive regions. For these and other reasons concerning defence, the comparison between sea and air is clearly not perfect. Robert L. Thornton, *International Airlines and Politics: A Study in Adaptation to Change* (Ann Arbor: University of Michigan, 1970), p. 3.

[142] Kranakis, "The 'Good Miracle',".

[143] The first of these treaties was struck prior to the First World War, effectively from the moment it was possible for a regular air service to operate. These agreements are sometimes called "bilateral air transport agreements". For the purpose of simplicity, they will be referred to as bilateral air agreements throughout the remainder of the text. Barry R. Diamond, "The Bermuda Agreement Revisited: A Look at the Past, Present and Future of Bilateral Air Transport Agreements," *Journal of Air Law and Commerce* 41 (1975), p. 419.

[144] Haanappel, "Bilateral Air Transport Agreements," p. 241-3.

enter the other's airspace, associated tariffs and fees, and any other relevant restrictions,[145] but also opened the door to exploitation and onerous regulations: countries could leverage their strategic geographic position astride a desirable air route to receive preferential deals, or would simply impose heavy fees on airlines using their airspace.[146] Some countries were notably reluctant even to strike deals with some others.[147]

The Paris Convention enshrined the idea of complete national sovereignty over airspace and built common rules and regulations for international air travel. Among the various concepts set out were the creation of internationally recognized pilot certification standards, radio frequencies and emergency signals, and navigational aids. The Convention also created the International Commission for Air Navigation (ICAN), a global body to oversee the implementation of those rules.[148] Skeptics of the terms of the Paris Convention pointed out that the civil aviation was far too immature for any type of permanent, inflexible arrangement to be implemented at that time.[149] Recognizing this, ICAN included bodies that would oversee and amend the rules for private and commercial air services. The participating countries would be

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[145] John C. Leslie, "International Air Transport Association: Some Historical Notes." *Journal of Interamerican Studies and World Affairs* 13, no. 3/4 (July-October 1971), p. 337. Important details could be overlooked in these early agreements from time to time. The British and Dutch entered into fierce competition over routes through their Asian colonies once the subject of air mail (which had not been explicitly dealt with by the British when granting Dutch airline KLM passage through India) brought the matter of prestige and colonial authority onto the table. For more on this, see: Marc L.J. Dierikx, "Struggle for Prominence: Clashing Dutch and British Interests on the Colonial Air Routes, 1918-42," *Journal of Contemporary History* 26, no. 2 (April 1991), p. 333-351.

[146] Eugene Sochor, "International Civil Aviation and the Third World: How Fair Is the System?" *Third World Quarterly* 10, no. 3 (July 1988), p. 1304-5.

[147] Turkey forbade overflight of its territory altogether in the prewar era, and in 1939 Spain barred airlines from countries that fought against Franco. Jönsson, "Sphere of Flying," p. 279.

[148] United States of America, etc. "Convention relating to the regulation of Aerial Navigation, signed at Paris, October 13, 1919, with Additional Protocol, signed Paris, May 1, 1920," League of Nations Treaty Series, 1922 LNTSer 99; 11 LNTS 173, retrieved from: http://www.worldlii.org/int/other/LNTSer/1922/99.html November 11, 2014, p. 190-8.

[149] Arthur Sifton, working for Canadian Prime Minister Sir Robert Borden, was one such skeptic. He wrote that the early versions of the Convention plans would have given Britain near-total control over the Canadian aviation sector, and that some countries would have a disproportionate say in future talks. Most of these problems were addressed during the course of the Convention talks. MacKenzie, *Canada and International Civil Aviation*, p. 10-3.

entitled to partake in all meetings, propose new rules and regulations, and receive updates on best practices as they were decided.[150]

While the United States and the Soviet Union did not join the Paris Convention, both adopted the principles of airspace sovereignty. America joined the 1928 Pan American Convention, which was modeled upon the Paris Convention, cementing its principles in the biggest aviation market.[151] Generally, the United States favoured the principles of a liberal international air regime. It, alongside Britain, the Netherlands, and Sweden, backed widening the rights of airlines to operate in foreign airspace at a 1929 conference. Those four countries considered policing powers sufficient to enforce air sovereignty. Most European countries disagreed, favouring the sweeping exclusion of foreign airlines from their airspace unless explicit permission was granted in advance.[152]

These organizations were ambitious attempts to improve the international aviation system but were limited in scope. Their rules could only apply to members and even then did not account for all possible abuses. Some countries simply imposed restrictions on foreign airlines using their airspace, particularly on routes that passed over but did not terminate in their territory. Some flights were required to land regardless of economic or technical need, allowing the country "to employ personnel, nationals of the territory flown over, that they do not need; and to participate in various complicated divisions of traffic and of revenue with local enterprises". Such legal and economic impositions were usually just onerous enough to keep a route viable, or else to win some compensatory diplomatic prize from the country seeking

[150] NARA RG 237, Box 434, Folder 922.1 "International Air Navigation Committee/Vol. 2," (folder 1 of 2). Summary, "International Air Convention of October 13, 1919, International Commission for Aerial Navigation and Other Aeronautical Organization," September 30, 1938, p. 4-5

[151] Jönsson, "Sphere of Flying," p. 277-8.

[152] Warner, "Atlantic Airways,", p. 467-8.

overflight rights.[153] Germany exerted its limited post-First World War sovereignty to detain and harass French flights that landed in its territory. Italy denied Britain access to its airspace over most of the 1920s and later required Britain to pay to get access to Italian airspace on routes to British colonies.[154] Italy granted most other countries permission to use its airspace in a quick and timely manner. Francisco Franco's Spain allowed Germany and Italy air rights that it then denied to the Netherlands, France, and Britain.[155]

Planning for Regular Transatlantic Flight

The early experimental flights proved that there was a great need for government support before transatlantic air service became routine. All such flights relied on risk-taking aviators to push the limits of what was considered possible and, on occasion, some paid with their lives. In order to make commercial air service safe, practical, and affordable, the governments of North Atlantic countries recognized that they had a role to play. Throughout the 1930s, Britain, France, Germany, America, Canada, and others were highly interested in tapping the potential market for flights between North America and Europe. Non-state actors lacked the resources to properly scout and develop the infrastructure necessary to create crossings that could become the stuff of family vacations rather than expensive life-or-death gambles. The various governments

[153] The most egregious offenders in this case were unspecified countries in the Near and Middle East that leveraged their geographic position between Western Europe and India to earn some revenue from the wealthier countries using their airspace. *Ibid*., p. 470-1.

[154] The specific reasons for exerting sovereignty in this way varied depending on the ends being sought. Germany wanted to make it difficult for the French to use its airspace freely as leverage for the restoration of greater sovereignty; it operated under heavy restrictions during that time. If France felt that the price of fast air travel was worth the cost of letting Germany act as an independent power once again, it would be worth the effort, by German thinking. Italy meanwhile limited British access in part to bolster its influence over the Mediterranean region, while the later payments were used to subsidize its own airline. Eda Kranakis, "European Civil Aviation in an Era of Hegemonic Nationalism: Infrastructure, Air Mobility, and European Identity Formation, 1919-1933," in Alexander Badenoch and Andreas Fickers, eds. *Materializing Europe: Transnational Infrastructures and the Project of Europe* (New York: Palgrave Macmillan, 2010), p. 297-8.

[155] Eda Kranakis, "The 'Good Miracle': Building a European Airspace Commons, 1919-1939," in *Cosmopolitan Commons: Sharing Resources and Risks across Borders*, ed. Nil Disco and Eda Kranakis (Cambridge, Mass.: The MIT press, 2013), p. 70.

funded wide-ranging tests, expeditions, and development programs over the course of years to achieve this goal.

The United States, Canada, Britain, and Ireland met at conferences in Ottawa and Washington in 1935 to cooperate on North Atlantic flight. The conferences were held specifically to lay the groundwork for experimental flights between the countries, with regular air service in mind. The Ottawa conference focused primarily on how members of the British Empire could cooperate. Delegates discussed the Empire Air Mail Service to convey mail by plane across the North Atlantic and designated Canada to build a series of weather stations along its Atlantic coast and in Newfoundland.[156] The Washington conference concluded with the hope of normal air service between North America and Europe by 1937 at a rate of four passenger flights per week with the understanding that the details were preliminary: planes already existed that could traverse the ocean but even basic elements such as which American city might be the terminus were as of then undecided.[157] The Canadian delegation was particularly concerned with the choice of Canadian terminus, wanting to make Montreal the North American hub of future transatlantic flight. The Americans wanted a more direct route between New York and Europe, specifically through Shediac, New Brunswick. Trippe suggested that if the Canadians did not press the issue, Pan Am would ignore the American government's requirement to use Shediac, following a period where it would be the base for experimental service. The Canadians backed down on the issue, and by 1937 agreed to the American terms in the hope that Trippe would honour his word.[158]

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[156] Morley K. Thomas, *Forecasts for Flying: Meteorology in Canada, 1918-1939* (Toronto: ECW Press, 1996), p. 186-91.

[157] NARA RG 237, Box 433, Folder 921 "Air Missions Conference – Washington, DC / December 5-12, 1935." Press Release from the Department of State, December 12, 1935.

[158] MacKenzie, *Canada and International Civil Aviation*, p. 50-4.

America's airlines had the technological ability to regularly cross the North Atlantic as early as 1935, according to Christer Jönsson, but Britain refused to give them permission to use British territory at that time.[159] Pan Am possessed the Sikorsky S-42 and Martin M-130 seaplanes, each of which had sufficient range to fly the distance provided that at least one intermediate stop was available between the United States and Europe.[160] While Bermuda did not yet have a suitable airport in service, Britain's Ministry of Aviation wanted a flying boat that could compete with American planes before granting the Americans permission to use the island's facilities. Thus, the Ministry estimated that a New York-Bermuda service would not begin "for 18 months to two years". As the delay prevented British flights into New York just as it kept American aircraft out of Bermuda, it was not an act of spite but merely an attempt to retain reciprocity.[161]

In 1937, the British authorities allowed Pan Am to fly to Bermuda, Newfoundland, and the British Isles provided it did so in a strictly reciprocal capacity. As the British government expected that its national airline, Imperial Airways, would be able to fly to all of those destinations in the near future, it did not want to see America profitably operating there until the playing field was level.[162] Britain saw joint agreements with Pan Am as a necessary precondition of transatlantic flight. While Imperial Airways could operate a route between the British Isles and North America without landing in the United States, the British Air Ministry feared that doing so, or imposing onerous requirements on America's airlines, might drive the Americans towards other European powers, Germany in particular. Throughout the planning

[159] Jönsson, "Sphere of Flying," p. 280.

[160] Pan Am did not face the same political restrictions in the Pacific as it did in the Atlantic, and so inaugurated an air mail service between San Francisco and Honolulu in November 1934. The distance of this leg was 2,410 miles (3,880 km), which was more than enough to manage the North Atlantic. MacKenzie, *Canada and International Civil Aviation*, p. 38.

[161] TNA CO 323/1327/3, Part 1, "Trans-Atlantic Air Service". Letter from H.F. Batterbee to Lt. Col. G.P. Vanier, February 18, 1935, 8.

[162] Jönsson, "Sphere of Flying," p. 280.

sessions at the 1935 Ottawa and Washington conferences, there was an explicitly repeated understanding that the British had to involve America as an equal partner in North Atlantic aviation. Both Britain and the United States would offer the same number of flights in each direction. Initially, three flying boats would be used by Imperial Airways with an aim of providing two round-trip flights per week, while Pan Am would provide the same. Ireland, Canada, and Newfoundland would all be party to the talks in order to find the most effective and affordable means of building the transatlantic link.[163]

Reciprocity was precisely observed during the first transatlantic flight by American and British airlines. Pan Am sent a flying boat out from Botwood, Newfoundland, westbound while Imperial Airways sent one westbound from Shannon, Ireland, on July 5, 1937. Imperial's flying boat *Caledonia* proceeded to Montreal and New York while Pan Am's reached Southampton.[164] A great deal of supporting infrastructure had to be built before the flights were possible, including the seadromes themselves:

> [S]pecial control launches had to be built, moorings laid, a complete radio set-up, including Direction Finding apparatus, installed, meteorological services organized. Last but not least, a distress procedure had to be worked out in conjunction with other departments, (General Post Office, Admiralty, Board of Trade, Chambers of Shipping) so that, should any accident occur, prompt assistance could be called for and be instantly rendered.[165]

Trippe, was conscientious about observing reciprocity with the British where possible. In May 1939, Trippe was under pressure from Washington to begin transatlantic flights that summer. He knew that the British wished for their airline, Imperial, to be the first to carry air

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[163] TNA AVIA 2/1957, "Trans Atlantic Air Service Discussions in Ottawa & Washington, Nov/Dec 1935". Notes of a meeting within the Air Ministry, "Air Service to Canada and the United States via the Irish Free State and Newfoundland," October 24, 1935, 2A.

[164] TNA AVIA 2/1163, "Record of Trans-Atlantic experimental flights by Imperial Airways." "Notes on the first experimental trans-Atlantic flights carried out on 5th-6th July, 1937," 9A.

[165] The reports indicated that all support systems worked perfectly. The only noted shortcomings concerned the absence of thorough weather data due to a general lack of detailed North Atlantic meteorological records. One particular example pointed to the winds regularly blowing strongly out of the west, but that it exceeded 45 mph on only 7 known occasions. It was simply unknown how often bad weather or strong winds could be expected. *Ibid*.

mail between their country and the United States. Out of respect for this arrangement, Trippe informed Imperial Airways that Pan Am would begin regular transatlantic service along the southern route. The United States Post Office agreed that Pan Am would not carry any Britain-bound mail until Imperial was ready for its own transatlantic service in the months that followed, which would also see Pan Am inaugurate northern route service directly to Britain.[166]

Some of the technology used for the ocean crossings was just intended as a stopgap, to temporarily make such flights possible until more practical air travel systems were developed. In one such case in 1937, the British planned to use two ships with catapults for test flights. The catapults both improved the range of viable takeoff conditions (flying boats could not take off in even slight chop) and the flight's weight capacity since less fuel was consumed during takeoff. While the regular operating costs were a matter of debate among the various British ministries, the catapult-assisted flights would potentially save £71,000 to £167,000 per year on an investment of £500,000 per ship. The Air Ministry was the most vocal supporter as they claimed it would be 20 years before the catapult ships were obsolete. An analyst for the Treasury, Mr. Barlow, believed that 10 years was more probable in light of the experimental nature of the flights. Barlow pointed out that there was no evidence that paying passengers would be comfortable with choosing such an unusual takeoff method. With a shorter amortization period, the overall savings were thus on the lowest end of the scale noted above but still worth pursuing.[167]

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[166] British Airways Heritage Centre, AW/1/6164, Part 4 "Atlantic Services, Services, Jan-June 1939." Imperial Airways memo from Woods Humphery to the Chairman, May 5, 1939.

[167] The catapults accelerated the planes rapidly across the deck of the ship to takeoff speed as aircraft carriers do today. Estimates on the cost per ship were about £500,000 according to both the Board of Trade and the Admiralty. The annual costs of the program varied: the Board of Trade cited £50,000 per ship per year, the Admiralty suggested £60,000, and the Air Ministry said £64,000. TNA T 161/715, "Projected Transatlantic Air Service, 1936." Notes on a meeting by Mr. Barlow, "Catapulted Services," June 11, 1937.

Refined estimates on the cost of catapult-equipped ships put the price at £650,000. An interdepartmental committee, including the Air Ministry and the Admiralty, determined that the ship's greatest value was not to civil aviation but to military purposes. All departments vocally supported the development of ships that could rapidly launch planes, but if civil aviation might benefit too that would be a bonus. The committee found that passengers would only experience about 1.25 G of acceleration and so would not likely object.[168] Although there were no technical reasons why the catapults would be impossible for regular passenger use, none of the regular transatlantic air services used catapult-launched planes. The increasing range of both sea and landplanes made the catapult system obsolete almost immediately.

An even more extreme technological stopgap was conceived specifically to address the challenge posed by the North Atlantic: the Armstrong Seadrome, a noteworthy if exceedingly impractical solution designed to obviate long ocean hops. Conceived by influential American inventor Edwin Armstrong, the planned seadromes were vaguely reminiscent of a modern aircraft carrier, with elevated platforms 80 feet above the sea, offering a 1,200-foot-long runway 200 to 400 feet wide, and permanently anchored in place at 400 mile intervals between North America and Europe. In addition to providing a chance for conventional airplanes to refuel, they would feature hotels and restaurants beneath the runway. Building the fleet of seadromes was anticipated to cost $12 million, far more than was economically viable.[169] Even an experimental rig was expected to cost £500,000 (about $2.45 million) for a service that no country strongly supported. Only the United States was reckoned to have the wealth to build such a test structure

[168] TNA T 161/715, "Projected Transatlantic Air Service, 1936". Inter-Departmental Committee on International Air Communications, "Report of Sub-Committee on Catapulted Flying Boats," p. 3-5.

[169] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 19, Folder 4: Atlantic Division, 1930-37. "Report No. 20, Comprehensive Review Transatlantic Air Transport Survey, May 16, 1930," p. 19-22.

but it lacked the desire to do so.[170] Political considerations could have scuppered the plans had the cost not been at issue. The French government objected to building seadromes near its territorial waters since it was unclear who would have legal sovereignty over them. By 1938 all plans for building a seadrome were rejected and the idea was shelved as the economic and political challenges surrounding them proved intractable.[171]

Despite extensive political groundwork, red tape continued to hinder transatlantic air service even as the planes began to take off. In 1939, Howard Hughes, head of TWA, was preparing a flight to Europe and had secured overflight permission with the Canadian and Irish authorities. His planned route included stops in both France and Britain but their Embassies had not responded to his request. European tensions were cited as the cause of the delay as the request was made in late August of 1939; mere days before Germany invaded Poland.[172] The very fact that a single flight required permission from several governments is proof of the legal complexities of the international aviation system: no single authority or agreement could assure that the flight was permissible.

Some of the most common problems on the path to transatlantic flight were of human invention. Europe and North America had developed their own aviation cultures in relative isolation from one another until the 1930s. Suddenly, they had to consider how a plane from one continent would communicate with a ground station on the other, for example. Mundane technical matters proved divisive. Often, the United States was the cause of these disruptions as it preferred not to adopt ICAN standards. Such was the case when L.H. Simson, Acting Chief of the Radio Development Section of the Civil Aeronautics Administration, objected to an ICAN

[170] TNA AVIA 2/1923, Part 1, Trans-Atlantic Air Service: French Proposals. Folio 59A, Extract from "Modern Transport," undated (circa 1935).

[171] Warner, "Atlantic Airways," p. 475.

[172] NARA RG 237, Box 431, Folder 900 "General." Letter from Edward C. Sweeney to Mr. Gates and Mr. Wald, "Trans-Atlantic flight of Howard Hughes," August 25, 1939.

proposal to make use of 333 kHz for all flight radio calls. North American aeronautical broadcasts already used 329 kHz, 332 kHz, and 335 kHz. Including the new frequency would introduce interference problems in what was already a crowded part of the broadcast spectrum. Simson suggested instead that several other frequencies at 6210 kHz, 8280 kHz, or up to five between 8100 and 8140 kHz would be better suited to the task.[173]

The United States was not the only country that did not follow established international practices. Air France Transatlantique did not observe conventional radio communication protocols during its experimental flights in 1939. Bermuda's wireless receiving station, which had not been informed of several flights until they were already airborne, struggled to follow the French communications since the planes regularly changed their broadcast frequencies without notice. Further, the planes only used the generic "CQ" identifier when transmitting.[174] J.W. Millest, the engineer operating the Bermuda station, pointed out that Pan Am, Imperial Airways, and Lufthansa all followed proper and consistent procedures on their transatlantic flights. Their itineraries were known to the Bermuda station in advance and communicated with the station regularly and on the same frequency each time.[175] The British responded by cabling French Aviation Minister Porquet to request that future French flights follow the established protocol, adding that "[t]his is not a complaint from the Bermuda station. It was framed instead as a safety

[173] Simson did not propose that use of the 333 kHz frequency be abolished: it could be retained for international flights alone to minimize the disruption to the existing frequencies already in use. An additional requirement from ICAN would have had all aircraft equipped to use 333 kHz, which Simson noted did not require its use and therefore he did not object to it being added to the list of American aircraft radio frequencies. NARA RG 237, Box 438, Folder 924 "International Radio Telegraph Conventions Vol. 1," (folder 1 of 3). Memo from L.H. Simson, "Cairo Radio Conference; International aircraft calling frequency," October 1, 1937.

[174] The flying boat in question, the *Fnord*, departed New York for Horta. While Bermuda was not on the French itinerary, no one outside of Air France Transatlantique knew this. A contact in Baltimore called the Bermudan station to advise them that the flight might be headed their way, and the Bermudans had to man the station until informed otherwise. It was not until 2:30 in the morning, several hours of continuous overnight labour later, that Air France Transatlantique confirmed there would be no stop in Bermuda. TNA AVIA 2/1923, Part IV, "Trans-Atlantic Air Service: French Proposals." Telegram from J.W. Millest to the Manager of Cable and Wireless (W.I.) Limited, June 23, 1939, 20C.

[175] *Ibid*.

measure: without foreknowledge of the flight's route, it would be far more difficult to perform a rescue or keep other aircraft clear of the route.[176]

Provisions for aviation radio frequencies and communication schedules were highly specific. By 1940, Pan Am and Imperial Airways had carved out the exact times when their airline was exclusively allowed (and required) to make contact with ground stations (Pan Am at 10 and 40 minutes past the hour and Imperial at 25 and 55 past the hour). This offered two key advantages: it minimized the chance that a call by an aircraft from one airline would interfere with a transmission by the other and left regular intervals to listen for distress calls (three minutes each at 15 and 45 minutes past the hour). It meant, however, that further airlines would have to find portions of the clock to safely make transmissions of their own. Air France Transatlantique was tentatively given a slot (at 5 and 35 minutes past the hour).[177] This was only a temporary solution while there were few enough airlines that this system might work.

Standardization between American and European aeronautical commercial conventions also needed to be sorted out. A.M. Green, of Imperial Airways' Traffic Manager's Office, detailed some of the issues that needed sorting out in 1939. Green noted that Pan Am assessed freight weights in pounds rather than in kilograms as European countries did. He felt that it behoved Pan Am to adopt the European custom to facilitate trade. European airlines only charged cargo shipments by weight whereas Pan Am also added a surcharge that Green thought ought to be dropped from transatlantic shipments.[178] Basic commercial standards similarly had

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[176] TNA AVIA 2/1923, Part IV, "Trans-Atlantic Air Service: French Proposals". Telegram from J.J.W. Herbertson to French Air Minister Monsieur Porquet, July 25, 1939, 27A.

[177] Particular frequencies were reserved for civil aviation, with all main transatlantic ground stations using 333 kHz and several of them having other frequencies as well. Shannon and Newfoundland had five point-to-point frequencies for direct contact with one another. TNA AVIA 2/1923, Part IV, "Trans-Atlantic Air Service: French Proposals". Letter from W.W. Burkett to French Aviation Minister Monsieur Porquet, March 31, 1940, 61B.

[178] British Airways Heritage Centre AW/1/2818, "Part 1: Atlantic Fares & Rates, 1938-45". Letter from A.M. Green, Traffic Manager's Office (Commercial Branch) to Mr. Bewshea, U.S. Commercial Manager, "Trans-Atlantic Air Freight," July 20, 1939.

to be harmonized between Europe and North America. This included ticket formats, where IATA members (mostly in Europe) followed common guidelines. In 1939, IATA consulted with Pan Am about adopting the standard used among IATA's members for tickets. All details were spelled out in detail, including the size of the ticket, languages use (at least English, French, or German), departure and arrival points, luggage size (with its own tag to be carried), date and time issued, and so on.[179]

Conclusion

The first transatlantic flights in 1919 made it clear that aeronautical technology was up to the job of crossing the North Atlantic, or at least that it would be once it matured. Those flights highlighted existing weaknesses in post-First World War aviation: too many resources had to be dedicated to individual flights to make them practical and regular commercial flights were simply not possible with the limited lifting capacity those planes provided, especially with so much weight allocated to fuel. The gradual evolution of aircraft and engines throughout the 1920s and 1930s proved the optimists right as new planes entered the market with both greater range and lift. The competition between airplanes and airships likewise showed the superiority of the more versatile and durable planes for travel. Both airlines and governments recognized that the time was ripe and turned their attention to spanning that most tempting, prestigious, and potentially lucrative aeronautical target.

Studies and test flights proved that crossing the North Atlantic was not just feasible but economically viable by the late 1930s, albeit with considerable government financial and

[179] British Airways Heritage Centre AW/1/4779, "Trans Atlantic Documents, I.A.T.A., 1939-41." International Air Traffic Association, "Report of the Committee to Settle Forms of Traffic Documents and Conditions of Carriage for Transatlantic Air Services. To be submitted to the 39th General Meeting, New York, September 13, 14 and 15, 1939. Point 13 of the Agenda".

infrastructural support. A great deal of work remained before all countries rimming the ocean could provide regular commercial operations, with only Pan Am offering service as the Second World War broke out. Infrastructure was largely absent in the north even though the British, Canadians, Irish, and Newfoundlanders were working to remedy the situation. Much of the infrastructural development was subsumed by the war effort as will be discussed in Chapter Two, proving indispensable for both the military during the war and civil aviation after the war's end. But above all else it was the work of the governments, supported by their national carriers, that saw the North Atlantic turned from the sole purview of ocean liners into the crown jewel of international flight, a route so prestigious that airlines paid premiums for the privilege to fly and aerospace firms built planes specifically to cross it.

Chapter Two: Wartime Transatlantic Flight

The final peaceful days of 1939 witnessed the first regular commercial air service to span the North Atlantic when Pan Am inaugurated its North America to Europe route with the Boeing 314 *Yankee Clipper*. The flying boat departed from New York on May 20, 1939, to Lisbon, Marseilles, and finally Southampton. A small fleet of boats bedecked with flags, a few with bands playing, greeted the flight in the Azores. "Rockets were fired from the shore to mark a new epoch in the history of the islands."[1] This optimistic spirit, that the conquest of the Atlantic skies marked a period of peace, was soon rudely quashed as the Second World War began mere months later. But that war marked the emergence of transatlantic flight as a large-scale, if not entirely routine, endeavour. Military spending programs turbocharged the civilian airlines and aviation infrastructure throughout the North Atlantic region to bring the resources of North American industry to the European battlefields as quickly and safely as possible. Airlines from both sides of the Atlantic were brought into the war effort to supplement military air capabilities. Regular transatlantic flight during the war gave the airlines the knowhow needed for their postwar transatlantic commercial services and, in some cases, also some of the first aircraft for their fleets. And the infrastructure in place prior to the war paled in comparison to that built for the swarms of planes that crossed the ocean in the early 1940s. Without the huge military effort to bring large numbers of planes to Europe quickly and safely, civil aviation on the North Atlantic still would have developed during that time, but it would not have occurred as rapidly or as extensively.

[1] "Yankee Clipper Reaches Lisbon, Crossing Atlantic in 26 ½ Hours," *New York Times*, May 22, 1939, p. 1.

Military/Civilian Airline Cooperation

Few aircraft in late 1939 had suitable range to fly across the ocean, whether civilian or military. Ships were therefore used to transport warplanes from North America to Britain until the fall of France in 1940. Following that event, German submarines practiced unrestricted submarine warfare throughout the ocean, presenting a far larger threat to North Atlantic shipping and to the planes so recently carried in relative security. The Allies lost 1,170 merchant ships in 1942 alone,[2] with many carrying planes in the cargo holds. While flying the planes to Europe under their own power offered a potentially safer alternative,[3] it carried risks of its own as well. Experimental transatlantic flights had just recently concluded and first-hand knowledge concerning how best to fly across the ocean was limited and incomplete. None of the military aircraft models, nearly all of which were landplanes, were designed with long ocean crossings in mind. What little was known of the northern reaches of the North Atlantic was that the weather was often bad and there were few if any safe places to put down a plane in the event of a problem. To address such shortfalls, the Canadian Meteorological Division, part of the Department of Transport, was approached by the Department of National Defence to support transatlantic air and sea transportation. The weather agency worked closely with the military to deliver reports directly to pilots about to cross the ocean. It also built further weather stations along the Canadian and Newfoundland coasts to improve the quality and quantity of data it received.[4]

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[2] Roger Turner, *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science* (Dissertation: University of Pennsylvania, 2010), p. 137.

[3] Alison Corke, *British Airways: The Path to Profitability* (London: Pinter, 1986), p. 29. Harold Lee George, "The Air Transport Command, Army Air Forces," *Annals of the American Academy of Political and Social Science* 230, Transportation: War and Postwar (November 1943), p. 89-90.

[4] Morley K. Thomas, *Metmen in Wartime: Meteorology in Canada 1939-1945* (Toronto: ECW Press, 2001), p. 30-3.

Early projections on the difficulty of bringing the planes across the ocean safely were pessimistic. Trans-Canada Airlines (TCA) was one of the airlines tasked with flying those aircraft to Europe. Its worst case estimates suggested that up to half of all the planes attempting the crossing would not arrive. The British were made aware of this sobering figure in 1940. This high estimate was acknowledged and accepted as a military necessity.[5] British Major Robert Hobart Mayo recognized the importance of an air ferry to supply his country with planes at nearly any cost, stating "if, through bad weather or other unfavourable circumstances, the results are not 100 percent successful in the first instance, I hope it will not be concluded that the scheme itself is not feasible."[6] While the first run of bombers to use the direct route indeed encountered minor problems, all seven of the Lockheed Hudsons completed the journey.[7] Despite the wildly negative initial predictions, TCA did not lose any planes[8] while the British lost just three by July 1941.[9] Thus began the initial stage of aircraft transportation overseen by the Ministry of Aircraft Production (MAP) under the name ATFERO, short for Atlantic Ferry Organization.[10] A total of 300 bombers, mainly Hudsons, crossed safely between 1939 and 1941 when the Royal Air Force's Ferry Command took over from the MAP.[11] This is not to say that

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[5] J.R.K. Main, *Voyageurs of the Air: A History of Civil Aviation in Canada, 1858-1967* (Ottawa: Roger Duhamel, Queen's Printer and Controller of Stationary, 1967), p. 129-31.

[6] Jeffrey Davis, "ATFERO: The Atlantic Ferry Organization," *Journal of Contemporary History* 20, no. 1 (January 1985), p. 74-5.

[7] The planes departed from Gander on November 10, 1940, and landed ten hours later in Aldergrove, Northern Ireland. Poor but passable weather plagued much of the crossing, with turbulence and occasional mechanical failures adding to the misery for the flight crews. Despite the hazards, the flight proved successful and paved the way for future runs. *Ibid*., p. 75-6.

[8] George, "The Air Transport Command, Army Air Forces," p. 89-90.

[9] The three planes lost represented 1.1% of all planes involved in the North Atlantic crossing. Davis, "ATFERO," p. 88.

[10] *Ibid*., p. 77-8.

[11] Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986), p. 87-8.

the North Atlantic Ferry route flew without incident. During the war 560 people lost their lives on the British-run Ferry in crashes or other incidents after 1941.[12]

Britain's Royal Air Force (RAF) "return air service" was critical for sending pilots back to North America after they brought newly-made planes to Britain and turned them over. In 1941, the RAF estimated that up to 35 planes would be needed on permanent assignment to the service (three of which would be kept in reserve), assuming that the interiors of the B-24 Liberators then in use could be rearranged to accommodate 14 passengers rather than 12.[13] Together, these planes could return the estimated 1100 pilots and air crews that needed transportation each month to North America expediently. As each B-24 required regular maintenance after the repeated long ocean crossings, a place could fly 2.5 round trips each month. Maintenance for the B-24s necessitated a large supply of spare parts and ground storage space, including new hangars for any planes unable to make their scheduled crossings. The airports in Newfoundland and Montreal were singled out for expansion in case planes needed the work there.[14] Seven of these planes entered regular service on May 4, 1941, marking the start of the first British transatlantic passenger service.[15] It was not until the summer of 1942 that sufficient infrastructure and experience had accrued to allow more than a small number of planes to travel at the same time thanks to the opening of the northern route's airfields.[16]

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[12] Carl A. Christie, *Ocean Bridge: The History of RAF Ferry Command* (Toronto: University of Toronto Press, 1995), Appendix 2.

[13] TNA AIR 2/8133, "British ferry command – transatlantic Liberator ferry service." "Estimated Return Air Service Requirements for Atfero," June 23, 1941, 3A.

[14] Each B-24 had four engines, so between all active planes on the ferry service there would be a total of 3,000 plane-hours and consequently 12,000 engine-hours. Each B-24 engine needed an overhaul after 600 hours. Additionally, airscrews had to be dismantled and checked every 200 hours. In total, the RAF estimated that there would be 20 engine and 60 airscrew overhauls every month. *Ibid*.

[15] This was also the first year-round transatlantic air service. Davis, "ATFERO: The Atlantic Ferry Organization," p. 80.

[16] George, "The Air Transport Command, Army Air Forces," p. 89-90.

While the RAF was officially in charge of the Return Ferry Service,[17] it did not fly the planes. Instead, the British Overseas Airways Corporation (BOAC) with the support of the RAF in ground control was tasked with the safe operation of the Ferry flights to and from Britain. Britain's two main airlines, Imperial Airways and British Airways, were merged into BOAC in 1939, and employed in the Return Ferry Service. The airline possessed a skilled and experienced corps of pilots and flight crews that the RAF sorely needed for the converted B-24 Liberators. The first flight departed Montreal for Britain on May 4, 1941. While BOAC lacked commercial transatlantic flight experience, it received extensive assistance from the RAF and from Trans-Canada Airlines (TCA) in Canada.[18] In doing this, BOAC began flying the first year-round transatlantic air service.[19] BOAC was granted some modest leeway as air crews could refuse to carry passengers that risked the safety of the flight while the company bore no responsibility for the skill level of its crews. The corporation had the authority to maintain its aircraft and could contract out the work to third parties. The RAF retained control over the timing, route, and clearances for the actual flights.[20] BOAC's Boeing 314s carried Sir Winston Churchill twice in 1942 on Atlantic-crossing flights, once to Bermuda and the other time to Washington.[21] The 314s were based in Baltimore and flew the northern route during the summer months, shifting to the southern route between October and June.[22]

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[17] Much of the groundwork of the ferry service in Canada was performed by Canadian Pacific Railway, including building the airfields and coordinating day-to-day operations until 1940 when the MAP took over completely. This coincided with the relocation of the main staging airport from St. Hubert to a new, larger facility at Dorval, both of which were in the vicinity of Montreal. Davis, "ATFERO: The Atlantic Ferry Organization," p. 79-80.

[18] BOAC gained such valuable experience by regularly flying the North Atlantic during the war that the Ferry Service was in all practical senses the forerunner of regular transatlantic civil operations after the war's end. Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), p. 27.

[19] Corke, *British Airways: The Path to Profitability*, p. 29.

[20] TNA AIR 2/8133, "British ferry command – transatlantic Liberator ferry service". Note from the Secretary of State for Air A.W. Street, "Direction to the British Overseas Airways Corporation under section 32 of the British Overseas Airways Act 1939," September 5, 1941.

[21] Bray, *The History of BOAC, 1939-1974*, p. 33-4.

[22] *Ibid*., p. 42.

Britain needed a rapid means of sending pilots back to North America after they flew their planes to Europe. Without it, the pool of available pilots would be stuck in Europe awaiting slower ships for the return trip. This was a program to return pilots to North America after they had delivered planes to the European theatre. TCA assisted BOAC on the Canadian side through maintenance work.[23] Despite the need for the rapid return of pilots for further flights, 90% of them had to return to North America by ship. The decision to return a pilot by ship was only made after an assessment of the weather determined that conditions were suitable for the flight first, if a plane was even available; a delay that worsened the bottleneck.[24] This was in part due to the limited number of aircraft at its disposal: it could only use long-range planes that were not directly engaged in the fighting. By 1941, the British Ferry obtained an American bomber that was converted for carrying passengers. Its flying time across the North Atlantic was as much as 20 hours and the passengers endured an unheated and unpressurized cabin. The flights primarily used the airport at St. Hubert in Quebec near Montreal, but to alleviate overcrowding at the busy airport the flights occasionally used Dorval in Montreal itself. TCA not only gave the British permission to do so but provided three full crews to service the planes.[25]

As was the case in Britain, Canada's civil aviation sector benefitted from government largesse in wartime. TCA received substantial maintenance fees on aircraft bound for Europe.[26] In 1943, TCA also introduced a converted Lancaster bomber (dubbed a "Lancastrian"), a plane

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[23] David Collins, *Wings Across Time: The Story of Air Canada* (Toronto: Griffin House, 1978), p. 20; Bray, *The History of BOAC, 1939-1974*, p. 42.

[24] British Airways Heritage Centre, AW/1/6152 Pt. 2. "Atlantic Ferrying Service, Services, 1941." Telegram from G. Sherman to J.R. McCrindle, BOAC, 30 December 1941.

[25] Cabin pressurization was still uncommon in 1941. The Boeing 307 "Stratoliner", which entered the market in 1940, was the first aircraft built for commercial service to boast a pressurized cabin. R. Miller, and D. Sawers, *The Technical Development of Modern Aviation* (New York: Praeger Publishers, Inc., 1970), p. 224; Smith, *It Seems Like Only Yesterday*, p. 89.

[26] Charles Allan Ashley, *The First Twenty-Five Years: A Study of Trans-Canada Air Lines* (Toronto: Macmillan, 1963), p. 25.

contributed by the British, on the North Atlantic for air mail.[27] This marked the start of independent Canadian operations on transatlantic service and set the stage for TCA's postwar European service.[28] Building around TCA personnel, planes, and resources, Canadian Minister of Munitions and Supply C.D. Howe authorized the creation of the Canadian Government Trans-Atlantic Air Service (CGTAS). This was the first Canadian air service with transatlantic air capabilities, operating an air route between Montreal and Prestwick, Scotland. Since all CGTAS planes, crews, and materials reverted to TCA in 1947 this could be considered to inaugurate TCA's own transatlantic service.[29] CGTAS was reserved for public officials and high priority mail, however, rather than being open the general public. Regular commercial service was simply not a consideration during that time.[30] By mid-1944, CGTAS ran 3 planes averaging two flights per week, carrying a total of 217,000 pounds of mail in the second quarter of the year.[31] By the end of 1944, it had flown fully one million pounds of mail and 2000 passengers across the Atlantic.[32] But the Lancastrians, as converted bombers rather than purpose-built transport planes, were poorly suited for the route. They had low reliability during the early months of

[27] The British provided the plane only after the Americans chose not to deliver any aircraft to Canada, although the memo does not draw a direct line between the two events. It is probable that the British recognized the importance of giving Canada the means to conduct a ferry service of its own. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. "Ministry of Transport. Air Traffic – Operations. Volume 1, January 1942-June 25, 1943." Folio 19797, no. 29. Memo from J.R. Baldwin to ICICA, "Canadian Trans-Atlantic Air Service," February 1943.

[28] Bray, *The History of BOAC, 1939-1974*, p. 42.

[29] CGTAS was created to serve a military need that ended soon after the war concluded. The Canadian government turned over CGTAS in its entirety to the airline from which it had originally been hewed, TCA, to make effective use of resources that the government no longer required directly. Soldiers were not charged for flights to Britain during the war, which could debatably be considered a passenger air service. Ashley, *The First Twenty-Five Years*, p. 22; Collins, *Wings Across Time*, p. 79; Smith, *It Seems Like Only Yesterday*, p. 91-4.

[30] Collins, *Wings Across Time*, p. 23-5.

[31] The exact value of post office payment to CGTAS by July 13, 1944, was $491,442.40, of which $234,169.90 was paid by the British government for westbound mail. CGTAS by that date flew 26 times in each direction across the North Atlantic, averaging two round trips per week (with three trips per week foreseen in the near future potentially carrying a boost in its share of air mail). The air mail CGTAS carried across the Atlantic amounted to 340,690 ton-miles by the end of June, 1944 (TCA carried 140,000 ton-miles in an average month on all of its services combined), and 13,800 tons of freight. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Volume 3, March 15, 1944-August 8, 1945. J.R.K. Main to D.A.S., "Quarterly Report on Canadian Government Trans-Atlantic Air Service," July 13, 1944.

[32] Main, *Voyageurs of the Air*, p. 153-5.

operation. Each plane required extensive maintenance, and Canadian requests to the British and Americans for replacement aircraft were refused given limited available resources.[33] Canada had put together an independent airline on the North Atlantic thanks in part to the war, but it did not have an easy time of it.

America ran a transatlantic air ferry of its own, beginning on May 28, 1941, in parallel to the British and Canadian efforts, run by the United States Army Air Force under the name Air Corps Ferrying Command. It was renamed the Air Transport Command on June 20, 1942. The ferry service, it should be noted, began prior to the American entry into the war: fully 1,200 planes were transferred to Britain through this program before Pearl Harbor was bombed on December 7.[34] The American government rationalized its support for the British in that it helped America defend the neutrality of Greenland and Iceland from potential German aggression. But the United States military was inexperienced with many facets of transoceanic flight as the war began. And as with the British and Canadians, it had to rely on the civil sector both to provide the services it needed and to train military personnel on best practices. Civilian practices were applied throughout the growing air support network, including in the production and development of the planes themselves.[35]

The United States' biggest airlines proved to be valuable resources for the American military: Pan American Airways' extensive international air transportation knowledge was sought out, along with Trans World Airways (TWA)[36] and American Airlines, to bolster the military foray. Pan Am's particular experience as the only airline with regular transatlantic

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[33] Smith, *It Seems Like Only Yesterday*, p. 94-6.

[34] Arthur J. Larsen, "The Air Transport Command," *Minnesota History* 26, no. 1 (March 1945), p. 2-3.

[35] George, "The Air Transport Command, Army Air Forces," p. 91.

[36] By entering into the war effort and ferrying between North America and Europe, TWA gained the extremely valuable international service and experience that had been the sole preserve of Pan Am in the prewar years. In 1945, it parlayed this into regular international commercial service and changed its name from Transcontinental and Western Air to Trans World Airlines to reflect this. T.A. Heppenheimer, *Turbulent Skies: The History of Commercial Aviation* (Toronto: John Wiley & Sons, 1998), p. 117-8.

capabilities made it the natural choice to guide and inform the Transport Command. The airlines initially received military contracts to fly cargo and, after December 13, 1941, were placed under the authority of the Secretary of War. The Ferrying Command gained control of a large number of the country's aircraft. Only minimal aircraft capacity was spared for domestic civil use, while airline staff was militarized.[37] The most critical diplomatic mail, and a steady stream of VIPs, received the highest priority for flights between the United States and Europe in 1941. The Air Corps Ferrying Command flew B-24 Liberator bombers to carry the mail and passengers.[38] Even after the United States formally entered the war, Pan Am flew a non-commercial service in support of the war effort that flew air mail and high value individuals. Between 1941 and the end of 1944, just under ten million pounds of mail as well as 68,000 passengers were carried across the North Atlantic.[39]

Airlines involved in these ferrying services reaped huge rewards. In addition to providing vital manpower and material to the war effort, they gained a great deal of direct experience flying the North Atlantic that formed the foundation of future regular transatlantic operations. Their flight crews learned how to safely fly across the long ocean spaces regularly. The close dealings between the respective ferries in the three principal countries built a working relationship with the airlines and their counterparts in the other countries. It also offered a huge advantage to those airlines fortunate enough to continue service during the war as the airlines of the United States, Canada, and Britain inherited many of the planes that their crews had flown during the war. This made the introduction of regular passenger service in the postwar era a

[37] Larsen, "The Air Transport Command," p. 7-8.
[38] *Ibid*., p. 3-4.
[39] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 199, Folder 4, "Company History Atlantic Division, 1939-1945." Pan Am press release, December 13, 1944.

transition rather than an entirely new service, bootstrapping transatlantic air travel at a time when it was primed for rapid growth.

Wartime Infrastructure

Flying the planes across the ocean is only half of the story. Each flight needed a network of support infrastructure lining the route, guiding the planes and giving their crews every possible advantage on their dangerous journeys. The Allies therefore built a widespread network of airfields, radio towers, and weather stations across the North Atlantic. These were critical pieces of support, providing refueling points and emergency services. Not every plane necessarily needed to take advantage of all those stopping points, however: some bombers possessed sufficient range to make the direct route hop. Flying those planes on the direct route cut the factory-to-battlefield time down from ninety days to just ten.[40] But many bombers and all fighters could not make the long hop and therefore needed stepping-stones.[41] In addition to the airfields built in Canada and Newfoundland, several were built on the more remote islands of Greenland and Iceland. Greenland was placed under American military protection following a 1941 request by the Danish government-in-exile, with Denmark retaining sovereignty. The United States was granted permission to build airfields, weather stations, and radio facilities around the island.[42] It soon did so and a total of fourteen installations straddled Greenland's

[40] Some of the factories building the planes were as far away as California and even from there, with the direct route, it was possible to have a plane fly through Montreal to Britain in a week and a half. In addition to the far quicker delivery, more cargo space was made available on ships that would otherwise have carried the planes in their holds. John D. Carter, "The Early Development of Air Transport and Ferrying," in *The Army Air Forces in World War II. Vol. 1: Plans and Early Operations, January 1939 to August 1942,* ed. W.F. Craven and J.L. Crate (Chicago: University of Chicago Press, 1948), p. 313-4.

[41] John M. Hightower, "U.S. Air Corps May Soon Fly Planes to U.K.," *Globe and Mail*, November 27, 1941, p. 13.

[42] The official treaty was *The Agreement relating to the Defense of Greenland*, signed April 9, 1941. It also included provisions for the United States to improve harbours and anchorages, and all upgrades were to be open to

coast. Some stations had complete air bases while others were merely isolated weather observatories. Bluie West One[43], an airstrip at Narsarsuaq, was the main facility for the air ferry in Greenland,[44] with a backup airstrip at Bluie West Eight.[45] Iceland, similarly under American protection after a 1941 agreement with Icelandic Prime Minister Hermann Jonasson,[46] used the Keflavik air base near Reykjavik as a crucial step on the ferry.[47] This put the last hop to the British Isles (at Prestwick, Scotland) a manageable 844 miles (1,358 km) from America's Icelandic airfield.[48] Even though the United States was not yet at war, its leadership recognized the value in supporting its military air power through a robust system of meteorological stations.[49]

Gander, Newfoundland, became a major hub for the ferry's activity. The British specifically built Gander's large airport just before the war began for Imperial Airways to use for its commercial transatlantic service. Gander's large runways and strategic location were ideally suited for the war effort. As noted in Chapter One, Gander sat astride the direct route between North America and Europe and close to the northern route. As it was also on the northeastern

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the countries of North and South America in the general defence of the hemisphere. "Agreement Whereby United States Becomes Protector of Greenland," *New York Times*, April 11, 1941, p. 4.

[43] Each base was given a simple designation based on its position in order outwards, east or west, from Cape Farewell (the southernmost point in Greenland). Using the military codeword 'Bluie', which referred to the island, the bases east of Cape Farewell were thus called Bluie East One, Bluie East Two, and so on, while the bases westwards were called Bluie West One, Bluie West Two, and so on. There were five to the east and nine to the west at the peak.

[44] Embassy of the United States in Copenhagen, "Joint Committee Annual Report 2011," p. 27. Retrieved from: http://photos.state.gov/libraries/nuuk/1069938/lindpl/JC%20Annual%20Report%202011.pdf (April 30, 2016).

[45] Bluie West Eight's airstrip involved only slightly longer flights to bridge the gap between Goose Bay and Reykjavik (949 miles and 845 miles to each point, respectively) than using Bluie West One (777 miles and 770 miles, respectively).

[46] The Americans sent forces to Iceland at the request of the newly independent Icelandic government to replace the British and Canadian forces then present. This move was done with the explicit recognition that Iceland would retain sovereign control over internal affairs and that the United States would withdraw its forces as soon as the war concluded. "Navy Forces Land; Roosevelt Holds Move, on Reykjavik's Bid, Bars Triple Threat," *The Times*, July 8, 1941, p. 1, 3.

[47] "Swedes Worried by Iceland Bases," *New York Times*, October 13, 1945, p. 5.

[48] Christie, *Ocean Bridge*, p. 130.

[49] Donald S. Dorr, "Weather Watch: Making Straight the Way for Air Travel Over the North Atlantic," *No. ACSC-87-1780* (Air Command and Staff Coll: Maxwell AFB, Alabama, 1987), p. 8-9.

edge of North America, it became the last fuel stop for planes headed across the North Atlantic to Britain on both routes. As even the long-range bombers of the day were barely capable of making the ocean jump it was often necessary to attach additional fuel tanks.[50] BOAC routed their Return Ferry flights between Montreal and Prestwick through Gander on either direction, ultimately running a total of 136 Liberator flights through the airport.[51]

Some of these transatlantic stopping points were better suited for regular air travel. Weather conditions were a perfect example of this, as Canadian and Newfoundland airports concerned military planners almost from the beginning. The winter of 1940-41 was the first time that Ferry services operated in cold and snowy weather. Ice buildup was a potentially deadly threat to planes in wet air. De-icing sprays were used on the ground and de-icing equipment was installed on any plane that could accommodate it.[52] Planes using those airports had to be sheltered in hangars so their engines would not seize in the severe cold while runways were plowed. Hangar space was already limited in Canadian airports involved in the war effort, compounding the challenge of keeping the Ferry Service running at maximum capacity. While new hangars were built to handle the growing traffic, alternatives were pursued too. Some of the longer-range bombers could make the direct flight from the United States to Britain and were pressed into making the long flight rather than the safer series of hops along the northern route. Without the need to accommodate the big bombers, the hangars could be used for the smaller planes that could not make the long ocean jump and more planes could be fit in them.[53]

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[50] Smith, *It Seems Like Only Yesterday*, p. 88.

[51] A small number of the 136 flights were routed instead through Goose Bay, Labrador, or Reykjavik, Iceland, when conditions made Gander impractical or inaccessible. Bray, *The History of BOAC, 1939-1974*, p. 34.

[52] For more on the hazards of cold weather operations, see Chapter Six. British Airways Heritage Centre AW/1/5464, "North Atlantic, Meteorology, 1941-46." "Weather Conditions on the North Atlantic Route," July 20, 1943.

[53] British Airways Heritage Centre, AW/1/6152 Pt. 2. "Atlantic Ferrying Service, Services, 1941." Memo from Captain J.S. Percy to S.A. Dismore, Ministry of Aircraft Production, "U.S.A. Aircraft delivered to the U.K. by air and pilots' air ferry service from U.K. to Canada," 23 April 1941.

By mid-1942, the ferries using Gander recognized that there were serious shortcomings with the airport and the route through it. The civilian and military flights did not receive meteorological communications as often or as rapidly as should have been the case. A weather forecasting centre in newly-built Dorval airport, near Montreal, diverted experienced people from Gander. Ferry operations headquarters was also moved to Dorval from Gander at that time.[54] This slowed the local weather reports as they relied more heavily on Canadian meteorological transmissions. The RAF, in charge of all air traffic control operations over the North Atlantic, planned a conference with Pan Am and BOAC to address this problem.[55] These logistical problems were sorted out in time thanks to proper planning and sufficient staffing at the meteorological stations in both Montreal and Gander. Unfortunately for Gander, it had other serious shortcomings that were not so easily solved.

Since most planes required a refueling stop in Newfoundland before their transatlantic flight, the island represented a critical bottleneck when bad weather struck. One memo from the British Air Ministry in 1942 expressed consternation and confusion as to why planes alighted in Gander at all, a site where weather-related delays were more frequent than anywhere else along the North Atlantic. The memo's author suggested that it would be preferable for planes to fly the entire Dorval-to-Prestwick route without a landing at Gander. As there was no apparent requirement for the planes to make the landing, the author suggested that it might merely be for the pilots to receive the latest weather updates that could just as easily be handled by radio.[56] An

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[54] Thomas, *Metmen in Wartime*, p. 93-5.

[55] Communications between the RAF-run Gander and RCAF-run Botwood bases were also limited despite their relatively close proximity. They shared a single landline for a time that suffered from poor sound quality until it was replaced. TNA BT 217/243, "Trans Atlantic Flights Northern Route W/T Organization, Part 1, 1940-5." Confidential telegram from H.A.L. Pattison to C.B. Collins, July 4, 1942.

[56] British Airways Heritage Centre, AW/1/2594. "North Atlantic Ferry Service, Communications, 1941-43." Memo from A.O.S. Grand Spa, Bristol, to C/S N.B. Prestwick, NS.2.654, "Return Ferry Service," March 30, 1942. The memo was written in a tone that implicitly requested a reason for the stopover in light of the constant delays.

internal memo from BOAC, which was engaged in the Ferry Service, likewise recommended scrapping stopovers in Gander. The memo cited the fact that roughly half of the days in the winter of 1941-42 were impossible for air travel into or out of Gander. Poor weather often developed shortly before landing and forced a return to Dorval. In an extreme case, a flight was grounded in Gander for 12 days during a run of particularly bad weather.[57] As P.D. McTaggart-Cowan, from Forecast Services in the Canadian Department of Transport, noted, "there is no period of the year which one can rely upon for stable weather conditions as flying is concerned in Newfoundland."[58]

Alternatives to using Gander for transatlantic flight operations were thoroughly considered in light of the weather hazards. The United States military pushed for alternate airfields in Newfoundland and Labrador in 1941, even before it formally entered the war. The American government was particularly pushy about building airfields in Labrador and the Northwest Territories in 1941. It insisted that should the Canadians or British not be up to the task, American workers would build the airfields with American funding. The Canadian military did not wish to lose its claim on aviation infrastructure in the region and so acquiesced, building the facility at Goose Bay over the summer and autumn of 1941 up to the point that flights could land there.[59] Goose Bay, Labrador, was particularly favoured over sites on Newfoundland Island due to its strategic location.[60] It sat closer to the direct route for flights heading to Greenland and

[57] Alternate transatlantic flight options were seriously being considered. A direct route between Dorval and Britain was one option, while Goose Bay's airport in Labrador was being analysed as a potential replacement. A breakdown of months over the winter of 1941-2 showed the following number of "days unfit for flying" at Gander: November, 12; December 18; January, 12; February, 19; March, 16. British Airways Heritage Centre, AW/1/5464. "North Atlantic, Meteorology, 1941-46." Memo from A.O.D. – Return Ferry Service to O.D. – Bristol, "Return Ferry Service," April 1, 1942.

[58] *Ibid*.

[59] Christie, *Ocean Bridge*, 127-9.

[60] Goose Bay's airport was built in 1941-2 by the Canadian Department of Transport for the RCAF's transatlantic war effort. It's relatively remote location meant that there were no ground lines for communication at

its weather was reliably better than that in Gander.[61] By 1943, flights between Gander and Britain experienced on average a 79% chance of making the voyage without weather-related complications. When Goose Bay was used instead of Gander, the success rate climbed to 93%. And if a plane was able to make the direct voyage beginning at any airport in Canada or Newfoundland as far west as Montreal there was a 99% chance of enjoying favourable weather. The data clearly indicated that any means of avoiding the Atlantic coast of North America was preferable.[62] These were meaningful concerns for future civil flight as both Gander and Goose Bay later served as vital refueling points for postwar air traffic. Indeed, they were built with the expectation that these airports would serve a vital role in the civil air traffic then predicted following the cessation of hostilities.[63] This foresight proved valuable for until the introduction of the DC-7C in 1956, no civilian plane could reliably cross the North Atlantic without having to use one of those two airports to top up its fuel tanks.[64]

While entirely new facilities were built in the northern reaches of the North Atlantic, British airports were upgraded during to accommodate the Ferry traffic. Some of these included the systems that would both improve the quality of air travel immediately and serve civil air traffic in the years to come. In 1941, the RAF planned to install a central radio transmitter for voice traffic in Prestwick to cover Ferry Service flights in a facility already broadcasting direction-finding radio signals. Doing this carried a useful advantage: planes could home in on

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the time of its construction, so wireless equipment provided by the United States was used extensively. Thomas, *Metmen in Wartime*, p. 103-4.

[61] The American military, aside from worries about the weather, was also concerned about using airfields that were not at least partially under their own control. By developing other sites, it ensured that it would have some say in operations. Dorr, "Weather Watch," p. 15-8.

[62] British Airways Heritage Centre, AW/1/5464. "North Atlantic, Meteorology, 1941-46." "Preliminary Report on Various Meteorological Factors Affecting the Regularity of Transatlantic Air Services," October 14, 1943, p. 6-7.

[63] David Clark MacKenzie, *Canada and International Civil Aviation 1932-1948* (Toronto: University of Toronto Press, 1989), p. 76-7.

[64] Bray, *The History of BOAC, 1939-1974*, p. 93.

the voice transmission frequency when their own transmitters were malfunctioning. The range was as much as 25 miles (40 km) from the station.[65] This was too short a distance to act as a long-range navigational signal but it was the kind of backup that could save lives in an emergency.

Extensive work was done all around the North Atlantic during the war to provide many of the major airports with robust electronic navigation aids. Radio beacons and beams were situated at the airports as short and medium-range navigational aids. Incoming planes could use the signals to find the direction of the airport, especially when visibility was poor.[66] The beams were an early form of the ICAO's modern Instrument Landing System used to guide planes safely onto a runway in limited visibility. An ultra high frequency transmitter with a tight beam is sited near the close end of a runway and angled up at about 3 degrees, so a plane can follow the signal easily down along the safest approach angle. A second very high frequency transmitter placed at the far end of the runway similarly projected a signal beam that can only be detected as a plane is closely aligned with the runway during approach. When combined, these two simple transmitters could guide a plane in near-zero visibility onto a runway with little difficulty.[67]

Short-range radio guidance was helpful at airports but was irrelevant over the long stretches of open ocean where a flight crew could go off course without access to a long-range

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[65] British Airways Heritage Centre AW/1/2594, "North Atlantic Ferry Service, Communications, 1941-43." Extract, "Official Minutes of Discussion held by Trans-Atlantic Ferry Pilots and R.A.F. Representatives," September 4, 1941.

[66] Prestwick had several types of radio beacon: a track guide beam (to determine whether the plane was on the correct path), vertical marker beacon (to determine altitude), and omni-directional low power wireless beacon (which could be used with an aircraft's radio compass) were all in use there. Other airports involved in the Ferry employed at least one of these. TNA AIR 2/8151, "Questions concerning air control of trans-Atlantic air traffic." 44 Group Air Staff Instructions, "Part 2. Aircraft Control," November 26, 1941, 33A, p. 4-5.

[67] Gene Banning, *Airlines of Pan American since 1927: Its Airlines, its People, and its Aircraft.* R.E.G. Davies, ed. (McLean, Virginia: Paladwr Press, 2001), p. 558-60. For more on the development and implementation of radio beams to assist landings, see Arjun Singh, *Airport Ground Navigation Systems* (New York, NY: McGraw-Hill Education LLC, 2012), Chapter Six.

navigational radio signal. The Signals Officer at Prestwick suggested a solution to this: setting up a network of 5 kilowatt beacons (10 kilowatts if possible) at several strategic points around the North Atlantic to assist in position-finding. He recommended one each for the Labrador coast due east of Goose Bay, the Newfoundland coast near Gander (or Belle Isle if necessary), the southernmost point of Greenland, and the south coast of Iceland for a start.[68] Radio communication and navigational aids provided total coverage over the northern route by 1944. Such coverage was not necessarily enough to provide a perfect position fix but marked a vast improvement over conditions found throughout most of the oceans.[69] By the war's end, North Atlantic infrastructure had leapfrogged other air routes, with navigational aids such as these leading the way. After 1945, regular civilian night flights were possible over the Atlantic when most parts of continents were not then suited for it.[70]

Air traffic control (ATC) at Prestwick was also a key feature in transatlantic flight. The primary station, called the Master Transatlantic Control (East), normally operated out of Prestwick and provided ATC coverage for the airspace above the eastern North Atlantic. RAF Station Gander covered the west. The two stations worked closely together, sharing information to ensure the safe operation of ferry services. Since the majority of planes departed from Gander headed to Britain, Gander guided the aircraft on the outbound portion of the flight until they reached 30° west. Prestwick then took over ATC duties to guide the flights until they reached

[68] The specific recommendation was spurred on by the success of a beacon in Berrynacross, Ireland, for existing transatlantic services. Such stations had an effective range of 120 miles so they were mainly useful for guiding aircraft to nearby airports or waypoints. Their usefulness in communicating weather information was limited excepting for wireless telegraphy, according to the Signals Officer: difficulty in understanding accents could cause confusion and voice communications took up too much radio time when compared to other means of transmitting information. British Airways Heritage Centre AW/1/2594, "North Atlantic Ferry Service, Communications, 1941-43." "North Atlantic Radio Facilities," February 12, 1943.

[69] "Terminus for Atlantic Flights," *The Times*, March 20, 1944, p. 5.

[70] Bray, *The History of BOAC, 1939-1974*, p. 93.

10° west.[71] Regional Control was the designation assigned to the various airports in Britain that took over ATC duties once the planes passed 10° west, guiding them to a landing at their final destinations. Radio communications, transmitted in code, primarily gave the flight crews updates on weather conditions. [72] All weather information was broadcast in code for the duration of the war; only transmissions by wire were considered safe enough to send in the clear.[73]

This intricate network had to accurately account for the position, speed, direction, and altitude of dozens if not hundreds of planes at a time. It was a direct precursor to the ATC system that followed in peacetime, drawing on the experience of the ATC operators and station network to guide commercial aircraft passengers as safely as they had bomber pilots. Although it became a fixture of air travel in the years that followed, radar was not employed as a part of civilian ATC at that time.[74] During the war, radar was used by the British and Germans to detect incoming enemy bombers so they could send their fighters to attack the planes.[75] Radar was too imprecise at that time for the fine resolution needed to guide planes and maintain separation

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[71] TNA AIR 2/8151, "Questions concerning air control of trans-Atlantic air traffic." 44 Group Air Staff Instructions, "Part 2. Aircraft Control," November 26, 1941, 33A, p. 1.

[72] *Ibid*.

[73] The ban on weather broadcasts applied across Canada during the war. Civilians across the country could only receive weather information by phone, with the exception of a few agricultural regions that needed the data in a timely and accessible fashion. Thomas, *Metmen in Wartime*, p. 35-8.

[74] Unlike radio beacon position-finding, radar works by having a radio transmitter send out a pulse at a specific frequency. This pulse is reflected off of any object in the field of view and a receiver (sited close to the transmitter) records the direction of the radio "echo" from the pulse after it has bounced back and notes how long it took the echoed pulse to return. A clear line of sight is necessary for this to work, and as long as the target is clear of obstructions it is possible to find both the range and distance to a given object. A series of echoes detected from the target object will indicate its speed and heading as well; a fact that is critical for air traffic control. In fact, since the principles for air and sea travel are the same, radar has been employed on ships to detect objects that might pose a threat (such as other ships or icebergs) since nearly the same time as for air travel. Some of the lower radio frequencies (about 3-30 MHz) can even return a signal from beyond the horizon by bouncing off of the electrically charged layer of the atmosphere called the ionosphere, although these require very large antennae. Simon Kingsley and Shaun Quegan. *Understanding Radar Systems* (Raleigh, NC: SciTech Publishing, Inc., 1999), p. 1-5; Louis Brown, *A Radar History of World War II: Technical and Military Imperatives* (Philadelphia: Inst. of Physics, 1999), p. 196.

[75] Philippe Lacomme, Jean-Philippe Hardange, Jean-Claude Marchais, and Eric Normant. *Air and Spaceborne Radar Systems: An Introduction*. Norwich, NY: William Andrew, 2001), p. 1-2.

between them except within a few kilometres of the radar receiver.[76] Radar technology of the day enabled radar systems to be installed on some planes. The Messerschmitt Me 110 G-4 was the first of these, equipped with a large antenna that had a range of up to 3.5 miles (about 5.5 km). This was used to detect the presence of enemy aircraft for attack and defence but it also established the principle that, by scanning nearby airspace for other planes, such systems could be used for in-air collision avoidance.[77]

Conclusion

British, American, and Canadian participation in the air ferry systems gave transatlantic civil flight a major boost. The limited facilities in place in 1939 could provide only some of the support regular air travel required. The military development program that followed the outbreak of hostilities expedited the construction of airfields, weather stations, communication relays, and navigational aids. It also built a solid knowledge base for all future flights in the region, military and civilian. The harsh weather could be handled with proper planning and a network of safe landing strips: Gander was built as the final stop before the Atlantic. But when Gander was too foggy to use, Goose Bay was a viable alternative. And the planes need never be far from position-finding radio beacons on their flight. In less than six years the North Atlantic was transformed from a dangerous frontier to a highly developed air corridor.

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[76] Radar technology was rapidly improved throughout the war. By the war's end, radar was used to guide planes on approach for landing in poor visibility regularly. For an extremely detailed look at the development of radar during the war, see: Henry E. Guerlac, *Radar in World War II* (American Institute of Physics series, vol. 8.) (New York: American Institute of Physics, 1987).

[77] Although the antenna built onto the Me 110 was quite large (so big, in fact, that it cut down the plane's airspeed by 25 mph), future airborne radar systems used higher frequencies. Radar antennae are built to a specific size determined by the frequency they use for scanning and there is an inverse relationship between the size and frequency, so the higher frequency signals allowed for far smaller antennae on planes that made their use much less disruptive. George W. Stimson, *Introduction to Airborne Radar* (Raleigh, NC: SciTech Publishing, 1998), p. 5-13.

Governments participating in the Atlantic ferry recognized the route's value for civil aviation. Using earlier ocean liner passenger statistics as a guide to future demand for commercial air travel, which was finally becoming a viable if expensive transatlantic option, there was a strong reason to expect that this route would pay dividends. When the war concluded, the route had the necessary infrastructure for safe commercial flight. And the primary value of the North Atlantic air routes in the postwar era was clearly going to be commercial air service: aircraft with transatlantic capabilities had already been built by the thousands during the war and needed only to be repurposed for civilian use. Indeed, Pan Am began regular service with DC-4s between New York and London via Shannon on October 27, 1945; the same planes they used for the ferry service. Using the same equipment on the same route gave Pan Am an easy transition between military and commercial operations. It also marked the beginning of commercial landplane service across the Atlantic Ocean; the Boeing 314 flying boats used previously were no longer in favour.[78] The ferry service was useful training for the airlines as well. BOAC, TCA, and TWA, having carried military pilots and government officials repeatedly across the ocean, joined Pan Am as transatlantic-capable airlines once they returned to normal operations. Their fleets needed to be upgraded and expanded to meet the higher standards for comfort that paying customers expected, but the war laid the groundwork for what would follow.

[78] Banning, *Airlines of Pan American since 1927*, p. 541.

Chapter Three: ICAO, IATA, and the Bermuda Agreement

Sovereign governments and airlines were not the only parties that had a hand in making the North Atlantic into the well-traveled flight corridor it is today. International organizations and bilateral agreements added the critical function of bridging the frequently conflicting interests of individual countries. Two organizations played instrumental roles in setting and managing the rules of flight throughout the world: the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA). ICAO, successor to the International Commission for Air Navigation (ICAN) that existed during the interwar era, is a forum for governments to coordinate their standards and practices for civil aviation, specifically designed to harmonize international flight standards to improve the safety and ease of air travel. Together with IATA, an airline association that regulated their operating procedures and international airfares, these two organizations crafted a robust international system to handle international flight. Some aspects of air travel remained outside the purview of ICAO and IATA. The Bermuda Agreement, a bilateral agreement between the United States and Britain, was created specifically to deal with the elements that the two organizations did not, with service capacity and fifth freedom traffic rights (see below) chief among them. The Agreement became the cornerstone for air travel over the decades that followed, both in the North Atlantic and around the world. Taken together, ICAO, IATA, and the Bermuda Agreement channeled aviation down a path that made it safer, more reliable, and more affordable than would otherwise have been the case, bringing transatlantic air travel to the masses.

The Chicago Conference and ICAO

The international aviation system as it existed in the interwar era was conceived with small, relatively slow planes in mind and was ill-suited to the needs of transatlantic flight in the postwar era. During the 1920s and 1930s European countries had established as series of agreements that enabled international travel to function smoothly through pooling arrangements, whereby airlines shared their revenues between both parties serving a given route.[1] The interwar European system was designed for the needs of Europe-wide flight, built around planes that had a range of just hundreds of kilometres, and was therefore inadequate for the needs of a truly global aviation system[2] but security concerns in the final years before the Second World War precluded action at that time. Civil aircraft were regularly being used for military training by several European countries, including surveillance flights over foreign territory, and the planes could be easily converted for military use in the event of war. Any improvement of the regulatory situation would have to wait until hostilities died down.

By the time the Second World War neared its end, the United Nations[3] invited its members as well as neutral countries[4] to Chicago for the International Civil Aviation Conference "to achieve the greatest amount of standardization in international air travel in an effort to make

[1] These pooling arrangements put an end to anti-competitive practices that were far more harmful to aviation, such as detaining flight crews or imposing fees to fly through airspace. Eda Kranakis, "The 'Good Miracle': Building a European Airspace Commons, 1919-1939," in *Cosmopolitan Commons: Sharing Resources and Risks across Borders*, ed. Nil Disco and Eda Kranakis (Cambridge, Mass.: The MIT press, 2013), p. 68-73.

[2] Alan P. Dobson, "Negotiating the EU-U.S. Open Aviation Area Agreement 2007 in the Context of Transatlantic Airline Regimes Since 1944," *Diplomacy & Statecraft* 20, no. 1 (March 2009), p. 138; David Clark MacKenzie, *ICAO: A History of the International Civil Aviation Organization* (Toronto: University of Toronto Press, 2010), p. 24-5; L. Gilles Sion, "Multilateral Air Transport Agreements Reconsidered: The Possibility of a Regional Agreement among North Atlantic States," *Virginia Journal of International Law* 22, no. 1 (Fall 1981), p. 155-6.

[3] The United Nations originally consisted of the Allied countries during the Second World War. As such, the body did not include any of the Axis countries or some of the neutral countries.

[4] Some countries joined the ICAO before they became UN members, including West Germany, Switzerland, Indonesia, South Korea, and Vietnam. John Cobb Cooper, "The Chicago Convention-After Twenty Years," *University of Miami Law Review* 19, no. 3 (Spring 1965), p. 333.

air travel as easy and safe as possible."[5] While the Soviet Union originally planned to participate, it abstained from both the Chicago Conference and the International Civil Aviation Organization (ICAO), the group created by the Conference to manage regulations pertinent to international flight, until 1970. Former Axis countries were permitted to join the ICAO a few years after the war ended: Italy in 1947, Japan in 1953, and Germany in 1956.[6] Freedom of operation and safety for the future of air travel were central concerns. If countries restricted access to their airspace or failed to come to some consensus on how to govern international air travel, commercial aviation would be crippled. As such, the preamble to the Chicago Convention, the final agreement struck at the Conference, encouraged participants to embrace reciprocity for the common good.[7] The new agreement was not totally comprehensive but outlined many common principles about air sovereignty and fair practices agreeable to the signatories.[8] A final agreement was signed on December 7, 1944, which established the Provisional International Civil Aviation Organization (precursor to the permanent organization pending ratification by 26 countries).[9]

Like the Paris Convention of 1919, the Chicago Conference of 1944 was mounted to plan out the future of international aviation with a common set of rules for all parties to abide by.[10]

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[5] MacKenzie, *ICAO*, p. 40.

[6] The Soviet government officially refused to attend the Chicago Convention only at the last minute as its representatives were about to depart for the talks. This refusal was officially a reaction to the inclusion of Spain, Portugal, and Switzerland at the conference, which the Soviets decried as pro-fascist regimes and whose participation tainted the proceedings. John C. Leslie, "International Air Transport Association: Some Historical Notes." *Journal of Interamerican Studies and World Affairs* 13, no. 3/4 (July-October 1971), p. 329; MacKenzie, *ICAO*, p. 25; Robert L. Thornton, *International Airlines and Politics: A Study in Adaptation to Change* (Ann Arbor: University of Michigan, 1970), p. 22.

[7] Edward McWhinney, "International Law and the Freedom of the Air - The Chicago Convention and the Future," *Rutgers-Camden Law Journal* 1, no. 2 (Fall 1969), p. 229-30.

[8] Cooper, "The Chicago Convention-After Twenty Years," p. 334-5.

[9] International Civil Aviation Organization, "International Air Transport Agreement Signed at Chicago on 7 December 1944." Retrieved from: http://www.icao.int/secretariat/legal/list%20of%20parties/transport_en.pdf (April 26, 2016).

[10] P.P.C. Haanappel, "Bilateral Air Transport Agreements," *International Trade Law Journal* 5, no. 2 (Spring-Summer 1980), p. 243-6.

Of the 54 delegations in attendance, the American and British delegations were the largest, each country bringing over thirty advisers, technical experts, and officials. All other delegations were much smaller; Canada's delegation was about half as large as the big two.[11] Britain and America held divergent, often incompatible viewpoints while "[t]he Canadian position throughout these talks was that of an intermediary attempting to bring the United States and United Kingdom into agreement."[12] Canada was the logical middleman between the Americans and British. No other country had such close ties to both the United States thanks to a long history of good relations, familiarity, and extensive trade links, and to Britain given imperial and family ties. With the level of animosity between the American and British delegations, which at times included personal attacks between the delegates and accusations of impropriety, the need for a neutral intermediary was indisputable.[13]

The Chicago Conference succeeded in that all contracting states agreed to a common set of operational standards and practices for civil aviation, building on the model and precedents of ICAN. These included a common set of aircraft registration guidelines,[14] the development and maintenance of infrastructure suitable to build and sustain air travel (airfields, radio and weather stations, navigational aids), the use of communication codes and signals understandable to all parties, and the sharing of maps and charts between all parties.[15] Also discussed at the Conference were the freedoms of the air, the core principles that permitted airlines to fly

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[11] Of the remainder, only the Canadian, Chinese, and French delegations exceeded fifteen people. MacKenzie, *ICAO*, p. 26-7.

[12] NARA RG 197, Box 79, Folder "UK" 1948. Bureau of Economic Regulation, Foreign Air Transport Division, "Postwar International Aviation Policies," November 9, 1948, p. 5.

[13] The British chief delegate, Lord Swinton, was a last-minute replacement for the man previously in charge of aviation talks in preparation for the Chicago Conference, Lord Beaverbrook. While the latter man had a good relationship with the American chief delegate, Adolf Berle, Swinton and Berle were at loggerheads throughout the talks. Canada's role in keeping talks from ending amid a petty squabble proved critical in light of the personality clash. MacKenzie, *ICAO*, p. 11-3.

[14] Joan H. Stacy, "International Civil Aviation Organization," *Journal of Air Law and Commerce* 16, no. 2 (Spring 1949), p. 222.

[15] Clinton V. Oster and John S. Strong, *Managing the Skies: Public Policy, Organization and Financing of Air Traffic Management* (Aldershot, England: Ashgate, 2007), p. 21-2.

passengers into and through foreign airspace. Such freedoms include: 1) to overfly another country without landing (innocent passage), 2) to land in another country for technical reasons without exchanging passengers or cargo, 3) to carry passengers from one's home country to another country, 4) to carry passengers from another country to one's home country, and 5) to bear passengers from another country into a third party country.[16] The freedoms of the air were accepted separately from the Convention itself. Only the first two freedoms, to overfly another country, and to land for technical reasons without exchanging passengers or cargo, were uncontroversial.[17]

The fifth freedom of the air, the right for an airline based in one country to carry passengers between two foreign countries, proved to be contentious as only the United States supported it unreservedly since it stood to benefit from it the most. The American delegation sought a compromise in the multilateral Chicago Convention that would only require acceding countries to accept the fifth freedom with reservations.[18] Even this limited compromise solution proved intractable since only the Americans favoured any multilateral agreement with fifth freedom rights. A multilateral agreement of this sort would have rendered bilateral air

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[16] Further freedoms extend from these basic five but are not recognized by official treaties; they are instead logical corollaries based on the five listed above. They are: 6) to transport passengers between two other countries with a stop in one's home country, 7) to operate a route between two countries that is not connected to one's home country in any way, 8) to operate a route entirely within another country with a connection to one's home country, and 9) to operate a route entirely within another country without any connection to one's home country. International Civil Aviation Organization, *Manual on the Regulation of International Air Transport* (Doc 9626, Part 4), retrieved from: http://www.icao.int/Pages/freedomsAir.aspx (November 12, 2014). For more on how cabotage was perceived by the governments and airlines both prior to and during the Chicago Convention, see: W.M. Sheehan, "Air Cabotage and the Chicago Convention," *Harvard Law Review* 63, no. 7 (May 1950), p. 1157-67.

[17] These two rights, the First and Second Freedoms of the Air, were contained in Article 5, paragraph 1 of the Chicago Convention. They did not absolutely assure that a foreign flight had the right to traverse all airspace (a country could still restrict regions of its airspace for safety reasons) but they did open up most of the skies. Nathan Calkins, Jr. "The Role of the Civil Aeronautics Board in the Grant of Operating Rights in Foreign Air Carriage," *Journal of Air Law and Commerce* 22, no. 3 (Summer 1955), p. 255.

[18] Most countries accepted the principle of fifth freedom air traffic but disagreed on high frequencies of such traffic, which the United States would obviously dominate for years following the war's end. Barry R. Diamond, "The Bermuda Agreement Revisited: A Look at the Past, Present and Future of Bilateral Air Transport Agreements," *Journal of Air Law and Commerce* 41 (1975), p. 441-2.

agreements effectively obsolete. All relevant provisions for air travel between parties to the multilateral agreement would have been spelled out in advance, committing participants to a new paradigm that they would be unable to easily renegotiate unilaterally. As such, few countries could countenance what amounted to a surrender of some of their sovereignty (exclusive control over their airspace, as understood since the Paris Convention in 1919) without greater guarantees that their interests would be represented.[19] The Americans were generally opposed to the idea of creating an independent multilateral agency to enforce such an agreement.[20] The American delegation was extremely displeased by the exclusion of what they considered vitally important traffic rights from the final Convention. Conversely, the British would not agree to an "escalator clause" proposed by the Canadians that the Americans considered to be the cornerstone of commercial flight, designed to keep traffic growth in line with demand on international routes.[21] The British delegation was adamantly opposed to what amounted to unregulated growth of fifth freedom traffic even if there was a (fairly high) ceiling, although it was willing to allow it for third and fourth freedom (direct passenger) traffic.[22]

Without broad agreement on the breadth and scope of fifth freedom rights, the delegates found it impossible to include the freedoms of the air as well as controls on rates or capacity in any final agreement. The International Air Services Transit Agreement (IASTA, allowing only the first two freedoms) and the International Air Transport Agreement (permitting all five

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[19] *Ibid*., p. 421-3.

[20] The American delegation opposed a multilateral agency since there were no guiding principles for such an agency at that time so its powers were almost totally undefined, and its decisions would not have legal backing and the protections that state actors could bring. Few countries, including the United States, were willing to turn over the level of sovereignty such an agency would need to function effectively. J.G. Gazdik, "Rate-Making and the IATA Traffic Conferences," *Journal of Air Law and Commerce* 16, no. 3 (Summer 1949), p. 307-8.

[21] The escalator clause would enable an airline to unilaterally offer more flights on a scheduled international service if passenger demand for the existing service was regularly higher than a predetermined capacity. It was essentially a flexible cap on traffic that reflected the expected growth in the aviation sector. MacKenzie, *ICAO*, p. 39.

[22] NARA RG 197, Box 79, Folder "UK" 1948. Bureau of Economic Regulation, Foreign Air Transport Division, "Postwar International Aviation Policies," November 9, 1948, p. 5-7; MacKenzie, *ICAO*, p. 39, 42-3.

freedoms, not to be confused with the International Air Transport Association, an airline group) were thus signed separately from the Chicago Convention.[23] IASTA was a fundamental part of civil aviation even if it was not part of the final Convention. Airlines that were party to IASTA gained a powerful tool for international operations. The British Overseas Airways Corporation (BOAC), Britain's primary international airline in the postwar era, was one such beneficiary. It was able to overfly a number of other signatory countries in its network of air routes, particularly throughout Asia and Africa where it held a vast patchwork of colonies. Airlines whose governments did not sign on to this found that their own growth was restricted.[24] The International Air Transport Agreement and IASTA, in contrast, were separate documents that any interested party could voluntarily sign onto.[25] When the final Convention was signed, just 26 countries actually signed on to IASTA[26] and 11 backed the International Air Transport Agreement.[27]

The Conference also settled on a location for the ICAO's international headquarters in Montreal. The decision to build the headquarters in Montreal stemmed partly from a recognition for the major role that the Canadian delegation played during the Chicago Conference and partly as a compromise location between the United States and Europe. Canada was seen by many at the Conference as a neutral location between the American and British/European camps, and was untouched by the ravages of war that would make a European city problematic for setting up such a major organization for several years.[28]

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[23] Ibid., p. 7.

[24] Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), p. 81.

[25] MacKenzie, *ICAO*, p. 47.

[26] *Ibid*., p. 51.

[27] International Civil Aviation Organization, "International Air Transport Agreement Signed at Chicago on 7 December 1944." Retrieved from: http://www.icao.int/secretariat/legal/list%20of%20parties/transport_en.pdf (April 26, 2016).

[28] MacKenzie, *ICAO*, p. 47-8.

But while the Chicago Conference was convened to address the issues noted above, it was also called to settle controls over how many international passenger flights would be acceptable and how often they could operate; their capacity and frequency. There was wide disagreement over how to regulate the number of flights between two countries to reach the fairest outcome. Some countries preferred to create a multilateral framework that would have transferred the authority to strike and modify air agreements from governments to an international authority. America was largely alone in wanting a highly liberalized and competitive market, with Britain leading the opposing camp that favoured greater airline protections. No agreement on those matters was reached and so the Conference concluded with the creation of a somewhat limited yet still widely functional system.[29]

The Convention on International Civil Aviation, the ICAO's constitution, entered into force on April 4, 1947 and reflected the limited power of the organization in light of what it was first conceived as. It sought to "promote the orderly, safe, and efficient development of international aviation". But the freedoms of the air were not technically tied to the ICAO, and the new organization lacked a number of important powers. Only those who had signed on to IASTA or the International Air Transport Agreement gained the additional rights that underpin easy international flight with other signatory states; when one or both countries were not members they had to strike bilateral agreements in much the same fashion as happened in the interwar years.[30] ICAO also did not handle the actual operation of the airlines, leaving that power to IATA, including the important role of regulating international airfares as discussed below. Additionally, something was needed to replace the multilateral agreement that was the

[29] Linda A. Mabry, "Bermuda 2: New Model for International Air Services Agreements," *Law and Policy in International Business* 9, (1977), p. 1260-1.

[30] Thomas Buergenthal, *Law-making in the International Civil Aviation Organization* (Syracuse: Syracuse University Press, 1969), p. 3-5.

original aim of the Chicago Conference. The Americans and British both recognized that while they vocally disagreed on what form travel between their countries ought to take, they had to strike a new bilateral agreement that would endure: the Bermuda Agreement. This influential air agreement settled many of the outstanding issues between the two and became the model for countries around the world, as noted below.

The International Air Transport Association

Many of civil aviation's more practical matters were not dealt with directly by the ICAO. In the interwar years, regulatory matters and common safety procedures were the purview of the ICAN, an intergovernmental body. But ticketing, flight timetables, best practices for carrying passengers and mail, and other such operational procedures were handled by another agency: the International Air Traffic Association,[31] formed at The Hague in 1919 by British, Dutch, German, and Scandinavian airlines. It grew to include most European airlines prior to the Second World War (Pan Am was the only non-European member and only joined in 1938). Its postwar successor, the International Air Transport Association (IATA), represented 92 airlines from 86 countries from around the world by 1970.[32] The decision to create IATA stemmed from informal talks begun at the Chicago Conference in 1944 and was founded by 61 airlines in Havana during April of 1945. Its headquarters were located in Montreal alongside the ICAO headquarters, rather than the former IATA's European locale. The selection of Montreal as the headquarters for ICAO was not without its share of debate: a large contingent of ICAO members were unhappy with the selection of a relatively remote location, and the Canadian dollar's strong postwar value made it expensive for many of the members to stay in the city. A movement

[31] Mahlon R. Straszheim, *The International Airline Industry* (Washington: Brookings Institution, 1969), p. 131.

[32] Leslie, "International Air Transport Association," p. 320-2.

emerged, principally among Latin American members, to relocate ICAO's headquarters elsewhere. This was mainly opposed by English-speaking countries who lobbied hard to keep the Montreal site and ultimately prevailed.[33] The IATA Charter mandates the organization to foster collaboration both directly between states and other organizations, as well as improving the quality and safety of flight for the general population.[34] Specifically, it was:

> (1) To promote safe, regular and economical air transport for the benefit of the world; to foster air commerce and to study the problems connected therewith; (2) To provide the means for collaboration among the air transport enterprises engaged directly or indirectly in international air transport services; (3) To cooperate with ICAO and other international organizations.[35]

Perhaps IATA's most important function was its role in setting international fares, a power that governments effectively delegated to the airlines that participate in IATA.[36] This authority was granted to IATA, in part, due to a rate dispute between Pan Am and its European competitors in 1945. When the American airline wished to cut its transatlantic rate to London from $375 to $275, the provoked British threatened to limit Pan Am to two flights per week on that route. The first flight that operated under that airfare thus had to stop at Shannon and could not continue on to London, as it lacked permission. Even America's own CAB sided with the British against Pan Am, effectively halting the airline's right to fly the route at the $275 rate.[37] Pan Am acquiesced and raised its rate to $375. The matter was not permanently resolved until the Bermuda Agreement of the following year. It effectively guaranteed that IATA would be in charge of airfares, which would be agreed upon by all concerned parties.[38]

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[33] MacKenzie, *ICAO*, p. 131-44.

[34] Leslie, "International Air Transport Association," p. 326-8.

[35] MacKenzie, *ICAO*, p. 63.

[36] NARA RG 237, Box 123, Folder 5800-2 "IATA", 1964. Civil Aeronautics Board, "Statement on Rates and Fares to be Negotiated by the IATA Traffic Conference at Athens – October 1964," October 7, 1964, p. 1.

[37] Gene Banning, *Airlines of Pan American since 1927: Its Airlines, its People, and its Aircraft.* R.E.G. Davies, ed. (McLean, Virginia: Paladwr Press, 2001), p. 543-4.

[38] Rates thereafter were set at Traffic Conferences (see below). Straszheim, *The International Airline Industry*, p. 131-2.

IATA was not designed to permanently keep rates high but rather to prevent a single actor from outcompeting other airlines, so gradual price cuts were always under consideration. The final settlement following the Bermuda Agreement, which cut the New York-London fare to $325 in 1946, marked the first of four important rounds of IATA rate reductions on the North Atlantic market over the following twenty years. The second and third of these were the introduction of tourist and economy rates in 1952 and 1958 respectively. Each one was an entirely new discount passenger class, discussed in greater detail in Chapter Ten. The fourth round of rate cuts came in 1964 following the disruptive rise of jet travel, as noted in Chapter Four.[39] By 1958 there were over 30,000 separate rates, each set for a single one of the multitude of international routes under IATA's umbrella, i.e. New York-London, New York-Paris, London-Montreal, etc. Concentrating decisions in a single body made up of the airlines affected by those rates simplified the decision-making process. If the matter had been left in the hands of state actors rather than IATA, the international air route marketplace could well have been far slower to react and adapt to airline needs.[40]

IATA's rate-setting role was often criticised for putting higher costs on passengers, and the organization itself was condemned as a cartel by free market supporters and by members of the United States government. The organization indeed fixed prices in a cartel-like fashion, but IATA defended this as necessity as the alternative was for governments to keep rates high through the slower process of bilateral agreements with inflexible price controls that risked

[39] In each of the four rate cuts, the CAB or Pan American sought greater price reductions than were actually implemented by IATA. Lucile Sheppard Keyes, "The Making of International Air Fares and the Prospects for Their Control," *Journal of Air Law and Commerce* 30, no. 2 (Spring 1964), p. 176-8.

[40] Fares were set at regular Traffic Conferences held as part of IATA General Meetings and votes had to be unanimous. All members were bound by the decisions, whether they were present or not: abstentions were counted as votes in favour of a rate under debate. Leonard Bebchick, "The International Air Transport Association and the Civil Aeronautics Board," *Journal of Air Law and Commerce* 25, no. 1 (Winter 1958), p. 8-10. For more on the challenges of setting up IATA's Traffic Conference system, see: Gazdik, "Rate-Making and the IATA Traffic Conferences," p. 298-322.

driving prices higher still without adapting to market forces at all.[41] IATA, in fact, technically violated American anti-trust laws by artificially fixing airfares. The American government permitted this by a special dispensation, technically granted to its airlines for as parties to IATA they were the relevant agents of the organization within the United States. Without this permission, international air travel would have come to a standstill.[42]

By 1967, IATA had a dominant place in air agreements struck worldwide. A majority of bilateral agreements explicitly referred to IATA when indicating their fares (872 out of 1,248 agreements in force worldwide).[43] As members of IATA, most major airlines on the North Atlantic did not engage in price competition on the North Atlantic run only charter services and smaller, non-IATA airlines stood outside of this pricing structure. The influential airlines that had joined IATA often had their governments refuse access to the non-IATA carriers or limit them to unfavourable routes to diminish their ability to undercut the price regime. This left a small but lucrative market for those carriers bold enough to pursue it, notably Loftleidir and its service between North America and Luxembourg as discussed in Chapter Ten.[44] Despite its dominance in regulating airfares, IATA's price-setting role declined. The United States vigorously pushed for airline deregulation following the oil shocks of the 1970s to keep their airlines afloat economically. Other countries followed suit to keep their own airlines

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[41] Nils Petter Gleditsch, "Towards a Multilateral Aviation Treaty," *Journal of Peace Research* 14, no. 3 (1977), p. 248-9, 395-6. In the interest of making international air travel fairer towards the developing world, Gleditsch argued that transferring power from IATA, which he claimed was strongly influenced by Western countries and airlines, to ICAO was a sensible option. ICAO was an intergovernmental agency with wider membership and could, he claimed, bring about more equitable agreements for all.

[42] In the latter 1970s, the American government removed some of IATA's protections. This threatened to bring an end to the international air travel system had other countries not reached a new agreement quickly. Duncan Campbell-Smith, *The British Airways Story: Struggle for Take-off* (Sevenoaks: Coronet, 1986), p. 38-9.

[43] McWhinney, "International Law and the Freedom of the Air," p. 239-40.

[44] Paul Stephen Dempsey, "The International Rate and Route Revolution in North Atlantic Passenger Transportation," *Columbia Journal of Transnational Law* 17, no. 3 (1978), p. 397-9.

competitive.[45] Thereafter, airlines increasingly set fares on a bilateral basis for international routes. This cut IATA out of the rate-setting process: only the approval of national governments was necessary in many cases, and sometimes even this was not required. The airfare system had matured to the point where IATA was no longer considered indispensable for price control mechanisms.[46]

While IATA's power over airfares captured much attention during the mid-twentieth century, that was not its only function. Seemingly trivial items also fell under its mandate. Comfort-related aspects of flights were more or less standardized: meal services, seat sizes, luggage allowances, movie screenings, and many more.[47] IATA even licensed travel agents without which they could not receive a commission for ticket sales on an IATA airline.[48] This power emerged as a complementary regulatory role to price setting. Most European airlines could not compete with the extensiveness of American airlines' world-spanning route networks but could instead offer luxuries and creature comforts to draw passengers seeking premium service. America's airlines objected to IATA. Giving passengers a premium experience, they argued, violated the principles enshrined in the common fare structure. European airlines charged the commonly agreed fares, but ran tourist services with more legroom than American airlines, gave away luxuries like champagne, flowers, or gourmet meals, and skirted the spirit of the fare agreements. The CAB argued that if everyone had to abide by European fare requirements, then the Europeans ought to offer similar quality of experience for that fare

[45] Walter R. Kendall and Charles Jordan, "Fare and Income Elasticities in the North Atlantic Air Travel Market: Economic and Policy Implications," *Transportation Journal* 28, no. 4 (Summer 1989), p. 35; George R. Thompkins, Jr. "The North Atlantic – Competition or Confrontation: The Potential Impact of United States Antitrust Law on International Air Transportation," *Air Law* 7, no. 1 (1982), p. 49-50.

[46] Mark Ashworth and Peter Forsythe. *Civil Aviation Policy and the Privatisation of British Airways* (London: Institute for Fiscal Studies, 1984), p. 30-1.

[47] Andreas F. Lowenfeld, "A New Takeoff for International Air Transport," *Foreign Affairs* 54, no. 1 (October 1975), p. 39.

[48] Stephen F. Witt, Michael Z. Brooke, and Peter J. Buckley. *The Management of International Tourism* (New York: Routledge, 1995), p. 30-2.

especially so for lower-rate ticket prices.[49] America's airlines fought to keep the quality of the passenger experience at a common level through IATA negotiations.[50] Maintaining a common quality of passenger experience kept wealthier airlines, which had to charge the same rate under IATA guidelines, from exploiting their financial advantage in other ways to attract passengers at the expense of airlines that could not afford to offer the same luxuries.[51]

IATA's authority to regulate such diverse elements of commercial air travel would have been impossible to sustain without a powerful safeguard against abuse. Without some mechanism to prevent an independent-minded airline like Pan Am from protecting its basic interests, the club risked disintegrating after any contentious decision. Unanimity was therefore a critical component of IATA's machinery. Every member airline possessed a veto over rule changes to protect both its own interests and the interests of the country it represented. Pan Am, the chief American airline in the postwar era, used this power when it came to transatlantic route regulations. Unlike most other airlines, Pan Am stood alone in pushing changes to cut rates and tariffs i.e. eliminating a $25 surcharge on sleeper berths for North Atlantic flights that other countries were forced to accept. The British expressed concerns about the veto power. They pointed to Pan Am using excessively legalistic interpretations of rules to undermine IATA and

[49] European airlines consistently pressed for higher rates on transatlantic routes than the American airlines preferred. Although the actual operating cost for the flights was (debatably) lower than the rates European airlines fought for, this did not account for additional hidden costs such as the imbalance of passenger traffic towards North America (due to immigration) and from infrastructure costs typically borne by governments on domestic services. Bebchick, "The International Air Transport Association and the Civil Aeronautics Board," p. 28-31.

[50] TWA incidentally ran afoul of these rules when it introduced movies in its cabins in 1961. TWA saw its passenger numbers climb by about 50% over the following two years while the other airlines on the North Atlantic runs saw much smaller gains. When other airlines complained that showing movies drew passengers from their services but did not attract new passengers, IATA agreed in 1964 to prohibit movies for transatlantic operations. John Lewis McGoldrick, "Regulation of Service Competition in International Air Travel," *Harvard International Law Journal* 8, no. 1 (Winter 1967), p. 96-8.

[51] Lowenfeld, "A New Takeoff for International Air Transport," p. 39.

reduce rates, but could do nothing to prevent it.[52] For some airlines, primarily those offering charter services, it was worthwhile to remain outside IATA altogether as they could take advantage of the lower rates they could then charge or distinct services they could offer provided that their passengers were willing to accept the restrictions on where they could fly. Since IATA membership was voluntary, this was a viable option for an airline that might offer discount airfares in exchange for limited services (i.e. no meal service, smaller baggage weight restrictions) or fewer destination choices (fewer airports will serve an airline that is not an IATA member).[53]

Transatlantic air travel shaped and was shaped by IATA. As noted below, a rate dispute between the British and Americans on the North Atlantic enshrined IATA's rate-setting powers for decades. This brought the United States and its biggest international carrier, Pan Am, into the international fold. By lumping the interests of all big transatlantic nations' airlines into a single group, IATA gained greater legitimacy to settle disputes between any of its members globally. Furthermore, with IATA's close control over the quality of passenger experience and fares, airlines that wished to offer better deals for passengers were forced to seek out the newest, fastest planes instead of offering incremental improvements in comfort, driving the aerospace sector. And while its price controls kept air travel artificially high, slowing the natural growth in the transatlantic passenger market, those controls reassured the Europeans enough that they did not close the door to the competitive American airlines. With ICAO regulating the rules for international flight and IATA setting the operating standards for the airlines, one important factor also had to be addressed: the right to fly freely across the North Atlantic. Air agreements already

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[52] NARA RG 197, Box 80, Folder "United Kingdom-U.S. Negotiations V," January 1949-December 1949. Vice Chairman of the Civil Aeronautics Board Oswald Ryan, "Report on the United States-United Kingdom Discussions Held in London August 18-25, 1949," September 20, 1949, p. 12-3.

[53] Craig M.J. Allely, "Laker Airways v. Sabena: Comity and Conflict," *Law and Policy in International Business* 17, no. 1 (1985), p. 158-9.

covered the basic permission but no existing agreement offered sufficient flight frequency to match the needs of commercial airlines in the burgeoning new market. This was what the Bermuda Agreement was designed to deal with.

The Bermuda Agreement

The Bermuda Agreement was a compromise agreement between the Americans and British. Its primary aim, and arguably its most important resolution[54], was to settle their dispute over how to regulate the number of flights between their two countries. America wanted to fly enough planes to satisfy the passenger demand while Britain, who lacked the planes to compete with America on volume of air service, wanted a cap that could protect its aviation sector. The Bermuda Agreement became necessary after the Chicago Convention failed to produce the planned multilateral agreement that would have put such things as airline frequency under international control. But it was Pan American's regular postwar service to London that set Britain and American on a path to the Agreement.[55] This service began on October 20, 1945, and was carried out under the restrictive flight frequency limits established by the original 1936 Anglo-American air agreement, which was supposed to be in force until 1951. It was signed in anticipation of transatlantic flight since no aircraft capable of such service existed at that time, which explains how the agreement failed to appreciate how rapidly the route would expand. The terms of this prewar arrangement limited Pan Am to two flights per week into London pending Britain's ability to operate services more frequently on the same route. As BOAC lacked the resources for more than two flights per week the American carrier was limited to the same

[54] The importance of resolving the capacity problems between Britain and America had a far-reaching impact on civil aviation in both countries and around the world. A significant number of future agreements were based on the structure set down here. Diamond, "The Bermuda Agreement Revisited," p. 419-20.

[55] "USA: P.A.A. service transatlantiques," *Interavia* no. 1076, November 8, 1945, p. 6.

frequency. By 1945, Pan Am had continuously offered some transatlantic service, primarily in support of the war effort, for six years and had recently added landplanes to the transatlantic fleet. BOAC could only offer transatlantic flights on flying boats and lacked the capacity to expand beyond the two flights per week it operated through Bermuda between Poole and Baltimore.[56]

But the United States exerted a great deal of indirect pressure on the British to come to a new understanding. America struck a series of bilateral air agreements with European countries between 1944 and 1946: Spain, Sweden, Denmark, Iceland, Ireland, Norway, Portugal, Czechoslovakia, and Turkey all agreed to let American planes fly into their airports as often as they chose, setting a precedent for the Bermuda Agreement's liberal traffic caps. Fifth freedom permission was included in all of those agreements and opened the door to many new European destinations for American air carriers.[57] The situation weakened the British position. With the United States already building a widespread air network through Europe, the British risked losing their influence over future air agreements both with the American government as well as within Europe. Compounding the British woes, Britain was also in desperate need of American loans in 1945, totalling $3.75 billion, which gave the United States considerable leverage over the British during bilateral talks late in 1945.[58] Of further concern, Pan Am unilaterally decided to cut rates to London in 1945 (although this was reversed under pressure from the British and the CAB; see Chapter Nine). Had the price drop been permitted, this would have made BOAC highly uncompetitive on the London-New York route. Since Britain set airfares at the governmental level, the British state handled the dispute rather than BOAC. The United States

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[56] *Ibid*.

[57] Jacqueline Dutheil de la Rochère, *La Politique des États-Unis en matière d'aviation civile international* (Doctorate Thesis: Université de Paris, 1971), p. 67-8.

[58] David Clark MacKenzie, "The Bermuda Conference and Anglo-American Relations at the End of the Second World War," *The Journal of Transport History* 12, no. 1 (March 1991), p. 65-6.

government, by contrast, left the determination of airfares to its airlines. It became involved with these negotiations because bilateral agreements were handled at the state level.[59]

Both the United States and Britain recognized that the situation was untenable in the long term, yet they were unable to come to a suitable settlement. In late 1945, representatives from both governments began talks to create a better, permanent arrangement. The British made it clear that they had no objections in theory to unlimited third and fourth freedom air traffic between their countries as long as it was granted on a reciprocal basis. Unrestricted American fifth freedom traffic, on the other hand, through London and on to points throughout Europe, posed a serious problem: each passenger that boarded an American flight in London to fly into Europe was a passenger essentially poached from Britain's airlines.[60] Fare controls were another concern for the British. They feared that subsidies and price wars might devastate revenues unless there was some protection against a unilateral price drop, as Pan Am had recently sought to do.[61] British Air Ministry's Director-General of Civil Aviation Sir William Hildred and Livingston Satterthwaite, the American Embassy's civil aviation attaché in London, shared the belief that IATA and America's CAB should reach agreements on fair transatlantic rates, which would ease British capacity concerns. By including IATA, which represented airlines from Europe as well as the United States and was bound by unanimous votes on changing fares, the settlement theoretically would be a safeguard against future unilateral rate changes. British views on rate controls were shared by countries throughout Europe, strengthening Britain's position. If America cut its international air rates unilaterally no European country could

[59] Haanappel, "Bilateral Air Transport Agreements," p. 247-8.

[60] John C. McCarroll, "The Bermuda Capacity Clauses in the Jet Age," *Journal of Air Law and Commerce* 29, no. 2 (Spring 1963), p. 120-2.

[61] NARA RG 197, Box 79, Folder "United Kingdom-U.S. Negotiations," 1937-1945. Paraphrase of telegram from the American Embassy in London to the Secretary of State, No. 12442, November 28, 1945. In the final Bermuda Agreement, third and fourth freedom traffic was indeed allowed to operate freely. Fifth freedom traffic was the big sticking point and remained regulated, albeit permitted in the Agreement. McCarroll, "The Bermuda Capacity Clauses in the Jet Age," p. 118-20.

compete with it, which would have forced all other countries to heavily subsidize their airlines. Other European countries, notably France, were less focused on running their airlines for commercial gain than America or even Britain, but nevertheless did not wish to spend additional monies supporting their flag carriers.[62]

In 1946, the United States and Britain met in Bermuda and struck a new bilateral air agreement covering all flight between their countries and territories under their control: the Bermuda Agreement.[63] This treaty[64] became the model for the majority of bilateral air agreements that followed.[65] Both governments went so far as to publicly advocate that the Agreement should serve as the basis for all of their future bilateral agreements. Part of the reason that both the Americans and British were so enthusiastic about the Bermuda Agreement was that it included fifth freedom rights but held them to be no more than half of all relevant air traffic, reserving the majority of traffic to direct flights between the two contracting states (third and fourth freedom traffic), which most states preferred to emphasize.[66] It enumerated many technical details including which airlines were to fly the route,[67] cut down on frequency

[62] NARA RG 197, Box 79, Folder "United Kingdom-U.S. Negotiations," 1937-1945. Paraphrase of telegram from the American Embassy in London to the Secretary of State, No. 12442, November 28, 1945.

[63] Officially titled: Final Act of the Civil Aviation Conference, held at Bermuda, 15th January to 11th February, 1946, and Agreement between the Government of the United Kingdom and the Government of the United States of America relating to Air Services between their Respective Territories.

[64] Technically, the United States was not striking a treaty but rather an executive agreement, as it had done with all previous bilateral air agreements. This simplified the process of creating and modifying the terms of the agreement since it did not require congressional involvement in each step. They are "politically binding" but not strictly "legally binding", so the scope of executive agreements will be narrower than full-fledged treaties. This is still sufficient for air services and so is the general American practice. Albert W. Stoffel, "American Bilateral Air Transport Agreements on the Threshold of the Jet Transport Age," *Journal of Air Law and Commerce* 26, no. 2 (Spring 1959), p. 123.

[65] Christer Jönsson, "Sphere of Flying: The Politics of International Aviation," *International Organization* 35, no. 2 (Spring 1981), p. 282; Mabry, "Bermuda 2," p. 1259; McGoldrick, "Regulation of Service Competition in International Air Travel," p. 88.

[66] H.A. Wassenbergh, *Post-war International Civil Aviation Policy and the Law of the Air* (The Hague: M. Nijhoff, 1962), p. 17-8.

[67] Lowenfeld, "A New Takeoff for International Air Transport," p. 38.

controls,[68] spelled out a system to manage fare rates, designated stopping points, and enshrined the five freedoms of the air.[69] The Agreement's chief success, according to Barry R. Diamond, was getting Americans to accept airfare regulations in exchange for the British acceptance of limited regulation on flight frequencies.[70] The flexible, liberal-minded approach to settling route frequency was the cornerstone of the Agreement as it enabled each country to operate a "reasonable" number of flights as long as there was sufficient, provable demand for it. The Agreement's workability relied upon both contracting parties willingly abiding by all terms of the text since there was little to prevent one party from imposing some indirect form of frequency controls (i.e. limiting available airports or gates at those airports for scheduled flights) except for good faith.[71] The Agreement's very "vagueness" made it highly useful in bringing both sides to a final settlement. It was only as detailed as it had to be to satisfy both parties, leaving a sufficient framework that it could resolve most outstanding disputes without tying actual air operations with a rigid operating structure.[72]

The Bermuda Agreement favoured America first and foremost. It received access to many points around the world through the British territories included in the Agreement. Britain acquiesced to the terms of the Agreement in part since it needed American funds for

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[68] Britain abandoned its requirement for both strict frequency limits as well as implementation of a formula to determine the appropriate number of flights, instead agreeing to flexible conditions including a "close relationship" between capacity and traffic demands, that each country's airlines would have "a fair and equal opportunity" to carry passengers on all routes, and due consideration of the traffic needs of both countries. NARA RG 197, Box 79, Folder "UK" 1948. Bureau of Economic Regulation, Foreign Air Transport Division, "Postwar International Aviation Policies," November 9, 1948, p. 15-7; MacKenzie, "The Bermuda Conference and Anglo-American Relations," p. 67.

[69] Fifth freedom traffic rights, previously a stumbling block, were allowed provided that the operating country demonstrated a clear need for the service from their own country to the final destination. *Ibid*.

[70] Diamond, "The Bermuda Agreement Revisited," p. 444-5; McCarroll, "The Bermuda Capacity Clauses in the Jet Age," p. 115-6.

[71] While there were provisions for *ex post facto* capacity review, any party could still have unilaterally pulled out of a Bermuda-style Agreement if it felt aggrieved. Good faith in the relationship with the other contracting party was at least as important as the terms of the Agreement. Wassenbergh, *Post-war International Civil Aviation Policy*, p. 58-61.

[72] Isabella Henrietta Philepina Diederiks-Verschoor, *An introduction to air law*. (Boston: Kluwer Law and Taxation Publishers, 1985), p. 40-2.

reconstruction, American planes to build strong airlines, and American tourists that would bring hard currency.[73] The terms of the deal were similarly lopsided. America convinced Britain to forego opposition to fifth freedom rights, to adopt limited capacity and frequency controls, grant change of gauge rights,[74] and to accept a weak international authority for oversight. America only had to agree to allow IATA control over fares (which it was willing to do already), and an *ex post facto* mechanism to review disputes about flight frequencies (numbers of flights per week).[75] Reflective of their lukewarm acceptance of the treaty, the British government did not intend to apply Bermuda principles to all of its future air agreements. Indeed, the British implicitly did not wish to see America conclude Bermuda Agreement-type deals with other European countries. Britain's view of transatlantic air traffic into Europe stood in opposition to America's and even those of other European countries, any of which might supplant Britain's place as the main entry point for North American flights into Europe. In the British government's ideal scenario, London would act as the gateway to flights throughout the continent; to the Americans, London was merely a single point of entry among many.[76]

Britain anticipated a future where BOAC would match American competition, as did other European countries that struck Bermuda-style air agreements with the United States. The prospects for European growth were good on paper for Americans accounted for 2/3 of transatlantic air passengers in the 1940s in part because of depressed European demand for air

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[73] Tourists did not amount to a significant volume for some years thereafter but the principle of tourist travel (and tourist spending) to Britain was a big concern. Dobson, "Negotiating the EU-U.S.," p. 138-9; Lowenfeld, "A New Takeoff for International Air Transport," p. 38.

[74] Change of gauge rights allow passengers flying into another country to catch a connecting flight to their final destination could transfer onto a second plane to complete their trip without additional fees or tickets.

[75] MacKenzie, "The Bermuda Conference and Anglo-American Relations," p. 71.

[76] This telegram noted that air routes between the United States and other European destinations (extant and forthcoming) were "circular": they entailed stops in various cities around the continent, not strictly through one city (or several). These routes might lead to a network of further routes such that a passenger might enter Europe through London but depart on a flight back to North America through an entirely different route that created a rough loop across the continent. NARA RG 197, Box 79, Folder "UK" July-December 1946. Telegram from Satterthwaite to the Secretary of State, No. 7951, September 5, 1946.

travel following the war. Once European peoples rebuilt their wealth, their governments reasoned, they would fly on their rebuilt national carriers.[77] In 1950, BOAC expected its share of bilateral passenger traffic to increase to parity with the United States by 1956, thanks to the Bermuda Agreement (and also with Canada on its London-Montreal route). The introduction of the de Havilland Comets, the first commercial passenger jet, coupled with a dedicated marketing and advertising campaign by BOAC in the United States, was anticipated to offer a solid competitive advantage once they entered service in 1954. The expectation that these two elements alone would lift BOAC into a stronger position was an aspiration rather than a carefully studied prediction. It relied upon the Comet's success to boost its passenger share, but the plane's failure amid several spectacular crashes put paid to that hope. Britain was also not nearly as desirable a travel destination as the United States, or the rest of Europe (in aggregate), which undercut the potential for tourism to drive growth as fast as the airline hoped. A more modest transatlantic passenger growth rate of about 10% annually into Britain between 1950 and 1955 was still reasonable despite those shortcomings.[78]

By 1955, however, some European countries that had concluded Bermuda-style agreements with the United States including Britain, France, and Italy, privately voiced their concerns about the treaty format's shortcomings. In their view, America gained an undue advantage in passenger-transport capacity thanks to Bermuda Agreement provisions.[79] A CAB

[77] Contemporary analysts on both sides of the Atlantic assumed that the people of Europe would preferentially seek to fly on their country's national airline, which was in fact the case. Lowenfeld, "A New Takeoff for International Air Transport," p. 40.

[78] The memo did recognize the importance of the North Atlantic for civil aviation: it was the busiest international route for shipping and stood to handle a huge amount of air travel. British Airways Heritage Centre, AW/1/6172, Part 12 "Atlantic Services, Services, July-Dec 1950." BOAC memo from J.W.S. Brancker, General Manager Commercial, to Members of Management Panel, "North Atlantic Policy 1950/56," December 15, 1950.

[79] Italy specifically complained in 1954 that Pan Am and TWA enjoyed excess traffic on their Paris-Rome service. As a result of consultations between the United States and Italy, both airlines cut two flights per week on the run, thus reducing their service from 38 to 34 weekly flights. NARA RG 197, Box 37, Folder "Germany," July

report in 1955 concluded that, outside of the Netherlands and Scandinavia, every European country with a bilateral flight agreement with the United States operated substantially fewer flights to the United States than America flew to their country; anywhere between half as many for Switzerland to barely an eighth in West Germany (although Lufthansa had just returned to service in 1955).[80] CAB revenue statistics largely mirrored this finding. America earned three times as much as Britain did through flights between their two countries in 1955: $50.6 million to $17.7 million. West Germany ($23.9 million to $2.1 million) and Italy ($18.0 million to $4.3 million) earned a disproportionately small share compared to their potential in later years, but both countries had just begun to rebuild their national airlines in 1955. Other countries presented less dramatic examples that substantiated this trend. France, for example, earned $16.4 million to America's $24.0 million. Among European airlines with transatlantic services, only those from the Netherlands, Scandinavia, and Switzerland managed to bring in more than the United States did, in part since they were smaller countries peripheral to the major European route networks. Foreign airlines flew fewer services through their big population centres so their airlines, KLM, SAS, and Swissair, lost fewer passengers to fifth freedom traffic.[81] While the

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1955. Civil Aeronautics Board, "Report to the Senate Committee on Interstate and Foreign Commerce Concerning the United States-West Germany Air Transport Agreement," July 22, 1955, p. 19-22.

[80] Most of the countries lagged the United States by roughly two flights per week to one: UK 52 to 18, France 42 to 13, Scandinavia 5 to 23, Germany 44 to 6, the Netherlands 9 to 21, Italy 38 to 6, Spain 8 to 3, and Switzerland 14 to 7. NARA RG 197, Box 37, Folder "Germany," July 1955. Civil Aeronautics Board, "Report to the Senate Committee on Interstate and Foreign Commerce Concerning the United States-West Germany Air Transport Agreement," July 22, 1955, p. 23.

[81] Switzerland earned $6,792,328 compared to the $3,011,506 American made from their bilateral air services. The Netherlands ($15,209,171) and Scandinavia ($15,114,850) both made large sums considering that the United States did not in turn make over $2.2 million from air service to their countries (the information provided only listed the top 25 countries by revenue provided to and received from the United States, so the precise amounts for those two are not provided except that they were each less than the $2,202,937 that 25th place Turkey paid the United States). NARA RG 197, Box 84, Folder "UK 1956: International Aviation Policy Review," November 14-16, 1956. Tab 8, "Economic Benefits Exchanged, in order of Magnitude, with Selected Countries, Under Air Transport Agreements between the United States and Foreign Governments and Under Statutory Authority," 1955.

United States offered European carriers reciprocal fifth freedom service, the monetary balance usually remained in America's favour.[82]

The Bermuda Agreement's shortcomings frustrated the British government and BOAC as the market evolved and new aircraft technologies entered service. When the original agreement was struck "the route pattern originally worked out was geared to short-range piston-engined aircraft."[83] BOAC expanded considerably between 1946 and 1957 and its fleet of large planes let far more passengers travel farther in a single aircraft than ever before, straining the limits of the growth anticipated in the original Bermuda Agreement.[84] Compounding the Bermuda Agreement's oversights, non-government travelers accounted for a negligible share of transatlantic air passengers when the Bermuda Agreement was struck. According to TWA, "travel between the United States and Europe [was] largely governmental or emergency in character; it was 'forced' travel."[85] Average people could not afford regular air travel, whereas those who traveled for work had that expense covered.[86]

The changing character of international flight bothered American and British airlines. TWA argued that flights in 1946 were point-to-point and so did not reflect the needs of air travel by 1956, after tourist travel had overtaken government and business trips by passenger volume. Bermuda restrictions on fifth freedom traffic meant that TWA often had to turn over its

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[82] Only the Netherlands ($10,194,663), Scandinavia ($6,889,079), Belgium ($4,700,938), France ($3,749,800), and Iceland ($1,360,403) earned more from fifth freedom traffic through the United States than America's airlines did through their countries in 1955. Britain ($6,676,856) lost the largest amount to the United States among European countries if Germany ($10,254,076), whose airline only returned to the skies in 1955, was ignored. Italy ($5,144,028) was in a similar position to Germany. NARA RG 197, Box 84, Folder "UK 1956: International Aviation Policy Review," November 14-16, 1956. Tab 8, "A Comparison of Fifth Freedom Economic Benefits Exchanged with Selected Countries under Air Transport Agreements between the United States and Foreign Governments and under Statutory Authority," 1955.

[83] "Civil Air Pact Review: Anglo-American Talks Soon," *The Times*, January 2, 1957.

[84] *Ibid*.

[85] NARA RG 197, Box 83, Folder "United Kingdom-U.S. Negotiations XI," January 1956-April 30, 1956. Information sheet from Trans World Airlines to the United States Delegation (US/UK Conference), "TWA Objective in these Negotiations," March 4, 1956.

[86] Air travel was primarily the preserve of government officials and businessmen in the 1940s. Even at that time, however, air travel was a luxury reserved for the most pressing government and business matters. *Ibid*.

passengers to other airlines, principally to British European Airways (BEA) in London, upon arrival in Europe. BEA even advertised within the United States that it operated 50 flights per day from London into continental Europe. TWA thus pressed the American government to seek a loosening of the terms of the Bermuda Agreement as it wished to expand its existing right to fly through London on to Frankfurt to serve points farther east. TWA hoped that expanding its route network eastward would let it retain its predominantly American passengers, who typically visited at least four countries during their time in Europe.[87] With both British and American airlines seeking alterations to the Bermuda Agreement, a series of bilateral Anglo-American talks in 1957 led to a conference designed to address the problems[88] but the British delegation proved unwilling to grant the American airlines any further concessions and the conference ended without any action.[89]

Fundamental weaknesses in the Bermuda Agreement were widely noted. Other countries, both in Europe and around the world, chafed under the terms of their Bermuda-styled bilateral agreements with the United States. By the late 1950s onwards, smaller countries, as noted above, often found themselves in an uncompetitive position with respect to commercial airline operations. This was especially true when their airline was relatively new compared to the big established airlines flying out of the United States. Many small carriers sought government protection or subsidies to survive.[90] Ironically, the American carriers also became victims of competition fostered by the Bermuda Agreement. As some of the bigger international carriers became truly competitive on the global market, they carried ever larger shares of fifth

[87] TWA included statistics showing that 70% of all transatlantic passengers in 1954 were Americans, and that 96% of TWA's own transatlantic passengers were American during the busy season (down to 89% in the off-season). *Ibid*.

[88] "Civil air pact review: Anglo-American talks soon," *The Times*, January 2, 1957.

[89] "Why air route talks failed: Concessions too great for U.K.," *The Times*, July 2, 1957, p. 3.

[90] Nawal K. Taneja, *Airline Planning: Corporate, Financial, and Marketing* (Lexington, MA: Lexington Books, 1982), p. 111-3.

and sixth freedom traffic through the United States itself. The American airlines turned to their government to restrict the foreign operations in response to the threat facing their dominant position.[91]

For all of the European complaints about the Bermuda Agreement favouring the United States, American dominance in the North Atlantic marketplace was relative. After the mid-1950s its airlines no longer had an outright majority of North Atlantic commercial flights and their share dropped further still over the years that followed. According to IATA statistics, American airlines declined from a 68.1% share of scheduled North America-Europe commercial flights in 1948 to 39.8% in 1960 (they last had an absolute majority of 52.4% in 1956). Those numbers do not include unscheduled charter flights or scheduled non-IATA flights (such as those by Icelandic), which would further reduce the American share. The decline was not unique to the North Atlantic but reflected a broader trend: international flights to and from the United States were being operated in ever greater numbers by non-American carriers during the 1950s.[92] The United States had some intrinsic qualities that gave the country a big edge over its competitors early on. In 1937-8, when ships were the only transatlantic travel option, an average of four Americans visited a foreign country for each visitor that traveled to America in return. It was an incomparable source of tourists that acted as a driver for aviation by the mid-1950s.[93] The British stood to gain by attracting this large market, particularly in a few places. By 1945, fully 99% of American tourists who traveled somewhere within the British Empire visited the United Kingdom, Bermuda, or the British West Indies (this figure excluded the Dominions:

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[91] *Ibid*.

[92] Oliver J. Lissitzyn, "The Participation of the United States in World Air Transport: Statistics and the National Interest," *Journal of Air Law and Commerce* 28, no. 1 (Winter 1961-1962), p. 1-4.

[93] NARA RG 197, Box 79, Folder "United Kingdom-U.S. Negotiations II," January-December 1946. Civil Aeronautics Board Analyses Division Chief F.H. Crozier, "Reciprocal Air Transport Rights United States-British Empire," January 11, 1946.

Canada, Newfoundland, Australia, New Zealand, and South Africa). These were the easiest destinations for the American tourist to reach within the Empire whether by sea or, increasingly, by air. As long as the British were more interested in attracting paying tourists than in having them use a British airline, it was well worthwhile to cultivate that market. Happy Americans with money to spend might well return to a place they enjoyed.[94]

Similarly, the United States had big airlines not because it unfairly imposed Bermuda Agreement-style deals on other countries but because it had many prospective passengers within its borders. As Americans in the 1940s and 1950s were on average the wealthiest people in the world, they were the nationality most likely to travel across the Atlantic, especially compared to citizens in still-recovering Europe. And while American airlines flew fewer than half of all flights across the North Atlantic, their planes had a higher load factor than their foreign competitors. Pan Am, TWA, and Americas various charter services carried 58% of transatlantic passenger traffic in 1964.[95] It is important to note that TWA and Pan Am accounted for only 38% of all transatlantic passenger traffic in the mid-1970s despite their disproportionate dominance in Britain. Some smaller European countries managed to retain a large relative market share. The national carriers of Belgium, the Netherlands, and Switzerland each carried up to 90% of the passengers flying between their country and North America.[96] This trend was bolstered by the desire among many European expatriates living in America to fly on the national carrier of their homeland.[97]

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[94] Of those three destinations, the United Kingdom received three Americans for each Briton traveling to the United States, while Bermuda and the British West Indies were dominated by Americans (93% of all bilateral traffic). *Ibid*.

[95] The 58% figure is closely in line with the total number of people who traveled to or from the United States on an American craft of some sort, which was about 60% for all land, sea, and air vessels. McGoldrick, "Regulation of Service Competition in International Air Travel," p. 81-3.

[96] Mabry, "Bermuda 2," p. 1269.

[97] McGoldrick, "Regulation of Service Competition in International Air Travel," p. 83.

While the terms of the Bermuda Agreement did not call for an equal, reciprocal number of flights between the contracting parties, leaving it to the airlines to determine capacity and frequency,[98] it created a mechanism for either party to assert its right to expect a fair share of traffic into the other country through *ex post facto* review. In fact, Bermuda Agreement protocols contained no predetermined limit on the number of flights permitted on a given route. This was true both for flight into and through the partner country (referring to fifth freedom traffic).[99] The Agreement even allowed for change of gauge rights whereby passengers transfer to another plane to complete a trip though the second plane had to be smaller than the one that carried the passengers across the Atlantic. The second plane could carry additional passengers if there was room for them.[100] Each airline was permitted to use as many planes on a route as passenger demand justified but no more than that. If the other airline participating on a particular route felt that it was being denied a reasonable amount of passenger traffic, it could appeal to a higher authority to rectify the situation (as discussed below).[101] In effect, no airline could cut into the market of another airline without running the risk of invoking some punitive remedial action. The Bermuda Agreement created a managed market rather than a free market.[102]

The interpretation and implementation of the Bermuda Agreement's review mechanisms could be complicated. In one case in 1955, the British grew concerned about America's CAB

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[98] Jönsson, "Sphere of Flying," p. 282.

[99] Details such as flight frequency could be dealt with bilaterally at any time, of course, but this was not a prerequisite of Bermuda-style agreements. David Clark MacKenzie, *Canada and International Civil Aviation 1932-1948* (Toronto: University of Toronto Press, 1989), p. 235-6.

[100] Passengers might change planes as part of a trip that did not have the same capacity needs of the first leg. For example, a passenger traveling from New York to Florence via London might take a large plane from New York to London but, with fewer passengers heading on to Florence, have a smaller plane complete the trip. The following flight would often carry the same flight number as well. Peter Belobaba, Amedeo R. Odoni, and Cynthia Barnhart, eds. *The Global Airline Industry* (Chichester, West Sussex: Wiley, 2009), p. 28-9; MacKenzie, "The Bermuda Conference and Anglo-American Relations," p. 69.

[101] Mabry, "Bermuda 2," p. 1262.

[102] Haanappel, "Bilateral Air Transport Agreements," p. 250; Mabry, "Bermuda 2," p. 1262.

having granted Seaboard & Western (S&W) permission to begin cargo flight operations from the United States through London and onto points in Europe. W.C. Gawthorne, of the British Board of Trade, noted that Pan Am already had 34 transatlantic passenger flights per week through London and TWA had 15 more compared to 19 for BOAC. The British airline's figure included 5 flights to Montreal with no American connection.[103] Adding S&W would further weaken Britain's competitive position as BEA stood to lose £80,000 ($223,200) on its service to Germany[104] and BOAC estimated it would lose up to £120,000 ($334,800).[105] Gawthorne recommended that the British ought not to single out S&W for capacity limitations as it could set a bad precedent and was founded on shaky legal ground. Instead, he felt that Britain should treat all American airlines collectively as a single legal entity under the terms of the Bermuda Agreement (albeit without specifically referring to the Agreement).[106]

In another case, the Belgian airline Sabena was flying between Belgium and North America through Manchester. Roughly half of Sabena's passenger traffic on that route was fifth freedom picked up in Manchester and flying onwards to points beyond Britain. A 1956 BOAC memo indicated that the airline was unhappy with the arrangement but could not act to restrain

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[103] TNA BT 245/871, "UK/USA Air Services Agreements Other Matters: Designation of Seaboard and Western for all cargo flights across the Atlantic, 1955-9." W.C. Gawthorne to R.S.S. Dickinson, October 11, 1955, Minute 7.

[104] TNA BT 245/871, "UK/USA Air Services Agreements Other Matters: Designation of Seaboard and Western for all cargo flights across the Atlantic, 1955-9." R.S.S. Dickinson to Sir George Cribbett, October 11, 1955, Minute 8.

[105] The initial loss might initially be as low as £71,000 ($198,090) assuming that S&W operated only three flights per week across the North Atlantic, rising to the figure above after it ramped up to daily service. The figures assumed that the flights were strictly between the United States and Europe through Britain. In the event that S&W expanded service as far onwards as Calcutta, the figures rose drastically to an annual loss of £306,000 ($853,740) for three flights per week or £439,000 ($1,224,810) for daily flights. The large figure for India-bound flights was for animals carried to and from the country. TNA BT 245/871, "UK/USA Air Services Agreements Other Matters: Designation of Seaboard and Western for all cargo flights across the Atlantic, 1955-9". Letter from L.E. Hough at BOAC to W.C. Gawthorne at the Ministry of Transport & Civil Aviation, March 1, 1956, 57. These calculations from British pounds into American dollars was made using historical exchange rate data for 1955 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[106] TNA BT 245/871, "UK/USA Air Services Agreements Other Matters: Designation of Seaboard and Western for all cargo flights across the Atlantic, 1955-9." W.C. Gawthorne to R.S.S. Dickinson, October 11, 1955, Minute 7.

Sabena since it "could not cry out until [BOAC was] hurt, i.e. the operators of either country on any agreed route may operate as many frequencies as they wish until the other country cries halt because it can be shown that excess capacity is being operated to the detriment of its airline."[107] In effect, BOAC interpreted the Bermuda Agreement as giving the Belgian airline permission to fly as much as it liked through Manchester without having to ask. BOAC could not have the British government refuse Sabena to continue flying as often as it wished until it could prove that its own services in some way were being harmed.[108] In both the S&W and Sabena cases, BOAC (and Britain in general) had to weigh the best approach to exact some fair settlement from its competitors. The Bermuda Agreement gave it little recourse. Unless BOAC could expand its own services to fill a service void that it had arguably left, there was little it could do other than verbally express its displeasure.

While it was an imperfect solution, the British, Americans, and other national governments recognized that the Bermuda Agreement was a broadly reasonable and effective model for future air agreements, at least for now. It was a workable compromise between the American desire for flexible air regulation and the European preference for a strong role for both the state and protections for their airlines. The Americans and British publicly and vociferously applied it as a template to most of their ensuing agreements with other countries as well. Its broadness and flexibility, which could accommodate a wide array of conditions set down by national governments and airlines, soon made it the standard for other countries conducting air agreements. Many future agreements based on the model set by the original Bermuda Agreement made only minor modifications from the original document's format, chiefly to the

[107] British Airways Heritage Centre RS/1/10935 "Part 6: Atlantic Services, Services, 1956 Jan-May". BOAC memo from P. Jack, Asst. to Advisor on International Affairs, to Sales Planning Manager, "Sabena Manchester Services," April 17, 1956.

[108] *Ibid*.

number of flights and passenger capacity permitted.[109] By 1973, roughly a third of all active air agreements in the world were closely styled on the Bermuda Agreement; another third were similar enough that they had clearly drawn inspiration from it.[110]

As it turned out, the final failing of the Bermuda Agreement was the British government's original concern: Britain never managed to carry more than 38% of travelers between Britain and America at its peak compared to 58% for the American carriers.[111] Each of America's two big international airlines, Pan Am and TWA, carried nearly as many passengers as BOAC. But even if BOAC could match one American airline alone, there were twice as many planes from American carriers flying into Britain as vice versa. Fifth freedom traffic from Bermuda Agreement routes likewise favoured the United States. In a broad exchange of routes, America won prized routes from London onward into Europe whereas Britain gained routes with limited growth potential into Pacific territories. These apparent imbalances finally drove Britain to renegotiate the terms of the Bermuda Agreement in 1977,[112] settling on terms that were more restrictive towards the number of permitted flights but opened new gateway cities and allowed additional airlines to serve those routes.[113]

While the Bermuda Agreement did many things to ease transatlantic air travel, it did not totally open the skies. Protectionist impulses were not quashed even among adherents to this

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[109] Hannigan, "Unfriendly Skies," p. 251.

[110] Diamond, "The Bermuda Agreement Revisited," p. 428. For more on the impact of the Bermuda Agreement on bilateral air agreements and how it shaped other organizations, see: Z. Joseph Gertler, "Bilateral Air Transport Agreements: Non-Bermuda Reflections," *Journal of Air Law and Commerce* 42, no. 4 (Autumn 1976), p. 779-824.

[111] Britain also had a lower average load factor than the American airlines, at times dropping to just 30% compared to America's 48% low point. British revenue on transatlantic routes reflected this: in the year ending on March 31, 1976, America's airlines received $512.8 million compared to Britain's $227.5 million. Mabry, "Bermuda 2," p. 1263.

[112] *Ibid*., p. 1263-7.

[113] The new agreement, called Bermuda II, was technically signed ten minutes after the original Bermuda Agreement expired on June 22, 1977 (one year after Britain declared its intention to withdraw). For a brief period there were flights en route between the two countries that had no legal permission to land. Kendall and Jordan, "Fare and Income Elasticities in the North Atlantic Air Travel Market," p. 36; Paul B. Larsen, John Gillick and Joseph C. Sweeney. *Aviation Law: Cases, Laws and Related Sources* (Ardsley: Gazelle Drake Academic, 2006), p. 266-7.

style of agreement as there were other ways for a country to promote its flag carrier abroad. Transatlantic flight was primed to grow rapidly in the postwar era following the introduction of better, faster planes in the 1940s and 1950s, rapidly growing middle class wealth in both North America and Europe, and booming global trade. The Agreement did its part to spur the growth of transatlantic flight by easing the process for the airlines but it was one factor among several. But the Agreement did build a strong and competitive market for air travel. The United States used its economic and political leverage to make the Agreement highly favourable to its interests. While Britain did not come away from the Agreement as the biggest beneficiaries, it did not come away empty handed either for Britain's airlines were given guarantees of access to the United States as well as protections against excessive competition. The Agreement also built a useful framework that they could apply to future deals.[114] The Bermuda Agreement was a compromise for all parties that represented a workable format for international aviation for the decades that followed.

Conclusion

While the prospect of flight between North America and Europe drove aviation throughout the interwar era, the European and American camps had each built commercial aviation networks and systems tailored to their own strengths. There were therefore fundamental differences between how each side sought to bridge the gap between their approach to aviation once their spheres connected above the North Atlantic. The European countries rallied behind Britain, the biggest commercial air power after the United States, to support a system with strong restraints on airline operations. This was specifically designed to counter America's push for a lightly regulated aviation system that favoured its considerable competitive advantage. The

[114] MacKenzie, "The Bermuda Conference and Anglo-American Relations," p. 71.

Chicago Conference brought the dispute to the forefront. The failure of the final Convention to include a multilateral agreement, one that would have bound everyone to an American-backed liberal system with extensive fifth freedom rights, showed how deep the divergent philosophies ran. The Convention, nevertheless, led to the creation of the ICAO and IATA, institutions that harmonized many of civil aviation's outstanding issues, improving the quality of flight for all.

It was not until the Bermuda Agreement in 1946 that a workable bilateral agreement enshrined the contentious fifth freedom traffic rights in a broadly workable framework. The British conceded to a greater degree by permitting the United States as many flights as they could justify, but in so doing they ensured that air travel would be able to grow with the market's need. The compromise embodied in the Agreement also boosted IATA into a pivotal position, bringing it considerable power over the regulation of airfares and even mundane details airline operations. By harmonizing airline standards, IATA protected the European carriers on an equal footing with the big American airlines and kept the air network from collapsing into petty protectionist squabbles. In two short years, civil aviation gained two organizations designed to flexibly manage international aviation and the template for bilateral agreements to make commercial air travel more responsive to the needs of all countries, to their airlines, and above all to the passengers of the North Atlantic.

Chapter Four: Aircraft on the North Atlantic

As airlines sought to make transatlantic air service a reality in the 1930s, aeronautics industries designed and built the bigger and far more expensive planes. But such planes were built by a handful of big companies in just a few countries, and they did so with considerable help from their governments. The United States dominated the transatlantic aeronautics sector postwar thanks to its emphasis on long-range bomber construction during the war, giving its industries experience with the construction and design techniques that would serve them well after 1945.[1] Europe's smaller aircraft firms received direct government assistance, but thereby invited governments into the design process, with the British aeronautics industry offering the clearest examples of the advantages and hazards of this strategy. American aeronautics firms benefited from Cold War military spending by using that revenue to pay for civil aircraft programs, without which it would have been prohibitively expensive for them to design and build advanced planes with long development times and thresholds for realizing returns on investment. Technological advances such as pressurized cabins and jet engines transformed civil aviation considerably during the postwar era and, because of the prestige and intensive use of the North Atlantic routes, they were a crucial proving ground for cutting edge commercial aircraft.

Government Backing for Transatlantic-Capable Aircraft in Wartime

The United States had a considerable advantage in long-range aircraft production over the British both before and during the Second World War. The first commercial plane to cross the North Atlantic was the Boeing 314 "Clipper" in 1939, funded by corporate rather than public

[1] Alan P. Dobson, "The Other Air Battle: The American Pursuit of Post-War Civil Aviation Rights." *The Historical Journal* 28, no. 2 (June 1985), p. 430-1.

money.[2] After 1941, however, commercial services were curtailed and the 314 flew in support of the war effort. All aeronautics work in the United States was brought under government control. The American industry concentrated heavily on bomber construction, whereas the British focused upon short-range fighters.[3] Bombers shared the long-haul capabilities needed for transatlantic air travel. The construction processes that proved useful for building bombers could thus be applied to build transatlantic passenger aircraft following the war. Indeed, most of the popular civilian airliners in the latter 1940s were based directly on military models.[4] Britain's aeronautics sector was smaller and less innovative than that of the United States during the war. Just one civil aircraft model, the Avro York, was produced during the war and only five of them were put into service by March 1945. It could fly 3,000 miles (4,827 km), enough for transatlantic passenger service with intermediate stops, a top speed of 298 mph (479 km/h), and could carry 56 passengers. But it was unpressurized at a time when American planes started to regularly offer pressurization and could therefore fly higher than 10,000 feet without breathing apparatuses for the passengers.[5]

The United States rolled out several new models by 1945 that were more than a match for the York. These included the Douglas DC-4, Lockheed L-049 Constellation, and prototypes for the Douglas DC-6, all three of which had transatlantic ranges. The DC-4 had a cruising speed of 227 mph (363 km/h) at 10,000 feet; an altitude it would not have flown much above for

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[2] The Boeing 314 "Clipper" planes had a range of 3,685 miles (5,896 km) at its 188 mph (302 km/h) cruising speed, with room for up to 74 passengers. John W.R. Taylor, ed., *Jane's Fighting Aircraft of World War II* (New York: Military Press, 1989), p. 211.

[3] America's focus on production of long-range aircraft during the war was actually done in part by the request of the British government as it recognized that the United States was far better suited to the task during the war. British Prime Minister Winston Churchill chose to focus his own country's production on fighters since that was where their immediate needs were best addressed. Marc L.J. Dierikx, "Shaping World Aviation: Anglo-American Civil Aviation Relations, 1944-1946," *Journal of Air Law and Commerce* 57, no. 4 (Summer 1992), p. 795-6.

[4] Dobson, "The Other Air Battle," p. 430.

[5] Bridgeman, *Jane's Fighting Aircraft of World War II*, p. 105.

passenger service since the cabin was unpressurized. Under ideal conditions, the DC-4 had a range of 3,300 miles (5,280 km).[6] The Lockheed L-049 Constellation was the predecessor to a successful commercial variant, the L-749, that entered service in 1947 and is discussed below. The L-049 cruised at 313 mph (503 km/h) at up to 25,300 feet in its pressurized cabin, and could fly up to 3,995 miles (6,428 km).[7] The L-049 could make an Atlantic crossing in under 20 hours into a headwind including refueling stops, a considerable improvement over the 33 hours that the Boeing 314 could manage.[8] The versions of the DC-6 in use by the late 1940s had a range of up to 4,480 miles (7,168 km) when cruising at up to 25,000 feet. Typical cruising speeds were 269 mph (430 km/h) at the maximum takeoff weight of 93,200 pounds. The DC-6 had room for 52 passengers for long-distance flights with sleeper cabins and private toilet facilities throughout the cabin, although configurations for shorter distances (without beds and private cabins) could accommodate up to 68 passengers.[9] These planes were well into the design phase by the beginning of the war and their production was accelerated to serve the war effort. Four more civilian models were late in the design stage but were not yet ready for production by the war's end.[10]

The Avro Yorks, Britain's only domestically-designed and built civilian model with transatlantic range, were widely recognized to be uncompetitive against the American planes.[11] In his book *Cold War at 30,000 Feet*, Jeffrey Engel blamed the British aeronautics industry's poor postwar position on the nearly-exclusive emphasis on military aircraft production during the

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[6] Leonard Bridgman, ed., *Jane's All the World's Aircraft* (Toronto: The Macmillan Company of Canada, 1948), p. 251c.

[7] *Ibid*., p. 277c-279c.

[8] Bray, *The History of BOAC*, p. 119.

[9] *Ibid*., p. 249c-250c.

[10] The DC-4 became a big part of the war effort as 1,163 were built as transports during the war. Just 20 Constellations were ready by the war's end. R. Miller and D. Sawers, *The Technical Development of Modern Aviation* (New York: Praeger Publishers, Inc., 1970), p. 134-5.

[11] The Avro York was not even conceived as a civilian plane but was a modified version of the Lancaster. Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), p. 71.

war. Whereas American companies were big enough to produce military and civilian planes simultaneously, their British counterparts lacked matching scale or resources.[12] Wartime spending turbocharged the aeronautics sector in both countries: Britain's aircraft output leapt a hundredfold while America's increased fifty times. America produced far more aircraft than Britain before the wartime boost: Britain's relative increase masks the fact that it was still lagged far behind the United States. America made about 2,000 planes in 1939 but, with strong government support, turned out 96,318 in 1944.[13] The public purse rather than commercial investment funded this rapid expansion in both countries. In the United States, 92% of the $16.7 billion cost of aircraft production in 1944 came directly from the American treasury.[14]

While the American government was technically uninvolved with civilian aircraft development, the British government was considerably invested in its civilian aircraft sector both during and after the war. British planning for postwar civilian air service began several years before the war concluded, headed by Colonel Moore-Brabazon beginning in 1942 with what became known as the Brabazon Committee.[15] The Committee reasoned that as America could produce far more planes than Britain, only a technological advantage could give British planes an edge. A branch of the Brabazon Committee was specifically devoted to designing a plane

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[12] Jeffrey A. Engel, *Cold War at 30,000 Feet: The Anglo-American Fight for Aviation Supremacy* (Cambridge, Massachusetts: Harvard University Press, 2007), p. 53.

[13] *Ibid*., p. 19-20, 30.

[14] The 1939 value of aircraft production was a far smaller $250 million, making the 1944 figure nearly 67 times bigger. The disproportionate cost of the planes (67 times versus 48 times more planes) is in part credited to lucrative bonuses provided to the manufacturers for turning out the planes quickly. It is worth noting that none of the major DC-3 transport models (C-46, C-47, and C-54) were being built before the war although they were fully designed and their production went ahead in the war. *Ibid*., 30-1.

[15] The Brabazon Committee sought to guide the growth of transatlantic flight to the advantage of British Imperial prestige, with London to serve as a hub for flights between Europe and North America. Frank Jackson, "The New Air Age: BOAC and Design Policy 1945-60," *Journal of Design History* 4, no. 3 (1991), p. 168-9. The Brabazon Committee was put in charge of postwar planning for Britain's civil aircraft needs but included no one from Britain's airlines or the aeronautics sector. The Committee was composed of only a handful of government officials including Col. Brabazon and members of the Air Ministry. Bray, *The History of BOAC*, p. 71.

with Atlantic-spanning range.[16] The Committee consulted British Overseas Airways Corporation (BOAC) about what types of planes it wanted, to which BOAC replied that one model ought to have transatlantic range.[17] The Brabazon Committee initially proposed five plane models to meet specific needs[18] including one model specifically designed for flights from London to New York, the Type I, which would have been revolutionary in both size and technical sophistication. It was to accommodate 120 passengers in a pressurized cabin (a relatively uncommon feature for passenger planes at that time) with sleeper cabins, a bar, and a lounge. But the extremely long design cycle and heavy government involvement saddled the plane with obsolete technologies that made it outdated before it could ever have been built.[19] The Type I could have competed well against the American DC-4, which offered similar amenities but was unpressurized and could only carry at most 44 passengers.[20] The Type I could have made a real impact had it reached the transatlantic aircraft market by virtue of its size alone.

Early Postwar Aircraft Development

Almost immediately following war's end in Europe, BOAC made building a fleet with transatlantic capabilities a top priority. In mid-May, 1945, the airline considered using the aircraft it had operated on the Return Ferry Service (see Chapter Two) to form the nucleus of this new civilian operation. Despite such hopes, the military could at best supply the airline with ten

[16] Engel compared the thinking of the Brabazon Committee as emphasizing quality over quantity. He compared the American planes to sausage against the British filet mignon. All of this was aspiration when the Committee first met, however, since no plane was even on the drawing board. Heavy government financing and the use of the latest and most sophisticated technology (jets were specifically sought out) were critical components of the plan. Engel, *Cold War at 30,000 Feet*, p. 33-9.

[17] Bray, *The History of BOAC*, p. 72-3.

[18] The five models included a pressurized landplane for transatlantic service, a jet for transatlantic mail service, a four-engine plane for Empire routes, a somewhat smaller unpressurized plane for European services, and a small two-engine plane for domestic routes within the United Kingdom or other Commonwealth lands. *Ibid*., p. 71.

[19] Jackson, "The New Air Age," p. 173-4.

[20] The DC-4 had a cruising speed of 227 mph (363 km/h) at 10,000 feet; an altitude it would not have flown much above for passenger service since the cabin was unpressurized. Under ideal conditions, the DC-4 had a range of 3,300 miles (5,280 km). Bridgman, *Jane's All the World's Aircraft* (1948), p. 251c-252c.

B-24 Liberator bombers (with two more "permanently off service" for replacement parts) or nine variants of the B-24 designed for transport. The Consolidated B-24 Liberator bomber was a very versatile model, with many variants made during the war for a variety of purposes. The B-24D had perhaps the longest range at 3,700 miles (5,955 km) and a top speed of 290 mph (467 km/h) and room for nine passengers.[21] This was sufficient for BOAC to offer a continuation of the wartime level of air service to Montreal or New York but little more.[22] Airlines such as BOAC desperately wanted purpose-made civilian planes with transatlantic range.

After the war ended, several aircraft manufacturers turned out planes suited to the needs of transatlantic civil aviation. Among the first of these purpose-built planes was a Canadian variant of the DC-4, the Canadair Four "North Star", which entered service for TCA in 1946. It offered upgraded engines superior to the basic DC-4 and improved amenities (including cabin pressurization) with room for 40 passengers on its transatlantic service. The Canadair Four had a much higher top speed than the DC-4, flying at 320 mph (512 km/h) at 24,000 feet thanks to its newer engines. Premium flights might offer more lush cabin appointments with fewer passengers, as low as 20 passengers on the flights with the most luxurious private suites. In addition to TCA, BOAC also purchased 22 of the planes for its international services.[23] The North Star enjoyed a solid record with TCA and in 1953 its cabins were converted to carry even more passengers, up to 48, on long-distance services.[24]

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[21] Chris Chant, *The Essential Aircraft Identification Guide: Allied Bombers, 1939-1945* (London: Amber Books Ltd., 2008), p. 143.

[22] Lancastrians, modified B-24 Lancaster bombers, were the first plane mentioned in the memo but their use was reserved for the Australians and New Zealanders until sometime in 1946, by which time it was believed that Tudor I civilian planes would be ready for service. While the Liberators in service were not provided in whole through Lend-Lease they included many parts that were, inviting the possible complication of commercial restrictions. British Airways Heritage Centre RS/1/69, "Lease/Lend, Accounts General, 1943-48". BOAC memo from D.A.D.G.(T) to the Chairman, "North Atlantic: Services 1945/6," May 16, 1945.

[23] The only notable complaint about the North Star was that it was exceptionally noisy. *Ibid*., p. 115c-116c.

[24] "Civil Aviation: Good Year for T.C.A.," *Flight International*, March 27, 1953, p. 411.

America's aircraft manufacturers were just as active after the war as they had been during it. Lockheed developed an upgraded Constellation in 1947 called the L-749, based on the L-049 that had served so well. The L-749 could accommodate 64 people, cruised at 328 mph (528 km/h), and could make the North Atlantic crossing with its 3,300 mile (5,310 km) range. The plane was exceptionally popular thanks to its well-appointed cabin and was flown by Pan Am, TWA, AOA, Air France, KLM, and BOAC on their transatlantic routes.[25] Constellations were a game-changer for BOAC. A news report from *Interavia* remarked on its travel speed during the inaugural 1945 flight between New York and Paris, which averaged 410 km/h during the 14-hour trip. Travel times of 12 hours or less possible in favourable winds. Stops for refueling would cut into these times, but the improvement over existing planes was considerable.[26]

Boeing introduced its new transatlantic-capable model, the 377 "Stratocruiser", in 1949. Pan Am and BOAC were the only airlines to use it on the North Atlantic. The plane usually carried 63 to 84 seated passengers, or 28 in berths, and featured a lounge with a bar on its lower level. It cruised at 302 mph (486 km/h) for up to 4,400 miles (7,080 km).[27] The new plane was not without shortcomings. S.T.B. Cripps, the British Civil Air Attaché in Washington, evaluated the plane for Britain's two main airlines. Cripps noted that if three of the big planes had to put down in one of the smaller airports at the same time accommodations would be needed for 150 people, far in excess of that typically available. Hangars might not fit the Stratocruiser since its tail fin was 36 feet high, whereas most hangars were 28 feet high. Proper hangar accommodation might necessitate either the temporary removal of the fin (which was technically difficult) or the construction of larger hangars. Operating and maintenance costs for the

[25] Bridgman, *Jane's All the World's Aircraft* (1948), p. 278c-279c.
[26] "USA/France: Lockheed Constellation," *Interavia*, no. 1036, August 7, 1945, p. 9.
[27] "Commercial Aircraft of the World," *Flight International*, November 20, 1959, p. 582.

Stratocruisers were estimated at $350,000 by American Export Airlines, which Cripps believed was a cause for concern.[28]

The Douglas DC-6 entered mass production by 1946 too and displaced the DC-4 as the face of Douglas on the North Atlantic. Airlines began buying the upgraded DC-6B in 1951, which cruised for up to 4,720 miles (7,594 km) at 315 mph (507 km/h) at 22,500 feet with room for up to 102 passengers. Although the DC-6B was not a revolutionary plane, its performance redefined the passenger market. The planes were fuel-efficient and reliable, making them ideal for spurring cheaper service, and were snapped up by Pan Am, Sabena, SAS, Swissair, and Alitalia for transatlantic operations. Pan Am pressed for cheaper transatlantic tourist airfares (see Chapter Ten) in part because of the solid economics offered by the DC-6B.[29] Lockheed kept up with Douglas by introducing the Super Constellation L-1049, an upgrade over the original Constellation in nearly every way. It entered service in 1953 and brought a key feature to propeller planes: turbo-compound engines. A turbo funnels an engine's exhaust into a turbine to generate additional power at little extra fuel cost, so a bigger plane like the L-1049 did not need considerably heavier engines. The plane made a big splash in the transatlantic market with the L-1049C variant used by TWA, TCA, and Air France, the L-1049E used by KLM, and the L-1049G by TWA, Air France, Lufthansa, TCA, and KLM on their transatlantic runs. The L-1049G could be configured for several passenger classes, with a luxury version seating just 59-63 people to a tourist class cabin with room for 99; the other models sported similar cabin arrangements. The L-1049G, the most popular model could fly 5.840 miles (9,400 km) at 320

[28] TNA BT 217/1438, "Use of Boeing Strato-Cruisers on Trans-Atlantic Routes, 1947." Letter from S.T.B. Cripps, Civil Air Attaché at the British Embassy in Washington, to Civil Air Intelligence, Ministry of Civil Aviation, "Report on the Estimated Operational Performance of the Boeing Model 377 Stratocruiser," April 15, 1947, 2A.

[29] "Commercial Aircraft of the World…," *Flight International*, November 23, 1961, p. 816.

mph (519 km/h).[30] America's civil aeronautics industry was highly productive during the latter 1940s and 1950s, building a strong reputation for quality passenger planes that no one else in the world was able to beat. They made the flying across the North Atlantic a reasonably short and comfortable experience.

Britain's public management of its civil aeronautics industry after the war was less successful than America's hands-off approach. American commercial aircraft were developed by private companies for the needs of airlines, whereas the British government retained a direct hand in domestic aircraft manufacturing. Immediately after the Second World War, Prime Minister Clement Attlee pursued a policy of expanding Britain's civil aeronautics sector. According to historian David R. Devereux, Attlee pursued this course for three reasons: to boost British industry, to act as a bulwark against American competition, and to enable better connections throughout the British Empire entirely by British means.[31] According to an American analysis in 1948, policies such as this had been pursued by the British "since the close of World War I". Establishing connections throughout the Empire and building prestige were worth any cost in the minds of British officials.[32] This did not stop BOAC from buying the DC-7, which had both the range and passenger capacity it needed on its transatlantic routes. The DC-7, which entered service in 1953, actually offered poorer economic performance than the DC-6B it was supposed to replace.[33] The DC-7 was run faster than its ideal airspeed to meet demanding schedules, a practice that wore out the engines and propellers faster. It also needed

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[30] Bridgman, *Jane's All the World's Aircraft* (1956-7), p.300-2.

[31] Government support for the British aeronautics sector could be considered tacit acknowledgement that British industry was unable to compete on its own against American industrial might. David R. Devereux, "State versus Private Ownership: The Conservative Governments and British Civil Aviation 1951-62," *Albion: A Quarterly Journal Concerned with British Studies* 27, no. 1 (Spring 1995), p. 65.

[32] NARA RG 197, Box 79, Folder "UK" 1948. Bureau of Economic Regulation, Foreign Air Transport Division, "Postwar International Aviation Policies," November 9, 1948, p. 3.

[33] "Commercial Aircraft of the World…" *Flight International*, November 23, 1961, p. 816.

longer runways due to its heavier takeoff weight.[34] Its transatlantic service with Pan Am used an 82 passenger configuration, cruised at 307 mph (494 km/h), and sported a range of 3,860 miles (6,211 km),[35] and the DC-7C variant that debuted in 1955 most commonly used for transatlantic service[36] could cruise at 354 mph (570 km/h) for 5,630 miles (9,059 km). The DC-7C was put into service on the North Atlantic by Pan Am, BOAC, KLM, Swissair, Sabena, and Alitalia.[37] The British government approved a purchase order for ten of the DC-7Cs at £13 million ($36.27 million[38]) in early 1955. As the emphasis on domestic planes remained, the deal included a proviso: the planes were to be resold once a British aircraft then in development, the Bristol Britannia, was ready for service.[39]

The Bristol Britannia was the only commercial airliner of note that the British aviation industry managed to produce before the jet age began. A propeller plane, the Britannia was saddled with a lengthy development cycle and bureaucratic mismanagement. Although it sported a range of 5,000 miles (8,045 km), a cruising speed of 385 mph (619 km/h), and a big cabin with room for up to 139 passengers, it only debuted in 1957. It was a good propeller plane that had the bad fortune to hit the market just as jets were about to take flight. Only a handful of airlines purchased the plane: BOAC and Canadian Pacific Airlines for transatlantic services, with

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[34] Miller and Sawers, *The Technical Development of Modern Aviation*, p. 25-6.

[35] "Douglas DC-7," *Flight International*, July 30, 1954, p. 143.

[36] Noise was a big complaint about the planes, however, because of the powerful engines needed for the long-haul service. "Commercial Aircraft of the World…" *Flight International*, November 23, 1961, p. 817.

[37] Miller and Sawers, *The Technical Development of Modern Aviation*, p. 130.

[38] The calculations from British pounds into American dollars were made using historical exchange rate data for 1955 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[39] Bray, *The History of BOAC*, p. 154-5.

Cubana and El Al also buying some.[40] The Britannia proved to be little more than a stopgap until the Boeing 707, DC-8, and other competitors made it obsolete.[41]

The era of propeller planes saw the expansion of regular transatlantic service to clientele beyond the elites. New commercial planes had room enough to carry scores of passengers in comfort, with all models offering pressurized cabins (except for a few of the very first postwar planes), and reliably flying at increasingly high speeds across the North Atlantic. These flights still had to make refueling stops along the way, though the DC-7, which could make a nonstop flight when the winds were fair, promised a future where all transatlantic flights might make just one hop. It was also an era of American dominance: the big three companies of Douglas, Boeing, and Lockheed, built the most common transatlantic planes used throughout the early postwar era and did so without direct government assistance. Even the Canadair Four, the only Canadian-made plane serving on the North Atlantic, was a derivative of the American DC-4. But it should not be forgotten that the United States government had spent considerable sums during the war to develop and build the wartime models that were later adapted to become the popular civilian craft. And the American government paid the aeronautics companies huge sums for military development simultaneous to this, keeping the big companies in a strong financial position as noted later in this chapter. The British companies Avro and Bristol were more directly managed by the government and lacked the financial resources needed to make their own planes competitive during this time and failed to capture more than a meagre share of the market. The models discussed above all stopped production by 1958 as the propeller age gave

[40] "Commercial Aircraft of the World," *Flight International*, November 20, 1959, p. 586.

[41] Cost-cutting was credited here for preventing the development of more powerful engines on the Britannia's airframe. James Hamilton-Patterson, *Empire of the Clouds: When Britain's Aircraft Ruled the World* (London: Faber and Faber, 2010), p. 206-7.

way to the jets, although the planes continued to operate for years (and in some cases decades) to come.

Jets Transform Transatlantic Travel

Despite the initial postwar production issues, Britain's aviation industry had an advantage over the Americans in one key area: jet engine technology. Jet fighters were used in the closing days of the Second World War so the British simply had to translate their experience with the technology to civilian applications.[42] This proved feasible as the de Havilland DH 106 Comet, based on Brabazon Committee plans (specifically Type 4), debuted in 1952. The first passenger jet boasting speeds of up to 500 mph (805 km/h),[43] it was a visually striking (and heavily promoted) aircraft that offered the world's first regularly scheduled jet service. But the plane had a terrible safety record: several of the planes crashed with all passengers and crew lost. The crashes cut short the Comet's commercial service: only 29 of Comet models 1 and 2 ever flew by the time the planes were grounded in 1954.[44] The plane had other drawbacks. Fuel capacity was insufficient to make the entire London-New York flight in one hop (just 2,600 miles or 4,183 km)[45] as was the case with the propeller planes, undercutting the time saved by the faster jet speeds.[46] It also had high operating costs and a limited passenger capacity, at most 44 passengers, which made its use impractical on any but the most prestigious BOAC routes. The North Atlantic run was therefore ideal for this plane as the its allure alone would attract

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[42] Jeffrey A. Engel, "The Surly Bonds: American Cold War Constraints on British Aviation," *Enterprise & Society* 6, no. 1 (2005), p. 7-8.

[43] "Transport Aircraft – 1955," *Flight International*, March 11, 1955, p. 337.

[44] Myron J. Smith, Jr. *The Airline Bibliography: The Salem College Guide to Sources on Commercial Aviation* (West Cornwall: Locust Hill Press, 1988), p. 130-1.

[45] "Transport Aircraft – 1955," *Flight International*, March 11, 1955, p. 337.

[46] Refueling stops were only needed on the westbound flights since these had the longer route with less favourable winds. Eastbound flights could fly directly between North America and Europe, technically speaking. Bray, *The History of BOAC*, p. 157.

passengers who wanted to travel on the advanced new model, and the high profit margins generated on transatlantic flights would offset some of the expense. Although the plane flew its routes profitably, it was retired from service within two years following the third crash.[47]

Jets transformed air travel once they entered regular service in the latter 1950s. The transition from turboprops to jet planes came quickly: in 1958 just 5.7% of revenue passenger kilometres offered on commercial air services on the North Atlantic were on jets, climbing to 92.2% by 1962.[48] Jet technology offered huge improvements over propellers. Their engines are more powerful and so could provide greater speeds and carrying capacity.[49] The Comet 1, introduced in 1952 but removed from service two years later, was an anomaly. It existed in numbers too small and for too brief a period to make a lasting impact: the Comet 1 failed due to metal fatigue in the bodies rather than problems in the engines. It marked, however, the point at which jets neared commercial readiness. In 1957, just three years after it was grounded, several new jet models entered the market. The turboprop planes they replaced were not immediately rendered obsolete. Jets were on average 22% faster than turboprops (561 mph versus 460 mph for turboprops) but cost 30% more to operate and maintain. The jets also required longer runways that were not yet built at many airports as of 1957.[50] Planes equipped with turboprops

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[47] Metal fatigue caused by cabin pressurization was ultimately found to be the problem. The fuselage simply tore itself apart under pressure. This revelation badly damaged the reputation of British aviation: if the most prestigious and advanced plane they produced had such critical flaws, what else might go wrong on future flights? Jon Proctor, Mike Machat, and Craig Kodera. *From Props to Jets: Commercial Aviation's Transition to the Jet Age 1952-1962* (North Branch, MN: Specialty Press Publishers and Wholesalers, 2010), p. 20-4; Jackson, "The New Air Age," p. 175-7.

[48] Mark A. Welge, "Impact of Technology on IATA Ratemaking: Problems Prognostications Proposals," The *George Washington Law Review* 39, no. 5 (July 1971), p. 1182.

[49] Propellers encounter problems with air flow when the tips of their blades approach Mach 1, which limits the airspeed they can be safely used for. Jets are designed such that air is slowed as it enters the engine so no component encounters this problem. Laurence K. Loftin, Jr., *Quest for Performance: The Evolution of Modern Aircraft* (Washington: National Aeronautics and Space Administration, 1985), p. 223-5.

[50] These numbers were calculated based on two planes flying between New York and London (the original data was in nautical miles per hour). A turboprop plane was assumed to have four Bristol Orion Series 2 turboprops while the jet was assumed to have four scaled-down Bristol Olympus 531 Stage 2 turbojet engines. The jet weighed an extra 81,900 pounds or 38% more (299,000 lbs versus 217,100 lbs) and, when engine efficiency was accounted

already flew one round-trip transatlantic service in a day, which required an average flight speed of 383 mph (or airspeeds of 436 mph into a headwind). A jet would have to fly at 691 mph groundspeed (or 791 mph airspeed; faster than the speed of sound) to perform a round-trip plus an extra one-way flight in a single day.[51] The time saved would be valuable to passengers but fell short of transforming the long-haul market.

The introduction of the de Havilland Comet 4 in 1958 gave British aviation a reason to celebrate. The Comet 4 was the first jet to offer regular transatlantic service on a permanent basis. It began flights between London and New York on October 4, 1958, just ahead of the Boeing 707.[52] BOAC purchased nineteen of the jets and took delivery between 1958-9 at a price of £1.16 million ($3.26 million) per plane, totalling £35,437,566 ($99,551,460[53]) for all planes plus spare parts and additional material.[54] BOAC was the only airline to use the Comet 4 on the North Atlantic. Other airlines preferred the Boeing 707 or the DC-8, both of which were about to enter the market. The 707-120B, the version that entered service in 1960, had room for 189 passengers, a cruising speed of up to 606 mph (975 km/h) at 35,000 feet, and a maximum range of 5,985 miles (9,632 km). Pan Am, TWA, Air France, Sabena, Lufthansa, and even BOAC bought the 707.[55] While the 707-120B was superior to the original 707 on offer in 1958, even

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for, required 72% more fuel (121,950 lbs versus 70,800 lbs) while carrying the same weight in passengers and cargo. TNA DSIR 23/25900, "Report on comparison between transatlantic transport aircraft with turbo-props and turbo-jets." Short Brothers and Harland Limited, Project Design Department, "Report on Comparison Between Transatlantic Transport Aircraft with Turbo-props & Turbo-jets," March 1958, p. 1.

[51] The report here suggested that there might be value in running the jets farther on beyond their initial stopping-points after crossing the Atlantic to maximize the use of the planes. *Ibid*. p. 14.

[52] *Ibid*., p. 219; Sam Howe Verhhovek, *Jet Age: The Comet, the 707, and the Race to Shrink the World* (Toronto: Penguin Group (Canada), 2010), p. 202-3; Proctor et al, *From Props to Jets*, p. 102-3.

[53] The calculations from British pounds into American dollars were made using historical exchange rate data for 1958 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[54] BOAC had an extensive agreement with de Havilland for the Comets. In addition to the order, the manufacturer was promised a bonus if the first four Comet 4s were given to BOAC and done so at least 8 months ahead of all other airlines. A Comet 11E was part of the order as well. The plane was used for a series of test flights in preparation for the Comet 4 service. *Ibid*., p. 218-9.

[55] John W.R. Taylor, ed. *Jane's All The World's Aircraft 1960-61* (Toronto: The Macmillan Company of Canada, 1960), p. 267-9.

the original model had a performance superior to the Comet 4. The Douglas DC-8 was widely adopted as well, serving transatlantic runs on Pan Am, CPA, Alitalia, Swissair, and Iberia. The DC-8 also cruised at 35,000 feet, flying at speeds of 543 mph (872 km/h) with a range of 5,093 miles (8,195 km). The DC-8 had similar passenger space to the 707, with room for up to 177 passengers on tourist class configurations or 122 with first class cabin seating throughout. Notably, all of these jet models did away with sleeper cabin arrangements and often amenities like bars, reflecting the reduced need for some creature comforts due to the much reduced flight times:[56] TCA's average travel times on its Montreal-London run dropped from just over 11 hours to around 6 hours.[57]

Jets were the popular choice for airlines despite their incremental improvement over existing technology. In 1955, Juan Trippe was so eager to put Pan Am at the forefront of jet technology that he put in an order for twenty Boeing 707s at a cost of $269 million, with a further deal for twenty-five Douglas DC-8s. Both planes were still in development and would not enter service until 1958.[58] Prestige was an important motivator for Trippe and, where he saw the future of aviation, other airlines followed his lead. Sometimes, merely incremental improvements caused competitive angst. This was the case when BOAC promoted the new Comet 4 on its transatlantic service. While the British airline wanted to fly a British plane on its most prestigious route, the Comet offered slightly lower average speeds than its direct competitor, the Boeing 707, although both boasted advanced jet engines. The American model was slightly faster by all objective measures. BOAC's sales manager L.G.S. Hyland believed

[56] "Commercial Aircraft of the World…" *Flight International*, November 23, 1961, p. 818.

[57] Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986), p. 173-4.

[58] The new jets were not merely faster than the propeller planes they superseded but also larger. The 707 had room for 125 passengers and the DC-8 could fit 131. At a single stroke, Pan Am had enough room on those planes to carry 50,000 transatlantic passengers per year. Verhhovek, *Jet Age*, p. 196-7.

that to counter the perception that the Comet was inferior, BOAC should advertise an identical London-New York travel time of six and a half hours rather than the more realistic six hours and forty-five minutes. Doing so meant that prospective passengers would not see the Comet as second-rate due to the small difference.[59] This plan banked on travelers ignoring (or forgiving) delays of as much as an hour. It also callously pointed out that customers could not expect a refund for the service, which Hyland rationalized thusly:

> How many passengers would be disgruntled and dismayed if they arrived in London from New York anything up to 30 minutes late?! It is surely an accepted fact by the majority of air travellers on the North Atlantic that adverse winds and other climatic conditions must be accepted. Even on the shortest Continental journeys, air travellers are, in the main, prepared to accept delays of up to one hour, without voicing any loud criticism against the airline concerned. From a commercial point of view we should be prepared to stand the risk of passenger criticism when services arrive in London anything up to 60 minutes late, for *the fact should not be over-looked that we have actually carried the passenger and received the revenue for this journey* [emphasis added].[60]

Despite the apparent superiority of the American planes, British planes were not obsolete and could hold their own up to the late 1950s thanks to infrastructure and flying conditions that favoured them over the American aircraft. A 1959 report by the British Aero Projects and the Royal Aircraft Establishment tested two American planes, the Boeing 707 and Douglas DC-8, and two British planes, the then-planned de Havilland Comet V[61] and Bristol Britannia 430, in real-world flying conditions. By most metrics, including fuel efficiency, airspeed, and especially

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[59] The actual flight times were based in part on reliability: a Comet 4 with a stated flight time between London and New York of six hours and fifty-five minutes had a 65% chance of arriving on time. This fell to 50% for stated flight times of six hours and forty minutes, and to 30% for six hours and thirty minutes. There was some pressure from the sales department to push below the "400 minute" psychological mark despite the potential backlash when services ran regularly behind schedule, and which Pan Am might counter with similarly reduced (and improbable) flight times. British Airways Heritage Centre RS/1/10941 "Part 12: Atlantic Services, Services, 1958 July-Dec." BOAC memo from R.A. Doust, Senior Planning Officer, Planning Manager, Western Routes, to Sales Manager, Western Routes, "Comet Schedule," August 30, 1958; British Airways Heritage Centre RS/1/10941 "Part 12: Atlantic Services, Services, 1958 July-Dec". BOAC memo from L.G.S. Hyland, Sales Manager, Western Routes, to Planning Manager, Western Routes, "Eastbound "Comet" Schedule," September 2, 1958.

[60] *Ibid*.

[61] The de Havilland Comet V never entered production.

weight, the British planes performed as well if not better than their rivals.[62] The British cost advantage, as much as 18% cheaper per ton-mile on the Britannia 430 compared to the Boeing 707,[63] rested on a large assumption. The two American planes had a greater maximum payload capacity when sufficient runway length was available. In 1959, neither London nor New York had runways long enough for them to reach takeoff speed at their maximum takeoff weight.[64] With sufficiently long runways, the American planes' payload capacity leapfrogged that of the British planes by up to 27%.[65] The British planes were designed to use the infrastructure already in place while the American firms were building for the future when runways would be long enough to let their planes fly to the maximum potential. Britain's smaller aeronautics manufacturers were still building under the assumption that the government would assure them a market. Unfortunately for those companies, they were being protected to the point of un-competitiveness.

BOAC remained under government ordinances to buy British planes but did not have to restrict itself entirely to them when superior alternatives existed. When the Boeing 707 appeared, the airline recognized it as the game-changer it was for transatlantic flight. Unlike the Comet 4, designed with range "good enough" to cross the North Atlantic with a single stop,[66]

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[62] The Bristol Britannia was, however, somewhat slower than the others. It had a cruising speed of Mach 0.60 against 0.78-0.83 for the other three. TNA AVIA 6/25697. The Staff of Aero Projects/R.A.E., "A comparison of civil aircraft for transatlantic operation," September 3, 1966.

[63] Cost per ton-mile: Boeing 707, 19.5d; Douglas DC-8, 17.9d; Comet V, 17.0d; Britannia 430, 16.0d. *Ibid*.

[64] London's runway was 9,570 feet long and New York's was 9,422 feet. The Boeing 707, which had the longer runway length requirement by 200 feet, would have required an extension of 2,100 feet to London's runway and 2,700 feet to New York's. The difference in the necessary length between the two runways might reflect better winds or a shorter overall route when departing London. *Ibid*.

[65] In this case, the cost per ton-mile was: Boeing 707, 12.4d; Douglas DC-8, 12.4d; Comet V, 17.0d; Britannia 43, 16.0d. *Ibid*.

[66] The Comet 4 had a range of 3,225 miles (5,190 km); not quite enough to make the leap between New York and the cities of Western Europe (at least 5,500 km) in a single hop. Taylor, *Jane's All The World's Aircraft* (1965-6), p. 153-4. The Comet 4 was a scaled-up version of the Comet 1 with better engines and did sell fairly well, with 74 of the new model purchased by airlines. But the plane hit the market late due to the British government holding it back while studies on the failure of the Comet 1 were completed, making its jet technology less attractive in light of the more efficient American planes produced by 1958-9. The Comets were essentially only competitive

some models of the 707 would soon to be able to fly the entire distance between London and New York without a stopover in Gander (although the early 707 models still needed to stop to refuel in Gander). Their nonstop capability and higher average speed made them a critical component for the long distance route. Without the 707, BOAC feared it could not effectively compete. The American airlines would have the planes in their fleet crossing the North Atlantic at the first opportunity. BOAC pushed the Ministry of Aviation to grant it the right to purchase 17 of the planes in 1957 for service in 1959. The Ministry initially rejected the purchase on the grounds that the major airports lacked runways suitable to the 707's needs. It reconsidered once it realized how comparatively small an investment the required runway extensions would be, and how large an improvement over existing service the new 707's represented. Ultimately, the government approved the purchase of 15 of the planes.[67]

Following the Americans and the British in the late 1950s, other countries' airlines soon joined the jet age. Each airline put their jets on the North Atlantic run as soon as they could. Air France planned to begin continental Europe's first transatlantic jet service in 1959 using Boeing 707s. Initial flight times between New York and Paris were expected to be as low as six and a half hours for the eastbound flight. The French airline made a push towards jet technology with a purchase of seventeen of the American-made 707s and a further twenty-four French-made Caravelle jetliners. The Caravelles were a medium-haul plane suited to Air France's intra-European routes including Paris to Rome, Istanbul, and Moscow.[68] Air France did not roll out

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against propeller craft, so in an open market they were soon obsolete. Miller and Sawers, *The Technical Development of Modern Aviation*, p. 26-7, 43-4.

[67] Bray, *The History of BOAC*, p. 220-3.

[68] Although the Caravelle did not have the range to fly the North Atlantic, it was successful enough in its market that even United Air Lines, an American carrier, purchased twenty of them. Verhhovek, *Jet Age*, p. 186. NARA RG 197, Box 34, Folder "France-U.S. Negotiations XII," January-December 31, 1958. Foreign Service Despatch from the American Embassy in Paris to the Department of State, "Civil Aviation: Air France Program for Initial Jet Aircraft Utilization," December 22, 1958. It is telling that the French did not seek to build their own long-haul jet planes to compete with those being built by the Americans (and a handful of British models as is discussed

the 707s on schedule and Belgium's airline Sabena offered continental Europe's first transatlantic jet service in 1960.[69] Canada's TCA had its first transatlantic jet flight on June 1, 1960, with the introduction of its DC-8, capable of carrying 127 passengers. At a cruising speed of 550 mph (885 km/h), it was over 50% faster than the Super Constellation that it replaced.[70] Faster planes also translated into more predictable arrival times for transatlantic service. Of the over 500 transatlantic flights serving JFK in New York in January 1967, 40.4% departed at least thirty minutes late but only 18.4% of arrivals were over thirty minutes behind schedule.[71]

In addition to the faster speeds jets offered, they were also built much larger than their propeller-based predecessors. With more seats available per flight and more trips possible with jets in a given time frame because of their greater speed, their impact was swift and disruptive. Available passenger capacity surged while actual passenger numbers remained relatively flat. Pan Am's revenue per passenger-mile declined from 7.7 to 6.7 cents between 1959 and 1963 as it phased in jets, falling to 5.4 cents by 1970.[72] This saving was partially offset by the rise in passenger volumes during the 1960s. In 1968, over 5 million people flew across the North

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below). This is reflective of the limitations of the fragmented European aerospace sector during this era: no single European country could easily assemble the resources and large amount of skilled workers to design and build planes to compete with the United States by that time.

[69] Sabena World Airlines, http://www.sabena.com/EN/Historique_FR.htm (retrieved on January 21, 2016).

[70] Smith, *It Seems Like Only Yesterday*, p. 173-4. As discussed in Chapter Six, wind conditions affect slower planes far more than faster ones. While the Super-Constellation flew at nearly 2/3 the speed of the DC-8, the aircraft would have to trace a route much farther from the ideal great circle path to realize the shortest flight time. This is why the disparity in travel times was greater than airspeed alone would account for.

[71] The article broke down the total arrival and departure times for each transatlantic flight grouped by airline during January 8-28, 1967, at JFK International Airport. Although each of the 16 airlines had a percentage indicating how often its flights were early, late, or nearly on time, none of the airlines had more than 64 flights under consideration during the interval studied and so was not a statistically significant sample. "Transatlantic Airlines Arrive 81% On-Time," *Air Transport World*, April 1967, p. 22. The article stopped short of drawing conclusions explaining why arrivals were regularly closer to their scheduled landing times. The ratio of delayed departures at European airports was not stated, implicitly suggesting that delays were approximately as common on both ends of the route. It is possible that the pilots used the long North Atlantic travel time to their advantage and increased their travel speeds to compensate for the late takeoff time. Doing this would ensure that they reached their destination close to their scheduled times and saving work for both the airport and the flight crew on the return voyage at the cost of uneconomic fuel use.

[72] Richard M. Smithies, "The Changing Demand for Air Transport: The North Atlantic Case," *Journal of Transport Economics and Policy* 7, no. 3 (September 1973), p. 237-9.

Atlantic,[73] up from just 430,585 in 1952.[74] But available seat supply far exceeded the demand. Load factors declined from 58.7% in 1966 to 57.3% in 1967 and to 53% in 1968. There were effectively two seats available for each person flying across the North Atlantic.[75] Pan Am led the crowd throughout this time. That changed in June, 1969, when TWA finally overtook Pan Am to carry the most transatlantic passengers by a total of 3,000, coupled with a slightly higher load factor than Pan Am.[76] By 1970, however, the excessive competition on the prestigious North Atlantic led to a dramatic fall in profitability there. This dovetailed with the Oil Crisis of 1973 that drove fuel prices up to a quarter of ticket prices, undermining the route further still.[77] This downturn was an aggregate: some airlines still operated quite profitably.[78]

Within a few years every airline had jets on their main long-distance runs. Despite how critical jets were to air travel, especially on the North Atlantic, there were only three main models used by the seventeen IATA airlines on all transatlantic routes in 1967. Two of the planes were American, the Boeing 707 and the Douglas DC-8, the former of which was the most common by far, accounting for nearly three out of every four planes in the North Atlantic skies. The third plane, making up barely 5% of the market, was the British-made Vickers VC-10. Only

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[73] "Passengers Edge Over 5-Million On North Atlantic," *Air Transport World*, May 1969, p. 81.

[74] "North Atlantic Passengers Top 4-Million," *Air Transport World*, May 1967, p. 78.

[75] "Passengers Edge Over 5-Million On North Atlantic," *Air Transport World*, May 1969, p. 81.

[76] By 1969, load factors had been higher on TWA than Pan Am for several years. TWA managed to capitalize on labour problems at Pan Am (including strike threats) to entice passengers to fly with them rather than their competitor. "How TWA Overtook Pan Am On Atlantic," *Air Transport World*, December 1969, p. 21.

[77] John Mutti and Yoshitaka Murai, "Airline Travel on the North Atlantic: Is Profitability Possible?" *Journal of Transport Economics and Policy* 11, no. 1 (January 1977), p. 45-7.

[78] The North Atlantic continued to be a net loser for the airlines into the 1980s, in contrast to more profitable international flight areas such as Western Europe. Richard Pryke, *Competition among International Airlines*. (Brookfield, VT: Gower Publishing Limited, 1987), p. 16-9. British Airways was not one of the lucky ones. The successor of BOAC and BEA following their merger in 1972, it struggled to generate profits there in the years that followed. Some of its competitors artificially drove their prices down by cross-subsidizing their own North Atlantic service (reducing ticket prices on that route by overcharging on other, busier routes) to draw customers away from the British carrier. Doing so meant that other airlines had to cut their own rates to remain competitive. Mark Ashworth and Peter Forsythe. *Civil Aviation Policy and the Privatisation of British Airways* (London: Institute for Fiscal Studies, 1984), p. 36-9.

the then-upcoming Boeing 747 threatened to disrupt the trio's dominance in the busy market.[79] The Boeing 707 remained the frontrunner with 293 performing passenger service across the North Atlantic in 1969 and another 99 on cargo runs. The various DC-8 models included 91 passenger planes and another 14 convertible aircraft suitable for cargo or other needs, while the VC-10 and Super VC-10 combined accounted for just 29 aircraft.[80] Only BOAC flew the VC-10 and it had even been pressured by the British government to increase orders for the model as a sop to the domestic aeronautics industry.[81] The VC-10 and Super VC-10 were popular among passengers thanks to their quiet and comfortable cabin, but they offered no special qualities to interest other airlines when the American planes already suited their needs.[82] The profusion of jets had beneficial secondary effects. As many of the propeller planes displaced from the long-haul routes were still in good shape, airlines put the older planes on routes where service quality had lagged behind that of the main routes, boosting the overall quality of service.[83]

In 1965 Pan Am pressed Boeing to produce a huge new plane to give the airline a competitive edge for passenger carrying capacity on its major routes. The new plane was the

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[79] There were 320 Boeing 707s, 101 Douglas DC-8s, and 24 BAC VC-10s in service at the end of 1967, with orders for another 77 707s, 34 DC-8s, and 24 VC-10s yet to be filled. The 747 was still two years from service but already had 95 orders. Only BOAC flew the VC-10. TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75." "Passenger traffic between Europe and the USA with particular reference to the UK-US routes," Folio 35, paragraph 3.1, 3.6, table 3.1.

[80] While the Boeing 707 was the frontrunner in total planes, it was not the biggest plane in operation at that time. It could accommodate 165 passengers (as could the conventional DC-8) whereas the DC-8 model 62 had 190 seats (24 passenger DC-8s were of this type as were another 6 convertible planes) and the model 61 and 63 had 250 seats (16 of these were in service). The VC-10 in contrast held only 125 seats and the VC-10 Super 160 seats. TNA BT 245/1132, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part B, 1968-75." Working Paper prepared by the Institut du Transport Aérien for the European Civil Aviation Conference, "Development of Traffic and Capacity Offered on the North Atlantic," September 1969, table 14.

[81] The 1958 order for the planes was increased to 35 at a cost of £68 million, which was then the biggest ever order for British civil aircraft. BEA was also made to buy more of the planes than it wished. Compounding the expense for BOAC, it lost money by running the planes instead of the American models. Engel, *Cold War at 30,000 Feet*, p. 190-1.

[82] The VC-10 cruised at 607 mph (977 km/h) at 26,000 feet and had a range of 5,527 miles (8,900 km) fully loaded. The Super VC-10 flew most economically at 545 mph (877 km/h) at 30,000 feet, giving it a range of 4,700 miles (7,560 km). Taylor, *Jane's All The World's Aircraft 1960-61*, p. 71-3.

[83] Some of the bigger airlines putting jets into service sold their older propeller planes to other airlines rather than hold on to the older technology. Smith, *The Airline Bibliography*, p. 84-5.

Boeing 747. Boeing was not constrained by any requirement other than that the new plane be far bigger than anything else flying and its discussions with other airlines echoed Pan Am's request for a plane with room for 350 or more passengers, or about 2.5 times more than could fit on the Boeing 707 and DC-8, the biggest planes then flying. Surprisingly, Boeing's early estimates assumed that it might sell just 50 of the model since the supersonic Boeing 2707 was expected to be the company's big item in the future.[84] As large as the jets in use at the time were, they were dwarfed by the Boeing 747, the "jumbo jet".[85] Juan Trippe pushed for the development of the 747 since each one offered the same capacity as about 2.5 Boeing 707s, Pan Am's workhorse on the North Atlantic, and would fly for about 30% cheaper than the 707 per seat-mile. Thanks to Trippe's enthusiasm for the new plane, Pan Am put an initial order for 25 of the 747s in 1966 for delivery in 1969. In the months after Pan Am made its order, several other airlines similarly placed orders: Lufthansa and JAL each put money down for three of the planes while United made an order for fifteen.[86]

In 1967, aviation trade magazine *Air Transport World* forecast that the introduction of 747s would be swift and disruptive to the North Atlantic market. Their large passenger capacity risked compounding the overcapacity problem plaguing the busy corridor unless airlines phased in the new planes gradually.[87] BOAC recognized the potential costs and overcapacity problem: putting the 747 on the routes from London to New York or Montreal was one thing, but when

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[84] Joe Sutter and Jay Spencer. *747: Creating the World's First Jumbo Jet and Other Adventures from a Life in Aviation* (New York: Harper Collins Publishers, 2006), p. 84-91.

[85] One jumbo jet could replace two or three existing narrow-body planes on the North Atlantic. The study specifically referred to the Boeing 707 and DC-8 planes then-currently flying North Atlantic routes when comparing passenger capacity to the 747. No specific passenger numbers were given for this estimate but the passenger capacity of the planes bears out the estimated carrying capacity per flight in theory. European Commission Archives, BAC 3/1978 no. 1479. Commission des Communautes Europeens, "Actions a entreprendre dans les domaines de la navigation maritime et de la navigation aerienne (Projet de Communication de la Commission au Conseil)", Communication de M. Bodson, 28 May, 1970, p. 289.

[86] Martin W. Bowman, *Boeing 747: A History: Delivering the Dream* (Barnsley: Pen & Sword Aviation, 2014), p. 39.

[87] "A Look At The North Atlantic In The '70s," *Air Transport World*, May 1967, p. 75-6.

soberly considered, there were few other destinations that merited such a big aircraft. The equation changed in 1966 when Pan Am ordered 25 of the jumbo jets. All other airlines, BOAC included, suddenly had to reassess their needs. Without 747s in its fleet, the British airline risked looking like it could not keep up with the giant American airline. By the end of 1968, BOAC committed to twelve 747s at a cost of $320 million.[88] As predicted, load factors indeed fell further in the late 1960s in large part due to the introduction of the 747.[89] The Boeing 747 presented other potential disruptions to the existing order. Airports across Europe depended upon American air traffic for their economic survival. But a small number of large planes drawing from the same passenger pool made it hard to see how transatlantic service would still call upon every European airport then being served. Secondary destinations risked losing visitors to the largest terminals. Flights between New York and Paris were not at risk, but a 747 would be unlikely to depart New York and set down in Marseilles. Less prominent destinations feared that they either had to beef up passenger demand else see their airports wither.[90]

Pan Am's inaugural Boeing 747 flight (the first 747 passenger flight in commercial aviation history) departed New York's JFK International Airport for London's Heathrow on January 15, 1970.[91] No other route was as important to commercial flight. Paul Stephen Dempsey, the Attorney-Advisor of the Office of the General Council for the CAB, noted in 1978

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[88] BOAC had trouble financing the 747 purchase. The pound was devalued during that time, so the relative cost jumped. The final figure of $320 million was set in American dollars in the event of further pound devaluation: at the time the exchange rate meant that the bill was £165.5 million. This included some of the additional equipment but also £7 million in specialized traffic handling materials due to the sheer scale of the plane. Its doors and hangar requirements were larger than any other passenger plane of the time. Bray, *The History of BOAC*, p. 330-4.

[89] Concurrent work on supersonic planes such as the Concorde was similarly expected to exacerbate the decline of load factors into the 1970s. Welge, "Impact of Technology on IATA Ratemaking," p. 1167.

[90] European Commission Archives, BAC 3/1978 no. 1479. Commission des Communautes Europeens, "Actions a entreprendre dans les domaines de la navigation maritime et de la navigation aerienne (Projet de Communication de la Commission au Conseil)", Communication de M. Bodson, 28 May, 1970, p. 288.

[91] The flight had the bad luck to run into a minor engine problem during the power-up phase of takeoff. A maintenance check turned up no serious problem (a stray gust of wind caused one engine to briefly overheat) and the flight departed JFK six hours late. The actual Atlantic crossing was uneventful. Laurence S. Kuter, *The Great Gamble: The Boeing 747* (University, AL: The University of Alabama Press, 1973), p. 106-9.

that "the gateways of New York and London have traditionally dominated transatlantic passenger service."[92] In 1971, 24.9% of all flights across the North Atlantic ran between New York and London. A mere seven airlines carried 77% of the 1.26 million London-New York passengers in 1971, with charters carrying the remaining 23%. Of the scheduled carriers, Pan Am, TWA, and BOAC each took over a quarter of the 975,000 non-charter passengers (Air India, El Al, Qantas, and JAL split the remainder). Airlines were eager to put the most prestigious airplanes in its fleet on this marquee route. By 1972 this meant the Boeing 747, which accounted for roughly 60% of the available seats from those seven airlines.[93] Each airline fought over a large but finite pool of passengers, cutting into one another's profits. Other factors magnified the already fierce competition. Noise restrictions at both ends of the route limited departure times for the big planes, leaving windows of only a few hours per day when the 747s might enter city airspaces. As such, there were brief intervals when all of the airlines made huge numbers of seats available leaving passengers little choice over departure times.[94] This was not a small problem for the airlines as the North Atlantic accounted for 41% of Pan Am's and 82% TWA's available international passenger-kilometres in 1967.[95]

The emergence of the jumbo jet marked the point where transatlantic air travel had become more than a routine process, it was almost boring. Passengers could fly by the hundreds on the massive plane at a reasonable cost and, just six hours later, step onto the other side of the

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[92] Paul Stephen Dempsey, "The International Rate and Route Revolution in North Atlantic Passenger Transportation," *Columbia Journal of Transnational Law* 17, no. 3 (1978), p. 396.

[93] Smithies, "The Changing Demand for Air Transport," p. 239-41.

[94] *Ibid*.

[95] Available passenger-kilometres is only an indication of how many people *could have* traveled had every seat been sold. Load factors are, with minor exceptions, far below 100% even on very busy routes. These figures instead demonstrate the emphasis that the airlines placed on the route. Pan American had a capacity for a total of 39.1 billion international passenger-kilometres in 1967 of which 16.1 billion was on North Atlantic routes. TWA had a far smaller 5.5 billion passenger-kilometres but most of it, totalling 4.5 billion, was for the North Atlantic. However, TWA had a domestic market that accounted for 44.6 billion passenger-kilometres in 1967, which would have softened the blow from low transatlantic capacity. TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". "Tentative estimate of capacity offered on the North Atlantic by US certificated carriers and US supplementals in 1969," Folio 36, p.5.

Atlantic. Over a million people did just that every day by the 1970s, more than had made the crossing in all of 1946 when propeller planes ruled the skies. The continuous progress provided by technological improvements, the intense government backing (both overt and behind the scenes), and the productivity of the big three American aeronautics firms turned out a steady stream of innovative new jets.

Airbus: Europe Responds to American Aeronautical Dominance

The story of civil aeronautics development from the 1940s to the 1960s was one of American ascendancy: Europe was not in the same league. The advantage that American aeronautics firms enjoyed began well before direct transatlantic competition was an issue. They had a head start on the development of large planes suited to transatlantic flight and the scale of industrial operations and market size required to build them. Douglas DC-3s, built by the thousands during the Second World War,[96] were sold as surplus by the United States military to any airline able to afford their relatively cheap price: some DC-3s cost under $10,000 apiece. This gave the American company a foot in the door among many of the world's airlines.[97] European aeronautics companies of that time had the skills to build planes that could match what the United States could produce. But by the 1960s, with the sole exception of the British-made VC-10, they were no longer making transatlantic-capable aircraft. And for each passenger jet built by a European company, the United States built 4 or more.[98]

[96] A total of 10,926 DC-3s were built by the time the last one rolled out in May 1946, all but 803 of which were specifically made for the military. Miller and Sawers, *The Technical Development of Modern Aviation*, p. 103.

[97] Proctor et al., *From Props to Jets*, p. 9.

[98] Between 1958 and 1984, European companies, mainly in Britain and France, never built more than 82 jets (which they did in 1966) of any range. The exact number produced fluctuated considerably from one year to another but was typically between 40 and 65 planes. The United States, in comparison, made about 100-200 each year in the early 1960s, had a spike in production in the late 1960s (peaking at 681 planes in 1968 as the Boeing 737 entered mass delivery), and settled to between 200 and 300 thereafter. David Weldon Thornton, *Airbus Industrie: The Politics of and International Industrial Collaboration* (New York: St. Martin's Press, 1995), p. 192-3.

America's unified internal market and geography made the country ideally suited to commercial aviation. It had several widely dispersed population centres ideally suited to spur growth in its civil aviation sector. The international market was a profitable but secondary revenue stream for America's aircraft manufacturers. Europe's larger population, in contrast, was densely concentrated so the average distance per intra-European flight was smaller, making aviation a less desirable option compared to other means of transportation. This is coupled with the fact that the United States had three regions where the population was most densely concentrated (in the northeast, the west coast, and south) that could benefit from rapid, long distance air travel to link these isolated areas. Europe, on the other hand, had a single massive concentration of people (in a region roughly outlined by the cities of London, Paris, Rome, and Berlin) and air travel there had strong competition from ground transportation. Daily airport departures bear out these figures as America saw 5,700 daily commercial flight departures whereas only 900 flights took off daily in Europe.[99] As recently as 1997, the average flight within Europe averaged 900 kilometres versus about 1,200 kilometres for those within the United States.[100] Europeans were also less wealthy per capita than their American counterparts. Since flights were more expensive per kilometre than road or rail travel, air travel was less competitive still.[101] These factors reduced the demand for air travel within Europe and kept it

[99] The United States has a surface area of 9.4 million square kilometres compared to Western Europe is 4.4 million square kilometres. In 1970, America also had a population of 200 million against 360 million in Western Europe. Western Europe at that time was therefore 3.8 times more densely populated, which made it likelier that travelers crossing that region had a shorter trip before reaching their final destination than a similar traveler might in the United States. European Commission Archives, BAC 129/1983 no. 550, p. 450-2. European Parliament, "Documents de séance, 1972-1973; Document 195/72," December 21, 1972, p. 26-8.

[100] By the late 20th century, high speed rail offered yet another form of ground transportation to eat into air travel within Europe. Flights could still offer advantages in time and distance savings within Europe, but far from that witnessed in the United States decades earlier. James Patrick Hanlon, *Global Airlines: Competition in a Transnational Industry* (Oxford: Butterworth-Heinemann, 1996), p. 84-94.

[101] The per capita GNP in the United States was $4,000 against $1,700 for Western Europe in 1970. In the study cited here, Americans were also described as being more inclined than Europeans to use the latest technology regardless of cost, and therefore likelier to use planes than people from other parts of the world. European Commission Archives, BAC 129/1983 no. 550, p. 450. European Parliament, "Documents de séance, 1972-1973;

too expensive for the average European, in turn reducing demand from European airlines for planes made within Europe. America's airlines, conversely, could provide domestic aeronautics firms with a market that was more than sufficient to support them; aircraft sales outside the United States were a bonus. By 1959, even after more than a decade of postwar recovery, the airlines of Britain and the European Community combined had barely half as many planes as did America's airlines.[102]

The market for planes was only half of the story: European aeronautics companies were far smaller than their American counterparts. By 1972 the biggest companies in Europe averaged roughly a quarter of the size of those in the United States. Each of the three largest American firms (McDonnell Douglas, Lockheed, and Boeing) was bigger than all three of the biggest European firms put together.[103] American companies also received government contracts that dwarfed those given out by European governments to their own companies. As early as

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Document 195/72," December 21, 1972, p. 26. Even as recently as 1992, Americans spent the most on international travel per capita, but other countries had largely closed the gap with the United States by 1992, with six of the top ten countries by international tourism expenditure dollars from Europe. The United States, with $39.87 billion spent, was closely followed by second-place Germany at $37.31 billion. European countries would not necessarily spend as much on air travel for these trips since an international voyage could easily be done by land rather than air, as opposed to the United States where it is difficult to reach a foreign country by land quickly. Stephen F. Witt, Michael Z. Brooke, and Peter J. Buckley (*The Management of International Tourism*. New York: Routledge, 1995), p. 39.

[102] The total number of planes operated by IATA members in 1960 was 1,217 for all American airlines versus 408 among European Community members (the six members at that time were France, Italy, West Germany, and the Benelux trio) and 234 held by Britain's airlines. All other IATA members combined possessed a further 1,543 planes. It should be noted that many of the American airlines were purely domestic (or at least did not offer transatlantic flights), but still demonstrate the scale of the American aviation market. These figures include only IATA airlines. While Luxembourg was a member of the European Community, its airline, Luxair, was not a part of IATA and so its data was not counted among the values listed here. European Commission Archives, BAC 71/1988 no. 228. Communauté Economique Européene Commission, "Applicabilité aux transports des règles de concurrence enoncées dans le traité instituant la communauté économique européene," November 12, 1960, Annex III, p. 17.

[103] A table provided in a European Commission report noted the average sizes of the eight biggest aeronautics firms in 1971 and 1972, finding that the relative size of European aerospace companies grew from about 22.5% to 26.6% of the eight largest in the United States during that time. However, McDonnell Douglas (2.523 billion EUR), Lockheed (2.315 billion EUR), and Boeing (2.194 billion EUR), remained far beyond the scope of the largest European companies, Aérospatiale (723 million EUR), Hawker-Siddeley-Av. (560 million EUR), and Dassault-Bréguet (391 million EUR). Note: EUR was a forerunner to the euro and represented a weighted average of currencies in European Community member states. European Commission Archives, BAC 94/1985 no. 156, p. 154-5. Commission des Communautés Européenes, "Les actions de politique industrielle et technologique de la communauté à entreprendre dans le secteur aéronautique," January 30, 1974, p. 48-9.

1954, the year following the end of the Korean War, the United States spent $10.6 billion directly on military aerospace research and development. Public spending on aerospace research and development in the United States had a primarily military character during the Cold War: between 1945 and 1969, the military portion of R&D spending was at least 65% of the total in every year.[104] In 1968, European Community governments spent under a quarter of what the United States did on various aeronautics projects, including all military and civilian funding. These government contracts amounted to an indirect subsidy by the American government that no single European government could match. Europe, for example, did not have a space program to rival America's NASA, and military spending in the United States was far higher than in Europe. When these are excluded, America's airlines spent about twice as much to purchase planes as the airlines of Europe did.[105]

What Europe lacked was a commercial airline market big enough to buy the planes in economically viable quantities, forcing European governments to intervene. The political drive to assemble the resources through partnerships with other European countries proved to be the only real obstacle to producing planes able to rival the best planes built by the United States.[106]

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[104] Thornton, *Airbus Industrie*, p. 25-8.

[105] Combined spending on space and military projects amount to 47.5% of all aviation spending in 1971 among European Community members (1.902 billion ECU out of 4.003 billion ECU) compared to 78.1% in the United States (15.361 billion ECU out of 19.663 billion ECU). After factoring out the impact of public funding, the total value spent directly on aviation rather than through subsidies was 2.101 billion ECU in the European Community against 4.302 billion ECU in the United States; a far closer figure. European Commission Archives, BAC 94/1985 no. 156, p. 159-61. Commission des Communautés Européenes, "Les actions de politique industrielle et technologique de la communauté à entreprendre dans le secteur aéronautique," January 30, 1974, p. 53-5. In 1970, the European Commission supported the Airbus program for the benefits that unifying Europe's aerospace sector represented to the European economy. America's aerospace companies enjoyed three major advantages over their European competitors: a domestic market that absorbed 60% of all civil aircraft produced in 1970, government contracts European states could not match, and protection against international competition by a tariff wall. These let the American companies amortize research and development costs. Plus, extensive production in the United States permitted entire "families" of planes to be built around a single model and realizing economies of scale. European Commission Archives, BAC 28/1980 no. 20, p. 9-11. Commission des Communautés Européenes, "Problèmes poses à l'industrie aéronautique européene," June 5, 1970, p. 3-5.

[106] European Commission Archives, BAC 129/1983 no. 550, p. 207-10. Conseil des communautes européennes, "Note d'information," July 4, 1967, p. 1-4.

In the mid-1960s, airlines believed that they needed ambitious planes like the Boeing 747 or then-planned supersonic Boeing 2707. European air ministries similarly believed that the ability to build those large and impressive planes was essential for the European aerospace industry to remain competitive and relevant on the global market. But by the late 1960s, European governments believed that they would find greater success in smaller aircraft where the United States could not leverage its advantages as thoroughly. Short and medium-haul planes, suited to Europe's urban geography, could be built faster and cheaper, making the total investment easier for Europe to afford. Once the planes proved their worth, the program could be expanded. This outlook formed the foundation of the Airbus program, an inter-European aerospace industry alliance conceived to compete with American aircraft manufacturers.[107]

The trend that led to the creation of Airbus began in the years after the Second World War. From the 1940s onwards Europe's aeronautics sector underwent an increasingly pressing need for such a partnership. The big aircraft manufacturing companies of the United States utterly dominated the industry. Transatlantic skies were almost exclusively the preserve of American-made planes by the 1960s. Even most short-haul and medium range planes were American-made.[108] The problem stemmed from the need to develop increasingly expensive materials for the new airframes and electronic components to operate the faster planes, both of which drove costs higher.[109] Compounding the problem for the Europeans, the American companies were so big that they could afford to gamble on the development of expensive jets

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[107] *Ibid*.

[108] American aircraft companies had a huge head start after the war's end. Some of their most successful models, the Douglas DC-3 and DC-4, as well as the Lockheed Constellation, were already on the drawing board before the war began. Wartime production needs pushed those models into production at great volume that continued until the war's end, leaving a surplus of long-range planes in America's inventory ready for commercial service. Roger E. Bilstein, *The American Aerospace Industry: From Workshop to Global Enterprise* (New York: Twayne Publishers, 1996), p. 136-8.

[109] Steven McGuire, *Airbus Industrie: Conflict and Cooperation in US-EC Trade Relations* (New York: Palgrave, 1997), p. 26-8.

that might bankrupt a smaller firm if the model proved unsuccessful.[110] They took advantage of the large American market for civil aircraft sales while also generating income from the United States Department of Defense. Foreign markets were a profitable afterthought in which they easily out-competed the smaller European companies. European domestic markets simply did not provide the same opportunities for companies to thrive, with limited exceptions. But by uniting the industries of several countries, and concentrating on a few areas showing strong signs of growth, Western Europe was able to establish a company that used international cooperation to achieve what would otherwise have been impossible.[111]

The initial (if gradual) response by European governments to the American challenge was to unify their aeronautics industries at the national level.[112] Britain and France both consolidated their industries: Britain went from 13 companies in 1955 to two large ones by 1970, and France pared down the 7 it had in 1940 to one by 1970. The resulting companies were still far smaller than those of the giants in the United States. By 1970, both countries realized the limits of domestic consolidation. They simply could not keep up with the growing costs of research and development on their own: new planes were increasingly expensive to design and produce. Only at that point did they consider international partnerships.[113] The Germans were eager participants as well. As part of the peace settlement following the Second World War, both East and West Germany lost their domestic aeronautics industry and were prohibited from pursuing

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[110] Even though their jets offered superior performance over the British Comet, Douglas, Boeing, and Convair each had to effectively write off sums in the hundreds of millions of dollars to bring their planes to the market since they could expect a return in the long run. Bilstein, *The American Aerospace Industry*, p. 143.

[111] Philippe de Woot, *High Technology Europe: Strategic Issues for Global Competitiveness*, (Cambridge, Massachusetts: Basil Blackwater Ltd., 1990), p. 106-10.

[112] Thornton, *Airbus Industrie*, p. 1-2.

[113] Katja Weber and Mark Hallerberg, "Explaining Variation in Institutional Integration in the European Union: Why Firms May Prefer European Solutions," *Journal of European Public Policy* 8, no. 2 (April 2001), p. 179-80. Where a country's aerospace industry remained weak following consolidation, the government underwrote losses. This state of affairs encouraged governments to consider more extreme options than they would previously have been amenable to. McGuire, *Airbus Industrie*, p. 33-5.

any major development in that sector. Small, civil projects were the only form of aeronautics industry permitted.[114] By the 1960s, with international partnerships offering a way back into the fold, the West German government was eager to join. A multinational aeronautics project presented the Germans with the chance to rebuild its technological expertise.[115] Europe's aeronautical industries were already holding regular talks, stopping short of full collaboration. Indeed, the British, French, and West Germans were meeting and exchanging ideas as early as 1966 to address Europe's lack of domestic aircraft production.[116]

The Airbus project, a jointly-owned and operated European aerospace firm, was officially conceived through talks at the 1965 Paris Air Show. Informal meetings between representatives of some of the larger European airlines grew more focused as the participants found common interest in creating large European aircraft to compete with American products. Forecast growth in the intra-European air market over the coming decade presented a significant opportunity that none of the countries was capable of meeting on their own. Each airline shared an interest in domestic manufacturing to build planes in medium-sized models for cheap regional transportation; an "airbus". Too many variables in the needs of airlines year-to-year precluded a single country from entering the market at that time, in their estimation.[117] Collaboration had costs but promised substantial gains for all participants. Estimates suggested that joint projects could carry additional outlays of up to 40% more than a plane developed by a single country. This extra expense, however, would be divided between multiple countries, reducing the individual burden. Furthermore, larger projects could be considered than would have been

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[114] East Germany had been the centre of Germany's aviation industry prior to the war's end, and the Soviets scoured the region under their control for every engineer, plane, and piece of equipment to bring back to the Soviet Union. The Western Allies acted similarly but to a lesser degree. Dolores L. Augustine, *Red Prometheus: Engineering and Dictatorship in East Germany, 1945-1990* (Cambridge: The MIT Press, 2007), p. 8.

[115] Thornton, *Airbus Industrie*, p. 64-5.

[116] Bill Gunston, *Airbus*. (London: Osprey, 1988), p. 14-8.

[117] "Airbus History," *Flight International*, October 29, 1997, p. 7.

possible separately. And in the case of Europe, cooperation in the aviation industry had the advantage of building a domestic competitor for the American-dominated large airliners.[118] A partnership between aircraft manufacturers had the additional advantage of eliminating competition and redundancy in a fiercely competitive field: there would be fewer similar products on the market.[119]

Airbus Industrie, as the company is formally called, found success by focusing its energy on the A300, a medium-range jet well suited for the intra-European market and the world's first wide-body twinjet.[120] Airbus managed not only to produce the plane but dominated that niche of the aircraft market, beating competitor Boeing's 767 by eight years, and securing its place in the market.[121] This came with a cost: state investment in Airbus was high. Between $4-8 billion was spent on Airbus by the participating countries over the first 15 years of operation. American companies criticised Airbus for high levels of government support, but those same companies received considerable indirect support from the American government through defence and space contracts as well as the early state backing made while the American sector was under development decades earlier.[122] Public spending on aeronautics reflected the need for intensive capital influx during the research and development phase of aircraft production before a long-term payback, lasting perhaps decades. Due to the size of the financial resources needed to develop aircraft, no single country in Western Europe could compete with the United States prior

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[118] Keith Hayward, "Politics and European Aerospace Collaboration: The A300 Airbus," *Journal of Common Market Studies* 14, no. 4 (December 1975), p. 354-5.

[119] Stephen Martin and Keith Hartley, "European Collaboration in Civil Aerospace: Success or Failure?" *Journal of Common Market Studies* 32, no. 2 (June 1995), p. 277

[120] The A300 was successful not only because it offered a considerable passenger capacity (250-300 seats) but also because its ample cargo space could fit full-sized cargo containers. Tom Crouch, *Wings: A History of Aviation from Kites to the Space Age* (New York: W.W. Norton & Company, 2004), p. 530-2.

[121] de Woot, *High Technology Europe*, p. 110-1.

[122] *Ibid*., p. 110-3. The United States government, and the Department of Defense in particular, spent upwards of $23 billion on Boeing and McDonnell Douglas between 1978-88, according to assertions leveled by Airbus. In light of net profits of $4.6 billion at Boeing and $2.4 billion at McDonnell Douglas during that same period lends some weight to the claim that those companies are the beneficiaries of American government spending. Ian McIntyre, *Dogfight: The Transatlantic Battle over Airbus* (New York: Praeger, 1992), p. 117-27.

to the arrival of Airbus.[123] While Airbus did not challenge the United States on the North Atlantic initially, it was able in later years to leverage its success in the medium-haul aircraft market to enter the long-haul market, producing several models such as the A330 and A340 that proved more than equal to the task. European aeronautics ultimately proved that it had a place in the modern aerospace world.

Decline of Ocean Liners and Ship-based Travel

Today, people cross the Atlantic Ocean exclusively by air, except for the occasional traveler that seeks a more exotic mode of transit. Crossings by ship have become uncommon but a century ago they were the only available option. As late as 1935, aircraft were used to complement a trip by ocean liners rather than compete with them. United Air Lines, from the United States, and Britain's Imperial Airways partnered together with the French Line passenger ship company to offer complete tourist packages from the United States into Europe. The American airline would carry the passengers to New York, where they would switch to the *S.S. Normandie* for the ocean crossing. Imperial Airways would then fly the passengers onward to their final destinations.[124] Such collaboration was temporary for while planes lacked the range to cross the ocean in 1935 they were on the cusp of offering an alternative to the slow-moving ships. As noted in Chapters One and Two, aircraft were recognized early on as a disruptive new technology that stood to earn a central place for transatlantic travel, if not totally supplanting ships. Governments and airlines alike poured extensive resources into studying the North Atlantic and developing the necessary infrastructure to make the harsh seas and islands safe for commercial flight. When civil aviation first took off in the region, however, air travel did not

[123] de Woot, *High Technology Europe*, p. 113-5.

[124] F. Robert van der Linden, *The Boeing 247: The First Modern Airliner*. Seattle: The University of Washington Press, 1991), p. 119-20.

monopolize the passenger market. Ships offered a competitive alternative for some time. Initial estimates for postwar transatlantic air passenger numbers were only comparable to first class ocean liner volumes prewar: about 400-500 people per day.[125]

This transitional period presented opportunities to those parties willing to exploit the new field of travel. For some, air travel represented a counterpart to sea travel, another realm of transportation with strengths and weaknesses that might serve a different market but that could be mastered in similar ways. Britain, for example, was particularly interested in building on its long history of shipping successes as it began transatlantic air operations. BOAC's General Manager of Commercial Operations J.W.S. Brancker used Britain's seafaring history as a reference point for future air operations. In 1950, he noted with some pride that British ships carried about 90% of trade between North America and the United Kingdom as well as a large share of passenger traffic.[126] Brancker claimed that Britain's success on the seas was due in large part to having the fastest and biggest ships with the most frequent service to North America. This technological edge informed British thinking with respect to air travel, including that of the Brabazon Committee during the war as noted above. With other countries conceding superiority on the seas to Britain there had been little competition to fear, whereas the growing air market represented a fresh start and vast room for newcomers.[127]

Ocean liners did more than just prove that there was a market for passenger service on the North Atlantic. They served as a basis for determining airfares on the earliest commercial

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[125] The estimates did not account for future growth or the size of current planes. It suggested that two flights each day with accommodations for 200-250 passengers would suffice for all transatlantic passengers once the war ended, despite the fact that this was far larger than any existing aircraft for years to come. TNA DSIR 27/11. Road Research Laboratory, Department of Scientific and Industrial Research, "Approximate Estimate of Transatlantic Aircraft Traffic at Terminal Airports," May 1944.

[126] British Airways Heritage Centre, AW/1/6172, Part 12 "Atlantic Services, Services, July-Dec 1950." BOAC memo from J.W.S. Brancker, General Manager Commercial, to Members of Management Panel, "North Atlantic Policy 1950/56," December 15, 1950.

[127] *Ibid*.

flights. Imperial Airways, in its criticism of Pan Am's "too low" transatlantic rates, cited the cost of first class cabins on the *Queen Mary* that ranged from £60 to £100 ($230 to $383[128]) for a one-way trip, with the higher price for the busy summer travel season. Pan Am, in contrast, offered rates for the coming 1940 summer high season at £80 ($306) one way. Imperial suggested that Pan Am should raise its fare to £100 so as not to price the liners out of the market. Pan Am was not bound by the suggestion of the British airline nor would it be adversely affected if the ocean liners were priced out of the market. But, sensitive to the wishes of the British government, it as Pan Am was not eager to antagonize its primary European market.[129] After the war, Pan Am again referred to ocean liner prices to justify its push for introducing discounted tourist rates. A round trip first class steamship ticket between New York and Southampton (or Cobh, Ireland) cost $490-750 during the peak season against $330-340 for tourist class tickets.[130] The concept of reduced tourist rates became a big consideration for transatlantic airlines in the 1950s, as discussed in Chapter Ten.

While steamships carried the majority (68.6%) of passengers between Britain and America at the beginning of the 1950s,[131] aircraft overtook them by the decade's end. It is worth

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[128] This calculation from British pounds into American dollars was made using historical exchange rate data for 1940 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[129] Wartime premiums drove the ocean liner prices higher still. In 1940, some cases saw prices rise by a third above their peacetime rate. Passenger traffic was way down as well, sorely undermining the bottom line for the shipping companies. Suggested prices for Pan Am were listed here, noting that a one-way ticket could reasonably be sold for £116 from New York to Southampton or £205 round-trip. British Airways Heritage Centre AW/1/2818, "Part 1: Atlantic Fares & Rates, 1938-45." Imperial Airways Ltd. Memo from L.W. Rashbrook to Commercial Officer, "Atlantic Fares and Rates," February 7, 1940.

[130] The reduction for off season prices varied by $20-60 depending on the ship but remained about 90-95% of the normal price. Tourist rates remained nearly identical during the off season with only a $10 cut. With Pan Am seeking to cut round trip tourist prices to $225 for a one-way tourist ticket or $405 for a round trip, planes would remain more expensive but far more competitively priced. British Airways Heritage Centre AW/1/6193 Part 1, "Atlantic Service – Tourist Class, Services, 1951." Pan American Airways, "Proposed Transatlantic Fare and Service Policy 1951-1952," May 4, 1951, p. 1-2.

[131] 691,195 of the 1,008,022 people traveling between the two countries in 1950 did so by sea in the three available classes (160,895 in first class, 235,554 in one & cabin class, and 294,746 in tourist class). Air passengers totalled 316,827. British Airways Heritage Centre AW/1/6193 Part 1, "Atlantic Service – Tourist Class, Services, 1951". Pan American Airways, "Proposed Transatlantic Fare and Service Policy 1951-1952," May 4, 1951, p. 3-4.

noting that air travel in 1950 represented a larger share of passengers (31.4%) than any single ship-based passenger class (29.2% for the cheapest "tourist" class). If considered as a premium class in its own right, air travel was already the preferred method of travel by those who could afford to travel in this way. By 1959, the ratio of sea and air passengers had reversed from where it stood in 1950. Fully two-thirds of Americans in 1959 visited Britain by plane rather than ship.[132] Ocean liner companies sought to compete by offering ever more luxurious accommodations and services at prices designed to compete with planes. Unfortunately, by the latter 1950s the writing was on the wall. Jets entered service as airfares dropped, making it hard for a tourist to justify the extra travel time in light of comparable prices, no matter how much nicer the experience might be.[133] Even passenger volumes were similar: a single jet such as the Boeing 707 or Douglas DC-8 could each carry nearly 200 people at a time[134] but could make a round-trip flight each day, whereas an ocean liner would take over a week to make the same trip despite its much larger passenger load.

Airborne passengers outnumbered those taking a ship across the North Atlantic in 1957 for the first time, and the share of passenger traffic by air grew over the years that followed.[135] Ship-based travel declined throughout the 1960s. In 1960, nearly 900,000 passengers traveled by sea compared to just over 2 million by plane, about 31% of the total,[136] dropping to 11.9% in

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[132] Aircraft passenger numbers rose faster than those voyaging by sea, although both grew in absolute terms throughout the 1950s. Jackson, "The New Air Age," p. 180.

[133] T.A. Heppenheimer, *Turbulent Skies: The History of Commercial Aviation* (Toronto: John Wiley & Sons, 1998), p. 192-4.

[134] The Boeing 707-320B (the intercontinental variant of the 707) could accommodate up to 189 people while the Douglas DC-8 could hold as many as 177 people. "Commercial Aircraft of the World…" *Flight International*, November 23, 1961, p. 804, 818.

[135] William Warntz, "Transatlantic Flights and Pressure Patterns," *Geographical Review* 51, no. 2 (April 1961), p. 187, footnote 1.

[136] Smithies, "The Changing Demand for Air Transport," p. 238.

1967.[137] This trend persisted until, in 1971, just over 200,000 went by sea in 1971 whereas planes carried over 11 million in that year, a mere 1.9%.[138] By the 1970s, sailing between Europe and North America was a choice rather than a cost-saving necessity. Planes had become more than merely cost-competitive but were the norm, faster and no less safe than an ocean liner. The newer technology had totally upended this market in a few decades.

Concorde and Supersonic Flight

This dissertation is concerned with how transatlantic flight became routine from the first tentative crossings to the point when nearly anyone could easily cross the ocean by plane. An important part of this story is the (ultimately abandoned) development of supersonic air service: the Concorde. With brief exceptions, the North Atlantic was the only place where the plane operated during its 27 years of service. Nowhere else was suitable for the plane's use and nowhere else was considered important enough to use it. Technological advances permitted the construction of ever faster planes throughout the twentieth century and by the 1960s some American fighter planes already boasted supersonic speeds. While commercial aircraft were built to different standards, the principles behind supersonic air travel were understood.[139] It was therefore logical for industry observers to expect ever-faster planes to continue entering the market indefinitely: a 1967 article in *Air Transport World* fretted that the introduction of the Concorde (alongside the 747) would be so successful that it would create massive overcapacity

[137] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". "Passenger traffic between Europe and the USA with particular reference to the UK-US routes," Folio 35, paragraph 1.1.

[138] Smithies, "The Changing Demand for Air Transport," p. 238.

[139] This is not to say that there were no remaining technical questions or that all issues were addressed, merely that it was understood by the 1960s that it was possible to build a supersonic commercial airliner. Fuel consumption and aircraft design were some of the obvious problems in need of solving even at that early stage. Andrew Wilson, *The Concorde Fiasco* (Harmondsworth: Penguin, 1973), p. 13-4.

on the North Atlantic market by the mid-1970s.[140] While the 747 succeeded, the Concorde never expanded beyond a niche market. Why this happened is crucial to understanding both air travel and the transatlantic sector.

Several studies predicted, or at least assumed, that commercial supersonic flight was not merely inevitable but that it would become the preeminent form of air travel. One report by the British Ministry of Aviation expected transatlantic passenger numbers to climb fivefold above their 1961 level by the mid-1970s by traveling on supersonic planes, totalling about 500 flights per day with 100 seats per plane.[141] The British Ministry of Technology produced a similar account in 1968 that estimated up to 200 Concorde flights per day by 1976.[142] Even as late as 1971, when the shortcomings of supersonic air travel were widely known, 16 airlines reserved 74 of the plane.[143] The Ministry of Technology study expected demand for supersonic air travel to be so widely adopted that it would become a victim of its own success. Conventional jets flew at up to 40,000 feet while Concordes would fly specially designated transatlantic tracks at between 45,000 and 60,000 feet. While the first Concorde would have the corridor to itself, additional Concordes would crowd the route. A 90 nautical mile separation between two Concordes on the same track was considered a necessary minimum until better navigational systems could reduce the distance.[144] The then-planned introduction of its competitor, the Boeing 2707, was seen as a

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[140] *Air Transport World*, "A Look At The North Atlantic In The '70s," May 1967, p. 75.

[141] TNA AVIA 6/21564. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "Preliminary studies for models of future North Atlantic air traffic control systems with particular reference to supersonic flight, March 1961", p. 6.

[142] TNA DSIR 23/28048. V.W. Attwooll for the Royal Aircraft Establishment of the Ministry of Technology, "Studies of the Design of a Transatlantic Route Structure for Supersonic Transports," July 1968, p. 3.

[143] Welge did note that, although the Concorde might have a major impact on air travel the nature of the effect was impossible to predict. The plane was certainly not ideal for all (or even most) routes. Welge, "Impact of Technology on IATA Ratemaking," p. 1167-8.

[144] This was a similar situation to that found with subsonic planes over the North Atlantic noted in Chapter Five. Alternate scenarios during that planning stage mentioned that longitudinal separations of 60 or even 30 nautical miles would be possible with proper precautions, experience, and better equipment. At its average cruise speed of Mach 2, the Concorde would cross 30 nautical miles in just over 80 seconds. TNA DSIR 23/28048. V.W.

solution to this problem. The American supersonic plane was designed to fly higher still, 10,000 feet above the Concorde, in another entirely new and therefore unoccupied track. The 2707 could thus ease the crowding by spreading the supersonic passenger load without the need for new infrastructure or equipment.[145]

Air France was particularly interested in supersonic air travel. In January 1964, soon after the Concorde moved beyond the planning stage, the airline increased its existing order from six to eight planes. The following month it also put in an order for six of the then-planned Boeing 2707. Representatives from Air France contended that buying two supersonic models was sensible: the Concorde was designed to fly at Mach 2.2 whereas the Boeing 2707 could operate at Mach 3, and each would fly at different altitudes. Each plane could therefore be used for different subsets of passengers.[146] As supersonic air travel remained some years in the future by 1964, it seemed prudent not to rely entirely on a single company to deliver an untested piece of hardware while much of the technology was experimental. Boeing in particular sought to make a technically challenging leap. The 2707 was designed with an expensive titanium and stainless steel body to cope with the intense heat encountered at Mach 3, rather than aluminum as used in existing planes and the Concorde.[147] Supersonic flight causes heat buildup on a plane's leading edge that increases as speed climbs. At Mach 2 the temperature will be about 100ºC, but

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Attwooll for the Royal Aircraft Establishment of the Ministry of Technology, "Studies of the Design of a Transatlantic Route Structure for Supersonic Transports," July 1968, p. 20.

[145] Exact specifications for the Boeing 2707 were not finalized since the plane never reached the prototype stage, so data included here is based on then-current plans. The 2707 was to fly at up to Mach 3 while carrying far more passengers than the Concorde. *Ibid*., p. 20-1.

[146] Air France did not comment on where one plane would be more appropriate than the other. "We Order Eight Concordes and Reserve Six American SSTs," *Aboard*, February 1964, p. 1.

[147] TNA DSIR 23/28048. V.W. Attwooll for the Royal Aircraft Establishment of the Ministry of Technology, "Studies of the Design of a Transatlantic Route Structure for Supersonic Transports," July 1968, p. 1.

at Mach 3 it is close to 300ºC. Aluminum becomes weak at 300ºC and so cannot be used for flight much faster than Mach 2 without elaborate cooling mechanisms.[148]

While the Concorde actually made it to production, the Boeing 2707 remained on the drawing board. The American project lost the critical government backing as the realities of supersonic flight, including cost and technical worries, became better understood. The first critical shortcoming came to light in 1963 when the IATA General Assembly discussed the need for further study of civilian supersonic air travel. The sonic boom was singled out an area of particular concern.[149] A sonic boom occurs when an object exceeds the speed of sound (Mach 1, or about 1,235 km/h). Since air displaced by the plane does not move quickly enough to fill the space behind it above that speed, it creates an empty pocket that the surrounding air rushes into. The air creates a cracking sound akin to a thunderclap or gunshot and is extremely loud even from a distance. These studies speculated that the sonic boom from a supersonic aircraft would be noticeable but generally acceptable to the public. A British study from 1961, using explosives to simulate the noise, found that while 85% of the general public was not bothered by the sound 10% found the noise excessive. The Ministry of Aviation believed that these results proved supersonic air travel to be acceptable.[150]

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[148] Concorde backers reasoned that the additional time savings for flights faster than Mach 2 were negligible on the transatlantic market: a London-New York service might take about 3 hours at Mach 2 but drop to only about 2 hours and 30 minutes at Mach 2.6, the speed that a titanium plane would most economically fly at. Wilson, *The Concorde Fiasco*, p. 17-23.

[149] The sonic boom was the biggest worry but there were a few unknowns and technical matters that had to be studies as well. These were more mundane matters such as high altitude meteorology, development of the necessary construction materials, and air traffic control that could reasonably keep up with the high speed flights. The study also noted the growing concern regarding noise around populated areas from conventional aircraft. This problem would prove vastly detrimental to the Concorde's prospects since it was a loud plane at even subsonic speeds. After takeoff, a Concorde had to be quickly guided to a corridor away from populated areas to minimize exposure to its loud engines.European Commission Archives, CEAB 10 no. 586, p. 114-7. IATA, no. 36 "Informations," October 1963, p. 1-4.

[150] Risks to the planes were assessed in the report as well since supersonic aircraft might fly at up to 100,000 feet. Their experience differs from flights at 30-40,000 feet. The higher altitude would expose planes to higher levels of radiation than conventional flights. Radioactive particles were a noted source of concern at those heights, so flights were recommended to carry radiation detectors. Exposure to ozone, which is found at far greater

America's FAA performed similar tests since the vast government funding for the Boeing 2707 would be for naught if the planes could not be flown through its own airspace. Unlike the British test, the Americans used aircraft-generated sonic booms conducted in several locations across the country during the early 1960s. The most thorough test was performed in Oklahoma City in 1964,[151] where 8 of the booms were audible every day between 7 a.m. and the early afternoon for six months. There were no public consultations before the tests and soon after they commenced citizens lodged complaints. The city was chosen for the tests in part since the large aerospace sector there made the people likelier to tolerate the noise. Despite efforts to carefully manage the power of the sonic booms, there was occasionally damage to windows and other fragile items and thousands of complaints were lodged over run of the program.[152] Fully 90% of Oklahoma City's residents found the daily sonic booms tolerable during the first weeks of the program but that number dropped to 73% near the end. A quarter of those polled claimed they could not tolerate the sound indefinitely while 56% found the booms annoying.[153] Public perception that sonic booms were simply too loud caused fatal damage to supersonic air travel's reputation in the United States. Without public backing, there was no way supersonic flights could operate within the country as the Concorde would generate a sonic boom audible 40 kilometres away while the higher-flying Boeing 2707 would be heard nearly 50 kilometres

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concentrations at the higher altitudes, was not considered a risk factor for the aircraft or passengers whereas the damage caused by the planes to the ozone was not considered. NARA RG 237, Box 83, Folder 5500 "Internat'l Oper," 1963 (folder 3 of 3). Memo from FAA Administrator to Heads of Washington Office and Services, "United Kingdom/European/African Trip; February 3-February 17, 1963," June 3, 1963, Appendix B, p. 21-3.

[151] Reactions to the sonic booms, including cases in Britain and France, were generally recorded as being either indifferent to very upset. Local conditions played a large part in how the audible the sound was, including atmospheric conditions and local topography (which might focus a boom into a very loud one). Wilson, *The Concorde Fiasco*, p. 56-66.

[152] Osita Nwanevu, *Slate*, "Boom and Bust: A half-century ago, sonic boom tests terrified Oklahoma City residents," July 29, 2014.

[153] Paul N. Borsky, "Community Reactions to Sonic Booms in the Oklahoma City Area, Volume I: Major Findings," Report No. 101, January 1965, p. 2-3.

away.[154] There was no corridor across the United States (or most other countries) wide enough to accommodate the noise without generating huge numbers of complaints. President Richard Nixon formed an ad hoc committee to study the prospects for the Boeing 2707 soon after he took office in 1969. The committee, in addition to echoing popular noise concerns citing similar problems with comparable military aircraft, also damned the plane for the likelihood that its development would run wildly over budget.[155] Between this and a growing fear of environmental damage to the upper atmosphere, the American government eventually banned supersonic air travel over land in 1973.[156]

With limited access to American airspace and other countries following the American example, supersonic air travel was restricted to flights over the open ocean.[157] The North Atlantic was one of only a handful of places where the Concorde would be allowed to fly. However, in a 1971 letter, Ernest Glinne, a member of the European Parliament, expressed his fear that the Concorde would prove impractical. He pointed to the fact that the state governments of both New York and New Jersey, covering all of the airspace around New York

[154] The altitude of the aircraft at supersonic speeds determined how far away its sonic boom could be heard. The Concorde was assumed here to fly at 17 km and so its "carpet", the swath of land below where the sonic boom would be heard, was 80 km across. The Boeing 2707 was assumed to fly at 19 km so its carpet was 95 km across. Also important was that the duration of a sonic boom was considerably longer than the sound of an explosion: 250-300 milliseconds compared to 10 milliseconds for an explosive, making the intensity of the sonic boom appear far greater. C.H.E. Warren, "Sonic boom exposure effects 1.2: The sonic boom—generation and propagation," *Journal of Sound and Vibration* 20, no. 4 (February 1972), p. 489-90.

[155] The committee also brought up the plane's potential environmental damage. Since supersonic aircraft would fly much higher than existing jets, they would introduce carbon dioxide and other exhaust chemicals into a sensitive part of the atmosphere with unknown effects. Most of the health and environmental concerns were speculative but were taken seriously due to their tremendous potential implications. John Costello and Terry Hughes. *Concorde: The International Race for a Supersonic Passenger Transport* (London: Angus & Robertson, 1976), p. 166-90.

[156] Environmental concerns included damage to the ozone layer by the exhaust from the plane at such a high altitude. The environmental movement was not mature at that time but American citizens were still cognizant of the dangers that atmospheric degradation could pose. Nwanevu, "Boom and Bust," July 29, 2014.

[157] Uninhabited lands such as deserts or tundra were still open for supersonic air travel, but this did not make up for the loss of virtually every profitable route. R.E.G. Davies, *Supersonic (Airliner) Non-sense: A Case Study in Applied Market Research* (McLean, Virginia: Paladwr Press, 1998), p. 21.

City's three major airports, had created laws restricting aircraft noise.[158] The Concorde was exceptionally loud even at subsonic speeds compared to other planes, but the sonic boom was considered intolerable above inhabited lands. Without a guarantee of access to the main North American terminal for transatlantic air service the economics of the plane were in jeopardy. Every American airline with outstanding orders for the Concorde asked for a refund, with Pan Am backing out altogether in 1973.[159] With only a few cities in North America and Europe able to handle the loud plane, the ticket price would have to be higher than usual and therefore attract a very small clientele. Other American airlines that were interested in the Concorde up to that time similarly turned their backs on the plane after reaching similar conclusions. Pan Am cited its own studies indicating the Concorde had poor economic prospects,[160] but the airline was in poor economic straits at that time and could hardly have afforded a major capital expenditure anyway.[161] Compounding this was the matter that both BOAC and Air France, the only airlines still intent on purchasing the planes, had pared their orders from 72 to 30. The major capital investment by the British and French governments, Glinne speculated, might fail before the Concorde flew for the first time.[162]

BOAC was already concerned with the growing price for the Concorde. In 1972, without a single plane delivered, the expected cost for the initial five supersonic planes and associated equipment was pegged at £115 million ($287.5 million). Following various cost overruns on the production side and decisions by America's airlines not to purchase any planes at all, BOAC's

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[158] European Commission Archives, BAC 28/1980 no. 20, p. 45-50. Commission des Communautes Europeens, "Réponse de la Commission des Communautés européennes à la question écrite no. 567/70 de M. Glinne," June 11, 1971.

[159] Davies, *Supersonic (Airliner) Non-sense*, p. 20-1.

[160] Costello and Hughes, *Concorde*, p. 10-3.

[161] *Ibid*., p. 213-5.

[162] European Commission Archives, BAC 28/1980 no. 20, p. 45-50. Commission des Communautes Europeens, "Réponse de la Commission des Communautés européennes à la question écrite no. 567/70 de M. Glinne," June 11, 1971.

bill climbed to £127 million ($297.18 million[163]) by 1974, at a time when the airline was in severe debt. The far more economical planes already in service, such as the Boeing 747, continued to bring in revenue. The British government was intent that BOAC not pull out of the project as the Concorde was being built in part by the British aerospace industry, representing a major technological coup despite the poor economic prospects.[164]

R.E.G. Davies, a noted expert on civil aviation, vociferously argued that politics trumped economic sense with the Concorde. He pointed out that Britain and France soldiered on to build the plane knowing that it could not fly over land and that it had a limited range compared to conventional jets. A route between London and Sydney (or any other city in Australia) was infeasible without at least two intermediate refueling stops, each one entailing detours and time lost on the ground. The duration of such a route was roughly a third less than that of a subsonic plane like the 747 or Airbus 340, enough to be notable but hardly cost effective.[165] The sonic boom restrictions also restricted the plane to corridors above the sea along almost the whole route. Only a handful of routes were ever operated as a result, all but one of which straddled the Atlantic Ocean. By 1993, only New York-London and New York-Paris remained in service.[166]

Davies was exceptionally critical of the economics behind the Concorde, justifiably so since it never operated profitably. Its limited seats and exceptionally high prices, not to mention its limited selection of destinations, meant that it was an anomaly. The Concorde kept the transatlantic region as a showcase for the cutting edge of aviation technology, but it had a limited

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[163] The calculations from British pounds into American dollars were made using historical exchange rate data for 1972 and 1974 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[164] Bray, *The History of BOAC*, p. 402-4.

[165] Australia was frequently cited as a primary destination for the Concorde during the planning stages. Davies felt that this was an absurd target even without the limited time savings since the entire country had a smaller population than the greater New York City area and so could never muster enough demand for the service. South Africa, another target for British supersonic flight, had a small urban population to make routes there economically viable either. Davies, *Supersonic (Airliner) Non-sense*, p. 13-5.

[166] *Ibid*. p. 22-3.

impact on aviation as a whole and barely a noticeable one within its own operational sector. The United States government had saved itself the economic burden of building and maintaining an expensive fleet of the planes by virtue of going it alone, therefore avoided the binding terms that the British and French imposed upon themselves with the Concorde agreement. The two European partners lacked an exit clause and so neither party could act on any doubts about the project.[167] This is not to say that there were no upshots to the Concorde. The plane served its small market quite well and was a testament to the advanced technology it used. It was, however, a plane without a real market, pushed into production by a politics of prestige rather than by market demand.[168]

Had Boeing succeeded in building the 2707 at a reasonable price, BOAC and Air France, and likely all other major airlines, might have bought the faster, more technologically ambitious aircraft. Its higher cruising altitude would have gone part of the way to diminishing the impact of the sonic boom at ground level, but would still have required careful implementation to minimize the disruption of daily life. The two European airlines still received several of the Concordes, which the French and British themselves had a hand in constructing, and they operated the planes until 2003 when they were finally taken out of service. As it happened, cost and technical factors coalesced to make the jump beyond the sound barrier much more challenging than previous steps in aerospace development. When and how this form of travel might re-emerge is well beyond the scope of this study, but for a time it appeared to have a critical part to play in the North Atlantic travel market. That oceanic airspace was the only place it flew, serving the routes between New York and London and Paris, is a further testament to the importance of the North Atlantic route for aviation as a whole.

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[167] Kenneth Owen, *Concorde and the Americans: International Politics of the Supersonic Transport* (Washington, DC: Smithsonian Institution, 1997), p. 172-4.

[168] *Ibid*., p. 177-81.

Conclusion

Aeronautical innovation transformed the North Atlantic during the twentieth century. What was once the sole preserve of ocean liners became dominated by airliners in mere decades. This would not have been possible if the newer technology remained expensive: the drive to make better planes encouraged the aerospace firms to find new ways for aircraft to fly economically, faster, and with more room for passengers and cargo. The new planes that entered use following the war, designed and built with transatlantic service in mind, could carry a passenger between the cities of Europe and North America in a day (including refueling stops) where the trip once took nearly a week. And the drive for better planes made the flying experience even more pleasant. The airlines demanded the best possible technology to put on this prestigious service, with the introduction of jets and a drive for supersonic air travel spurred on in large part for those runs. By the 1960s, nonstop service meant a transatlantic trip might last just 6 hours, or under 3 on the Concorde. But government support lay behind all of these advancements. The Cold War boosted American military spending on aerospace programs such that new civil aircraft, with long development timeframes and payback horizons, could be profitably developed without great financial difficulty. The European governments directly supported their aviation industry while the American government directed military contracts to its big companies that dwarfed European spending. The Airbus project would not have been possible without government support, but forming Airbus might not have been necessary in the first place had the American companies not received state funding through military contracts. Behind it all, the pull of the North Atlantic market transformed aeronautics. The promise and profit it represented for aviation focused public and private energy towards the betterment of the industry and for anyone who wished to fly.

Chapter Five: Transatlantic Air Traffic Control

Transatlantic flight depends on several levels of infrastructure to function smoothly and safely. One of the most important of these is air traffic control (ATC): the array of stations that monitor and communicate with planes in flight. On the North Atlantic, this network has to run well at all times since a single error can result in a fatal incident. The work has increased in direct relation to the number of flights, making the busy region a particular point of concern. If a plane's actual course or speed varied from its flight profile, it was up to the ATC operators to detect and log the change to prevent a collision. Much of this work is done at the major airports ringing the North Atlantic. The ATC operators at those airports had to direct the planes in both oceanic and local airspace and as they took off and landed. Tracking the planes at both long- and short-range without opening a gap in ATC coverage involved the coordination of separate technological systems including radio contact, direct radar sightings, and, when possible, simply by sight under visual flight rules (VFR). The implementation of the latest technologies was not always universal nor was it swift, and was sometimes stymied by poor communications between operators. Over time, experience and a more robust ATC network in both North America and Europe made the airspace safer for all flights.

Air Traffic Control and Airports

A flight across the ocean involves at least one handoff between air traffic controllers in several countries, all of whom require accurate information about the flight. The lives of those aboard depend on timely, correct data about the position of their flight and all others in the region so that each plane flies at a safe distance from all others. Each ATC centre serves a region where it guides the plane until the point of handoff. The handoff takes place at the

boundary between that controller's region and the next one along the flightpath.[1] During the Second World War, the Allies built a comprehensive and robust ATC network on the North Atlantic based on this practice. After 1945, this network continued to coordinate both military and civilian aircraft movements. An array of interlocking ATC zones covered the vast swath of water, each one handled by a single station tasked with following the exact track of each plane in its jurisdiction. Aircraft over (roughly) the western half of the northern Atlantic Ocean were monitored by and had to coordinate with an ATC tower at the Gander airport until they passed east of 30° west longitude.[2] A flight traveling on the east of that line was generally closer to a station in Europe, and one on the west was closer to one in North America. It was sensible for the country closest by to render support over the ocean.[3]

Until 1950, three separate ATC zones covered smaller patches of the eastern oceanic airspace and the British Isles together. These were Prestwick,[4] Shannon,[5] and London.[6] London's main international airport, Heathrow, was sited on a field west of the city and built

[1] In the 1950s, pilots were responsible for contacting the ATC centre as it entered the subsequent airspace. There was rarely any direct communication between ATC operators at different stations except when one forecasted a collision might be imminent. When one operator contacted another by phone, however, it was possible that the line might be busy. Communication problems such as the absence of dedicated phone lines were a serious but preventable risk. Lars Heide, "Eurocontrol: Negotiating Transnational Air Transportation in Europe," in Erik van der Vleuten, Arne Kaijser, Anique Hommels, and Per Högselius, eds. *The Making of Europe's Critical Infrastructure: Common Connections and Shared Vulnerabilities*. Basingstoke: Palgrave Macmillan UK, 2013), p. 191-2; 194.

[2] Overseas flights between 43° and 66°30' north latitude and bounded by 65° and 30° west longitude fell under Gander's ATC jurisdiction. Flights closer to the North American coast than 65° were handed over to a local ATC tower. This did not include the region north of 61° that stretched eastwards from the Greenland coast. That area fell under Iceland's Keflavik ATC zone that ran eastwards to the prime meridian. New York and Lisbon provided coverage south of 43° north, split along the 45° west meridian (watching the regions west and east of 45° west respectively). British Airways Heritage Centre, AW/1/7464, "Mid-Atlantic Services, Wireless/Meteorology, 1949-50." BOAC memo from P.J. Dundee, Senior F.O.O., to Operations Manager, "Flight Supervision Area – Lisbon," April 25, 1950.

[3] Who should maintain radio contact for aircraft over the Atlantic Ocean and transmit weather data was assigned in 1928 at a series of meetings including representatives from the United States, Canada, and Britain. Morley K. Thomas, *Forecasts for Flying: Meteorology in Canada, 1918-1939* (Toronto: ECW Press, 1996), p. 105-6.

[4] 54° to 61° north latitude by 30° west longitude to the prime meridian. *Ibid*.

[5] 43° to 54° north latitude by 30° to 6° west longitude. *Ibid*.

[6] 43° to 54° north latitude by 6° west longitude eastwards into European continental airspace. *Ibid*.

from 1944 to 1946 and handled ATC for part of the North Atlantic.[7] On May 15, 1950, these three latter zones were consolidated into a single large London-based ATC zone for all aircraft flying above British airspace, simplifying the work for both aircraft and ground stations.[8] But the primary ATC centres for North Atlantic flight are handled in Prestwick, Scotland, and Shannon, Ireland. Up to 1966, both Shannon and Prestwick provided ATC services for the same region of the Atlantic and the flight would simply connect to whichever centre was most convenient. But this duplication complicated operations in that region and was inefficient. To address this, the British and Irish governments agreed to unify their oceanic ATC service: Shannon handled communications while Prestwick performed the air traffic planning and guidance. The combined operations centre was called "Shanwick" and continues to operate in this capacity today, maintaining ATC services for all North Atlantic air traffic from 30° west to the shores of the British Isles.[9]

The major airports around the North Atlantic play an important role in support of that corridor. In addition to providing a great deal of the support infrastructure such as ATC, radar tracking, and radio communications, they were the hubs through which passengers from across Europe and North America gathered before and after their long oceanic journeys. A mere handful of them still guide flights across the North Atlantic today. A brief examination of some of these airports will illuminate the role these airports play in the context of transatlantic flight, both within their regional and international context.

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[7] Robin Higham, "A Matter of the Utmost Urgency: The Search for a Third London Airport, 1918-1992," in William M. Leary, ed. *From Airships to Airbus: The History of Civil and Commercial Aviation* (Washington: Smithsonian Institute Press, 1994), p. 21-2.

[8] British Airways Heritage Centre, AW/1/7464, "Mid-Atlantic Services, Wireless/Meteorology, 1949-50". BOAC memo from P.J. Dundee, Senior F.O.O., to Operations Manager, "Flight Supervision Area – Lisbon," April 25, 1950.

[9] Irish Aviation Authority, *History*. Retrieved from: https://www.iaa.ie/air-traffic-management/north-atlantic-communications/north-atlantic-communications---history (April 7, 2016).

European airports were widely built during the 1920s and 1930s through government funding. London, Paris, and Berlin all built large airports at Croydon, Le Bourget, and Tempelhof Airports, respectively, that reflected the importance placed upon both air travel and the central position that their capital cities would play in that field.[10] Berlin's Tempelhof Airport was even used as a propaganda piece by the Nazi regime, a showcase to the world of the nation's wealth and power.[11] With the exception of Washington National Airport serving Washington DC, American airports were not typically built with federal funding.[12] Most airports in the United States were instead built with private money or by local governments (the latter of which often purchased private airfields) during the 1920s and 1930s.[13] The National Airport Plan of 1938 changed this: the United States concentrated on upgrading a select few regions in support of international air travel, reflecting the rapid expansion of air travel at that time. Some airports in the American northeast were expanded specifically to make flights to Europe easier at that time.[14] What none of the airport designers of the prewar era expected was the sheer volume of air traffic in the postwar era. Built in or near major cities and often near secondary airports serving the same city, airspace in urban areas was a crowded, messy situation. The challenge of handling the increasingly saturated airspace fell to the ATC operators.

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[10] Janet R. Daly Bednarek, *America's Airports: Airfield Development, 1918-1947* (College Station: Texas A&M University Press, 2001), p. 100.

[11] It was during the 1930s that air travel became so popular that airfields were built up into airports, offering amenities to passengers such as restaurants, airport administration buildings, hotels, ground transportation facilities, and other services to make air travel more pleasant. Emmanuel Chadeau, "Part One. History of Airports: A Contextual Approach," in William M. Leary, ed. *From Airships to Airbus: The History of Civil and Commercial Aviation* (Washington: Smithsonian Institute Press, 1994), p. 17-8. An airfield is included as a part of an airport: it is where planes actually operate, including the runway, apron, taxiways, maintenance facilities, and other ATC-related facilities. The inclusion of a "landside" makes an airport, with the structures and amenities described above., Amedeo Odoni, "Airports," in Peter Belobaba, Amedeo R. Odoni, and Cynthia Barnhart, eds. *The Global Airline Industry* (Chichester, West Sussex: Wiley, 2009), p. 343.

[12] Bednarek, *America's Airports*, p. 100.

[13] Modern American airports are managed by either the local government (either the city or state in which it is located) or a private government-backed authority (such as the Port Authority of New York and New Jersey for the New York City area airports). Daniel S. Reimer, et al. *Airport Governance and Ownership* (Washington, DC: Transportation Research Board, 2009), p. 3-4; 32-41.

[14] *Ibid*., p. 151-2.

Few major American airports were built after the 1940s within the United States. The main cities of the east coast either built up the ground facilities for their commercial air service during the 1930s or inherited airfields built for military purposes during the war. La Guardia served as the main transatlantic hub for air travel for both the city of New York and the country after it opened. Newark, in nearby New Jersey, had an airport of its own that served New York City as well. Idlewild (later renamed JFK International Airport) was under construction during the war and completed in 1948, inheriting the role of transatlantic hub from La Guardia.[15] One important distinction between American airports and those in Europe was the early adoption of the hub-and-spoke nature system of connecting flights although European airlines adopted this model in the latter twentieth century following widespread European aviation deregulation. Regional connecting flights carry many (often a majority of) passengers to and from connecting international flights at a hub, such as at Idlewild. This means that considerably more planes were needed to carry the same number of passengers compared to the European airports, so the airspace and ground facilities were more crowded.[16]

There are therefore a huge number of domestic flights heading in or out of New York's airspace. Coupled with the fact that New York is the biggest city in the United States as well as the country's main hub of transatlantic air services and that planes fly to not one but three major airports, Idlewild, La Guardia, and Newark, all the elements were in place for a disaster in a moment of negligence. Such was the case in 1960 when a midair collision killed everyone on board two passenger planes circling over the city. Ground control facilities were unable to

[15] Janet R. Daly Bednarek, *America's Airports: Airfield Development, 1918-1947* (College Station: Texas A&M University Press, 2001), p. 180.

[16] European airports lag behind American airports in terms of the concentration of connecting flights at their hubs, having deregulated their market more recently with the "Single European Sky" program backed by the European Union. Amedeo Odoni, "Airports," p. 345-7.

prevent the incident on account of the limited visibility, crowded airspace,[17] and lack of coordination between ATC operators in the airports involved. The ATC tower in La Guardia was not in constant communication with the ATC tower in Idlewild at the time of the incident. Both planes followed their holding pattern flightpath by following a radio beacon signal network. One of the planes, however, had technical problems and its receiver was not working. While both planes communicated with their respective ATC controller, the controller at each tower lacked critical information about the exact position of the other plane.[18] This is not to say that short-range radar was an absolute necessity for landing operations: after it was installed in 1961, Idlewild experienced a 12-hour radar outage that made for landing delays of just 20 minutes.[19]

Paris used its existing airport at Orly for transatlantic services after the war's end.[20] It built its current primary international airport, Charles de Gaulle Airport, in 1974. Most of the non-European international air services were transferred there upon its opening. De Gaulle was sited on a stretch of land well away from the city centre where there would be minimal complaints about the sprawling complex, noise, and direct interference with the flight corridors of the other major airports at Le Bourget and Orly. But, for all the advantages of its location, passengers arriving from a long transatlantic flight faced a long drive into the city. Flight crews likewise had low clouds to contend with, regularly requiring ground control to guide the plane

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[17] The radar operator at La Guardia did note that a collision was possible in advance but could not be sure since his radar did not indicate the altitude of the plane headed to Idlewild, which he did not know in advance. *New York Times*, "U.S. Plans to Keep Air Traffic System," December 23, 1960, p. 11.

[18] The main long-range radar station covering all planes within 200 miles of New York was located at Idlewild. Paul J.C. Friedlander, "Air Traffic Control: Procedure at Idlewild," *New York Times*, December 18, 1960, p. E4. The long-range ATC centre was relocated to a site 40 miles east of the Idlewild facility in 1963. While the move was predicted to improve ATC efficiency thanks to new computers, radars, and better communication facilities, the decision to relocate was made in accordance with FAA policies that such centres should be put far from population centres in the event of a nuclear attack. Edward Hudson, "Air-Traffic Control Is Moved to Suffolk," *New York Times*, July 21, 1963, p. 1.

[19] "Radar Out 12 Hours Idlewild Carries On," *New York Times*, October 8, 1961, p. S10.

[20] Of particular note, in 1945 the Orly airport was building ten additional runways to accommodate anticipated air traffic. Modern airports have fewer than this (typically 2 to 6) at the busiest international airports. "Civil Aviation News," *Flight International*, September 20, 1945, p. 320.

down by radar up to the last moment before touchdown. The ATC tower in de Gaulle played a far bigger role in guiding planes onto the ground than in most other major airports for this reason.[21]

The small size of most countries in Europe meant that the continent was divided into a patchwork of small sovereign airspaces, each with its own ATC controller. This made long-distance flight a problem when a plane might cross several countries in an hour. To simplify the problem of coordinating air traffic at the international level, several West European countries centred around West Germany and the Benelux trio formed the nucleus of what would become Eurocontrol, a jointly-run European airspace with a centrally-coordinated computerized ATC system. The Eurocontrol authority would only exist in the upper atmosphere (above 20,000 feet) but would direct all civil aviation above that altitude in member countries.[22] As membership in Eurocontrol expanded following its 1960 founding, the organization became stymied by the refusal of several members to surrender their sovereign control over their airspace. By 2010, Eurocontrol had 38 members but it acted more as an intermediary between the ATC operators in each country than the authority it was conceived as. Eurocontrol also served as a clearinghouse for funding transatlantic ATC at Ireland's Shannon airport from 1969 onwards.[23]

These big airports were hubs for air travel worldwide. The airports listed above were all among the top thirty by annual passenger movements in 2007, reflecting the importance of the North Atlantic market as a gateway connecting major population centres.[24] One airport not mentioned above, Montreal's Dorval Airport, is also worth discussing. Although not as large or

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[21] "Charles de Gaulle," *Flight International*, May 30, 1974, p. 686.

[22] Heide, "Eurocontrol," p. 196-201.

[23] Ireland joined Eurocontrol in 1965 specifically to receive assistance in running its transatlantic ATC services. The small country had difficulty in putting together all the resources needed for supporting the busy corridor. *Ibid*., p. 201-4.

[24] Amedeo Odoni, "Airports," p. 344.

as integral to transatlantic flight as the others, it was Canada's primary international airport until Toronto's Pearson International Airport surpassed it in the 1980s. Built in 1941, it became Montreal's main airport by replacing the existing airport at St. Hubert airport to the city's south.[25] But air traffic control in the predominantly French-speaking city was conducted in English as required by transportation laws in Canada, following the guidelines set down by the ICAO. This arrangement caused friction among Francophones working in Dorval's ATC tower. Many French-speakers preferred to conduct operations in their native tongue for secondary services (ground-to-ground operations) but met stiff resistance from the aviation sector in Canada. In 1974, the Canadian government allowed the use of French for civil aviation but only for planes using VFR under 9,000 feet at five Quebec airports. International flights, and nearly all commercial services, were unaffected by this decision.[26]

Air Traffic Control over the North Atlantic

ATC infrastructure stemmed from the major airports depended on systems spread all around the North Atlantic. As these systems required constant updates to meet the growing needs of transatlantic flight, government spending on aviation infrastructure in Europe and North America totalled millions of dollars per year by the 1950s.[27] It was not merely a matter of augmenting the capacity of ATC's tracking capabilities but also of making the best possible use

[25] S.J. Hungerford, "Wings Over Canada Are More Common Sight," *Globe and Mail*, January 9, 1941, p. 14.

[26] William Johnson, "Language Tensions in Dorval Control Tower Threaten Safety of Passengers," *Globe and Mail*, December 13, 1975, p. 15.

[27] In the United States alone, government spending on air navigation infrastructure totalled nearly $104 million between 1945 and 1951. Upcoming microwave navigational aids, suitable for all-weather conditions, were estimated to cost the American government another billion dollars. Airlines did not pay for infrastructure services although they directly benefitted from them, effectively making them an indirect subsidy (although some funding was recovered in the form of airport landing fees or other taxes). Harvey C. Bunke, "The Fetish of Separating Subsidy from Air Mail Payments," *Journal of Air Law and Commerce* 20, no. 3 (Summer 1953), p. 274; M. George Goodrick, "Air Mail Subsidy of Commercial Aviation," *Journal of Air Law and Commerce* 16, no. 3 (Summer 1949), p. 253-4.

of existing resources. The allocation of aviation radiotelegram frequencies, in particular the Aeronautical Radio of Canada (ARCAN) for non-flight purposes, was just such a concern. Transatlantic flights in the latter 1940s used ARCAN's wireless telegraphy as an efficient way to transmit and receive flight information, but its resources were used for multiple purposes (administrative messages were sent along the same frequencies). Sending messages between ground stations in this way saved an estimated $100 per day for CGTAS (precursor to TCA on the North Atlantic) and BOAC, when compared to commercial channels.[28] Practices like this cluttered the radio frequency with extraneous messages that the system was not designed to handle, sometimes delaying more pertinent transmissions. To ensure that ARCAN's wireless telegraphs were reserved only for the most urgent messages, radioteletypes (wireless printers) were proposed as an alternate media for these messages, again with the priority put on normal aircraft operations, weather, air traffic control, and emergency messages.[29] As a government-owned and operated service, radioteletype pricing was left to be determined by policy rather than direct operating costs.[30] Since the airlines were the intended users for this critical system, a counter-proposal suggested that they should only pay about 9 cents per word, half the commercial rate.[31] Commercial transmission capacity was soon sufficient to replace the

[28] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 1, 1938-49. File 6819-4, May 5, 1947.

[29] Administrative messages sent through wireless telegraphs saved a considerable sum of money during their operation. A replacement radioteletype service charged nine pence per word for up to two addressees. LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 1, 1938-49. File 159, Notice from the Ministry of Civil Aviation in London to Airmen, "The Aeronautical Fixed Telecommunication Service," June 17, 1947.

[30] The commercial rate for a Moncton-Prestwick radioteletype service was 18 cents per word at that time, which would turn a profit at 400 words transmitted per day. TCA and BOAC would each incur roughly $18,000 in annual costs at that rate. LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 1, 1938-49. File 6819-4, 9892, letter from Browne to the Deputy Minister of the Department of Transport, December 18, 1947.

[31] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 1, 1938-49. File 6819-4, 30666, letter from Assistant Director Communications and Electronic Development C.J. Campbell to Browne, September 10, 1948.

ARCAN transmitters for all purposes by 1949.[32] The remaining capabilities were turned over to TCA.[33]

The transfer of North Atlantic radiotelephone service from the Canadian government to private hands included only operations, not ownership. This became relevant when a new international consortium, composed of several transatlantic airlines, including TCA, Pan Am, TWA, and American Overseas Airlines, took over radiotelephone service on October 1, 1949. Their high frequency radio telecommunications system was called North Atlantic Radio Telephone (NARTEL), effectively replacing ARCAN with a privately run network.[34] The Canadian Department of Transport, which had previously run all facets of ARCAN, took back control over Canadian NARTEL stations after discovering NARTEL's foreign constituency. ARCAN thereafter provided NARTEL with the use of radiotelephone services in Canada at a fee.[35] With official Canadian ownership over that part of the network, TCA rather than NARTEL ran the Canadian stations. TCA handled all radio traffic with minor exceptions in the stations at Dorval, Moncton, and Goose Bay, although some other airlines retained small staffs at those locations.[36]

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[32] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 2, 1949-50. File 7154-3, folio 14959, letter from Stevens to Browne, "Recommendations to the Department of Transport Regarding ARCAN and NARTEL Organization and Policy," July 11, 1949.

[33] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 2, 1949-50. File 7154-3, folio 41777, memo from the Director of Air Services at the Department of Transportation A.T. Cowley, "Government Policy air/ground Communication Facilities," August 31, 1949.

[34] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 2, 1949-50. Folio 53560, memo from Browne, "Agreement Between Department of Transport and Trans-Canada Air Lines re Radiotelephone Service North Atlantic," December 5, 1949.

[35] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 2, 1949-50. Memo from Browne to Stevens, January 19, 1950.

[36] TCA handled radio traffic for Air France and KLM in Dorval; for all airlines except BOAC, Pan Am, and Sabena in Moncton; and for all airlines in Goose Bay. TCA appeared to offer reasonable service as no complaints were lodged against it. LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada,

Both public and private involvement in infrastructure kept the network of ATC and radio stations growing to keep up with air traffic's needs. In the 1948 fiscal year, the Canadian government budgeted over $1.6 million in support of transatlantic air infrastructure. A Canadian Department of Transport memo broke down how the money was spent: radio services (including ATC duties) accounted for nearly half of the total infrastructure spending, followed by meteorology and a catch-all "civil aviation" category for the remainder. These were estimated costs, however, due to the intrinsic difficulty in determining whether any given flight was truly "transatlantic" or merely flying a route adjacent to the ocean that would later be discounted from the total, combined with the expected versus actual needs of the flights over the course of an entire year.[37]

Some North Atlantic ATC and radio stations were supported by several countries despite being under the effective control of a single state, since the stations were so vital to smooth flight operations. Iceland was a perfect example of this. Its strategic position, lying astride the northern fringe of the great circle route, made the island country indispensable for transatlantic air support infrastructure. The American military base at Keflavik had been built to serve the Air Ferry during the war and continued to act as an emergency landing strip for civil planes thereafter. Along with the civilian airport at Reykjavik, Keflavik provided weather data, communications support, air traffic control, and other services.[38] Beginning in 1947, all governments with airlines that passed near Iceland recognized this contribution by providing funds through ICAO to the agencies running the stations. America provided the biggest share

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"Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 3, 1950-7. Folio 40110, letter from Stevens to Browne, March 9, 1951.

[37] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 1, 1938-49. File 6819-4, 25093, Memo from Director of Air Services A.T. Cowley to the Deputy Minister, "Re: Estimated Operating Costs – Trans-Atlantic Service." October 27, 1947.

[38] *Archives Nationale*, 19760104/0001. "Conference au sujet de l'aide collective a l'Islande, Geneve, Juin 1948: Rapport de la Delegation francaise," p. 1-10.

since it had the most flights using the resources provided there, totalling 48.7% of the total. The Icelandic government provided a further 17.5% since virtually every flight made by the Icelandic people used this infrastructure.[39]

ATC and Planning Transatlantic Routes

The various ATC stations tracked flights in stages as noted above. There was no way for a ground station to directly monitor a plane's position over much of the Atlantic. The stations could still share the planned (and recorded) positional data with one another, giving a reasonable picture of how crowded the skies were in a given area. This system was sufficient for air traffic needs in the late 1940s when the North Atlantic was comparatively quiet. But booming transatlantic air traffic put strain on the ATC stations in the 1950s. Much of the infrastructure built during the war was designed to handle the volumes of military traffic at that time, when a few thousand oceanic crossings were performed per year. Just one decade later, that many planes might make the hop in a single month. The Canadian Department of Transport noted that Pan Am and TWA were expected to fly 200 planes through Gander's airspace each week in the then-coming 1955 summer season, plus planes flown by other airlines. Each plane had to be provided with ATC out of the Gander. Military traffic was also expected to be roughly double the previous year's volume.[40] The Department recommended that some of the ATC's upcoming stress could be alleviated by spreading out the hours when most of these flights occurred. Transatlantic crossings typically fell between 8 p.m. and 8 a.m. By including more daytime

[39] Since all funding was based on a calculation of transatlantic air traffic, only countries then making flights across the North Atlantic at that time (by mid-1948) were included in funding plans. After America and Iceland, eight other countries also provided funds. In order from largest share to smallest they are: Britain 9.9%, Canada 7.1%, the Netherlands 4.9%, France 4.1%, Sweden 2.6%, Belgium 1.8%, Norway 1.7%, and Denmark 1.7%. *Ibid*.

[40] British Airways Heritage Centre, RS/1/10932, "Part 3: Atlantic Services, Services, 1955 April-June." Letter from R. Dodds, Controller of Civil Aviation, Canadian Department of Transport, to S. Krzyczkowki, Secretary, Technical Committee, IATA, April 14, 1955.

flights, much of the pressure could be taken off of the ATC operators without unduly burden on airline schedules, it was argued.[41]

Proper ATC relies on all parties to practice the best, safest habits. As such, it is not limited to the ground stations that plan and coordinate the flights but also includes active engagement and oversight by air crews. Planes must maintain safe distances from one another lest they collide, a function that falls to the pilot, co-pilot, and navigator for flights over long ocean stretches. A plane's equipment played a big part in this. Radios let crews communicate with one another, avionics helped a navigator determine his plane's position, and radar systems installed on planes themselves offered a vital safeguard against collisions when planes neared one another.[42]

In the middle of the North Atlantic, the flight crew was the final line of defence when a plane deviated from its assigned track. When that happened, the crew needed every available piece of information to make the best decision; reliable equipment was a critical part of this. The flight crews were expected to follow their planned courses and communicate regularly with other aircraft. The British Ministry of Aviation framed these two complementary ATC functions as "strategic" and "tactical" air traffic control regimens. Strategic ATC in its most basic form involved centrally planned routes and timetables for all aircraft in advance and was the general practice for transatlantic flight. If all planes kept to a planned route and speed they would maintain a predictable separation from one another. This was usually sufficient to avoid collisions, cutting down on the need for radio communications except in emergencies. Tactical

[41] About 2/3 of transatlantic flights were of the more flexible "tourist class" that might more easily reschedule their times, which represented a good place to attempt implementation of a new ATC-friendly schedule adjustment. The recommendation for airlines to change their schedules was not official policy but a statement of fact: North Atlantic airspace was becoming increasingly difficult to manage with existing resources. *Ibid*.

[42] Safety and reliability were given the highest priority for equipment on planes. To maximize radar and other avionics' reliability, they were normally operated at well below their maximum power. In the case of radar, doing so traded off the its effective detection range for a longer lifespan and reduced chance of equipment failure. Merrill I. Skolnik, "Fifty Years of Radar," *Proceedings of the IEEE* 73, no. 2 (February 1985), p. 192-3.

ATC, conversely, required no advance flight plans and relied on radio contact between planes and ground stations on an ad hoc basis. Some tactical scenarios might retain a managing authority to sort out details.[43]

When the two regimens were combined, a pilot would have the greatest possible assurance that the plane was maintaining adequate distance from other aircraft. Strategic and tactical ATC regimens were ends of a spectrum built on good practice. They had been built up over years of experience to accommodate aircraft in varied conditions. In cases when a plane was over the middle of the ocean, for example, a strategic model was more appropriate for handling the long stretches without radio contact. As ATC needed to know roughly where and when every plane was at all times, a tactical ATC regimen used at sea that was unable to inform ground control of changes to the flight plan could cause unexpected delays or crowd other flight corridors. But by the 1950s, aircraft possessed navigational aids sufficient to fix their position and heading with great accuracy, so guidance corrections from ground controllers were not required on a constant basis. Once contact with an ATC ground station was re-established, or when in radio range of other planes, the tactical model provided a sensible alternative. Adopting a tactical ATC regimen remained prudent when a plane was out of range of ground control systems since it ruled out overreliance on a single point of failure, the plane's navigational equipment, for no matter how reliable these devices were, they could still fail. Tactical ATC also allowed flight crews to make reasonable accommodations for changes to expected traffic, which was probable during an hours-long flight without detailed updates.[44]

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[43] TNA AVIA 6/21564. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "Preliminary studies for models of future North Atlantic air traffic control systems with particular reference to supersonic flight, March 1961", p. 4.

[44] TNA DSIR 23/24202. Air Commander W.E.G. Mann for the Civil Aircraft Research Committee, Aeronautical Research Council, "The Value of Air-to-Air Interrogation as an Aid to Air Traffic Control over the North Atlantic," April 6, 1956, p. 2-3. The tactical ATC system rolled out in the 1950s heavily used omnidirectional UHF transmitters, an improvement over the accuracy afforded by similar VHF transmitters in use during the 1940s.

A 1956 study by Britain's Aeronautical Research Council made the case for adopting a tactical ATC regimen to alleviate congestion on transatlantic routes. The North Atlantic was prone to daily periods of intense bunching, when a majority of flights would depart North America in the late evening or Europe in the early afternoon.[45] The report argued that once a plane crossed over the ocean it no longer made sense for a pilot to strictly follow earlier ATC reports. The chances of a midair collision were remote given the vast spaces at sea and the ATC data a pilot hand on hand became effectively obsolete after a few hours as small navigational errors might compound one another and take a plane far from its expected position with enough time. Far better, it said, to delegate route-altering matters to the flight crews. If their planes were furnished with the best equipment, it would be a trivial matter for pilots to coordinate with one another on an ad hoc basis. Anti-collision lights were put forth as an example of a simple but effective technology that would assist in this, easily seen in most weather and lighting conditions, although universal adoption lay several years in the future.[46] The wholesale adoption of tactical ATC was not widely considered outside of technical reports such as this. New technologies were only a partial solution and did not invalidate strategic ATC over the North Atlantic. There was simply too much potential for minor problems to evolve into major,

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Planes were equipped with an antenna that picked up the signal from a nearby transmitter and gave the bearing relative to magnetic north. With two transmitters usually sited close beside one another, a calculation using the difference between the arrival time of the signal from each one (measured in microseconds) coupled with the bearing of the signal provided a position accurate to within half a nautical mile over a distance of nearly 200 nautical miles. For more on this, see: Arjun Singh, *Airport Ground Navigation Systems* (New York, NY: McGraw-Hill Education LLC, 2012), Chapter Ten.

[45] A sample of flights departing Montreal for points in Europe during a single week in July, 1973, illustrates the intense congestion caused by most flights leaving from one continent within a narrow window. Of the 168 flights recorded, only 6 left earlier in the day than 8 p.m. The actual separation between the planes would be large enough that few problems would be encountered due to this bunching, but the inefficient use of departure times for North Atlantic air traffic created an unnecessary complication for air traffic controllers. Nils Petter Gleditsch, "Towards a Multilateral Aviation Treaty," *Journal of Peace Research* 14, no. 3 (1977), p. 249-50.

[46] The report noted that pilots would not willingly forego a system that had worked well for one that depended on the random distribution of aircraft to avoid collisions. This method was merely put forward as a potential alternative rather than a viable model to emulate. TNA DSIR 23/24202. Air Commander W.E.G. Mann for the Civil Aircraft Research Committee, Aeronautical Research Council, "The Value of Air-to-Air Interrogation as an Aid to Air Traffic Control over the North Atlantic," April 6, 1956, p. 2-3.

intractable ones. If a plane under the tactical ATC regime changed course and encountered a problem, it would be far more difficult to locate than a plane operating under strategic ATC. The latter regime was also needed to offset any increased chance of collision due to inattentive air crews.

Tactical ATC could also make use of new technologies to improve operational safety. Anti-collision lights, as mentioned above, made an aircraft easily visible in a wide variety of conditions and from great distances. A pilot or a ground-based ATC station could use a sighting of one of those lights to make a position fix on the fly when other means of location-finding had failed. Developed by former Northwest Airlines pilot H.W. Atkins, the lights are installed at the plane's nose, tail, and wingtips and blink intensely at regular intervals. In 1959, the FAA recommended that they be installed on all American planes.[47] These lights were only a single part of a broader package of potential technologies that the Aeronautical Research Council recommended. All aircraft technologies such as these, however, were merely intended to supplement the existing ATC system rather than replace it. But over the ocean far from regular radio communication with ground stations, these items could reduce the chance of an incident.[48]

The strategic ATC regime was conservative by design as was notable when jets began service in 1958, ATC planners followed the same protocol they used for propeller planes: they blocked off the airspace around the jet. Faster-moving jets meant that there was little time for flight crews to act when a collision was imminent: speed and limited reaction time was the

[47] The lights blink at 5 million candle power for 1/8000 of a second, and could be adjusted to do so at between 60 and 140 times per minute. They were designed to be visible at 100 miles, and were 40 to 60 times more visible than similar collision-avoidance light systems. *Chicago Tribune*, "FAA Approves Anti-Collision Light System," October 7, 1959, p. 40.

[48] TNA DSIR 23/24202. Air Commander W.E.G. Mann for the Civil Aircraft Research Committee, Aeronautical Research Council, "The Value of Air-to-Air Interrogation as an Aid to Air Traffic Control over the North Atlantic," April 6, 1956, p. 6.

primary cause of a midair crash in 1958 near Las Vegas between a fighter jet and DC-7.[49] Jets flying the same North Atlantic route were therefore separated by 30 minute intervals along a given track, and each parallel track was separated by 120 nautical miles (222 km) and 2,000 feet altitude.[50] This crude solution meant that 36 times more space had to be reserved for a single plane at sea than for similar flights over land at that time.[51] But jets also introduced a new problem given their great speeds and high cruising altitudes. The range of altitude-separated tracks for them stretched from 30,000 to 38,000 feet, meaning that there were at most five available vertical slots on a single track that was still 120 nautical miles across.[52] The airspace blocked off for each jet effectively putting an upper limit on the number of planes that the North Atlantic could accommodate. Unfortunately, it was the only practical way to ensure that each flight maintained an adequate distance from other aircraft. D.O. Fraser, formerly of the Air Traffic Control Experimental Unit at Britain's Ministry of Civil Aviation, criticised the system for over-saturating the airspace: he claimed that the mandated distances were arbitrary, underutilized the airspace, and curtailed the potential for growth. Fraser was optimistic that new technology could resolve this problem as improvements in altimeters and positional instruments could reduce the amount of airspace that had to be blocked off, with smaller vertical and horizontal separation between planes. Better communications equipment could similarly make

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[49] Pilots within the United States at that time were supposed to operate under visual flight rules (VFR) when they could see more than 3 miles as opposed to receiving direct ATC guidance from the ground or from their instruments, the latter of which was to be used as a backup when visibility was poor. Bednarek, Janet R. Daly and Michael H. Bednarek, *Dreams of Flight: General Aviation in the United States.* College Station: Texas A&M University Press, 2003), p. 91.

[50] In 1961, transatlantic flights following the same course and speed were separated by only 20 minutes instead of the usual 30 minutes. TNA AVIA 6/21575. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "An exercise in costing the effect of air traffic control restriction on North Atlantic traffic, March 1963", p. 9.

[51] United Kingdom airspace was more closely monitored than even this, with only 1/72 as much space reserved for a single flight even when radar coverage was not available. TNA DSIR 23/24202. Air Commander W.E.G. Mann for the Civil Aircraft Research Committee, Aeronautical Research Council, "The Value of Air-to-Air Interrogation as an Aid to Air Traffic Control over the North Atlantic," April 6, 1956, p. 1-2.

[52] *Ibid*., p. 12.

pilots aware of their position relative to other planes from greater distances. These gains would be offset somewhat as jets became more common during the latter 1950s, which required greater space allocations if the system persisted in its existing form.[53]

ATC's growing limitations in the face of expanding air travel and the rise of jet aircraft were not only felt by those who planned for future air travel; they directly imposed greater costs on all flights. A plane that was not cleared to enter "oceanic airspace" (beyond a ground station's ability to track the flight) had to remain within tracking range of a ground station, burning fuel all the while. This extra fuel had a dual cost. First, a well-planned flight would not have to take off only to consume fuel awaiting clearance, so the fuel was wasted. Second, the additional fuel's weight offset passenger and cargo carrying capacity as extra fuel had to be loaded in case clearance came late. For jets, the 1961 estimated average cost for every minute awaiting clearance while airborne was £5 ($14) and 280 pounds of fuel.[54] This bottleneck was predicted to be significantly exacerbated by the ever-growing volume of traffic. Without improvements to the existing system, the average extra cost for fuel alone was forecasted to increase from £21 ($58.80) in 1961, to £54 ($151.20) in 1964, and £79 ($221.20) in 1967 during the transatlantic summer peak periods.[55] In the worst-case scenario, this represented a loss of up to £630 ($1,764) per flight by 1967 (including all lost revenue-generating space) totalling £15.5 million ($43.4 million)[56] for all airlines, or about 4.3% of total operating costs.[57] The airlines

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[53] D.O. Fraser, "Navigation and Traffic Control over the North Atlantic," *Journal of Navigation* X, no. 2 (April 1957), p. 115-20.

[54] TNA AVIA 6/21575. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "An exercise in costing the effect of air traffic control restriction on North Atlantic traffic, March 1963", p. 10-2.

[55] Since planes had to be equipped with greater fuel reserves than absolutely required, the average increase in fuel carried just for the delay for transatlantic flights was predicted to climb from about 5000 pounds in 1961 to 6700 in 1964 and 7800 in 1967. *Ibid*., p. 13.

[56] The calculations from British pounds into American dollars in this paragraph were made using historical exchange rate data for 1963 (the year in which the estimates were made) from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

needed updated and well-implemented ATC that could keep up with their expanding fleets of faster planes; every flight that had to loiter midflight because ATC was not up to the task cost the airlines money.

Improvements in aircraft instrument accuracy coupled with a large and growing record of transatlantic flight data eventually did permit a reduction in plane separation, as Fraser hoped. In 1965, an ICAO group agreed to cut the necessary track separation from 120 down to 90 nautical miles for all flights above 29,000 feet. Plans to reduce the "longitudinal separation" along a given track from 30 minutes down to 15 were tested on domestic American flights before North Atlantic implementation. This reduction depended on highly accurate airspeed indicators. Without a high level of certainty about where a plane was relative to the flight ahead of it, there was a chance that the following aircraft might enter the turbulent wake of the aircraft ahead with disastrous results.[58] Even with the best navigational aids available, such as inertial reference units, minor errors would still cause a plane to drift too far.[59] Highly accurate altimeters were equally critical. These were needed to ensure that planes maintained the necessary 1,000 feet of vertical separation on a narrowed track but the accuracy of the available equipment was insufficient to make any change at that time.[60] As recently as 1996, the longitudinal separation of aircraft on the North Atlantic remained 10 minutes, or about 80 nautical miles at typical jet

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[57] In the lowest-cost scenario, largely ignoring anything other than fuel costs, airlines were still expected to lose a combined total of £1.8 million representing about 0.5% of their operating costs. Smaller, certainly, but significant enough that it could not be reasonably ignored. TNA AVIA 6/21575. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "An exercise in costing the effect of air traffic control restriction on North Atlantic traffic, March 1963", p. 15-6.

[58] NARA RG 237, Box 163 "Records of the Federal Aviation Administration, Office of the Administrator. Administrator's subject/correspondence file, 1959-82,", Folder 5810 "International Civil Aviation Organization (ICAO)", 1965. Memo from the Acting Assistant Administrator for International Aviation Affairs Robert P. Boyle to the Administrator, "Results of Special North Atlantic Regional Air Navigation Meeting," March 30, 1965.

[59] Myron Kayton and Walter R. Fried, *Avionics Navigation Systems: Second Edition* (Toronto: John Wiley & Sons, Inc., 1997), p. 650.

[60] NARA RG 237, Box 163 "Records of the Federal Aviation Administration, Office of the Administrator. Administrator's subject/correspondence file, 1959-82,", Folder 5810 "International Civil Aviation Organization (ICAO)", 1965. Memo from the Acting Assistant Administrator for International Aviation Affairs Robert P. Boyle to the Administrator, "Results of Special North Atlantic Regional Air Navigation Meeting," March 30, 1965.

speeds,[61] dropping to 60 nautical miles by 2009 with improvements in satellite-assisted positioning and communications.[62] There was simply no system in place to accurately guide planes across the North Atlantic in practice as ground-based radar could not reach sufficiently far and aircraft instrumentation was not reliable enough even by the end of the twentieth century.[63]

The solutions for ATC's shortcomings were both organizational and technological, but military flights represented a further complicating factor. They operated independently of civilian ATC. This had not been a problem on the North Atlantic in the immediate postwar era since most air traffic was military in nature. But a memo from the Canadian Department of Transport in 1949 summarized the growing challenge of dealing with the often conflicting interests of military and civilian flight. The memo stated that the air forces of most countries, including the United States Air Force, used their own ATC stations. It suggested that future military flights should at least coordinate their plans with civilian ATC stations in the future under the auspices of the ICAO.[64] By 1963, the United States recognized the value of consolidating its ATC systems and operated a joint civilian/military air traffic control system. This arrangement offered a straightforward means of directing all aircraft in American airspace safely, a model that the United States encouraged other NATO members to adopt. European countries at that time generally retained segregated ATC systems, with an FAA report singling out France for its reluctance to make the change. As France was a major player in Europe, if it

[61] The separation distance assumed an airspeed of Mach 0.85 at 35,000 feet. Kayton and Fried, *Avionics Navigation Systems*, p. 649-51.

[62] When very good communication is possible over the North Atlantic, the separation can be reduced even further than this. Amedeo R. Odoni, "Airports," in Peter Belobaba, Amedeo R. Odoni, and Cynthia Barnhart, eds. *The Global Airline Industry* (Chichester, West Sussex: Wiley, 2009), p. 391.

[63] Within the United States where ATC could use radar, planes kept a separation of at least 3 nautical miles when they were within 40 nautical miles of a terminal site with a radar station, increasing to a separation of 5 nautical miles when outside the 40 nautical mile zone. Planes cruising (not near a terminal) kept a separation of 10 nautical miles. Although closer separation distances were tolerated where radar was used, longitudinal separation was widely applied as a precautionary ATC practice. *Ibid*.

[64] LAC, Department of Transport 5262-35, Air Traffic – Operations, Air Canada, "Radio Coverage Agreement between Air Canada & Dept. Of Transport – Policy" Volume 2, 1949-50. File 7154-3, folio 36936, "Communications with U.S.A.F. Aircraft – North Atlantic," August 11, 1949.

could be persuaded to adopt the unified structure America employed other European countries might follow. The FAA even gave French military and civilian ATC officials a tour of American ATC facilities to impress upon them the advantages of adopting the American model.[65]

ATC planners had to consider how best to arrange the route networks across the North Atlantic as new planes with greater ranges entered the market. Traffic patterns were well established by the latter 1950s, with planes jumping off from a handful of strategic refueling points ringing the ocean such as Gander, Shannon, Prestwick, etc. The emergence of jets with nonstop transatlantic range in the early 1960s complicated this setup. A new, far more complex route network with myriad separate tracks was designed. Routes between dozens of city-pairs had to be arranged not to intersect (or to do so in a predictable way). The great circle route between New York and the major cities of Western Europe was by far the busiest of these, accounting for about 50% of transatlantic air traffic in 1961. Other routes intersected this corridor including Washington-Copenhagen and Montreal-Paris. While these were flown less frequently, each plane's track had to stay predictably clear of all other tracks, whether by keeping to a different altitude or carefully managing their position to avoid coming into proximity with other planes.[66] Since some tracks would by necessity intersect in space, timing the flights so that planes would safely pass one another was the only remaining option where

[65] NARA RG 237, Box 83, Folder 5500 "Internat'l Oper," 1963 (folder 2 of 3). Letter from FAA Administrator N.E. Halaby to Secretary of the Air Force Eugene M. Zuckert, July 15, 1963.

[66] Brussels was selected here as the example European terminus. It is far from the largest city in Western Europe and did not handle the highest number of transatlantic flights. It is probable that Brussels simply represented the approximate geographic centre of the termini in Western Europe where the majority of such flights flew, as it lies within a quadrilateral that has London, Paris, Amsterdam, and Frankfurt at its outer points, all of which were larger and busier hubs. As such, North Atlantic flight tracks to that region would roughly approximate one another over the ocean to a far greater degree than the other destination-pairs listed. Flights to and from New York would largely follow the same path during the over-ocean portions when linking with those cities, so the route may simply reflect that. TNA AVIA 6/21564. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "Preliminary studies for models of future North Atlantic air traffic control systems with particular reference to supersonic flight, March 1961", p. 7.

ATC from the ground was unavailable. This meant striking a morbid balance: permitting the greatest number of flights that would produce the lowest acceptable aircraft collisions per passenger-mile. In a 1961 report by the British Ministry of Aviation, a sample figure of one collision per ten million flights (or about one lost passenger per ten billion passenger-miles) was given as tolerably low.[67]

Transatlantic route planning aspired to reach such a balance. It had to account for the complexity of an already crowded oceanic airspace and determine how far airlines would agree to divert traffic. One school of thought believed that it would be simpler to consolidate all of the oceanic traffic into a single set of parallel tracks that would diverge only when the planes were safely across the Atlantic. This had the advantage of keeping all aircraft on nonintersecting paths regardless of their point of origin or destination. But if a single set of transatlantic tracks were set up, it would involve shifting some established routes by a large distance. An airline might find the additional cost or time penalty of such a route too great to bear and thus cancel the route.[68] A 1963 report from the British Ministry of Aviation offered a compromise solution. In general, retaining three sets of tracks offered a good balance: one stream between the United States and Northern Europe, another between the United States and Southern Europe, and a third stream for all of Europe to Canada and northerly parts of America. Each path in the three streams would also be narrowed from the existing 120 nautical miles, drastically cutting delay

[67] TNA AVIA 6/21564. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "Preliminary studies for models of future North Atlantic air traffic control systems with particular reference to supersonic flight, March 1961", p. 8.

[68] As noted earlier in this section, any extra time that a plane spent in the air cost money due to the additional fuel requirements. A single extra minute in flight might cost just $14 in 1961 (and far more in the years thereafter) but a route alteration that added a full hour to the flight time would add $840. This would fully offset revenues representing several passengers, and the extra weight of the additional fuel meant several others would not be able to fit on the flight. TNA AVIA 6/21575. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "An exercise in costing the effect of air traffic control restriction on North Atlantic traffic, March 1963", p. 29-30.

times and costs without greatly increasing technical complexity for ground stations or adding to the risks associated with flying planes too close together.[69]

Radar and Radio Beacons

Civilian ground stations added a powerful tool to their ATC arsenal in the 1950s: radar.[70] In 1950, Heathrow was the first major airport to deploy radar powerful and accurate enough to track and guide planes along flight corridors rather than merely on approach to an airport. This change immediately extended the effective range for ATC up to 130 miles (215 km) away, four times farther than existing ground-controlled approach systems (short-range radar mainly used for landing in poor visibility).[71] The system displayed a plane tracked by the radar as a dot on a screen. A radar operator had to track a plane's progress by eye as the screen was updated to determine whether there was a potential collision ahead; a simple system but one that was reliable enough to improve long-range flight safety.[72]

America adopted a similar long-range radar system. Although a special government committee recommended the use of radar to track planes throughout the country in 1948, it was not until 1956 that the first airport employed radar for high altitude tracking. Part of the delay in implementation was so that a custom radar tracking system could be developed as existing radar systems were developed by the military and so were not ideal for keeping planes separated to

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[69] TNA AVIA 6/21575. P.G. Reich for the Royal Aircraft Establishment of the Ministry of Aviation, "An exercise in costing the effect of air traffic control restriction on North Atlantic traffic, March 1963", p. 29-31.

[70] Radar systems came to prominence during the Second World War as a tool for tracking enemy aircraft but the technology was almost entirely developed by civilian engineers during the 1920s and 1930s. It was difficult for many of the groups developing radar for civilian use to attract enough funding to make it useful for general use at that time; only military funding during the war brought systems into regular use. For more on the development of radar technology, see: Louis Brown, *A Radar History of World War II: Technical and Military Imperatives* (Philadelphia: Inst. of Physics, 1999), p. 33-96.

[71] "New Air Traffic Control," *The Times*, February 9, 1950, p. 4.

[72] Heide, "Eurocontrol," p. 194.

civilian standards.[73] The enactment was spurred on by a 1956 crash over the Grand Canyon in which 128 were killed due to a reliance on VFR and no ground control over the isolated flight corridor.[74] Long-range radar used for tracking planes at high altitudes are separate systems than those used for ground-controlled approach. Even as the United States set up its nationwide radar network along flight corridors, even large airports like those in New York did not use radar when guiding planes to land. A midair collision above New York City in 1960 noted above spurred the deployment of short-range radar for this purpose.[75] After radar was widely adopted for civilian ATC throughout the United States in the early 1960s, it improved the robustness of position-finding for planes both over land and in the nearby oceanic spaces.[76] This is not to say that radar coverage extended above all continental land, merely that it was used widely across major air corridors. Radar alone is still not the only means of tracking planes today. Planes are equipped with transponders that transmit a coded signal to relays on the ground with position data provided in part by the plane's navigational systems.[77] Tracking a plane's position over the ocean and relaying that information to stations on the ground in a timely fashion was critical to countries surrounding the North Atlantic. The first radar stations built to track planes beyond the horizon were developed in the early 1950s and deployed widely over the following decade. For all their improvements, they had a range of just 400 kilometres and were somewhat inaccurate at

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[73] Michael S. Nolan, *Fundamentals of Air Traffic Control, 5th Edition*. Clifton Park, NY: Delmar, 2011), p. 19-23.

[74] Heide, "Eurocontrol," p. 191.

[75] The incident occurred on December 16, 1960. A DC-8 in a holding pattern deviated from its assigned speed while it awaited clearance to land at Idlewild and entered the path of a Super Constellation in a holding pattern of its own for La Guardia. Neither airport was in direct communication with the other so the threat was not noticed in time, but had either airport possessed radar systems the collision would have been avoidable. Nolan, *Fundamentals of Air Traffic Control*, p. 27-8.

[76] The American FAA embarked on a program to install radar coverage over a broad swath of the United States. The target for radar uptime was over 99.9% at every location and was consistently met by the 1980s. Skolnik, "Fifty Years of Radar," p. 197.

[77] Amedeo R. Odoni, "Airports," in Peter Belobaba, Amedeo R. Odoni, and Cynthia Barnhart, eds. *The Global Airline Industry* (Chichester, West Sussex: Wiley, 2009), p. 385.

the farther edge of their reach. Depending on how tightly focused the radar beam was, the error could be a few kilometres.[78]

Radar's inability to track planes beyond their field of view left nearly the entire oceanic airspace a blank to the people supporting those flights from the ground except for the projections of flight paths based on the final sets of data as the aircraft faded from view. Coordinating and transmitting the data between all parties was taken seriously since lives hung in the balance. The Federal Aviation Administration of the United States and British Ministry of Aviation, as the agencies representing civil aviation from the two countries most heavily involved in transatlantic flight, discussed the best approach to handling the growing volume of transatlantic air traffic with respect to ATC in 1961. They concluded that the system relied too heavily on a network of stations that had become largely redundant. These included those in Iceland, Shannon, and Prestwick, all of whose primary job was to relay information rather than track planes. Running ATC data through these stations unnecessarily offered no advantages and risked introducing complications if the data was improperly interpreted. The British government backed a program to consolidate ATC stations, cutting those listed above to a single centre based in London for the European side and a single American station, although the existing stations were expected to challenge the decision.[79]

Radar had a fundamental weakness with respect to transatlantic flight: it depended on line-of-sight to work. There was, however, a powerful alternative to radar. As noted in Chapter

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[78] Simon Kingsley and Shaun Quegan. *Understanding Radar Systems*. Raleigh, NC: SciTech Publishing, Inc., 1999), p. 206-12.

[79] Some of the problems associated with locating planes was that the aircraft were unable to position themselves with any accuracy when over the ocean and out of range of ground stations. A solution proposed in this document was to include Doppler radar units to aircraft as well as better navigational aids so that the planes could better locate themselves and other aircraft in their vicinity. Initial testing of the radar systems was to begin shortly following this conference. NARA RG 237, Box 83, Folder 5500 "Internat'l Oper," 1963 (folder 3 of 3). Memo from FAA Administrator to Heads of Washington Office and Services, "United Kingdom/European/African Trip; February 3-February 17, 1963," June 3, 1963, Appendix B, p. 12-16.

Two, radio beacons set at strategic points could guide a flight along its course. This practice began in 1929 in the United States as simple, low-power radio antennas were installed along air mail routes as a supplement to lighted beacons. By the 1930s, planes had medium- and high-frequency direction-finders installed. A flight crew could deduce its position by rotating the plane's direction-finding antenna and triangulating the source from multiple points along their own track. Radio signals of certain frequencies can bounce between the surface and the ionosphere, a layer of the atmosphere, for thousands of kilometres. With the proper equipment, a flight crew could expect widespread radio beacon coverage.[80]

From the 1940s onwards America used a radio beacon network of LORAN[81] stations to track North Atlantic flights, built across the United States and at a few sites under its control abroad. LORAN, which was not a form of radar that relied on bouncing radio waves off of planes and tracking the position and delay in the echo, but it operated on a similar principle. LORAN stations broadcast a strong signal from a fixed position. When a plane was in range, its navigator could triangulate their current position with accuracy of a few kilometres. It was a crude but useful complement to the inertial navigational aids installed in most aircraft, although it required fairly expensive equipment on any plane using the system. By 1966, the United States argued that air traffic in the North Atlantic region had grown to such an extent that European countries should likewise deploy LORAN stations to cover the Atlantic's eastern region as it offered an additional means of tracking planes at long distances despite its limited accuracy. This was critical in light of the ICAO's push to reduce the separation distance

[80] Myron Kayton and Walter R. Fried. *Avionics Navigation Systems: Second Edition* (Toronto: John Wiley & Sons, Inc., 1997), p. 11-2.

[81] LORAN (in this case LORAN-A, the first version of the radio position-finding system) relied on unsophisticated technology with limited position accuracy (error range could be tens of kilometres on either side of the target), but provided extremely long-range coverage, up to about 1400 miles (over 2200 km) at night and 800 miles (over 1300 km) in the day. The system had the great advantage of all-weather operation, which was a huge boon to navigators. David Collins, *Wings Across Time: The Story of Air Canada* (Toronto: Griffin House, 1978), p. 34.

between planes on the same transatlantic route,[82] a move that the Air Line Pilots Association opposed on safety grounds. With no way of tracking planes over the ocean, pilots were highly skeptical about the prospect of flying planes closer than 120 nautical miles to the flight ahead. LORAN tracking was put forward by the United States government as a potential solution, although the system could only provide a position fix and could not confirm whether other planes were in their proper position as well.[83]

Satellite Tracking

Complete and accurate aircraft tracking over the ocean only became possible once satellites were applied to the North Atlantic problem. This is because most radio signals are limited to line-of-sight connections. Some high frequency "shortwave" radio waves can travel farther by bouncing between the ionosphere and the ground, as used in LORAN, but these become less accurate for position-finding at longer ranges due to scattering effects that become compounded with each bounce. The best possible accuracy is obtained only when an aircraft has an unobstructed line-of-sight with a radio source. A satellite in a sufficiently high orbit could provide line of sight coverage over a wide swath of the planet, whether for communications or for position-finding.[84] So in 1965, several American agencies actively began work on

[82] A network of LORAN stations positioned in East Blockhouse, England, Porspober, France, and El-Ferrol, Spain were strongly recommended by both the FAA and Air Line Pilots Association. A further network placed in the Azores and Portugal would have likewise offered coverage gains. NARA RG 237, Box 215, Folder 5800 "International Organizations", 1966. Letter from William F. McKee to Deputy Secretary of Defense Cyrus R. Vance, April 28, 1966.

[83] NARA RG 237, Box 215, Folder 5810 "Internat'l Civil Aviation Organization (ICAO)", 1966. Telegram from Air Line Pilots Association President Charles H. Ruby to Secretary of State Dean Rusk.

[84] The modern constellation of Global Positioning System (GPS) satellites orbit the earth at about 11,000 nautical miles' altitude. A considerable amount of experimentation and development work went into developing the equipment that can detect the signal from several GPS satellites simultaneously, refer to stored data about where each satellite should be, account for the receiver's current speed, and eliminate any atmospheric effects that might distort the signals. Precursors to GPS could not offer anywhere near the precision that the modern one does for all of these reasons (and certainly not with the few satellites available in the 1960s and 1970s to accurately triangulate a position) but could still offer a position accurate to a few miles. For ships or planes at sea, this was extremely

determining the most effective form of communication and tracking satellites to assist transatlantic aviation. NASA and the FAA collaborated with Pan Am and TWA, assessing the specific needs and requirements of the planes and the value of such a service. Ultimately, they planned to deploy at least two satellites outfitted with VHF transmitters and relays to geostationary orbit above the North Atlantic by 1967, following a test phase.[85]

The first of these navigational satellites, the ATS/C, was launched in 1967. Put into position above the equator at 40° west, it could provide coverage over the entire Atlantic Ocean.[86] It was designed to track up to 200 planes every two minutes and relay their positions to ground ATC stations. With advances in satellite technology, the lateral separation of transatlantic aircraft could be cut down from 120 nautical miles to 90 soon after implementation and even more as the system matured.[87] The question of the program's cost was an obstacle to its expansion. Planes were already equipped with navigational materials that could guide a flight crew across the ocean with a very small error. It was therefore necessary to determine that the system would produce position fixes better than existing equipment, which was a major consideration in light of the project's expense.[88] While GPS satellites today certainly offer

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helpful. For extensive details on how satellite position-finding works, see: Myron Kayton and Walter R. Fried. *Avionics Navigation Systems: Second Edition* (Toronto: John Wiley & Sons, Inc., 1997), p. 178-282.

[85] TNA AVIA 23/1122. Eric G. Ackermann for the Signals research & development establishment, Ministry of Aviation. S.R.D.E., "Visit Report No. 43: Visit to United States of America September 26th to October 1st 1965."

[86] Geostationary orbits are at an altitude of 35,786 km. Satellites stationed in such an orbit can cover an extremely wide swath of the planet from this height including entire oceans or continents. Modern communication satellites are typically put into this position since it is by far the easiest way to relay information: ground stations only need a proper antenna (a satellite dish) and the relevant satellite's coordinates to transmit data between widely separated points on the ground.

[87] Walter Sullivan, "Science: How to Navigate with Satellites," *New York Times*, April 2, 1967, p. 175. The ATS/C satellite system acted in a similar fashion to GPS: it tracked the exact angle of a signal from the plane and, based on the signal's delay (which would tell how far it was from the satellite), relayed the position data to an ATC station to get a fix. Unlike GPS, however, the data was not handled by systems on the planes.

[88] A network of ocean platforms was also considered to offer advantages that might at least temporarily put off the need for satellites as North Atlantic tracking and communication carriers. If a sufficient number of platforms could be fixed across the ocean with VHF and other radio capabilities, they could offer position fixes and transmission capabilities that would easily match those offered by satellites at a fraction of the cost. TNA AVIA

position fixes with unparalleled accuracy, the satellite technology of the day was a far cry from this.

In addition to offering position fixes, satellites offered a novel means of radio communication. They could cover wide swaths of the globe at once, and once the technology matured sufficiently, many radio channels could be used for commercial flights to communicate simultaneously. The satellites' value was not limited to a single country, nor could their potential be fully realized without international cooperation and infrastructure beyond the United States, the main backer of this technological application. In 1966, the FAA and British Ministry of Aviation considered a jointly run satellite program for the North Atlantic in part to alleviate the radio congestion existing in the region and to eliminate areas of limited or no coverage. This was not a planning meeting but simply a statement of intent: even a preliminary decision on how to fit aircraft with satellite communications systems remained a point of contention between the British and Americans. The British remained skeptical that existing satellite radio systems were adequate to the task of communicating with aircraft at that time: a limited number of radio channels were available for such a use, making the cost considerable compared to the apparent benefit.[89]

The British ultimately agreed to back the program. The satellite deployment proceeded apace following the test phase. By 1969, the FAA held talks with Britain's Board of Trade over cooperation on a new and more sophisticated system. The FAA proposed that a satellite station

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23/1122. Eric G. Ackermann for the Signals research & development establishment, Ministry of Aviation. S.R.D.E., "Visit Report No. 43: Visit to United States of America September 26th to October 1st 1965."

[89] The Ministry of Transportation recommended a trial testing period but did not anticipate such a system would be useful in the short term, although it did recommend that ocean stations be set up for regular communication between aircraft across the North Atlantic in a fashion reminiscent of the NOAS program. The FAA advocated for the satellite radio program and suggested including such systems on several planes in the short term to determine how to move forward. NARA RG 237, Box 213 "Records of the Federal Aviation Administration, Office of the Administrator. Administrator's subject/correspondence file, 1959-82," Folder 5500 "International Operations", 1966. Meeting between the United Kingdom Ministry of Aviation and the United States Federal Aviation Agency, "Report of Working Groups to the Closing Plenary," March 25, 1966.

be set up in Britain to coordinate the system's operations. Some of the system's functions and characteristics were organized during those talks as well. While VHF frequencies (30-300 MHz) were used on the test ATS/C and COMSAT satellites, it was not necessarily to be the frequency range used for communications; a secondary range between 1540 and 1660 MHz was being considered.[90] The technical and technological problems created many unknowns and even the system's deployment timetable was hard to predict. The British, preferring a stopgap rather than going without some form of the new positioning technology, proposed a temporary set of ship-based stations until the satellites were active sometime in the 1970s. The Americans rejected this: they were set on developing a satellite program and did not see value in the cost of a second network that would soon be redundant, even if it was far cheaper. The promise of ocean-wide coverage was worth the price in the eyes of the American government.[91]

Flights did not enjoy the truly worldwide coverage for navigation or communication that satellites provided until the 1980s, after the technology matured. Indeed, the first concrete plans to deploy navigation satellites to assist civil aviation began in 1976 with operations to begin in 1979, covering the North Atlantic region. The technological hurdles proved easier to overcome than the political ones: agreements between the American and European governments prevented earlier deals from being realized.[92] The satellites were an improvement over existing positional technology but still fell short of the high accuracy needed to close the large gaps between planes that lacked ATC guidance. It was not until the Global Positioning System (GPS), conceived and

[90] Actual costs for the satellite tests were about $3-4 million. TNA DR 45/5. "BOT/FAA Discussions, Agenda Item 2 – Satellite Communications," February 1967, 113.

[91] TNA DR 45/5. "BOT/FAA Discussions, Agenda Item 5(d) – Sea Stations," February 1967, 113.

[92] The partners for the satellite program were Comsat (USA, 47% ownership), the European Space Agency (international European space program, 47% ownership), and the Canadian government (6% ownership). "L'Europe, les États-Unis et le Canada vont realise deux satellites expérimentaux de navigation aérienne," *Le Monde*, January 29, 1976, p. 11.

run by the American military, was made available for civilian use that flight crews actually had truly worldwide positional coverage.[93]

Conclusion

It took the combined efforts of several countries working in harmony to make the North Atlantic a viable commercial air corridor. Their air traffic control systems had to closely coordinate between the control towers at the major airports, ensure that all operators had the latest available information about every plane's position, and guide the planes to a safe landing in another country. Technological improvements, principally the introduction of radar and radio beacons on the ground, as well as new avionics systems on the planes themselves, gradually made the ocean crossing easier. When the technology was not quite up to the task, it was up to ATC planners to craft a better way for planes to safely make the trip. They designed a route structure that could handle hundreds of flights per day without direct supervision by a central authority, setting down a network of tracks that ran the length of the ocean, and revising those tracks constantly to meet the growing needs of air traffic. While the introduction of satellites finally permitted full coverage over the Atlantic Ocean, the ATC system there was so mature and robust that it merely provided an improvement over existing traffic patterns rather than a revolutionary new paradigm for transatlantic traffic management. The promise of flight across the North Atlantic was enough to inspire countries on two continents to build a common network to guide planes between Europe and North America, spurring the development and deployment of the latest technology for the betterment of all aviation.

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[93] United States President Ronald Reagan explicitly opened GPS for civilian use after Korean Air Lines Flight 007 was shot down (the plane had flown off course into Soviet airspace on September 1, 1983). GPS use was offered to other countries by the FAA at a 1991 ICAO conference, and civilian GPS services began in 1995. Scott, Pace Gerald P. Frost, Irving Lachow, David R. Frelinger, Donna Fossum, Don Wassem, and Monica M. Pinto. *The Global Positioning System: Assessing National Policies* (Santa Monica: RAND Corporation, 1995), p. 247-8.

Chapter Six: Meteorology on the North Atlantic

North Atlantic weather conditions were poorly understood in the early days of flight. As transatlantic commercial service neared reality in the latter 1930s, it behoved all interested parties, public and private, to gain a thorough understanding of weather conditions there. They had to expand the limited meteorological knowledge base covering the region and expand the network of weather stations. By the mid-1930s, a mere handful of installations scattered around the North Atlantic coasts provided patchy coverage. Ships sometimes supplemented this picture with their own observations but there was no requirement for them to do so and few provided regular updates. Weather systems are vast. In the temperate parts of the northern hemisphere these systems are driven by a phenomenon called a polar front, which drives air masses around the world in bands thousands of kilometres across. Accurate tracking for weather systems across the North Atlantic therefore depended on assembling meteorological data at the biggest scale possible. The relatively small network of weather stations and ship reports available in the 1930s did not offer enough useful data to make forecasts for flight.

The needs of aviation were a big driver for the development of weather stations. Without reliable weather predictions, the slow, low-flying planes of the 1930s and 1940s could be caught in a storm and lost at sea, or fly into strong winds that could blow it far off course. Synoptic maps, the name for weather maps big enough to display and track large-scale weather patterns and pressure systems, needed to show flight crews what the latest conditions were so they could avoid the worst of it. Weather data was doubly important pre-1945 since commercial planes lacked cabin pressurization technology, making it impossible to overfly bad weather. Conversely, following a route that skirted weather systems could save a flight time by seeking out the most favorable winds. From the 1930s onwards, governments invested considerable

resources to build a reliable and wide-ranging network of weather stations, perform exploratory test flights, and develop ship-based weather stations. Even with the emergence of jets in the late 1950s that cruised above 30,000 feet, well above the worst conditions contained in Atlantic storms, tracking the winds could save a flight time. Meteorological data and infrastructure underpinned civil flight across the North Atlantic and served as a model for international cooperation in other aviation fields.

Prewar Meteorological Developments

Building the meteorological infrastructure necessary to support transatlantic flight was a challenging task due to the phenomena being studied. A storm may appear to be a local phenomenon but it is caused by larger wind and air pressure movements that are in turn part of a series of such systems that influence one another at the global scale. Planes in the interwar era could not fly above the worst of the weather, and flew so slowly that they were vulnerable to strong winds to a degree that modern, fast, high-flying jets are not as low air pressure at high altitudes keeps jets above the most severe weather conditions. Pioneering meteorologist Vilhelm Bjerknes developed much of the theory behind major weather systems in the early twentieth century. He noted how air pressure and wind patterns relate to one another at very large scales, discovering the existence and behaviour of pressure systems in the Arctic and temperate regions of Europe and how they influenced the weather. He coined the term “polar front” in 1919-20 to describe the boundary between the cold Arctic air masses and warmer temperate air found at mid-northerly latitudes, a region where the temperature gradient is very high over short distances. Rapid temperature changes produced by a polar front passing by causes strong storms.

Bjerknes suggested that these fronts could be tracked to the benefit of aviation.[1] As the polar fronts in particular are the most important driver of weather systems in the North Atlantic, any meteorological study of the region must consider them.

Because polar fronts are so large, they could only be detected and tracked with a network of stations spread across thousands of kilometres in multiple countries, a fact that required international data sharing to be effective.[2] Fortunately, meteorology was already a field in which international cooperation was widely practiced. In the nineteenth century, European and North American countries transmitted weather observations by telegraph. This cooperation led to the founding of the International Meteorological Organization (IMO) among those countries in 1873, which set out to standardize the format for weather information around the North Atlantic.[3] Sites for weather stations that could offer useful data had to be chosen, built, and manned; all of which depended on government funds. Europe had a head start as governments across the continent heavily subsidized their meteorological departments in support of civil aviation. The United States spent a comparatively paltry $2 million on the Weather Bureau to run just 200 stations across the entire country in 1922 for all observation and forecasting services despite how heavily America's commercial airlines relied on the data it collected.[4] Those countries participating in the International Commission for Air Navigation (ICAN), the interwar predecessor to the ICAO, shared their weather data through the agency for the benefit of all. ICAN encouraged its

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[1] Robert Marc Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology* (Ithaca, NY: Cornell University Press, 1989), p. 186-200.

[2] Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: The MIT Press, 2010), p. 90-1.

[3] Each country used its own format for weather data well into the twentieth century; the IMO was a weak organization that had little clout over its members. It was useful as a talking shop for the weather agencies to exchange information regarding best practices and new techniques but little more. Paul N. Edwards, "Predicting the Weather: An Information Commons for Europe and the World," in Nil Disco and Eda Kranakis, eds. *Cosmopolitan Commons in Europe* (Cambridge, Mass.: The MIT Press, 2013), p. 159-63.

[4] Kristine C. Harper, *Weather by the Numbers: The Genesis of Modern Meteorology* (Cambridge, MA: The MIT Press, 2008), p. 12, 19-22, 34.

members to use a common set of meteorological standards as well, thus cutting down the risk of miscommunication when sending weather data between people from different countries, a development that benefitted international air travel considerably.[5]

Arctic and North Atlantic weather patterns were the subject of study by meteorologists from both Europe and North America throughout the interwar era. Several countries, including the United States, Britain, France, Germany, and Scandinavian nations sent expeditions to the region to study weather conditions during that time. The findings only offered a rough idea of weather patterns but proved useful for determining where future weather stations should be sited.[6] A preliminary analysis compiled by British aviation officials in 1935 indicated that there was insufficient detail and quality about weather data on the southern route for the safe operation of transoceanic flights, although the conditions there were understood to be fair during most of the year. The direct route, however, was an order of magnitude more difficult to plan for. There was virtually no reliable meteorological record in Newfoundland or Labrador suitable for civil aviation. No weather stations operated outside of the capital, St. John's, so observations of current conditions across most of the North Atlantic relied on observations radioed in by ships on a voluntary basis.[7] Even much of the Canadian interior west of Labrador, where weather systems tended to form before crossing the Atlantic, was a blank. In short, a network of meteorological stations with radio equipment was needed to make the direct route viable.[8]

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[5] Paul N. Edwards, "Meteorology as Infrastructural Globalism," *Osiris* 21, Special issue on Science, Technology, and International Affairs: Historical Perspectives (2006), p. 233; Edwards, *A Vast Machine*, p. 54-5.

[6] Roger Turner, *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science*. Dissertation: University of Pennsylvania, 2010), p. 35-7.

[7] Morley K. Thomas, *Metmen in Wartime: Meteorology in Canada 1939-1945* (Toronto: ECW Press, 2001), p. 20-1.

[8] TNA AVIA 2/1939, "North Atlantic – Meteorological Organization," 1935. Director of the Meteorological Office at the British Air Ministry, "Memorandum on The Meteorological Organization required for the proposed Trans Atlantic Air Line, Appendix A" July 29, 1935, 1B.

Transatlantic aviation and hemispheric meteorology evolved together in the 1930s: without good weather data it was risky to fly long distances. Aviation representatives from Britain, Canada, Ireland, and Newfoundland held a conference in Ottawa in 1935 to create a North Atlantic civil air network entirely within the British Empire and to study the weather at sea. Two phases were planned. First, Britain would finance an experimental series of flights as well record relevant weather data and any other information to ease the construction of the transatlantic air network. Second, the four countries committed to establishing a joint-stock airline.[9] The Ottawa conference also dealt with improving meteorological observations and transmission between the participating countries and planes at sea. The resulting plan would have Canada build and oversee meteorological stations in then-separate Newfoundland.[10] Canada already operated some stations in Newfoundland and expected them to be used in the future for exactly that purpose. Additionally, Canadian weather data was already relayed from Toronto to Newfoundland twice per day in 1935, firming up the connection between the two Dominions. Finally, Canada had the resources and desire to enact this plan, and Newfoundland did not thanks to economic hardships stemming from the Great Depression. The British, the senior partners in the transatlantic project, supported the Canadian plan. The report noted that despite this, some in the Newfoundland meteorological circle wished to operate such a service

[9]The joint-stock airline would be majority (51%) owned by Britain's Imperial Airways, with Canada and Ireland each owning an equal minority share (24.5%), although this failed to come about due to the outbreak of the war and the technical difficulties of international ownership. The joint-stock airline was effectively owned by the British airline, but an international committee was tasked with running it. Financing was also to be shared: Canada would contribute up to 20% or £75,000 per year, with Ireland to pay a similar but as-then undetermined amount. Most interestingly was not that the agreement was struck so quickly but that Ireland, an independent country not part of the British Empire, was so eager to join into a permanent airline with Britain. This may have reflected the fact that Ireland (as well as Montreal on the North American side) was to be an integral part of the transatlantic route structure. All four countries likewise committed to harmonizing their air mail rates and regulations in anticipation of service beginning by 1938. TNA AVIA 2/1957, "Trans Atlantic Air Service Discussions in Ottawa & Washington, Nov/Dec 1935". "Trans-Atlantic Air Service," December 2, 1935, 55C.

[10] Newfoundland was a separate country with the British Empire until it merged with Canada in 1949.

independently.[11] The Ottawa Conference participants agreed that Canada should manage meteorological services for all airspace from Montreal eastward to 30° west, roughly halfway between the Newfoundland and Irish coasts. The Canadian Meteorological Division had the service up and running by 1937 to assist with the British experimental transatlantic flying boat operations in that year.[12]

Imperial Airways conducted a study of its own in 1935 on the transatlantic air routes and their associated weather problems (see Chapter One for more about the details of the three routes). Corroborating the findings of a 1930 study by the American Air Transport Engineering Corp., Imperial Airways concluded that the northern route presented weather that was too challenging for regular air service using existing technology. A substantial number of weather stations would be required in inhospitable regions, according to the study, and at huge expense. The southern route received favourable attention in contrast to the north. However, the route had issues unrelated to the weather: planes had to fly through the Azores, a part of Portugal, and land in Lisbon. Lisbon was a considerable detour for a flight between Britain and the Azores on top of the already onerous time penalty imposed by the route's greater distance. And only the direct route could be flown entirely over British-controlled lands, so despite its worse weather, Imperial recommended this route. Weather considerations came second to the political advantages.[13]

In 1936, the British Meteorological Office prepared for transatlantic flight by seeking to build up its knowledge base concerning weather patterns across the North Atlantic. To that end,

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[11] TNA AVIA 2/1939, "North Atlantic – Meteorological Organization." folio 25A, "Report on Meteorological Aspects of Visit of Unit[ed] Kingdom Air Delegation to North America including Preliminary Visit to Newfoundland. October 10th to December 21st 1935.

[12] A weather office was set up in Botwood, site of many flying boat operations in Newfoundland, in 1936. It relayed data to and from a main office in St. Hubert, Quebec, which was upgraded in light of its greater duties. Morley K. Thomas, "A Brief History of Canadian Meteorological Services Part 2: 1930–1939," *Atmosphere* 9, no. 2 (1971), p. 3-5; Thomas, *Metmen in Wartime*, p. 19-20.

[13] British Airways Heritage Centre, AW/1/6161 Pt. 1, Atlantic Services, Services, 1930-35. "Memorandum on Trans-Atlantic Air Services," Imperial Airways, June 1935. Appendix No. 1, p. 11-14.

it planned to send a meteorologist on ocean crossings for as much as a year to make a series of weather observations. These records would serve as a semi-regular and far more thorough complement to the existing weather reports ships produced at that time, offering consistent and professional data-gathering techniques.[14] The Marine Superintendent to the Manchester Liners Inc. provided passage and accommodation for this meteorologist on the *Manchester Port* for roughly 12 months between St. John, New Brunswick, and Manchester.[15] The meteorologist, D.A. Davies, performed a series of detailed observations including temperature, wind speed and direction, air pressure, and cloud heights. Other weather phenomena were recorded when possible; there was no telling what apparently trivial piece of information might be valuable.[16] Forecasting and weather modelling was still in its infancy but was already able to produce useful information for air travel. Pioneering work in meteorology from as early as the seventeenth century had gradually built up an understanding of what temperature, pressure, and wind conditions meant for upcoming weather. With the rapid dissemination of data across many points spanning long distances thanks to telegraphs and radios, it was possible to build accurate pictures of the systems that drove the weather and even forecast it for the benefit of civil aviation.[17]

There were a number of ways that air crews used weather data to improve flight operations, such as pressure pattern navigation. High and low pressure areas produce winds that rotate clockwise (high pressure) or counter clockwise (low pressure) around the centre of the

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[14] TNA BJ 5/40, "Attachment of meteorological officer to merchant ship on North Atlantic route for investigation purposes". Minute 17, M.C. Simpson, October 8, 1936.

[15] TNA BJ 5/40, "Attachment of meteorological officer to merchant ship on North Atlantic route for investigation purposes". September 10, 1936, 10A.

[16] Davies was unable to test the weather balloons during the initial voyage due to nearly constant gales and damaged equipment. He managed to overcome some of these problems by adapting practices already in use aboard the ship: wind speed and direction could be roughly calculated using the ship's bearing and speed with observations of the wind's direction and apparent speed using makeshift indicators. TNA BJ 5/40, "Attachment of meteorological officer to merchant ship on North Atlantic route for investigation purposes". D.A. Davies, December 22, 1936, 50B.

[17] Edwards, "Predicting the Weather," p. 159-66.

system. Developed for airships, which were easily blown off course in strong winds, pressure pattern navigation simply involved tracking air pressure systems to find the most favourable winds. Planes flew low (just a few thousand feet high) and comparatively slow during the 1930s, and the longer a plane spent aloft the more time there was for the winds to affect the flight. Transatlantic flights on a Boeing 314 flying boat could spend 12 hours on the ocean-spanning leg of the trip. A pilot following a path around these pressure systems could speed up a flight by eschewing a direct route in favour of one that skirted pressure systems, so it was critical that these systems were tracked as accurately as possible.[18]

The groundwork performed during the latter 1930s gradually improved the prospects for transatlantic flights. Despite this, British test flights during the summer of 1937 found that weather data were still insufficient for normal operations. Experimental flights successfully crossed the Atlantic at that time thanks to diligent and thorough planning despite the absence of permanent infrastructure to support the aircraft. One of the main findings was that there was still relatively little known about wind conditions on the North Atlantic. An Imperial Airways report on the flights cited some data to that end. It claimed that wind speeds only ever exceeded 45 mph (72 km/h) on seven known occasions to that time and pointed out that the winds typically blew out of the west, but that these were among the few facts known.[19] A later test flight found that winds were unfavourable to westward flights between 30 and 40 degrees north. The earth's rotation created zones where the prevailing winds favoured travel in one direction over another, a fact that sailors had long used when plotting courses between North America and Europe. The twentieth century extended this knowledge by confirming that similar patterns extended far

[18] Pressure systems rotate in the opposite direction in the southern hemisphere since they are driven by the Coriolis Effect, a force exerted by the earth's rotation that causes air systems to spin. William Warntz, "Transatlantic Flights and Pressure Patterns," *Geographical Review* 51, no. 2 (April 1961), p. 195-6.

[19] TNA AVIA 2/1163, Record of Trans-Atlantic experimental flights by Imperial Airways, folio 9A.

above the surface and could be used in an analogous fashion.[20] These data points were not conclusive nor did they categorically alter planning for air travel. They merely suggested that there was far more meteorological work to be done.

Monitoring and forecasting the weather was only part of the challenge for normal flight operations. Meteorological offices at both ends of the flight also had to pass their information on to the pilots as speedily as possible before (and if possible during) the trip. While relaying data could be done in person prior to takeoff, as early transatlantic flights could last longer than a full day, so regular updates on changing conditions were critical. Conditions observed at Botwood, Newfoundland, and Foynes, Ireland, were transmitted to planes by radio when possible, but the majority of those flights were spent in spaces beyond the reach of land-based radio stations. Even simple organizational matters sometimes proved difficult: the Foynes weather station initially kept its broadcasting equipment and landline equipment in the same room. The two systems in such close proximity created electronic interference that garbled transmissions to planes.[21] Most of the problems were resolved during shakedown operations. Practice relaying information between the various stations in Britain, Canada, the United States, and Newfoundland and to the planes smoothed out the process. By the late spring of 1937, the nine stations in the network produced reports of current weather conditions at regular intervals.[22]

Coordinating weather data between stations in Europe and North America was an important part of this complex international system. Data from just one side of the ocean were insufficient to ensure safety, limiting the picture available to flight crews. The governments of

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[20] A flight traveling from Europe to North America might have to travel farther south than the ideal in order to circumvent the winds at these latitudes, or else plan departures around breaks in the weather. TNA AVIA 2/1163, Record of Trans-Atlantic experimental flights by Imperial Airways, folio 31B.

[21] TNA BJ 5/55, folio 1A, "Report on meteorological procedure during flight of Imperial Airways "Mercury" from Shannon to Montreal on 20th.-21st. July, 1938, July 27, 1938.

[22] P.D. MacTaggart-Cowan, "Transatlantic Aviation and Meteorology," *The Journal of The Royal Astronomical Society of Canada* XXXII, no. 5 (May-June 1938), p. 220-3.

America, Canada, Britain, and Ireland, plus Pan Am and Imperial Airways, sent representatives to a conference in Dublin in 1937 to offer one another assistance for North Atlantic flight by sharing their aviation support infrastructures.[23] The conference created an independent organization to manage the sharing of this data, called the Trans-Atlantic Air Service Safety Organization (TASSO). TASSO handled transmissions, including meteorological broadcasts, to planes crossing the North Atlantic.[24]

By June 1939, a joint effort between the United States and Britain, France, Germany, Italy, Ireland, and Portugal, emerged to coordinate a regular meteorological broadcast standard for transatlantic flight. At the International Commission of Aeronautical Meteorology (CIMA, as it went by its French abbreviation) conference in Berlin, representatives from those countries offered their resources to broadcast regular radio information and share their data rapidly by landlines.[25] They decided to reserve several radio frequencies for those broadcasts, assuring that flight crews and ground stations would be able to communicate on a free channel as needed. CIMA also set up a broadcast timetable with four transmissions per day at six hour intervals, designed to offer the information at a "rapid rate" of 60 words per minute to minimize the disruption to other radio services. Existing transmitters were often not sufficiently powerful to be of use, so new ones had to be built. The main American transmitter was to be sited near New York at North Beach with a specially-built antenna. Orly, near Paris, was to have a transmitter ready for a twice-daily broadcast by that September. The use of other antennas in the remaining

[23] "Air Parley Charts Ocean Flight Aids," *New York Times*, March 25, 1937, p. 13.

[24] TASSO was absorbed into the ICAO following the war and its roles and functions transferred to the new organization. TASSO's standards and practices were to be studied so that they could be applied everywhere they might be useful on a global scale. "Planning for North Atlantic Safety," *Flight International*, March 14, 1946, p. 268.

[25] NARA RG 237, Box 440. Folder 929.5 "International Commission of Aeronautical Meteorology – C.I.M.Ae". "Minutes of the Fourth Meeting of 'Comité Pour la Protection Météorologique de l'Aéronautique sur les Océans'", June 19, 1939.

countries was temporarily offered to act as a stopgap despite the comparatively limited capabilities of existing broadcast stations.[26]

In addition to state-run efforts, Pan American Airways meticulously gathered and studied weather data. Doing so was important preparatory work for its transatlantic operations in 1939. The initial route, through Bermuda and Horta (in the Azores), relied on cutting edge aviation technology. The airline hence treated every piece of weather-related information as valuable both to improve the speed and quality of flights and to ensure the success of future flights. For example, it was long known that the prevailing winds blow towards the east throughout the North Atlantic and that these winds were stronger at higher elevations. Flights traveling east towards Europe therefore flew at 8,000 feet to take advantage of the higher wind speeds found at greater elevations. Conversely, westbound flights flew at a mere 1,000 feet to travel below stronger headwinds.[27] Pan Am likewise recorded the choppiness of the waters where their flying boats landed. The harbour in Horta experienced swells of 2.5 feet 57% of the time during the winter months of 1939-1940. At that time, this was considered too high for a safe landing. Flights that encountered choppier conditions than that resorted to a safe backup location or aborted the trip altogether. But the experience proved valuable as flight crews became more comfortable with their aircraft and familiar with the route. Pan Am anticipated that it would be able to set down in swells of up to 3 feet during operations in the following winter that occurred a much more manageable 35% of the time.[28]

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[26] It is noteworthy that this proposal included both ground stations and the possibility of permanently stationing ships at fixed locations for weather observations, as was the case both during and following the war. *Ibid*.

[27] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession II, Box 947, Folder 24: C.A.A. – Traffic Estimates (North Atlantic Route) 1940. "Pan American Airways Company of Delaware before the Civil Aeronautics Authority Docket 370, May 2, 1940" p. 4-6.

[28] *Ibid*., p. 8.

Wartime Meteorology

The meteorological work performed by the countries in the North Atlantic region became far more important with the onset of the Second World War. The huge material requirements of the Allied war effort necessitated the transport of goods from North America to Europe on a regular basis. Convoys regularly shuttled across the ocean to British harbours, risking attack by German submarines with each voyage. As discussed in Chapter Two, planes were primarily shipped rather than flown to Europe up to the fall of France in 1940. With most of the aeronautical challenges of transoceanic flights solved by the war's beginning, aircraft could often fly to Britain rather than sit in a cargo hold that could be used for other goods. What remained to be done was the construction of landing facilities and other infrastructure along a route that could be relied upon. Weather stations were the most valuable assets to put into operation around the North Atlantic, just behind the construction of airfields.

Forecasting and communicating meteorological conditions posed problems during the war, particularly along the northern route. Ship-based weather broadcasts had been an important source of information for this route during the interwar era. Few weather installations existed on or near the northern islands and the ships provided critical data from the region. In the early days following the declaration of war in September, 1939, ships ceased regular broadcasts of all kinds. Even distress messages were rare as sailors were reluctant to send out any signal that might give away their position to enemy vessels. Ground-based weather stations in the United Kingdom likewise halted broadcasts. Transatlantic flights therefore flew with minimal assistance once they were airborne.[29] The earliest workarounds were stopgaps rather than permanent solutions. Foynes' weather station gathered as much information as possible then

[29] British Airways Heritage Centre, AW/1/6165, Pt. 5. "Atlantic Services, Services," July-Dec 1939. Telegram from Captain Bennett, Atlantic Division, to The Manager, I.A. (Atlantic) Ltd., "Atlantic Services," September 11, 1939.

transmitted it to Britain and France in code. Airports there gave outgoing flights the latest reports before takeoff but otherwise could not maintain radio contact to give further updates.[30]

As meteorological and communications systems around the North Atlantic were built up the communications situation was gradually improved. Ground stations used encoded weather broadcasts that were easy to decipher and transmitted them at regular intervals. Crews on both ships and aircraft were made aware of one another's planned course so one could more easily locate the other in an emergency.[31] Since the United States was not at war in 1939, Pan American continued to operate its civilian transatlantic flights but at a reduced service. It offered additional weather observations through plane-to-plane radio broadcasts during the initial months of the conflict. While Britain's Imperial Airways did not carry out any transatlantic flights in 1939-40, the airline believed that it would be prudent to communicate with Pan Am plane-to-plane when their aircraft were in proximity. This would benefit both of their airlines, provided a common code system was in place for them to use.[32] Complementary to this, in 1941 the United States government concluded agreements with the Danish government-in-exile to protect Greenland and Iceland. The deal included the construction of weather stations that would offer a more complete picture of conditions across the northern Atlantic Ocean, primarily to support aerial crossings.[33]

With the assistance of this infrastructure, the early runs with landplanes for North Atlantic Ferry flights proved promising. But it was up to the flight crews to record and deal with the conditions over the ocean where the weather stations could not see. Planes were tested

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[30] TNA AVIA 2/1923, Part IV, "Trans-Atlantic Air Service: French Proposals". April 11, 1940, Minute 60.

[31] British Airways Heritage Centre, AW/1/6165, Pt. 5. Atlantic Services, Services, July-Dec 1939. Imperial Airways Limited memo, "Radio & Meteorology on Atlantic Services 1939," November 15, 1939.

[32] *Ibid*.

[33] Donald S. Dorr, "Weather Watch: Making Straight the Way for Air Travel Over the North Atlantic," *No. ACSC-87-1780* (Air Command and Staff Coll: Maxwell AFB, Alabama, 1987), p. 7-9.

through trial and error to find the optimal operating conditions: wind speed, air pressure, visibility, and other elements had to be logged, analysed, and tested under varying flight speeds and altitudes. The prevailing westerly winds on the direct route averaged 40 mph (65 km/h) at 20-25,000 feet, though only the long-range bombers could fly high enough to make use of these. These conditions offered a considerable speed advantage to planes bound for Europe. On the return trip to North America, it was still more economical to fly at that altitude than to opt for the slower 25 mph (40 km/h) headwinds found between 1,000 and 3,500 feet. This was due to the reduced drag in the thinner air that saved fuel despite longer travel times thanks to reduced engine power requirements.[34] Putting these findings into practice in 1941, average flight times for the westbound flights between Prestwick and Gander averaged just 13 hours versus 10 hours for the same route eastbound.[35]

Reports of current weather conditions across the North Atlantic were circulated hourly for the Ferry Service in 1941. These were not broadcast for fear of enemy interception but rather transmitted by cable between weather stations and airbases to be handed directly to flight crews. They detailed cloud ceiling altitude to the nearest 100 feet when known, or a more nonspecific "high" or "low" when uncertain. Clouds above 9,000 feet were described as having an "unlimited" ceiling because this was higher than most flights could operate at, except for the long-range bombers that could fly the direct route without stopping. When there was something obstructing visibility, the distance that could be seen clearly (up to seven miles, roughly eleven

[34] British Airways Heritage Centre, AW/1/6152 Pt. 2. Atlantic Ferrying Service, Services, 1941. Memo from O.D. to O.P.O., "North Atlantic Service: Landplane: Flying Times," OPO/OD/1095, 15 March 1941.

[35] The exact times in hours and minutes were 12:57 westbound and 10:01 eastbound. Additional flight times between Gander and Montreal were listed at 5:00 westbound and 4:28 eastbound. British Airways Heritage Centre AW/1/2594, "North Atlantic Ferry Service, Communications, 1941-43". BOAC memo from S/S., Prestwick, to A.O.S. Bristol, November 26, 1941.

kilometres) was noted as well as the cause of the obstruction, i.e. rain, fog, snow, haze, etc.[36] These sorts of visibility indicators became the standard in the postwar era for aviation throughout the world. Their simplicity and descriptiveness made them a valuable asset for flight crews seeking the best and safest routes.

In *Wings Across Time*, author David Collins detailed the importance of such accurate and timely weather information. He described the typical experience of the Canadian flight crews on a CGTAS transatlantic crossing as follows:

> Twenty-four hours prior to departure the captain and his flight crew would be briefed as to flight time and the weather patterns that were expected en route. Five hours before take-off another preflight briefing was held during which the crew, consisting of two pilots, a navigator, and a wireless operator, received last weather and intelligence reports concerning the flight. It was at this time that the captain made his final decision as to whether or not the machine would depart.[37]

Even during the height of the war, meteorological updates were at least as important as military intelligence reports for flight safety. The need for good, up to date weather information was certainly as much a consequence of the regularly bad weather found on the North Atlantic as it was the Allied air superiority in that region. Simply put, military threats posed a far smaller risk for the average transatlantic flight than the weather.

The Allied militaries set up what amounted to a parallel weather service separate from the civilian-run TASSO, which had proved useful for coordinating weather data in support of transatlantic air travel since 1937. TASSO, run out of non-belligerent Ireland in close collaboration with Britain, Canada, and the United States, was sidelined during the war.[38] The

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[36] British Airways Heritage Centre AW/1/2594, "North Atlantic Ferry Service, Communications, 1941-43". Extract, "Official Minutes of Discussion held by Trans-Atlantic Ferry Pilots and R.A.F. Representatives," September 4, 1941.

[37] David Collins, *Wings Across Time: The Story of Air Canada* (Toronto: Griffin House, 1978), p. 26.

[38] TASSO was absorbed into the ICAO following the war and its roles and functions transferred to the new organization. TASSO's standards and practices were to be studied so that they could be applied everywhere they might be useful on a global scale. "Planning for North Atlantic Safety," *Flight International*, March 14, 1946, p. 268.

complication to the Allies of running vital military information through neutral Ireland, coupled with the fact that military aircraft far outnumbered civil aircraft above the North Atlantic in the early 1940s, meant that most weather-related transmissions had to be handled separately from TASSO for security purposes. Dorval and Gander airports, heavily involved in the military Air Ferry program, took over the analysis and transmission of weather data from TASSO. The new centres, however, suffered from communication problems. Weather data was often slow to arrive for transmission. Some of the hastily-arranged facilities lacked phones even up to 1942. Information often had to be carried by hand to a relay station, frequently delaying departures.[39] In 1942, Royal Air Force staff also found that communications and weather forecasting were areas in need of improvement, with two stations, Goose Bay and Iceland, being singled out for their poor landline and radio links. These problems were comparatively small and easily addressed as more resources were brought to bear.[40] But for a time these shortcomings imposed unnecessary delays on a critical part of the war effort.

Royal Air Force data on flights during 1942-3 demonstrated both some of the hazards of transatlantic air travel as well as the limitations of weather records at that time. The Canadian Department of Transport issued a preliminary report on transatlantic flights from the RAF findings. It emphasized the threat of ice buildup on the aircraft in each season at certain altitudes. While it determined that there was never any ice hazard severe enough to completely curtail air travel, planes that could not reach altitudes above 25,000 feet were at risk of being caught in conditions that could cause potentially dangerous ice buildup. The higher altitudes, while colder, rarely contained enough moisture to form ice on planes. The air pressure is

[39] British Airways Heritage Centre, AW/1/2610. Trans Atlantic Air Service Safety Organization (T.A.S.S.O.), Communications, 1942-46. Telegram from Sgd. W.P. Hildred to Air Chief Marshal Sir F.W. Bowhill, 4 August, 1942.

[40] TNA AIR 38/7, "Transatlantic ferrying: far northern route, 1942-3". Minutes of a meeting by Air Chief Marshal Sir Frederick Bowhill, July 15, 1942, 27.

insufficient for more than trace amounts of water to exist barring strong storms. In addition, the report found little reliable information on the potential for unstable air masses to produce potentially damaging clear air turbulence. This phenomenon was common and unpredictable enough to cause concern, and doubly so since, unlike other hostile conditions, it could catch flight crews unaware.[41]

Generally speaking, very cold conditions were a known quantity on the North Atlantic by the war. They occurred often and predictably enough that appropriate countermeasures were regularly installed on aircraft. Planes unable to circumvent bad weather could be equipped with de-icing systems to spray an anti-freeze solution, or preheat sensitive components like carburettors. Synthetic rubber likewise hardened in extreme cold and had to be either protected or replaced with other materials.[42] Icing in particular was a reasonably well understood phenomenon by 1943. Studies conducted before the war had focused on what conditions caused ice. These studies recommended that planes avoid certain cloud types that were known to cause ice buildup in cold weather but offered no further suggestions about dealing with ice buildup.[43] But wartime needs sometimes forced planes to fly into such potentially hazardous clouds, so the Allied militaries gathered more data on ice and how to minimize or disperse it. Rime ice, which formed along the leading edge of the wing, and clear ice that adhered to the entire body of the plane, could become a serious problem. Ice added unwanted weight to planes, and clear ice carried the additional risk of freezing the wing such that the pilot might lose control of the plane. Pilots were advised not to risk flying through regions where clear ice might form on their plane,

[41] TNA DSIR 23/16454. Assistant Controller P.D. McTaggart-Cowan, Forecast Services, Department of Transport, Canada, *Preliminary Report on Various Meteorological Factors affecting the Regularity of Transatlantic Air Services*, May 20, 1947.

[42] British Airways Heritage Centre AW/1/5464, "North Atlantic, Meteorology, 1941-46". "Weather Conditions on the North Atlantic Route," July 20, 1943.

[43] Harper, *Weather by the Numbers*, p. 65-6.

at temperatures between 0°C and -18°C. When it could not be avoided, there were usually some predetermined safe altitudes at which the temperature and pressure would limit (or even reduce) ice formation. Ironically, use of de-icing equipment could diminish a plane's aerodynamic performance. In those cases, pilots were advised simply to endure the ice and attempt to reach a safer altitude.[44]

Another study produced by BOAC examined the meteorological experience on the Return Ferry Service during 1941-43. It repeated the concerns with icing and the remedy of flying at up to 25,000 feet to pass above clouds during the winter, as well as noting that this was not a severe concern in the summer, so planes could safely fly at just 12,000 feet during part of the year. Besides the hazard of ice buildup, challenges to ground operations factored into this study: flights through Newfoundland, particularly through Gander, were often delayed by foggy or stormy conditions that reduced visibility, making flights there particularly risky. The BOAC study also criticised Montreal and Atlantic Canada for their severe winters, specifically that cold weather froze flying boat waters and piled snow on the runways. The report did note that snow removal in Canada was up to the task of runway clearance, but only North American airports farther south than New York could expect snow-free and ice-free winters.[45]

During the war Ferry navigators used pressure pattern flying extensively, building on their knowledge of wind patterns near pressure systems by using air pressure data to compute a single course correction averaged over the course of their trip rather than many minor adjustments. Calculating just one course correction had the advantage of making a very long trip

[44] Ice was classified in nine specific categories based on how it affected the plane and where it stemmed from. Rime could be light, medium, or heavy, as could clear ice, as well as icing from precipitation not in clouds. British Airways Heritage Centre, AW/1/5464. North Atlantic, Meteorology, 1941-46. "Preliminary Report on Various Meteorological Factors Affecting the Regularity of Transatlantic Air Services," October 14, 1943, p. 4-5, 20-21.

[45] British Airways Heritage Centre, AW/1/5464. North Atlantic, Meteorology, 1941-46. "Weather Conditions on the North Atlantic Route," 20 July, 1943.

easier to navigate by providing a pilot with a constant heading. While pressure changes and winds along the route introduced navigational errors during transatlantic trips, these generally canceled one another out over the long voyage.[46] This method was improved by the addition of radar-altimeters to aircraft, which gave navigators additional position data with which to ascertain their position.[47] Up-to-date knowledge of weather conditions and how they could affect a transatlantic flight made pressure pattern navigation a useful tool for navigators.

By the war's end, the cumulative experience of flight crews and the wide network of weather stations made the North Atlantic safe enough for regular flight. Proper procedures in case of the sudden onset of adverse conditions were well practiced, alternate landing sites were developed, and many of the kinks in detecting and communicating data were worked out of the system. No longer were transatlantic aircraft flying into unknown conditions lurking just out of sight offshore; a pilot could be confident of what meteorological hazards lay ahead. This is not to say that there was no more work to be done to improve the quality of weather observations in the region. Shortcomings plagued the expanded civilian meteorological network, including harmonizing standards and communications both between the stations ringing the ocean and the aircraft flying above it. The system was far from perfect, but the wartime infrastructure and the Ferry services brought the region up to the standards needed for regular commercial flights even in the subarctic seas.

Postwar Meteorological Development

After the war, civilian weather stations continued to provide the support across the North Atlantic region that military stations had previously offered. Many military stations were

[46] Warntz, "Transatlantic Flights and Pressure Patterns," p. 198.
[47] *Ibid*., p. 199.

transferred or returned to civilian operation. The Allied countries around the North Atlantic recognized the need to share the data with one another to better understand the conditions at any given time. To that end, in 1946 they met in London and signed an agreement to service the former military weather stations and to develop new ones as the need arose.[48] Despite the achievement that the international weather station network represented, the stations suffered their share of limitations, including problematic communications with each other. For example, in 1949, weather data gathered in Newfoundland or Canada's Maritime provinces was not transmitted directly to Santa Maria in the Azores. Delays of up to four hours were commonplace due to an unfortunate combination of factors, chiefly that the information was sent through a station in New York rather than directly between the two endpoints.[49] As synoptic charts had to span regions several thousand kilometres across to be useful, even the far-flung islands of the southern route needed data from the north to form an adequate picture of conditions for aviation. The use of teletype compounded the transmission delay problem: messages were automatically relayed by New York to the Azores but appeared merely as code. With the Azores station acting as a primary telegraph relay between North America and Europe there was a huge amount of data to retransmit. The Newfoundland Controller of Radio (Air) C.M. Brant suggested that it was probable that the information was indeed reaching the Azores. But, since there was no obvious way to discern the coded data by eye, it was overlooked for hours. Upgraded equipment

[48] M.L.J. Dierikx, *Clipping the Clouds: How Air Travel Changed the World*. (London: Praeger, 2006), p. 38.

[49] British Airways Heritage Centre, AW/1/7464. Mid-Atlantic Services, Wireless/Meteorology, 1949-50. Memo from BOAC Senior Flight Operations Officer for Newfoundland and Labrador D.S. Keen to Manager, No. 3 Line, Filton, "Communications with the Azores," 24 January 1949.

was soon installed to permit direct communications between the two locations to alleviate the problem.[50]

In addition to such relatively manageable technical matters, discrepancies remained between each nation's descriptions of basic meteorological phenomena. Regional models of weather patterns needed data from all its sources to be compatible, which was critical for North Atlantic forecasts. The IMO gained additional power following the war, became a UN agency, and was renamed the World Meteorological Organization (WMO) in 1950. Its augmented authority as an intergovernmental group gave it the clout to push for the worldwide harmonization of standards in weather forecasting and data sharing (ICAN had pushed for this in Europe in the interwar era but other regions did not necessarily use the same standards). The development of accurate computer weather models in the 1950s and 1960s depended heavily on massive amounts of standardized data.[51] In 1951, the WMO singled out the United States for using different terminology than all other IATA member countries to describe the amount of cloud cover. Americans used a system that identified the ceiling, or observed cloud bottom, in a format that stitched together multiple observed cloud levels into a single altitude.[52] This format did not correspond to IATA recommendations for recording the actual cloud height or for ceiling reports, thus complicating the work for non-American flight crews who had to interpret the

[50] British Airways Heritage Centre, AW/1/7464. Mid-Atlantic Services, Wireless/Meteorology, 1949-50. Memo from BOAC Senior Flight Operations Officer for Newfoundland and Labrador D.S. Keen to Operations Supt., W. At., Montreal, "Communications with the Azores," 18 March 1949.

[51] Edwards, "Predicting the Weather," p. 167-9.

[52] Ceiling is only used to describe the bottom of the cloud layer when lower than 6,000 metres (20,000 feet) and is described by how many eights of the sky is so covered (above that height no ceiling is recorded). The example given here is when there is cloud coverage of 2/8 of the sky at 2,000 feet and 4/8 at 6.000 feet. American-style format would say that there was a ceiling at 6000 feet since most of the sky (6/8 in aggregate) was covered and the majority of it was at the 6,000-foot elevation, whereas IATA standards would say that there was no ceiling at all since no single layer of cloud covered more than half of the sky. British Airways Heritage Centre, AW/1/4748. Meteorological Group, IATA, 1950-53. BOAC memo, "I.A.T.A. World Met. Group – 2nd Meeting," 28 February, 1951.

information. The American method was thereafter changed to match the international norm.[53] Certain meteorological matters such as this did not become an issue until regular commercial transatlantic flights were commonplace.

Making use of weather information was just as important as gathering it. Further, the quality and quantity of the data improved airlines constantly refined their operations for maximum effect. For instance, TWA Navigation Officer George W. Hafner claimed that elevation readings at several selected air pressures offered great time savings for flights, even more so than a route based solely on wind patterns. He extolled the performance of pilots in observing and distributing their air pressure observations combined with the high quality of weather forecasting at Gander and Rineanna, Ireland. This combination of solid observations, forecasts, and the addition of weather ships (see Chapter Seven) in the years to come could lead to shorter flight times, more fuel savings, and keep planes on routes having the best possible weather.[54]

Weather was a greater concern for aircraft into the late 1950s before jets emerged. The slower speeds at which propeller planes flew meant a given route took them longer to travel, as noted above, so ambient conditions had more time to affect a flight.[55] Strong winds in particular had a larger relative impact on propeller planes than on high-speed jets. This factor necessitated the close observation of weather patterns to achieve the greatest time savings. Flights across the Atlantic were not plotted on the most direct route but on the route with the winds that would get

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[53] *Ibid*.

[54] Hafner did note that pilots sometimes failed to log the air pressure at times. There were several specific pressures that he singled out as worth recording: 1,000 millibars (sea level), 850, 700, and 500 millibars. It should be noted that these pressures predated the even lower pressures at which jets would fly in the years to come, typically at 300 millibars or less. LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. File 1651-6, 5951-6, letter from George W. Hafner, Navigation Officer, TWA Atlantic Division, to Andrew Thompson, Acting Controller at the Department of Transport, "Air Navigation – Meteorology – North Atlantic," September 27, 1946.

[55] Warntz, "Transatlantic Flights and Pressure Patterns," p. 191-3.

the plane to its destination the fastest. Even jet pilots needed meteorological data despite their reduced vulnerability to the vagaries of the weather. They could take advantage of pressure-pattern routes to speed their trip by staying to the most favourable tailwinds or weakest headwinds. The time saved was far less than propeller-driven planes would get but even cutting a few minutes off a flight could mean hundreds of dollars in fuel savings.[56]

Air pressure updates were sent out for both propeller and jet aircraft as early as the 1950s by meteorological stations. Each type of plane cruised at its own altitude, and the data provided for the North Atlantic weather reports reflected this. In a 1960 example, propeller-driven DC-7s required maps showing the altitude at which 500 millibar air pressures were found. This air pressure was typical of the 18,280-foot altitude at which the DC-7 operated, and a pilot making use of the isobar[57] pattern across the ocean could optimally navigate the fastest route across the ocean even while deviating from the shortest, most direct route. The DC-8 jet pilot similarly used a 300 millibar map since this was the pressure typically found at 30,050 feet where the plane flew.[58] Jets rarely had to deviate as far from the direct route between its point of origin and its destination. They flew so fast that it was easier to make a tiny course adjustment to get a small boost from the wind than to make a large detour and follow the fastest winds. Due to jets' lower reliance on pressure-pattern flying, it was simple and easy to accurately predict flight times for them.[59] Planes saved fuel for every minute their route was shortened, so following

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[56] D.O. Fraser, "Navigation and Traffic Control over the North Atlantic," *Journal of Navigation* X, no. 2 (April 1957), p. 116-7.

[57] Isobars are the contours on synoptic charts (weather maps) that denote a constant air pressure or, conversely, the altitude at which a constant air pressure is found.

[58] The DC-7 had an operational airspeed of 270 knots versus the DC-8 with 480 knots. The thinner air for the DC-8 meant that the jet plane encountered even less air resistance, winds or no, than the DC-7 regardless of winds. All of these factors combined to make the DC-7 far more vulnerable to winds on westbound flights than the DC-8 was when traveling in either direction. Warntz, "Transatlantic Flights and Pressure Patterns," p. 189-92.

[59] A summary table showing the flight times and paths of a DC-7 and DC-8 shows the impact of air pressure on the route and flight times. Flight times for the DC-7 using pressure-pattern flying eastbound between New York and Copenhagen was 11:20 (hours:minutes) against 11:42 (3.2% longer) when flying the great circle

pressure-pattern routes was the most economical option even for those minor course changes. This translated into huge cost savings both per flight and in aggregate. Pan Am flight navigator Robert K. Polson estimated that the average transatlantic propeller-driven flight saved $1,690 using this method. He derived that figure from fuel savings from the improved flight times and consequent increase in the amount of cargo weight the fuel savings permitted.[60]

Conclusion

The quality and quantity of meteorological data improved considerably over time. The network of weather stations tirelessly gave flight crews the means to plot out the fastest, safest, and most economical routes across the North Atlantic. By the mid-20th century, detailed and universally consistent reports of all weather systems across the ocean were available throughout the region several times a day. Flight crews from one country could pick up a report in another country and get an update in a third, never once having any trouble understanding it. Passengers traveling between North America and Europe could rest assured that their flight would run across nothing worse than occasional turbulence, a far cry from the Hail Mary hope for good weather that pioneering aviators had to rely upon just decades earlier. Even these advances were surpassed as satellites watched the whole ocean from geostationary orbits. This former frontier was not tamed but its threats were thoroughly staked out.

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directly, but westbound this climbed to 13:05 and 14:58, respectively (14.4% longer). For the DC-8, the westbound flight times were 6:56 versus 6:58 (0.5% longer), and eastbound 7:35 and 7:50 (3.3% longer). Even at its worst performance, the jet flight was barely affected by weather. The DC-7 deviated from the direct route between New York and Copenhagen far more than the DC-8 either eastbound or westbound, and in fact the DC-8 almost perfectly traced the great circle route on the eastbound leg of its trip. *Ibid*., p. 192-3.

[60] This average was done over the five models of piston-powered planes then operating over the North Atlantic during a seven-month period in 1955. Warntz went on to extrapolate the value of such savings for all transatlantic air traffic in 1956 based on total flight numbers recorded by Gander air traffic control. The 46,550 planes that crossed the ocean would have saved nearly $79 million had they all been such planes, but this estimate is likely high due to the reduced impact of pressure-pattern savings on jets. *Ibid*., p. 210.

Ironically, the most substantial improvements to transatlantic meteorology came as their relevance was waning. High-flying planes of the postwar era made the weather hazards of the North Atlantic a pale shadow of what they once were. Pressurized-cabin propeller craft and jets flew ever higher in the quest for faster ocean crossings, soaring to heights where poor weather could barely reach. Conditions that would have forced a Boeing 314 to turn back in 1940 meant little by 1960 when a DC-8 could simply pass above them or skirt the system entirely in minutes. Forecasts remained valuable primarily by how much time they saved: even into the present day, a few minutes saved through pressure-pattern flight can represent thousands of dollars in fuel and reduced wear on the planes. The fact that it is possible to predict something as ephemeral as the wind in the middle of the ocean hours in advance to save minutes off of flights traveling close to the speed of sound is an accomplishment well worth praise. The studies performed in the region similarly proved valuable for meteorology and air travel throughout the world. Data from varied sources was combined in novel ways by the meteorologists, weather bureaus, and airline analysts from several countries on a regular basis. In a sense, the North Atlantic became the biggest international weather laboratory in the world thanks to the need for good data for air travel. Meteorology's importance from an economic and safety standpoint was indispensable for transatlantic flight.

Chapter Seven: Weather Ships and The North Atlantic Ocean Station Program

As noted throughout the chapter on meteorology, transatlantic flight depended on adequate weather data for safe and efficient operations. Yet while the governments of the region invested heavily in building a network of weather stations ringing the North Atlantic during the interwar years, there was a sizeable gap in the coverage: on the ocean itself. Between the North American and European coasts there was no regular source of meteorological data up to the late 1930s. Ships and the handful of planes that crossed the ocean provided some observations. But, with few exceptions, this data was not gathered by trained meteorologists, rarely used the best possible equipment, and was often delivered upon arrival and so might be days out of date when reports were filed at all. In part to address these shortcomings the United States Navy deployed a series of ships to support the first transatlantic flight, the NC-4 flying boat.[1] This was a one-off measure but the value to the flight was tremendous and proved the need for ocean-based weather stations.[2] Following the Second World War, the countries surrounding the North Atlantic deployed a network of ships in support of civil flight, coordinated through the ICAO. The international fleet was the only means to provide consistent, ocean-level weather observations during that time and could only have been run by the navies and coast guards of those participating countries. This chapter will explore the history of the weather ships from the first test program to a regular observation network.

Ship-based Meteorology Before 1945

During the early interwar era only a few weather stations were equipped to observe conditions adjacent to the North Atlantic. And in the open ocean away from coastal weather

[1] "NC-4 Flew to the Azores in Fifteen Hours," *New York Times*, May 18, 1919, p. 1.

[2] Robertson Dinsmore, "Alpha, Bravo, Charlie...: Ocean Weather Ships 1940-1980," *Oceanus Magazine* 39, no. 2 (1996). Retrieved from: http://www.whoi.edu/oceanus/feature/alpha-bravo-charlie (March 30, 2016).

stations, the only available weather data came from ship reports. These were performed on a voluntary basis and so were neither produced rapidly nor did they provide data from the optimal positions for weather forecasts. As early as 1921, the International Meteorological Organization (IMO) proposed that a network of "ocean weather stations" (anchored ships) might remedy this. If deployed, the ships had to be sited at strategic locations around the ocean. By remaining in a fixed spot, the ships could provide reliable and consistent weather observations for ships and air traffic.[3] In 1937 a Norwegian pilot, Hj. Niiser-Larsen, pointed to the value of regular meteorological communications between ships at sea and aircraft. If planes were provided maps with the scheduled position of ships at noon each day as well as their course, it would at least offer a somewhat predictable source of information for planes. Since not all ships carried radios, alternate means of communication were suggested: an Aldis lamp to send Morse code messages or signal flags to deploy on the ships or planes, as necessary.[4]

Prior to 1939, air travel across the North Atlantic remained a matter of experimentation. When commercial transatlantic air service was initiated in the latter 1930s, the gap in coverage above the ocean could no longer be tolerated. Several countries began testing how best to address this problem. In 1937, the French ship *Carimare* became the first weather ship. Unlike the earlier proposal for a fixed observation station, the *Carimare* was only a trial run to determine how regular ship-based weather data collection might proceed. It sailed the North

[3] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from H.M. Hutchon, Esq., Liaison Meteorologist, Office of the Director of Air Services, Department of Transport, "Report on Ocean Weather Stations". March 15, 1949.

[4] Common radio signals would have to be worked out between the planes and ships in advance. Educating ship crews about the types of plane would carry an additional advantage for search and rescue operations as well: the author here noted that he (and other) pilots had put down their planes in the water near ships but the ship's crews did not recognize that the landplane was in distress and requiring a rescue. An additional method of communication for other purposes was the use of despatch boxes to be dropped from the planes in reasonably calm weather. British Airways Heritage Centre AW/1/4746, "Liaison Between Ships and Aircraft, I.A.T.A., 1937." Letter from Hj. Niiser-Larsen, Det Norske Luftfartselskap Fred. Olsen & Bergenske A/S, to the International Air Traffic Association, "Liaison between Aircraft and Seacraft," February 13, 1937.

Atlantic and took a variety of readings on meteorological conditions. Air France and the French Line (Compagnie Générale Transatlantique) jointly ran the ship under French government backing for the benefit of all air travellers.[5] Germany likewise sent a ship into both the North and South Atlantic to make weather observations at the same time. Britain managed to send out two ships by 1940, but both vessels were attacked and sunk.[6]

The United States government also undertook an effort to study conditions at sea. Following the loss of a Pan Am flight in 1938 from bad weather, America's Coast Guard and Weather Bureau took measures to monitor conditions beyond that which ground stations alone could observe. Weather balloons carrying radiosondes were used thereafter to observe high altitude winds and provide a fuller picture of atmospheric conditions. Balloons could only offer a guide to the situation above the place they were released, which to that time was always somewhere on the land. To fill in the gap represented by the Atlantic Ocean, the American government developed plans to permanently situate ships at sea to obtain similar data from remote locations.[7] In 1940, six ships were stationed at specific points well off of the American Atlantic coast to record weather data and radio their findings to American stations. This timing was not coincidental as merchant ships regularly broadcasted meteorological reports prior to the outbreak of the Second World War. The fear of German U-boats tracking down and sinking a ship that broadcast even an innocent weather report effectively curtailed all such transmissions. With the loss of this supplementary information, pilots had far less useful data for their

[5] "Weather Ship Posts Fliers," *New York Times*, September 5, 1937, p. 135.

[6] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from H.M. Hutchon, Esq., Liaison Meteorologist, Office of the Director of Air Services, Department of Transport, "Report on Ocean Weather Stations". March 15, 1949.

[7] While this was not the first time such a proposal was made, it was relevant in that it brought the United States into what had previously been a primarily European endeavour. Dinsmore, "Alpha, Bravo, Charlie...:".

upcoming flights.[8] On occasion, ships did make broadcasts when it was absolutely necessary. They did so in code throughout the war.[9] After becoming aware of the American weather ship project, the British government recommended that the American weather ships ought to broadcast their data in code as well despite American neutrality at that time, as British merchant ships did. The British also requested access to the data for their own flights and seagoing traffic.[10]

The first American weather ships were two Coast Guard cutters, the *Bibb* and the *Duane*. They were deployed to points one third and two thirds of the distance between Bermuda and Horta (in the Azores), along Pan American Airways' primary route between Europe and North America. Since the direct route to Britain was no longer in service, with Britain an active belligerent while the United States was at peace, Pan Am could only fly to neutral Portugal or Ireland. Observers from the Weather Bureau were attached to each ship.[11] Per the British recommendation, both the weather ships and Pan Am flights used coded transmissions for their weather data and refrained from making the information public.[12]

Following America's entry into the war, the weather ship program grew into a new and more essential service: the ships acted as monitors for the large number of military planes flown

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[8] "Second Weather Ship Off," *New York Times*, February 7, 1940, p. 42.

[9] Merchant vessels resumed regular weather observation broadcasts following the war's end, doing so at four hour intervals. As before, this was not a strict requirement but was done on a voluntary basis. LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. Letter from G.E. McKee, Manager-Secretary of the Shipowners Association (Deep Sea) of British Columbia, to Commander C.P. Edwards, Deputy Minister of Transport, "North Atlantic Weather Ships," June 21, 1947.

[10] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. Letter from W.C. Hankinson at the Office of the High Commissioner for the UK in Ottawa to O.D. Skelton, Under Secretary of State for External Affairs, Ottawa, January 16, 1940.

[11] Dinsmore, "Alpha, Bravo, Charlie...".

[12] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. Letter from J. Patterson, Controller, Meteorological Service of the Department of Transport to Commander Edwards, Chief of Air Services in the Department of Transport, April 15, 1940.

from American and Canadian factories to Europe. Over the course of the war, as many as 21 ocean stations were active at any one time. A station refers to the fixed point in the ocean rather than then ship itself. Each station was actively served by one ship at a time in rotation with one or two other ships available to relieve them. Due in no small part to support by the weather ships, the North Atlantic trunk route had the lowest loss ratio of any military air route despite having the worst weather of any such route.[13]

Postwar Weather Ships

Despite advances in aviation technology and ground-based infrastructure on the North Atlantic up to 1945, there was no peacetime plan for observing the weather over the ocean on a regular basis. The United States Navy, which takes charge of the Coast Guard in times of war, did not intend to continue running the weather ships.[14] Nor was there a system to offer aircraft a fix on their position, or to perform search and rescue in the event of a crash unless a ship happened to be nearby at the time. J.R. Smith, an experienced seaman with knowledge of the North Atlantic, proposed a solution. He suggested that a medium-sized aircraft carrier be permanently stationed midway between Newfoundland and Ireland. By keeping the ship at a fixed location, as the wartime weather ships had done, it could use a radio beacon to offer a

[13] The number of American ships used generally increased as the war continued: 4 ships in 1942, 9 in 1943-4, and between 17 and 21 in 1945 before falling to only 4 in 1946. The surge in 1945 represented the use of additional ships to guide planes back to North America following the conclusion of hostilities in Europe. LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from H.M. Hutchon, Esq., Liaison Meteorologist, Office of the Director of Air Services, Department of Transport, "Report on Ocean Weather Stations". March 15, 1949. The Coast Guard recalled its cutters for anti-submarine duties. They were replaced by a variety of smaller, mainly Coast Guard-operated vessels. Weather ships were also used throughout the Pacific during the war (and a small number following, albeit far fewer than in the North Atlantic), totalling 24 stations at its peak. Dinsmore, "Alpha, Bravo, Charlie...".

[14] *Ibid*.

waypoint for planes making the transatlantic trip, provide updates on weather data, and render assistance to aircraft in distress.[15]

A point-by-point rebuttal to Smith's proposal found that it was infeasible and insufficient to the task. The large vessel could not hope to maintain a perfectly fixed position in the deep waters of the mid-Atlantic without using an anchor cable that weighed nearly as much as the ship itself. Fixing the ship in place was considered infeasible in stormy weather when its services would be most valuable. Planes often deviated widely from their planned course to get around adverse weather, which would frequently take them far from the ship's location. Even in good conditions many planes did not follow a single track across the ocean, nor could they be assured that they were on course prior to reaching identifiable landmarks. And since a single ship would be unable to offer anything more than a small area of useful radio coverage and rescue capability, the proposal was considered too expensive and technically unsound. Although this specific application of ship-based weather observation and radio reporting was rejected, the report did endorse the principle provided a more practical form could be found.[16]

A new form indeed materialized in 1946 with the semi-permanent allocation of ships from several countries across the North Atlantic.[17] The decision to develop the program was made at the North Atlantic Air Route Service Conference in Dublin, attended by countries that regularly operated flights in the ICAO's North Atlantic region (one of eight ICAO designated

[15] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. J.R. Smith, "An Outline of a Proposed Scheme for Establishing an Air Control, Air Sea Rescue, W/T., and Meteorological Station in Mid North Atlantic," February 10, 1945.

[16] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. "Comments on proposal scheme for establishing Air Control, Air/Sea Rescue, W/T and Meteorological station in mid-North Atlantic," June 18, 1945.

[17] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. ICAO News Release, October 22, 1953.

regions encompassing the globe).[18] In 1947, eight of the countries that attended the Dublin Conference met in London and signed a pact allocating and funding the peacetime weather ships.[19] Called the North Atlantic Ocean Stations (NAOS) and overseen by the ICAO,[20] this network provided thorough coverage of the unpredictable and often dangerous weather across the ocean. The original NAOS plan, which was never fully implemented, consisted of thirteen stations located in strategic points that offered a reasonably complete picture of oceanic meteorological conditions.[21] To provide the best possible radio coverage, no plane would ever be more than one and a half hours of flying time (about 450 kilometres) from a weather ship or from land, and each ship had to remain within ten miles (16 kilometres) of its assigned position.[22]

The NAOS ships offered regular weather broadcasts every three hours and balloon-gathered information broadcasts every six hours. These balloons were equipped with radiosondes: probes containing sensors that detected ambient temperature, pressure, and humidity at regular elevations up to 50,000 feet. A radiosonde would transmit on a particular frequency while it ascended, tracked by radar from the ship below to determine wind speeds.[23] These were basic but thorough mechanisms for studying weather data. Radiosondes were so useful that many European and North American weather services regularly used them by the

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[18] David Clark MacKenzie, *ICAO: A History of the International Civil Aviation Organization* (Toronto: University of Toronto Press, 2010), p. 71, 182.

[19] "Ships as Air Guides in Atlantic Scant," *New York Times*, September 28, 1947, p. S9.

[20] "A Guide to Ocean Weather Ships," *The Times*, April 8, 1960, p. 10.

[21] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. Letter from Commander C.P. Edwards, Deputy Minister of Transport, to C.D. Howe, Minister of Reconstruction and Supply, "North Atlantic Weather Stations", September 27, 1946.

[22] Technically, the ships operated within a square ten miles to a side. "Ships as Air Guides in Atlantic Scant," *New York Times*, September 28, 1947, p. S9.

[23] Dinsmore, "Alpha, Bravo, Charlie...". Each system on the radiosonde (thermometer, barometer, etc.) activated in a particular order. Its transmissions were modulated so that each instrument had a distinct signal that prevented confusion over which reading was being taken. As it ascended, the radiosonde activated at certain air pressures corresponding to a particular elevation.

1930s, albeit only over land.[24] By providing better weather data over the ocean, early studies suggested that enough fuel would be saved to allow up to three more passengers on an average flight.[25] Since transatlantic-capable aircraft of the day typically carried fewer than 75 passengers, this was a great benefit.

The NAOS program formed in anticipation of growing civil transatlantic flight. Pilots needed more than merely meteorological reports from the ships: as noted above, accurate position data ensured that planes were on the correct path. Such information was vitally important as the North Atlantic skies grew ever more crowded. The United States initially provided the most ships since its airlines carried the most transatlantic passengers and flew the most planes. Participating countries agreed to commit a share of the NAOS funds based on their benefits from the program.[26] America's international airlines accounted for about two thirds of all transatlantic passenger traffic in 1947,[27] bearing out the relative burden expected of the United States. While the American government was reluctant to commit the large number of ships, it eventually agreed to dedicate fourteen vessels to the project. Britain, France, Norway, the Netherlands, and Canada also contributed at least one ship to the NAOS fleet. Other countries such as Belgium, Denmark, and Portugal paid to support the program in lieu of offering ships of their own. Each country paid an amount that reflected both the amount that they benefitted from the program as well as their ability to provide ships for the program's operations. As a country that carried a few dozen passengers across the North Atlantic per week

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[24] Roger Turner, *Weathering Heights: The Emergence of Aeronautical Meteorology as an Infrastructural Science*. Dissertation: University of Pennsylvania, 2010), p. 62-3. The United States had just 6 radiosonde sites in 1938, but the value of high altitude weather data to the war effort spurred the rapid expansion of the network to 335 sites by 1945. As of 2010, there were over 800 weather balloon launching sites around the world that deployed radiosondes daily. Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: The MIT Press, 2010), p. 107, 279.

[25] "Weather Ship Minimum Put at 13," *New York Times*, June 5, 1946, p. 29.

[26] Peter B. Schroeder, *Contact at Sea: A History of Maritime Radio Communications* (Thomas A. Koppel & Son, Co.: New York, 1967), p. 62.

[27] "Ships as Air Guides in Atlantic Scant," *New York Times*, September 28, 1947, p. S9.

did not rely upon the system as much as one that might carry hundreds, it was not expected to pay an equal amount.[28]

By September 1947 the first NAOS ship, at one of the British stations, was in place. This was not enough to provide a useful picture of weather conditions on its own and so posed a problem for the coming winter season. Without reliable weather data the direct route between North America and Europe would be far riskier. A thousand planes passed through Gander's airspace on transatlantic flights that September alone. This vital corridor required support commensurate to the scale of that volume. To that end, the Canadian Transport Ministry put pressure on the Canadian Department of Defence to send a ship to the joint Canadian-American station to alleviate those concerns.[29] Despite Canadian recognition for the value of the NAOS service by late 1947, American support for the endeavour was no longer considered certain by the Canadian government. Marshall Plan aid talks then underway were expected to consume vast financial sums that might otherwise be directed to other projects. While the cost of the aid program did not directly threaten NAOS, the Canadian government feared that the program might have a lower priority.[30]

The United States still had not begun deployment to its all of its stations by early 1948. The Canadian government was particularly anxious for the United States to send ships to the

[28] The number of ships used reflected both the ability of the country to offer ships for the program as well as the relative volume of air traffic operated by that country over the North Atlantic. While the Royal Navy possessed a substantial number of ships, Britain had a comparatively small number of transatlantic flights compared to the United States. As a result, the United States deployed 14 ships, Britain 4, France 2, Norway 2, Netherlands 1, and Canada 1. British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. "International Civil Aviation Organization: ICAO Conferences on the Joint Financing and Operation of Air Navigation Services, London, 1949 (Second Conference on ICAO North Atlantic Ocean Stations)," March 16, 1949.

[29] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 1, Jan. 10, 1940-Dec. 4, 1947. Letter from C.P. Edwards, Deputy Minister of Transport, to Mr. Mills, Deputy Minister at the Department of Defence, October 7, 1947.

[30] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2, December 4, 1947-June 9, 1953. Letter from Andrew Thomson, Controller at the Department of Transport, to the Director of Air Services, Department of Transport, "Ocean Weather Stations", January 6, 1948.

jointly-run Canada-United States station, tentatively called "B". When operational, "B" would provide support for the area around Northeastern Canada and Newfoundland as well as Greenland; a crucial area for transatlantic flight to and from Canada. A letter from Andrew Thomson, Controller at the Canadian Department of Transport, even recommended that the United States reduce its coverage at another site it operated in order to support "B".[31]

The weather ship program was a big benefit for the airlines but it was funded by governments. Each American ship in the NAOS program represented a $600,000 expense for the 1947-8 fiscal year. Every station the Americans ran required three ships, thus a total cost of $1.8 million per station.[32] With the United States still in the process of deploying ships, several stations were still not in service by 1948. The cost concerned the American government, which began to reconsider whether to roll out ships to every station as planned. But not every station was as expensive as those run by the Americans: the cost for the entire program was estimated at $13 million in 1948, and funding Canada's single ship cost only $344,788.[33] The program represented a net savings for airlines (albeit not for taxpayers) when all of the program's beneficiaries were accounted for. Airlines were estimated to save $26 million per year thanks to NAOS ships finding more favourable winds and providing assistance in bad weather.[34]

H.M. Hutchon, a Canadian meteorologist, reported on a possible reason for the higher than average cost of the American ships. He claimed that several American officials informed

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[31] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2, December 4, 1947-June 9, 1953. Letter from Andrew Thomson, Controller at the Department of Transport, to the Director of Air Services, Department of Transport, "Ocean Weather Stations", January 6, 1948.

[32] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2, December 4, 1947-June 9, 1953. Letter from C.P. Edwards, Deputy Minister for Air Services, to Vice Admiral H.T.W. Grant, Chief of the Naval Staff, October 15, 1948.

[33] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from H.M. Hutchon, Esq., Liaison Meteorologist, Office of the Director of Air Services, Department of Transport, "Report on Ocean Weather Stations". March 15, 1949.

[34] *Ibid*.

him that the Navy was likely padding the program's expenses and would soon have to rein in its overspending. The United States Army and Air Force, both of whom benefitted from NAOS support, preferred to retain the full complement of thirteen stations even as their government saw the program as a target for budget cuts. The Coast Guard meanwhile felt that the NAOS program provided tangible defence benefits and did not want to lose it.[35] The military received NAOS weather reports just as the airlines did. This was a valuable tool for any flights taking place over the sea. But while the armed forces gained information that its various services considered to be valuable, they did not pay for it; the American federal government did. Decisions pertaining to NOAS cuts were in the hands of elected officials who were more concerned with saving money than the military was.

The British Meteorological Office ran the British portion of the program in consultation with the Ministries of Civil Aviation and Transport, as well as the Admiralty. The ships it used were all naval surplus and fairly small to keep costs manageable. They carried an additional advantage: they were based on Norwegian whaling ships and specifically designed for long ocean voyages.[36] Britain used two ships for each of its stations rather than three as the Americans did, rotating them between 27 day stints at sea and 15 days in port. The stations were relatively close to Britain.[37] This comparatively short travel distance may have helped reduce the costs incurred by the British stations when compared to the widely spread American stations as less time would be wasted in transit.

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[35] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from H.M. Hutchon, Esq., Liaison Meteorologist, to the Director of Air Services, Department of Transport, "Report on Ocean Weather Stations". April 9, 1949.

[36] C.E.N. Frankcom, "The Operation of Ocean Weather Ships," *Weather* 3, no. 7 (July 1948), p. 212.

[37] "First Weather Ship Named," *The Times*, August 1, 1947, p. 2.

Countries that used NAOS services but were not participants in the program contributed to its funding. Switzerland, for example, possessed an airline with transatlantic routes but had no ships to offer. As such, it gave financial support in what it determined to be a fair proportion based on the services it received from NAOS. Calculating this share was not as straightforward as the Swiss government assumed. It initially offered 200,000 Swiss francs ($46,620) in 1950 to fully cover its portion of North Atlantic infrastructure expenses over the coming year. This included easily deduced figures such as ground station support from the Faroe Islands, Iceland, and Greenland. But weather ship expenses were difficult to compute based solely on previous flight data. Swissair, the Swiss flag carrier, was expected to fly a much bigger proportion of transatlantic flights in 1950 than in previous years 0.76% for 1948 and 1949 combined versus 1.77% for 1950. While the Swiss offered a sum greater than proportional to their share for previous years, the ICAO recommended that Switzerland should pay more for their expected future operations.[38]

Several other countries, mainly in Europe, paid for NAOS services as well. In addition to Switzerland, by 1955 Belgium, Denmark, Iceland, Israel, Italy, and Spain all contributed at least some funds based on their share of transatlantic air traffic. Any flights crossing the North Atlantic were assumed to make use of NAOS support.[39] These funds were paid to and disbursed through the ICAO to the governments running the stations. The sum paid was based on

[38] The NAOS system involved some coordination with ground facilities and was not totally restricted to the weather ships. The inclusion here of funds for those stations is reflective of the integrated network of infrastructure throughout the North Atlantic. Without those weather stations and radio beacons both on the ground and at sea, aircraft would have had a far more difficult time finding their best route across the ocean. Archives Nationale, 19760104/0001, "Conference au sujet de l'aide collective à l'Islande, Genève, Juin 1948: Rapport de la Délégation française". International Civil Aviation Organization Council, "Report on the outcome of the negotiations with the Government of Switzerland in connection with the existing joint support projects in the North Atlantic," June 12, 1950.

[39] Archives Nationale, 19760104/0001, "Conference au sujet de l'aide collective à l'Islande, Genève, Juin 1948: Rapport de la Délégation française". Henri Bouché, French representative to the ICAO Council, "Financement des navires stations météorologiques," April 1, 1955.

operating costs for the ships and associated infrastructure minus an amount representing that country's share of transatlantic traffic. For example, in 1959, Britain spent £464,000 ($1,303,840)[40] running its weather ships. The ICAO reimbursed it £150,000 ($421,500) after subtracting the British share of NAOS use by all of its North Atlantic flights. This reflected Britain's sizeable contribution, 4 of the then 21 ships, in spite of its large share of North Atlantic air traffic.[41]

The weather ships ostensibly acted as weather stations first and foremost. Aircraft support services ranked as a lower priority than meteorological observations, although search and rescue operations always took priority. This became an issue with the positioning of one of the stations to the northwest of Britain. IATA, the airline association, was an interested party since its members made use of the NAOS network every day. IATA preferred that one station, named "India", be farther to the east than its assigned location so that it could better perform navigation and search and rescue for planes crossing the North Atlantic. Weather data was easier to observe from a point farther west. The exact final position was decided as a compromise between the two interest groups: "India" was set at the midpoint of the two coordinates.[42]

On occasions where there was a large volume of air traffic, however, "India" station was relocated eastwards to accommodate the aircraft.[43] Such was the case in 1953 when Britain transferred some of its Sabre fighter jets to North America. The optimal position for the ship to

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[40] The calculations from British pounds into American dollars in this paragraph were made using historical exchange rate data for 1959 (the year in which the estimates were made) from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[41] Compensation for each country was recalculated annually based on its share of total air traffic (by the number of flights registered to that country) and changing operating costs for the ships. In 1960, the following year, Britain was expected to see a greater share of air traffic so the base ICAO contribution was to decline to £139,000, but an additional £31,000 was needed to maintain the four British ships, resulting in a total payment of £170,000. "A Guide to Ocean Weather Ships," *The Times*, April 8, 1960, p. 10.

[42] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. Telegram from I.T. Lawman, Esq., Ministry of Civil Aviation, to Capt. A.S. Wilcockson, British Overseas Airways Corporation, "Move of Ocean Weather Ship 'India'," 28 November, 1952.

[43] *Ibid*.

provide support on this occasion was directly on the great circle route between Britain and the North American destination.[44] This involved moving the station about 340 km to the northeast. Objections by the Canadian civil aviation sector pointed out that the change was not beneficial to the Royal Air Force since it was losing valuable weather data. Sending another ship for that purpose would have been a better solution. Alternately, an aircraft with a powerful beacon could orbit the coordinates to provide the position fix that the fighters required without losing the weather data.[45] The move was indeed made, and the British government made clear that it would repeat the change in future as necessary.[46]

IATA was not closely associated with NAOS despite the fact that IATA's members, the airlines, were direct beneficiaries from NAOS weather reports and location fixing services.[47] The program's day-to-day functions were run directly by the navies and coast guards of the participating countries. According to IATA, airlines were only one of several groups that benefitted from NAOS' services. Coastal communities, agriculture, military, and merchant marine all profited from the information provided. While the airline association trumpeted the program's benefits, the airlines claimed that they did not absolutely require the meteorological

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[44] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Letter from the High Commissioner for Canada, London, to the Secretary of State for External Affairs, Ottawa, January 17, 1953.

[45] Weather Station "India" was moved from its normal position at 59° N 19° W to 60°47' N 14°01'W. The memo also suggested that Britain could make such a change not merely because it operated the ship but since it also had a great deal of influence in that region. If Canada sought to request a similar change, Thomson believed that it would have been refused. LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Memo from Andrew Thomson to the Director of Air Services, Department of Transport, "Proposed change of position of Station India," January 28, 1953.

[46] LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 2: December 4, 1947-June 9, 1953. Letter from the High Commissioner for Canada, London, to the Secretary of State for External Affairs, Ottawa, January 17, 1953.

[47] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. International Air Transport Association, Technical Policy Manual, "Ocean Station Vessels – Operational Requirements of," July 1, 1953.

data it supplied to safely traverse the North Atlantic. This attitude by the airlines towards the weather ships was voiced in response to ICAO requests for IATA to take a direct role in funding the program. In short, IATA was willing to leave the cost to other groups or even to do without NAOS services altogether.[48] This rejection by the very group that NAOS was conceived to support represented a severe blow to the organization's long-term prospects.

Search and rescue were critical features of the NAOS program. As early as 1947 dozens of people were saved thanks to the efforts of sailors on the weather ships. The United States Coast Guard weather ship *Bibb* played a crucial role when the Boeing 314 flying boat *Bermuda Sky Queen* experienced trouble. The aircraft managed to set down on the sea near the ship.[49] The flight had run out of fuel midway between Foynes and Gander due to unexpectedly strong headwinds. Fortunately, the weather ship was in radio contact with the *Sky Queen* and guided it to the ship's position. The rough seas slowed the rescue operation: it took over 24 hours to safely unload the 69 passengers and crew onto the ship, but no lives were lost.[50] As a testament to the construction of the Boeing 314, it remained seaworthy until the rescue was complete and might have stayed afloat far longer. Since the seaplane represented a navigational hazard as it was, however, the *Bibb* was forced to turn its guns on the stricken aircraft and sink it.[51] By 1953, the NAOS ships were credited with having saved hundreds of lives, including the passengers and crews from at least four planes and six ships.[52]

The NAOS program had an excellent track record but it was not without its share of detractors. In 1953 Captain A.C. Loraine, Fleet Manager for Stratocruisers and Constellations at

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[48] IATA was concerned enough that it might be made to pay for NAOS services that it attempted to re-categorize the program as non-essential, despite how often the airlines used NAOS data. *Ibid*.

[49] "Mid-Atlantic Rescues," *The Times*, October 15, 1947, p. 4.

[50] "An Ocean Rescue," *The Times*, October 16, 1947, p. 5.

[51] "CAB Says Downed Sky Queen Carried Passengers Illegally," *New York Times*, October 18, 1947, p. 1.

[52] "Nations to Decide Weather-Ship Aid," *New York Times*, August 29, 1953, p. 29.

BOAC, offered his thoughts on the ships' contribution to transatlantic air service. He gave a sobering review. The ships indeed provided a variety of safety measures and improved navigation, he claimed, but without elaborating on this point, that they did not improve the quality of weather forecasting, nor did he think that any flights would be canceled were the ships completely out of service. He believed that the economic value of the weather ships to airlines was at best hard to calculate and possibly higher than the cost of their operation.[53] It is worth noting that both the Stratocruiser and Constellation had pressurized cabins. This allowed them to fly at higher altitudes than previous passenger aircraft, well above the height of the severe conditions that plagued earlier transatlantic crossings. Loraine's opinion, as a man deeply involved with such planes, thus appears to reflect the evolving nature of North Atlantic aviation, which became less dependant on the weather ships.

Program Cuts and NAOS' Decline

The United States government was dissatisfied with the weather ship program but this was borne out of financial rather than technical concerns. In 1949 the original thirteen North Atlantic stations were cut down to ten "mostly for economic reasons," according to German meteorologist Hans Ulrich Roll.[54] American airlines flew a smaller fraction of the total transatlantic flights than it had in 1947 when the original payment structure was devised. The financial share borne by the other participating countries was simultaneously increased as part of a deal struck at an ICAO Committee meeting. This reduction did not mark an American retreat from the program as the United States remained in charge of five of the then-ten stations (plus

[53] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. BOAC memo from Capt. A.C. Loraine, Fleet Manager, Stratocruisers & Constellations, London Airport to Operations Controller, Brentford, "Ocean Station Vessels," March 4, 1953.

[54] Hans Ulrich Roll, ed., *Physics of the Marine Atmosphere, Volume 7* (New York: Academic Press, Inc., 1965), p. 13-14.

part-time duties at a sixth station shared with Canada). The United States Coast Guard even transferred one of its cutters from a North Atlantic position to one in the Pacific to bolster the smaller fleet there from four up to five stations.[55] European countries flew an increasing share of transatlantic flights, so it followed that they ought to bear a greater share of the financial burden. Between 1947 and 1953 the American share of transatlantic flights declined from 63% to 41% while the European share nearly doubled, from 27% to 52%.[56]

This partial American withdrawal threatened the entire NAOS program. The United States talked seriously about pulling out altogether in 1953 amid widespread cuts in federal spending. The Weather Bureau, America's meteorological agency, reduced the number of ships patrolling for hurricanes that same year.[57] Groups affected by this possible withdrawal studied contingencies. The International Airlines Navigators Council pointed out that air navigators on transatlantic flights already exchanged weather information directly between one another on an "informal" basis. Similar arrangements were formally used on other long transoceanic air routes that did not have weather ships as a support mechanism, so there was precedent for safe operation without NAOS support.[58] Even a working paper by the ICAO in 1953 found that no group considered the NAOS data "essential" to transatlantic operations. Most airlines would continue to fly normally even without assistance from the weather ships.[59] This is not to say that airlines did not make use of the weather ships as flights tended to pass near the stations since

[55] The Pacific weather ship program was far smaller than its Atlantic counterpart. It was operated by the United States and Canada. "Atlantic to Lose 2 Weather Ships," *New York Times*, December 1, 1949, p. 63.

[56] The remainder consisted of airlines based in the rest of the Americas including Canada, which declined from a peak of 11% in 1948 to 6.5% in 1953. All figures are from the ICAO. Archives Nationale, 19760104/0002. M.D. Haguenau, "La Conférence, Paris, 1954," March 5, 1954, p. 9.

[57] Turner, *Weathering Heights*, p. 196.

[58] "Plane Crews Plan Weather Service," *New York Times*, October 26, 1953, p.43.

[59] Archives Nationale, 19760104/0002. International Civil Aviation Organization, "Fourth ICAO Conference on North Atlantic Ocean Stations, Agenda Item 2," December 17, 1953.

doing so provided the greatest safety. Their support offered an extra layer of protection through position fixes even if it was largely redundant.[60]

Finally concluding that there were limited benefits for the costs, in 1953, a budget-cutting United States government formally stated its intention to end participation by June 30, 1954. Since 14 of the 25 NAOS ships were American (each station was served by two or three ships in rotation),[61] this would have made it very difficult for the program to continue effectively. Officials with the State Department reported that "cost was not necessarily the main factor in the decision to pull out," without clarifying what other factors weighed in on the decision.[62] By this time, however, commercial transatlantic flights were performed with planes that boasted pressurized cabins and could therefore overfly the worst of the weather,[63] implicitly suggesting that the limited utility of the NAOS program for its original purpose may have been a contributing factor behind the decision. The French, Swedish, and British governments all voiced their apprehension at the American decision. In their opinion, transatlantic flight would be adversely affected without the most thorough weather information. Planes would require more fuel to avoid weather systems that were not visible from coastal observatories.[64] Despite the objections to the United States withdrawal, only Canada, France, and Britain actually

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[60] William Warntz, "Transatlantic Flights and Pressure Patterns," *Geographical Review* 51, no. 2 (April 1961), p. 208-9.

[61] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. ICAO News Release, 22 October, 1953.

[62] "U.S. Will Quit U.N. Weather Ship Service," *Washington Post*, October 23, 1953, p. 12.

[63] Even by the late 1940s most transatlantic airlines had Lockheed Constellations, Boeing Stratocruisers, or other planes with pressurized cabins. David R. Devereux, "State versus Private Ownership: The Conservative Governments and British Civil Aviation 1951-62," *Albion: A Quarterly Journal Concerned with British Studies* 27, no. 1 (Spring 1995), p. 67-9.

[64] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. ICAO News Release, 26 October, 1953.

opposed any reduction in NAOS stations; most other European countries were at least somewhat amenable to the idea.[65]

The British conducted a study in 1953 to assess how the European countries might adapt the NAOS program to offer some useful level of service without American involvement. Their study concluded that Europe acting alone could maintain only 3 of the existing stations; the minimum number that might offer any practical weather data. Only a single station could be sustained by Britain if no other countries participated in the scaled-back project.[66] An ICAO study from the following year explored the possibility of such a limited, entirely European endeavour to run the surviving stations. If the NAOS project was to continue in this reduced capacity, it would require ten ships supplied from the participating countries. Funding would be based on the number of transatlantic flights as before. Britain would supply the most ships followed by the Netherlands, a total of 12 countries altogether.[67]

By 1954, American attitudes towards the weather ships had softened. Although its government intended to pull out of the NAOS program altogether, America was talked into a revised program as several new program members, including Italy and Switzerland, agreed to pay a larger portion of the program's costs. This new arrangement retained nine of the ten

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[65] Archives Nationale, 19760104/0002. International Civil Aviation Organization, "Fourth ICAO Conference on North Atlantic Ocean Stations, Agenda Item 2," December 17, 1953.

[66] British Airways Heritage Centre, AW/1/5481. Weather Ships, Meteorology, 1945-53. Record of Meeting held in Berkeley Square House 16th December 1953 – para.3.12 of the minutes of meeting of 10th December refer. Appendix. December 30, 1953.

[67] Each country had a precisely calculated share of traffic that determined their contribution level. This produced fractions of a ship's worth of support. To round off a nation's contribution level, some countries would have to provide a greater or smaller number of ships than ideal. Most participants would offer financial support (as before) to account for their proper share, paid to countries sending out the ships. Britain's share of transatlantic air traffic in 1953 was assessed at 2.73 ships (out of the total ten required), the Netherlands at 1.79, France at 1.43, and Norway and Sweden were counted together at 1.31. The remaining seven countries were each assessed at under one ship's worth of support and so would principally provide funding to the others. Archives Nationale, 19760104/0002. M.D. Haguenau, "La Conférence, Paris, 1954," March 5, 1954, p. 10-4.

stations that remained after the initial review in 1949.[68] At an ICAO conference in Paris in 1954, several European countries proposed that nine stations would offer a balance between the quality of NAOS service and cost savings that all parties might find agreeable. This reduced the commitment from 25 to 21 ships and saw the Europeans foot a greater share of the bill.[69] The United States would remain in charge of only four stations, reduced from the seven, plus a partnership with Canada at an eighth, it ran in the program's original incarnation,[70] and its contribution declined from fourteen to ten ships. The station named "Hotel" near the American coast was dropped in favour of sending out a plane to observe weather conditions when necessary. Future financing was to be recalculated such that countries that benefitted from the services provided would pay for the ships, rather than the countries sending the ships.[71]

The nine NAOS stations continued to function for twenty years despite the American plans to step out of the program in the early 1950s. In fact, it was not until 1974 that the United States pulled out of the NAOS completely. Satellite observations and communications made many of the weather ship functions obsolete, including most radiosonde readings.[72] By that time the primary function of the weather ships was not support for aircraft as jets flew so high and fast that they did not need updated meteorological reports from the ships. Instead, the greatest benefit of the NAOS program was in weather forecasting for Western Europe. Bearing out that

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[68] All of the stations that were cut served the southern route, where conditions were usually less severe than in the north. The southern route was likewise less important for transatlantic flight following the introduction of planes that could make the Atlantic crossing with just a single stop, obviating the need for multiple refueling stops at Bermuda and the Azores, where the dropped stations were nearest to. MacKenzie, *ICAO*, p. 182-3.

[69] Archives Nationale, 19760104/0002. M.D. Haguenau, "La Conférence, Paris, 1954," March 5, 1954.

[70] Schroeder, *Contact at Sea*, p. 62.

[71] The manner in which a country made use of the NAOS data was part of the funding calculation as well. Aviation information was only of use for countries with airlines that traversed the North Atlantic, but many other might obtain some benefit from the scientific data or maritime studies that the stations performed. LAC, Department of Transport File number 602-13, 752-6, "Air Services-General, ICAO – International Civil Aviation Organization, North Atlantic Ocean Stations 'NAOS'." Volume 3, June 10, 1953-Febrary 29, 1968. Letter from the Canadian Ambassador in Paris to the Secretary of State for External Affairs, "North Atlantic Ocean Station Conference", February 24, 1954.

[72] Dinsmore, "Alpha, Bravo, Charlie...".

point, Britain, France, the Netherlands, Norway, and Sweden continued to maintain three weather ship stations under the aegis of NAOS. The Soviet Union joined the program in that same year by contributing a single station of its own, a barebones network of just four stations.[73] The last American weather ship completed its service (independently of NAOS) in 1977 and was replaced with a series of automated weather buoys designed to perform a similar function. The NAOS program finally concluded in 1981 as the last weather ship returned to port.[74]

Conclusion

Weather ships plugged a critical gap in meteorological and radio coverage across the North Atlantic. From the early 1940s when they first set sail in support of the war effort, they provided guidance and support to thousands of planes. Later, in peacetime, they guided commercial airliners while tracking the weather and also performing valuable scientific work. Their search and rescue operations saved hundreds of lives. The North Atlantic Ocean Stations consistently proved their ability to execute the duties set out before them. Unfortunately, they also rapidly became obsolete. Their original purpose, guiding planes across the North Atlantic, had only modest value following the introduction of planes with pressurized cabins and later jets, both of which made detailed weather reports somewhat superfluous. Even as need for their service declined, the weather ships offered highly valuable and difficult to replicate scientific and meteorological functions for years to come.[75] The North Atlantic Ocean Stations, pulling together the resources of two continents, accomplished their tasks admirably.

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[73] "20 Nations in Pact on Weather Ships," *New York Times*, November 17, 1974, p. 16.
[74] Dinsmore, "Alpha, Bravo, Charlie...".
[75] "20 Nations in Pact on Weather Ships," *New York Times*, November 17, 1974, p. 16.

Chapter Eight: Air Mail and Cargo on the North Atlantic

The earliest flights across the North Atlantic were funded in no small part by air mail revenue. Mail had been effectively used in the past to make new transportation networks on land and at sea mature faster than would have been possible otherwise. It had a similar effect on the North Atlantic, allowing the airlines to depend on government guarantees that the free market alone could not offer. The first commercial flight of any type, a short hop from Blackpool to Southport in England on August 10, 1910, was an air mail flight,[1] and the first nonstop transatlantic flight, Alcock and Brown's 1919 crossing, carried a token amount of mail.[2] Each piece of mail carried a profitable government stipend for the airline carrying it, an indirect airline subsidy that incentivized the development of faster planes with greater lifting capacity to bear yet more mail. Indeed, air mail was a major revenue stream for the airlines in the prewar era. The importance of mail declined as passenger volumes increased postwar, but mail continued to bring in a considerable part of airlines' total revenue. Air cargo conversely emerged as a major component of airline service after the Second World War. A largely unsubsidized rapid delivery service, air cargo was an important niche in the global cargo network that airlines used to bring in a reliable source of business. Transatlantic flows of both air mail and cargo, complementary to the growth of passenger service, played a critical role in airline success throughout the twentieth century. In time, alongside the economical evolution of air cargo, air mail contributed to making the North Atlantic a viable corridor for air travel every bit as much as the passengers that traveled on those same planes.

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[1] David Corbett, *Politics and the Airlines* (Toronto: University of Toronto Press, 1965), p. 26.

[2] "The Transatlantic Flight," *Flight International*, June 19, 1919, p. 805. The plane carried one mailbag that contained just 196 letters. Camille Allaz, *History of Air Cargo and Airmail from the 18th Century* (London: Christopher Foyle Publishing Limited, 2005), p. 114.

Air Mail in the Interwar Era

At a time when aircraft could barely keep aloft under their own weight, nearly every experimental transatlantic flight in the 1920s and 1930s carried some mail. In fact, it was mail service rather than passenger traffic that governments saw as the earliest practical option for regular air travel across the ocean. The high value in mail carriage compared to passenger traffic for a given weight made it a simple calculation. As few people could afford a plane ticket in the 1930s, the potential passenger market was small. The biggest and perhaps only major exception prior to 1945 when landplanes finally entered into permanent commercial transatlantic operation was the German airship program, Deutsche Zeppelin Reederei. The Nazi regime was not highly concerned with the economic operation of the Zeppelin fleet. The propaganda value of flying imposing vessels above world cities ranked more important.[3] But while international flight had its own challenges to overcome, domestic flight needed help in the early interwar era. Air mail offered a useful tool for governments to assist their national carriers.

Passenger fares alone rarely covered the costs of flight on interwar era planes. Subsidies, whether direct or indirect, were thus necessary for airlines to survive. The United States, averse to direct subsidies, used the indirect subsidy of post office fees, a guaranteed price for any piece of mail carried. An airline could be assured of bringing in some revenue as long as it managed to fit enough letters or parcels in its cargo.[4] An air mail network grew from New York to San Francisco between 1918 and 1925, which spurred aviation improvements, another indirect

[3] Most of the experimental transatlantic commercial services offered in the 1930s carried mail, but only a few also carried passengers. R.E.G. Davies, *A History of the World's Airlines* (New York: Oxford University Press, 1967), p. 319-21.

[4] Before airplanes were the beneficiaries of Post Office fees, mail was used in the United States to pay for the development of roads, canals, and railroads since early in the nineteenth century. This subsidy system provided a great deal of the nation's best transportation infrastructure in a manner that the public and politicians alike could stomach: by offering them all a vital and reliable service in exchange. Regular air mail service in the United States began in 1918. F. Robert van der Linden, *Airlines and Air Mail: The Post Office and the Birth of the Commercial Aviation Industry* (Lexington: University Press of Kentucky, 2002), p. 3-5.

subsidy for commercial flight. Night flights proved to be a valuable part of the air mail program. But as there was a need for navigational aids visible to the pilots in the dark, in 1921, a series of bonfires was used to guide the planes. These were upgraded to more reliable gas and electric lights by 1924. By 1926, the American government recognized the importance of these navigational beacons in support of air mail as the newly created Aeronautics Branch of the Department of Commerce took over beacon operations. The Aeronautics Branch ultimately built and maintained over 2,000 of these high visibility lights by 1946.[5]

America's air mail rate was conceived only to cover costs rather than assure profitability for the airlines.[6] In 1925 Secretary of Commerce Herbert Hoover backed the creation of the Air Mail Act that reformed the payments offered to America's airlines. The Act guaranteed payments by the mile for each letter the airlines carried. Contracts between airlines and the government guaranteed a regular income stream for the lowest bidder at a time when the airlines could not hope to compete with other, more established means of transportation.[7] As President in 1930, Hoover followed up on this by having Postmaster General Walter Folger Brown pass an amendment to the Air Mail Act. The Watres Act, as it was called, awarded contracts to airlines for bulk mail routes across the United States in an effort to consolidate America's small airlines into larger, more capable entities. Small airlines lacked the long-range route networks needed to

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[5] Clinton V. Oster and John S. Strong, *Managing the Skies: Public Policy, Organization and Financing of Air Traffic Management* (Aldershot, England: Ashgate, 2007), p. 113-4. By 1921, several airfields used electric lights that were visible from long distances to guide planes in for landings. Charles Stanton, a pilot and later head of the Civil Aeronautics Administration, recommended that airfields employ electric lights on large fields to guide planes at night. William M. Leary, *Aerial Pioneers: The U.S. Air Mail Service, 1918-1927* (Washington: Smithsonian Institute Press, 1985), p. 172-6.

[6] Even the airline operators agreed with this, although they did not object to the government funding and operating navigational aids (which they did not consider a subsidy). van der Linden, *Airlines and Air Mail*, p. 10-2.

[7] Robert Baehr, "America's Airlines: Unofficial Instruments of National Policy," *American Studies in Scandinavia* 19, no. 2 (1987), p. 74. The Act was designed not to be a direct airline subsidy: it sent money to the Post Office to cover its expenses, and the Post Office in turn paid the airlines up to (but no more than) 80% of the price for a mailed letter. Harvey C. Bunke, "The Fetish of Separating Subsidy from Air Mail Payments," *Journal of Air Law and Commerce* 20, no. 3 (Summer 1953), p. 275.

effectively carry mail across the vast territory of the United States.[8] In Europe, however, airlines were almost entirely state-run, and most were monopolies, so they could expect to receive air mail revenue from their governments without competitive bidding.

Domestic air mail contracts were lucrative for airlines but there was more money to be made carrying mail internationally, especially across the Atlantic. Steamships carried tons of it every week between North America and Britain alone, with roughly a tenth of mailers opting for pricier, faster first class service[9] amounting to 121,000 pounds weekly in 1936.[10] An American study claimed that there would be a market for express postage sent even faster by air with a modest markup. A sample study based on surcharges of five cents per letter would yield an estimated income for participating airlines at $5 per mile (at 1933 rates) assuming 10,000 pounds of letters were carried on each transatlantic air trip.[11]

Despite the emphasis on airplanes in the postal contracts, semi-regular transatlantic air mail service was at first limited to Zeppelins. Airships could fly much farther than planes while offering a reasonable carrying capacity. Yet flights dedicated exclusively to carrying mail "could never prosper", according to P.B. Collins of the British Ministry of Aviation. There was a finite volume of high priority mail (the only type worth carrying by air) and airships had very high operating costs compared to seagoing ships. Collins believed that only a combination of

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[8] Baehr, "America's Airlines," p. 75-6.

[9] TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." Dr. J.C. Hunsaker, MIT. "Notes on Airship Transport," September 1933, p. 5-8.

[10] The full weekly breakdown in 1936 for first class mail was 13,000 pounds from Britain to Canada/Newfoundland, 12,000 pounds Canada/Newfoundland to Britain, 23,000 pounds Britain to US, and 73,000 pounds US to Britain/Europe. British Airways Heritage Centre, AW/1/5067, "Atlantic Mail, Mail, 1938-47." Note from Air Mail Asst. To Traffic Manager, August 4, 1938.

[11] TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." Dr. J.C. Hunsaker, MIT. "Notes on Airship Transport," September 1933, p. 5-8. As with air mail, mail sent by sea carried a subsidy: President Franklin Roosevelt stated that ships bearing mail amassed annual revenues of about $27 million over and above the cost of a similar mass of cargo. The Merchant Marine Act of 1936 addressed the high price paid to shipping companies for carrying mail by separating mail rates from subsidies, with shipping agencies receiving an agreed amount for transporting mail. National Air and Space Archives, Juan Terry Trippe Collection, Acc. No. XXXX-0179. "Separation Airmail Pay and Subsidy Statement of Juan T. Trippe, President Pan American World Airways, Inc. Before the Senate Committee on Interstate and Foreign Commerce," July 26, 1951, p. 4-5.

mail alongside passengers and cargo - he believed the latter two would represent large markets once air service matured - offered the best chance of turning a profit on transatlantic service.[12] Collins' assumption reflected the realities of American air services at that time. The number of domestic mail-only flights declined from over 60% in 1926 to about 5% by 1932 following the Watres Act and its emphasis on cutting subsidies to a more modest level and eliminating costly loopholes such as drawing pay for carrying the same letters back and forth on the same route.[13] Air mail was seen early on as a supplementary revenue stream rather than the primary source of income for forthcoming commercial air services.

Postal contracts for transatlantic air routes were offered before regular air service: in the early 1930s the best that planes could do was to supplement the delivery of some high priority mail by ferrying it between major inland cities and ports along the Atlantic coast, saving perhaps a day on delivery times.[14] United States Assistant Postmaster General W. Irving Glover wished to expand air services out over the Atlantic and announced a ten-year contract for weekly air mail service to begin on June 1, 1931. The service did not have to run beyond Bermuda until after July 1, 1932. The conditions attached to the contract were designed to foster the creation of a safe and reliable transatlantic air service that could carry at least three hundred pounds of mail. The planes were expected to employ first-rate safety procedures only carrying as much mail as the pilot deemed safe, and they had to carry a working radio.[15] Although international air travel during the early to mid-1930s still did not include a North Atlantic service, American politicians

[12] TNA AVIA 2/1931, "Trans-Atlantic Service Operation by Airship." P.B. Collins, Minute 4, July 4, 1935.

[13] Dutch air mail service from the Netherlands to Batavia (modern Jakarta) was also turned into a mixed passenger-and-mail format to address the higher costs of its initial mail-only flights. British Airways Heritage Centre, AW/1/6161, Part I "Atlantic Services, Services, 1930-35." Note from M.D. to Col. Shelmerdine, "Canada and the Atlantic Air Mail Route," July 30, 1932.

[14] TNA AVIA 2/1885, Transatlantic Air Route Via Belle Isle and Ireland – Investigation of. Letter from the General Post Office, London, to W.W. Burkett, Esq., M.C., March 3, 1931.

[15] British Airways Heritage Centre, AW/1/6161, Part I "Atlantic Services, Services, 1930-35." Press Release from the Information Service of the United States Post Office Department, November 29, 1930.

eagerly supported it. They applied the same strategy as before: sponsoring an airline through new air mail contracts. To that end, the United States House of Representatives Appropriations Committee approved an air mail subsidy of $900,000 in 1937, with the prospect of normal air service beginning by the following year between New York and Southampton. This represented a subsidy of 21-25 cents per half-ounce (14 gram) letter over the course of a year.[16]

Pan Am was quick to see air mail's potential for fueling its own growth. In 1930 it struck deals with both the British and French international airlines (Imperial Airways and Aéropostale, respectively) to carry 50% of all future air mail traveling between the United States and their countries.[17] Pan Am snatched up many of the United States Post Office's other international air mail contracts. If it could also gain control over the other half of the transatlantic route, winning concessions from the American Post Office in addition to those from Britain and France, it would be a huge coup as roughly 80% of mail crossing the North Atlantic traveled to or from the United States. Pan Am already earned $2 from the American government for every mile it flew while carrying mail, amounting to $13 million in 1934. By the late 1930s, the government believed that the need for generous airline incentives had diminished for Pan Am and the domestic carriers were no longer in need of such generous public payments. Yet between 1928-

[16] The initial sum requested by the Post Office was $1,208,640, or £240,000. The reduced $900,000 figure was based on the assumption that the service would run twice weekly but also would not begin until the following November. This provided an estimated subsidy of $2 per mile traveled. British Airways Heritage Centre, AW/1/6163, Part 3, "Atlantic Services, Services, 1937-8." "Reuters' Message," February 15, 1937.

[17] The talks, held between Pan Am's Juan Trippe, Imperial Airways' George Edward Woods Humphery, and Aéropostale's André Bouilloux-Lafont in November 1930, were done with the hope that transatlantic service would be agreed to by the respective governments. While Pan Am was an independent company that could make its own business decisions, the other two airlines were government owned and needed official permission to act on the terms of the agreement. Pan Am also required a bilateral agreement before it could carry out flights on such a service, which meant American government involvement at a later stage of the process. Robert Bluffield, *Over Empires and Oceans: Pioneers, Aviators and Adventurers – Forging the International Air Routes 1918-1939* (Ticehurst, East Sussex: Tattered Flag Press, 2014), p. 209. Since no transatlantic air routes were then in operation (or soon forthcoming) and since the deal was struck without direct government support for the negotiations, this did not amount to a significant deal. R.E.G. Davies, *Pan Am: An Airline and its Aircraft* (New York: Orion Books, 1987), p. 30.

38 Pan Am drew about 70% of its total revenue from postal contracts. While it was in better economic shape in 1938 than a decade earlier, it still depended on government largesse.[18]

Imperial Airways, Britain's primary international airline and predecessor to BOAC, relied on air mail for a large portion of its income. It had an extensive network of air routes linking Britain with Africa, Asia, and Australia in the interwar years. But passenger and cargo traffic revenue was insufficient to support the airline's operations.[19] Indeed, passengers represented both a source of revenue and potential for losses as they carried legal liabilities that made the economics of carrying them unattractive. Any injuries or loss of life could represent a lawsuit costing millions of dollars and the negative publicity of an incident could hurt future growth prospects. Air mail, on the other hand, represented greater revenue at lower liability. This incentivized some airlines, such as Imperial Airways, to deliberately fly long distance routes without selling every seat. By lightening the plane's load, more mail could be carried without the need for more fuel.[20] Imperial put such a high priority on mail over passengers that it carried just 5 passengers weekly between Britain and India versus 75 flown by KLM.[21]

In 1938, America's complex system of public organizations handling air mail payments was simplified. Previously, the Post Office, Department of Commerce, the Interstate Commerce Commission, and the Bureau of Air Commerce each had a say in air mail regulations and pay. A single new organization, the Civil Aeronautics Board (CAB)[22], was formed in 1938 to regulate

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[18] Pan American earned $95.4 million between 1928-38, of which $65.9 million came from the Post Office contracts. Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 123; Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986), p. 28-9.

[19] This was true at least as late as 1939. Frank Jackson, "The New Air Age: BOAC and Design Policy 1945-60," *Journal of Design History* 4, no. 3 (1991), p. 168.

[20] Jackson, "The New Air Age," p. 168.

[21] M.L.J. Dierikx, *Clipping the Clouds: How Air Travel Changed the World*. (London: Praeger, 2006), p. 15.

[22] Originally, the organization was part of the Civil Aeronautics Authority (CAA). It was not until 1940 that the Civil Aeronautics Board and its functions were separated from the CAA to better focus on its tasks. The CAA continued to manage air traffic control, flight operations, and other aspects of civil flight in the United States.

air commerce and safety. From its inception, the CAB studied the cost of air mail to find what a fair payment would be.[23] It cut air mail rates in 1938 by 10% to bring payments closer to the real cost of carrying the mail.[24] The CAB's chairman, Joseph J. O'Connell Jr., summed up his philosophy on air mail subsidies in 1949 by saying: "[t]he subsidy program must be set up and administered in such a way […] that incentives are provided to the management groups within the industry to work towards self-sufficiency as rapidly as possible."[25]

Air mail payments were useful government tools to encourage airline expansion, but they consumed considerable sums of public money. M. George Goodrick, a lecturer in business administration, estimated the cost of air mail subsidy by leaving out the costs that airlines would incur for flying regardless of their air mail cargo, and considering only the expense of carrying and delivering the mail. He found that America's airlines were subsidized $149 million between 1938 and 1948 out of a total Post Office payment of $271 million.[26] Air mail generated more income per ton-mile than commercial passenger traffic. As the Postmaster General recognized that this was unsustainable, in 1948 he argued to cut the rates.[27] Imperial Airways published a study in 1935, which found that the British government provided direct subsidies to the tune of

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[23] John H. Crider, "CAA Policy Made Clear: New Air Regulatory Body Not to Spend Public Funds Recklessly," *New York Times*, September 18, 1938, p. 169.

[24] Alan P. Dobson, "The Other Air Battle: The American Pursuit of Post-War Civil Aviation Rights." *The Historical Journal* 28, no. 2 (June 1985), p. 430.

[25] O'Connell went on to say that a great deal of the money transferred to the airlines for mail carriage was offset by postage fees rather than government subsidy. The precise amount paid by the Post Office that constituted fair pay for the carriage of mail versus the amount that was subsidy was somewhat arbitrary, in O'Connell's view. He believed that someone might consider any amount paid to an airline for the carriage of mail to be fair, while others would argue that every dollar spent this was way wasted. In 1948, the United States Post Office paid airlines $112 million for mail contracts, climbing to $125 million in 1949. O'Connell rationalized the size of this payment as being "considerably less than what the government is spending to support the price of Irish potatoes." Joseph J. O'Connell Jr, "Air Mail Pay Under the Civil Aeronautics Act," *Indiana Law Journal* 25 no. 1 (Fall 1949), p. 27-8.

[26] These figures relied heavily on arbitrary assumptions on the fair rate of Post Office payments to airlines and so were guidelines rather than firm evaluations of the level of subsidy. M. George Goodrick, "Air Mail Subsidy of Commercial Aviation," *Journal of Air Law and Commerce* 16, no. 3 (Summer 1949), p. 258-62.

[27] *Ibid*., p. 265-6.

£548,000 ($2,323,580)[28] in 1933 for all of its airlines, not counting air mail payments. In absolute terms this was a paltry sum compared to American air mail payments. In 1933, the United States Post Office paid £1,427,553 ($6,052,825) to Pan Am alone[29] and £4,750,000 ($20,140,000) for all its airlines combined.[30] Simply stated, air mail payments in large part funded the growth of America's airlines, and Pan Am in particular, with sums that the British government did not equal through all of its direct subsidy assistance.

While the United States was the clear focus of transatlantic mail services, the Canadian government hoped that Canada would play a part in transatlantic air mail. Existing mail flows suggested that Canada might become a mere stopping point between Britain and America while planes refueled. The British Post Office made this claim in a 1932 analysis, pointing out that 80% of mail from North America to Europe came from the United States. Conversely, Britain accounted for only 25% of European mail bound for North America. This smaller share of the total mail flow limited potential British influence over America if the British government decided to press for a greater Canadian role.[31] That is not to say Britain lacked leverage as it remained the largest single European source of, and destination for, America's transatlantic mail. But it received more mail from America than it sent there. America had the greatest potential to

[28] The calculations from British pounds into American dollars in this paragraph were made using historical exchange rate data for 1933 (the year in which the estimates were made) from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[29] International air mail contracts accounted for less than half of the total value of all air mail payments to airlines: in 1933, the United States Post Office paid all airlines a combined total of £4,750,000. Between 1927-33, this payment totalled £25,000,000 including both air mail contracts and other government subsidies. British Airways Heritage Centre, AW/1/6161, Part 1, "Atlantic Services, Services, 1930-1935." Imperial Airways, "Memorandum on Trans-Atlantic Air Services," June 1935, p. 1-2.

[30] In total, the United States Post Office paid airlines £25,000,000 ($106,000,000) between 1927 and 1933. The United States was much larger and so bigger sums were easier to afford but the scale of spending was considerable by British reckoning. "A Masterly Summary," *Flight International*, November 29, 1934, p. 1271.

[31] British Airways Heritage Centre, AW/1/6161, Part I "Atlantic Services, Services, 1930-35." Note from M.D. to Col. Shelmerdine, "Canada and the Atlantic Air Mail Route," July 30, 1932.

shape air mail flows.[32] Fortunately for Canada, the United States had a strong and positive relationship with its neighbour. As noted in Chapter One, the two countries worked closely together as partners in transatlantic flight. Canada had a strategic position along the northern and direct routes across the North Atlantic and good relations with all parties.

The Canadian government shared America's and Britain's view that air mail was important to the growth of transatlantic air travel. A big reason for this was its imperial ties to Britain. By the mid-1930s Canada was the only major part of the British Empire that lacked air service to the mother country. The Ottawa Conference of 1935 between the British, Canadian, Irish, and Newfoundland governments set out a joint plan for transatlantic flight, with air mail regulations among the first matters to be dealt with.[33] Imperial Airways' chairman, Sir Eric Geddes, was a big proponent in building up the empire's air service through first class air mail conveyance. As Canada was the biggest destination for mail within the empire, in Geddes' view it was critical for the viability of both British aviation and the success of transatlantic air service that the airline run a route across the North Atlantic quickly.[34] The Conference participants agreed that Imperial would operate the route until a jointly owned company, run by all

[32] About 30.5% of all mail from the United States for Europe was directed to Britain, with Germany receiving the second largest amount at 14.8%, France third at 10.3%, and Italy fourth with 10.2%. First class mail, which was the category whose price most closely represented what air mail would be in latter years, totalled 3,578,226 pounds from the United States to Britain in 1929. British Airways Heritage Centre, AW/1/6161, Part I "Atlantic Services, Services, 1930-35." "Mail Figures – Trans-Atlantic Service," June 17, 1935.

[33] The Ottawa Conference plans were not enacted and were perhaps too idealistic to work. The proposed airline would be jointly owned and run by the four governments, with Britain controlling 50% of the company compared with 24.5% each for Canada and Ireland, and 1% for Newfoundland. This intergovernmental arrangement introduced the potential for a single country, Britain, to dominate the other three participants. The plans did propose that the respective partner countries build up to regular, practical air service across the North Atlantic, which still lay several years in the future at that time. In this plan, Britain was expected to earn its central position in the company by doing most if not all of the preliminary development work including spending on infrastructure and research on the requirements for flight in the region. A standing intergovernmental committee was also created. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. "Trans-Atlantic Air Service," December 2, 1935.

[34] In 1934, there were 1676 tonnes of outgoing first class mail from Britain to other points in the empire and 965 tonnes bound for Britain from the empire. Imperial Airways studies suggested that maybe 5-10% of that mail might travel by air at typical air mail surcharge rates. Peter Ewer, "A gentlemen's club in the clouds: Reassessing the Empire Air Mail Scheme, 1933–1939." *The Journal of Transport History* 28, no. 1 (2007), p. 78-9.

Conference participants, began regular service. The Canadians were quite happy with this suggestion since it put Canada in a central position for future transatlantic flight.[35] Common postage rates for all air mail sent between the participating countries was considered an essential precondition to mail service, the details of which took up three of the nine pages in the final Conference agreement. Canada's central place in this transatlantic air mail network was assured as Montreal was named the North American service hub rather than New York or any other point in the United States.[36]

In 1936 Canada's Post Office saw a transatlantic air mail route as a potential boon to domestic mail service, noting that European countries already benefited from easily sending their mail across long distances and even across borders by air. Canada's imperial links with Britain, as well as a strategic position along the route between Britain and the United States, meant that Canada could expect that it would play a supporting role in conveying air mail between the two larger nations.[37] Some of the first transatlantic flights in 1939 indeed carried air mail through Canada. Imperial Airways flew flying boats out of Southampton, England, to Foynes, Ireland, and then on to Botwood, Newfoundland, before reaching Montreal where the mail was deposited. At that point, TCA took over any mail that remained to be delivered to New York.[38]

The prospect of air mail across the Atlantic even helped grease the wheels of diplomacy. In most cases, the British were reluctant to help or were even hostile towards other countries in the race to run transatlantic flights. Competitor countries, principally Germany but also France, would cut into Britain's importance central place once their own transatlantic services were

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[35] David Clark MacKenzie, *Canada and International Civil Aviation 1932-1948* (Toronto: University of Toronto Press, 1989), p. 45-51.

[36] The text of the agreement stated that it should be the model for all British air mail throughout the empire. TNA AVIA 2/1957, Trans Atlantic Air Service Discussions in Ottawa & Washington, Nov/Dec 1935. Folio 55C, "Trans-Atlantic Air Service," December 2, 1935.

[37] LAC, Department of Transport File no. 5262-18. Air Traffic – Operations. "Memorandum Submitted by the Post Office Department on the Subject of a Trans-Canada Air Mail Service," August 5, 1936.

[38] David Collins, *Wings Across Time: The Story of Air Canada*. Toronto: Griffin House, 1978, p. 8-9.

running. The relationship between Britain and the United States was a major exception as America was the destination of most of Britain's transatlantic trade and a large proportion of its mail. For this reason, the British Ministry of Aviation concluded that Britain should concede the right to carry British-bound American air mail solely to Pan Am. The alternative, that Imperial carry all British mail in both directions, risked offending the Americans. In exchange, the Ministry of Aviation proposed that Imperial be recognized as sole carrier of outgoing America-bound British air mail.[39] Initial talks between Pan Am and Imperial in January 1935 proved fruitful.[40]

The United States government was more ambivalent towards German transatlantic flight than its was towards the British in the mid-1930s. Geographical considerations give the likeliest explanation for this as America had to rely on islands under British control as stopping points on any Atlantic crossing. Planes of the day had to make at least one refueling stop for such a long trip. Bermuda was an crucial stepping stone on the southern route while Newfoundland was even more important for the northern and direct routes (see Chapter One). These islands gave Britain leverage over the United States that Germany and France lacked.[41] The United States government eventually concluded that air mail contracts should be restricted to its own carriers and to those foreign partners that it could not afford to exclude, specifically the British. It therefore ruled against German applications to carry transatlantic air mail from America in 1937.

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[39] In the event that one or the airlines was unable to carry all of the mail to which it was entitled, either airline could delegate its duties to a third party airline and expect to be duly compensated. TNA AVIA 2/1978, Trans-Atlantic Air Service: German Proposals. Folio 5C, Interdepartmental Committee on International Air Communications, "Trans-Atlantic Air Service," June 12, 1935.

[40] Imperial's representatives believed that a pooling of all air mail could be arranged that might shut out all other airlines from carrying transatlantic mail, which might entice the American government to back the deal. At that time, however, the United States government had not yet officially authorized such an agreement. TNA CO 323/1327/3 Part 1, "Trans-Atlantic Air Service," 1935. "Final note of a meeting held at the Dominions Office on the 17th January to discuss the trans-Atlantic Air Service."

[41] TNA AVIA 1923, Part I, Trans-Atlantic Air Service: French Proposals. Folio 32A, Notes of a Meeting, May 24, 1935.

In essence, Germany had "nothing substantial to offer" the United States on the North Atlantic, whereas Britain controlled the most important stopping points around the ocean.[42]

Also in 1936, the French planned to carry air mail through Ireland to Nova Scotia on their own experimental service. Correspondence between Britain's Embassy in Paris and the British Department of Overseas Trade discussed the ramifications of granting the French permission on the route. While the prospect of German flights across the North Atlantic was negatively received, the French development was described in a neutral tone, perhaps merely reflecting British perceptions of France as an economic competitor rather than potential military adversary, as was the case with Germany.[43] France could certainly not outcompete the British with respect to air mail rights to the United States. When France neared readiness to begin regular transatlantic services in 1940 before its Second World War defeat precluded any actual attempt, it was only allowed to carry its own mail westbound and not to bring American mail back. This was largely in line with that of the Anglo-American arrangement discussed above.[44]

The British, despite being the beneficiary of America's calculated partnership, worried about America's strictly bilateral view of air traffic. Per the Anglo-American air mail agreements, Pan Am and Imperial could operate the same number of mail flights between the two countries. But this restriction only applied when the relevant airlines flew either into or through the territory of the other. By bypassing Bermuda on the southern route and flying directly to Horta in the Portuguese-controlled Azores, Pan Am could fly far more than the two weekly flights into Britain as agreed in 1937, assuming that the United States secured an

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[42] "Germany Bids for Transatlantic Mail," *San Francisco Examiner*, September 12, 1937.

[43] These talks were merely preliminary since France was still several years from being able to operate a transatlantic air service at that time. TNA AVIA 2/1923, Part II, Trans-Atlantic Air Service: French Proposals. Folio 30A, Telegram from C.R. Cahill, Commercial Counsellor at the British Embassy in Paris, to H.M. Principal Secretary of State for Foreign Affairs, Department of Overseas Trade, London, April 8, 1936.

[44] "French Will Start Atlantic Airline," *New York Times*, May 12, 1940.

agreement with Portugal that would permit service along those lines.[45] The United States was the terminus for the majority of North America-bound British passengers and mail. As such, it would be difficult for Imperial Airways to simply operate additional flights into Canada or other North American territories to make up for this shortfall. Imperial was therefore restricted to two flights per week into the United States while Pan Am could theoretically use the Azores stop to run many more trips to Europe.[46] Pan Am could also carry outgoing mail bound for other European countries, which would bring the American airline revenue over and above that covered by the Pan Am-Imperial Airways agreement. In light of this, J. Leydon of the British Department of Industry and Commerce recommended that Britain ought to consider terminating the existing air service agreement with the United States until it could secure better terms.[47] Britain's Air Ministry concluded that the existing agreement was effectively meaningless. Instead of planning for air mail to America directly, the Ministry instead decided that, for lack of a better alternative, it might be prudent to focus on sending British air mail to Canada for disbursement onwards to the United States using existing mail routes. Doing so would retain some additional revenue for Imperial to cover the airline's reduced importance.[48]

The future needs of air mail extended beyond merely planning for which country would receive the right to carry outgoing mail. It also played a role in the development of planes during

[45] TNA AVIA 2/1092, "Trans Atlantic Air Service Appl'n by Pan American Airways for Permission to land UK, Bermuda and Newfoundland". Letter from J. Leydon, esq., November 3, 1938.

[46] Imperial and Pan Am had a reciprocal flight agreement permitting two flights per week. This was predicated on the British assumption that all American flights would have to stop in British territory on their way to Europe (whether Bermuda, Newfoundland, or Canada). By striking deals with other European countries and eschewing a stopover in British territory, Pan Am could legally fly to Europe without consideration for this agreement. This preserved the text of the agreement while circumventing its spirit since the inter-company agreement was to ensure British parity (more or less) with the United States in the North Atlantic. *Ibid*.

[47] *Ibid*. Although revenue sharing between the two airlines was technically not a condition of the agreement, the spirit of the text implied some measure of parity to the amount of mail carried between the two countries. The implicit assumption by the British here that the United States was somehow bound not to carry any additional mail to Europe by other routes was unrealistic and certainly one that would not have stood for long in light of the rapid pace of America's aviation expansion.

[48] TNA AVIA 2/1092, "Trans Atlantic Air Service Appl'n by Pan American Airways for Permission to land UK, Bermuda and Newfoundland." British Air Ministry, "North Atlantic Air Service," November 22, 1938.

the 1930s. Mail rates proved valuable enough to substantially fund airline operations, so airlines constantly sought to maximize their mail carrying ability on each flight. To maximize this earnings potential, they requested aircraft manufacturers build transatlantic-capable planes with large mail capacities. A British government report from 1938 recommended that landplanes should be built to hold up to 3,000 pounds of mail and should fly at least 200 miles per hour.[49] Such changes would enable the planes to carry the British allotment of air mail from London to New York overnight, following the close of the business day in London and in time for the ensuing business day in New York. Rapid mail delivery between the two major financial hubs on the North Atlantic would be a huge driver of the service if it could be developed.[50]

In 1939 regular air mail flights across the North Atlantic began. Pan Am launched its first commercial transatlantic flight on May 20, 1939, the Boeing 314 *Yankee Clipper*, carrying just under a ton of mail.[51] Rather than paying the airline for each letter delivered across the Atlantic, the Post Office paid Pan Am a fixed annual rate of $2,454,000, assuming two mail-carrying flights per week.[52] The plane and its cargo of roughly 150,000 letters departed from New York and headed to the Azores, then on to Lisbon and Marseilles, finally reaching its ultimate destination in Southampton.[53] Mail bound from Britain to the Americas had to be first sent to Marseilles before being loaded onto the planes. This was done so as not to violate the strict interpretation of the Imperial-Pan Am agreement not to carry mail directly between the two

[49] The 3,000-pound estimate assumed an equal division of mail between American and British airlines based on 1935 Imperial Airways estimates of potential air mail volumes, and that each airline would operate the transatlantic route on alternate days. British Airways Heritage Centre, AW/1/6163, Part 3, "Atlantic Services, Services, 1937-8." "North Atlantic Air Services," February 23, 1938.

[50] *Ibid*.

[51] Davies, *Pan Am*, p. 42.

[52] The fee was the product of negotiations between the Post Office and Pan Am, the latter of which wanted an annual rate of $3.189 million. Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 125.

[53] The flight did not carry any mail to Southampton. Juan Trippe deliberately did this out of respect for the British desire to fly the first batch of British-American transatlantic air mail on its own airline. "Clipper Starts Air Mail Line to Europe Today," *New York Herald Tribune*, May 20, 1939; British Airways Heritage Centre, AW/1/6164, Part 4 "Atlantic Services, Services, Jan-June 1939." Imperial Airways memo from Woods Humphery to the Chairman, May 5, 1939.

countries until both airlines were able to do so. The initial British pricing structure offered a flat rate for any destination throughout the United States, Canada, and Newfoundland at one shilling and three pence.[54] Under Pan Am's operating agreement with the United States, the first five of the planned weekly flights on that route exclusively carried mail.[55]

Pan Am's direct route service between the United States and Britain began in August, 1939. The first flight departed from Southampton and carried mail out of Britain through Foynes, Ireland, and then through Botwood, Newfoundland, before reaching Canada and the United States.[56] British government officials wished to reserve 1,000 pounds of cargo space on that trip exclusively for mail, noting that the first westbound Pan Am flight from Marseilles to the United States carried 741 kilograms (over 1,600 pounds). Mail loads were smaller on the subsequent Marseilles-departing flights. The high initial mail volume was credited to a glut of people wanting to be among the first to send their letter by air across the ocean. There was therefore a similar expectation for such a surge when direct British service began, albeit to a smaller degree.[57] Waybills were to be used to ensure that the letters arrived at their proper destinations, with a simple description of the process sent in a message to all stations along the

[54] Air mail service for letters from Europe to places beyond the United States southwards (throughout Latin America) was also available at higher rates. The most expensive of these was for letters bound for Bolivia, Brazil, and Chile at three shillings and six pence; in general the price rose as the final destination was farther from the American mainland but some destinations cost more despite being nearer, perhaps reflecting worse air connections or additional fees not explained in the price listing. British Airways Heritage Centre, AW/1/5067, "Atlantic Mail, Mail, 1938-47." "Extract from Post-Office Weekly Circular," May 31, 1939.

[55] The choice of the southern route, with its longer oceanic step, was a temporary measure until ice free conditions in the northern route through Canada, Newfoundland, and Ireland prevailed later in the year. Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 199, Folder 3, "Company History Atlantic Division, 1937-1954." Internal news memo, May 19, 1939.

[56] British Airways Heritage Centre AW/1/5067, "Atlantic Mail, Mail, 1938-47". Press notice from the General Post Office, "North Atlantic Air Mail Service," June 21, 1939. The British Post Office claimed that 850 pounds of air mail was carried on the first Pan Am flight directly to Britain but estimated only about 400-500 pounds would be needed for the return flight. Further flights were only expected to require about 250 pounds after the initial rush died down. A further 150 pounds for "special freight" of unspecified nature on the first flight were also reserved that was to climb to 750 pounds on later flights. British Airways Heritage Centre AW/1/2818, "Part 1: Atlantic Fares & Rates, 1938-45". Imperial Airways Ltd. Memo from A.M. Green, Traffic Manager's Office, to Traffic Manager, "North Atlantic Service," July 25, 1939.

[57] British Airways Heritage Centre AW/1/5067, "Atlantic Mail, Mail, 1938-47". Letter to G.P. Hayward, Air Mail Section, to A.M. Green, Traffic Manager's Office, July 27, 1939.

route. While the process amounted to little more than signing one of several receipts along the way, and would be little different than acknowledgement of the reception of packages through other means,[58] the message is illustrative of how seriously the delivery of this first batch of transatlantic air mail from British territory was taken by the government.

Air Mail in the Second World War

After the outbreak of the Second World War, air mail took on a new character. It provided a critical information link between the Allies, principally Britain on one side and the United States and Canada on the other. Similarly, letters between soldiers and their families flooded the cargo holds of planes and ships. During this time, Pan Am continued the transatlantic service it began earlier in 1939. Importantly, it was no longer able to fly to Britain due to the United States Neutrality Acts. The two Neutrality Acts, passed in 1935 and 1937, put restrictions on American dealings with actively belligerent countries. If Pan American tried to fly to Britain and France even for strictly non-military purposes, the Acts would impose a heavy penalty on the airline.[59] Its destinations were therefore limited to neutral countries in Europe such as Ireland and Portugal. Any mail sent to the belligerent countries therefore had to be offloaded and transferred to a non-American plane or ground transportation.[60] BOAC optimistically planned to fill the void left by Pan Am once summer weather in 1940 permitted use of its own flying boats on the North Atlantic.[61] As a result of the short flying season,

[58] British Airways Heritage Centre AW/1/5067, "Atlantic Mail, Mail, 1938-47". Note from E.V. Dolby, Traffic Manager's Office, to various recipients, August 3, 1939.

[59] Lawrence Sherman, "United States Mail to France in World War II, Part I," *American Philatelist* (January 2013), p. 43.

[60] The Neutrality Act of 1939 restricted most kinds of commercial contact between the United States and a belligerent country, including trade and travel. "New York: Away From the War," *New York Times*, July 14, 1940, p. 52.

[61] British Airways Heritage Centre, AW/1/5067, "Atlantic Mail, Mail, 1938-47". Letter to E.P. Bell, Esq., Postal Services Dept., General Post Office, March 27, 1940.

however, the volume of air mail BOAC could take to North America was drastically curtailed. The British government could not easily send confidential air mail or diplomats to the United States for a large part of the year except on dedicated military flights at greater expense and at a reduced capacity. Retaining air mail service to North America was considered to be a strategic necessity to the war effort, one that the British government did not wish to lose at any cost.[62]

Despite the critical need for speedy mail delivery, the British government produced nearly twice as much "urgent diplomatic mail" bound for North America than could be carried by British aircraft in November 1941. Only two flights to North America were possible per week due to the limited planes free for non-military applications. The British government permitted eight ministries whose efforts were deemed paramount to the war effort to send mail on those few flights.[63] Supplementing this was an effort to photograph as many papers as possible and transmit the film instead;[64] a labour-intensive service that could only accommodate the highest priority of mail. All remaining official mail had to be sent by ship.[65]

The transatlantic air mail network was not as robust as the British war effort required. Owing to the poor weather on the North Atlantic during the winter months, mail sent by air might save only a small amount of time compared to ship-bound mail. Long layovers in remote areas of the North Atlantic caused by storms or snow could delay a plane-borne letter's arrival by

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[62] TNA AVIA 38/90, "Air: Trans-Atlantic Service." August 26, 1940.

[63] These ministries were allocated maximum quotas of between 14 and 84 pounds of transatlantic air mail per week, with emphasis placed on using only the lightest paper and smallest amount of correspondence possible. The ministries allotted a quota were the Admiralty, Air Ministry, Dominions Office, Foreign Office, High Commissioner for Canada, Ministry for Aircraft Production, Ministry of Supply (including War Office), and United States Embassy. TNA AIR 2/8133, "British ferry command – transatlantic Liberator ferry service," 1941. Folio 109A, Secret letter from J.H. Barnes to the Undersecretary of State, Air Ministry, "Transmission of correspondence by air to North America," November 15, 1941.

[64] Canadians or RAF officers stationed in North America were preferred for the reprinting process for all documents; British officials proved sceptical about trusting the then-neutral Americans. TNA AIR 2/8133, "British ferry command – transatlantic Liberator ferry service, 1941". Folio 116A, Secret Cypher Message from Airwhit to RAFDEL Washington, November 30, 1941.

[65] TNA AIR 2/8133, "British ferry command – transatlantic Liberator ferry service," 1941. Secret Cypher Telegram from British Embassy, Washington, to the Foreign Office, December 16, 1941.

days. On average, a letter sent across the ocean by air saved roughly one day on transit times compared to one sent by ship in spite of the superior speed of planes.[66] Alternate mail shipment routes were used as often as possible to supplement the main mail corridor on the northern route. Although Lisbon was used as a transshipment point for much of the air mail during the first years of the war, by late 1941 this was no longer the case. While Portugal was neutral, British security concerns trumped the value of the Lisbon routing as the war ground on. American-operated Boeing 314s were the only planes to carry air mail through Portugal thereafter and only for special despatches, with all other urgent mail bags sent through Canada on direct routes.[67]

Following the American entry into the war, Pan Am continued to fly air mail between Shediac, New Brunswick, and Foynes, Ireland, the only transatlantic service available for either private mail or passengers, albeit no longer for private citizens. Priority was placed on carrying the pilots of the Ferry Service, with all other passenger and cargo traffic transported only on the rare occasions when there was space on the planes. For Canadian civilian passengers and mail this was the only option for rapid travel to or from Europe.[68] Canadians and their goods received a low priority as it was hard to argue that the Americans and British ought to make their own diplomats, officers, airmen, and mail wait for a few Canadians.[69] In June of 1942, Canada's High Commissioner to the United Kingdom Vincent Massey pressed the other Allies to make

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[66] *Ibid*. The ferry service between Europe and North America improved its speed and reliability over time, as noted in Chapter Two, but in the early days and especially during the winter months there were frequently very long delays at airports in Newfoundland and Canada. Gander was noted as a stopping point plagued by extreme delays inflicting many of the planes crossing the ocean due to the common fogs and storms.

[67] *Ibid*.

[68] LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Volume 1, January 1942-June 25, 1943. J.R. Baldwin, "Canadian Trans-Atlantic Air Service," June 1, 1942.

[69] The British were sympathetic but could do little to assist the Canadians during the war's early years. There was another potential concern for the British: had they provided any planes to the Canadians for their own ferry service, it would contravene the 1935 Ottawa Conference agreement that Canada not fly its own separate transatlantic airline (it was only to do so as part of a British-centred joint airline). By the time Canada actually began its service in 1942, the issue was skirted since the airline did not carry paying customers. The matter was dropped altogether by 1945 as Ireland withdrew from the original 1935 joint plan, and in de facto acknowledgement that such a joint airline was no longer needed or practical. MacKenzie, *Canada and International Civil Aviation 1932-1948*, p. 80-4, 92-3.

room for four Canadian officials and roughly 600 pounds of parcels each week, noting that during the previous seven months only ten Canadians managed to obtain transatlantic passage by air. As many as 100 Canadians were supposed to have flown on British planes up to that time but the space was rarely available.[70] Even letters to Canadian soldiers faced significant delays. In part to address this problem, Canadian Minister of the Department of Munitions and Supply C.D. Howe authorized the creation of the Canadian Government Trans-Atlantic Air Service (CGTAS), as noted in Chapter Two.[71] The new service began operations with a recently-transferred British Lancaster bomber converted for transportation purposes and operated independently from both American and British ferries.[72] CGTAS passenger traffic was reserved for government officials and high priority mail rather than general mail.[73]

The Canadian government wanted CGTAS to run at the smallest possible cost. Air mail offered a solution. It generated a sizable sum of money for CGTAS as soldiers and government officials sent large amounts of mail across the ocean, with each letter paying part of the airline's costs. By late 1943, air mail carried by CGTAS generated $60,389.62 on its first 13 flights.[74]

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[70] The British proposed to give TCA two Liberator aircraft at that time, but on the condition that the British Air Ministry would retain control over space allocations, undermining the purpose of the request. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Memo from J.R. Baldwin to A.D. McLean, June 27, 1942.

[71] CGTAS was created to serve a military need that ended soon after the war concluded. The Canadian government turned over CGTAS in its entirety to the airline from which it had originally been hewed, TCA, to make effective use of resources that the government no longer required directly. Soldiers were not charged for flights to Britain during the war, which could debatably be considered a passenger air service. Charles Allan Ashley, *The First Twenty-Five Years: A Study of Trans-Canada Air Lines* (Toronto: Macmillan, 1963), p. 22; Smith, *It Seems Like Only Yesterday*, p. 91-4.

[72] The plane was provided to Canada by the British Air Ministry and Ministry of Aircraft Production in August 1942. Both ministries were happy to have the Canadians explore the potential of the aircraft model for transportation purposes. Seven converted Lancasters were ultimately put into service on the CGTAS run between Montreal and Prestwick by the war's end. Carl A. Christie, *Ocean Bridge: The History of RAF Ferry Command* (Toronto: University of Toronto Press, 1995), p. 289-91.

[73] Collins, *Wings Across Time*, p. 23-5.

[74] The bulk of mail traveled eastwards (5,000 pieces eastbound versus 3,600 pieces westbound per flight), which corresponds to the higher demand for mail bound for soldiers than those sent home in return. Each pound of mail cost $1.07, with a total of 56,370 pounds carried by those 13 flights. Forecasted volumes were expected to remained steady into the near future. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air

By the second quarter of 1944 CGTAS required only $200,000 in direct operating revenue from the government. Most of the funding was spent on converting Lancaster bombers into Lancastrian transport planes, with additional outlays for new buildings and operating expenses.[75] By mid-1944, CGTAS ran 3 planes averaging two flights per week, carrying 217,000 pounds of mail in the second quarter of the year and earning the airline nearly $500,000.[76] Canadians also sent about 600 pounds of mail to Britain per week in 1943-4 through the RAF Transport Command, while Pan Am recorded about 200 pounds of private air mail per flight with two flights per week.[77] Transatlantic air mail by all sources, eastbound and westbound, came to about 10,000 pounds per week in September 1943.[78]

The United States, Britain, and Canada were the only countries with air services on the North Atlantic during the Second World War. By 1945, each one had accumulated thousands of hours of transatlantic air mail service, reliably carrying tons of their citizens' letters across the ocean on a weekly (and sometimes daily) basis. This laid the groundwork for normal commercial services following the war. As the government and military mail abated, civilian mail could easily be sent to Europe or North America quickly and dependably at a nominal fee.

Traffic – Operations. Volume 2, June 26, 1943-March 14, 1944. Folio 32009, letter from the Chief Superintendent of Air & Land Mail Services to Capt. J.R.K. Main at the Department of Transport, December 6, 1943.

[75] LAC, Department of Transport 5262-33, Air Traffic – Operations, Air Canada, "Canadian Government Trans-Atlantic Air Service," December 1943-June 7, 1944. "Department of Transport War Appropriation 1944-45.

[76] The exact value of post office payments to CGTAS up to July 13, 1944, was $491,442.40, of which $234,169.90 was paid by the British government for westbound mail. CGTAS by that date flew 26 times in each direction across the North Atlantic, averaging two round trips per week (with three trips per week foreseen in the near future potentially carrying a boost in its share of air mail). The air mail CGTAS carried across the Atlantic amounted to 340,690 ton-miles by the end of June, 1944 (TCA carried 140,000 ton-miles in an average month on all of its services combined), and 13,800 tons of freight. LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Volume 3, March 15, 1944-August 8, 1945. J.R.K. Main to D.A.S., "Quarterly Report on Canadian Government Trans-Atlantic Air Service," July 13, 1944.

[77] LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Letter from the Assistant Deputy Postmaster General to Lt. Cmdr. C.P. Edwards, Deputy Minister of Transport, "Canadian Government Wartime Air Transport Service," Folio 25536.

[78] LAC, RG 12, Vol. 2697, File no. 5262-36, part 1. Ministry of Transport. Air Traffic – Operations. Memo by J.R.K. Main, Inspector of Airways, "Expansion of Canadian Government Trans-Atlantic Air Service," September 18, 1943.

The airlines that participated in the war effort inherited this valuable, mature service and exploited it to the best of their abilities. While the prewar market for transatlantic air travel was small but promising, the postwar world carried with it a guaranteed stipend of mail fees to ensure that the airlines fortunate enough to carry those letters would be profitable from the start.

Postwar Air Mail

Commercial airlines received a considerable share of their operating revenue from air mail both during and after the Second World War. Domestically, America's airlines earned about 1/5 of their total revenue from air mail during the war years. In 1944, this amounted to roughly $30 million out of $150 million.[79] The situation was similar on the North Atlantic as well. Canadian airline TCA, after inheriting CGTAS operations, made $735,000 in 1947 from mail it carried, with Europe as its primary mail destination. This figure climbed to over $1 million the following year and continued to grow. For comparison, cargo revenue amounted to only $330,000 in 1947 and despite similar growth reached just $822,000 in 1950.[80] Air mail represented such a popular service for the American people that 52% of transatlantic mail was sent by plane in 1950. This was in spite of a 15 cent surcharge per half ounce above the cost of mail sent by sea.[81]

Mail allotments were so important that BOAC carefully calculated how to prioritize air mail and passenger service postwar. This was evident during the rollout of Constellation planes

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[79] Airline revenue grew rapidly in the United States during the war years: $108,147,909 in 1942, $123,368,870 in 1943. Passengers remained the single largest revenue generator during that time at $108 million of the $150 million in 1944, with cargo and other services accounting for the remaining $12 million. "USA: Statistique du traffic aérien pour 1944," *Interavia* no. 989, April 14, 1945, p. 6.

[80] Ashley, *The First Twenty-Five Years*, p. 34-5.

[81] The 52% of transatlantic air mail sent in 1950 is comparable to the amount of transpacific mail sent by air at 47%, and somewhat less than air mail to Latin America at 62%. National Air and Space Archives, Juan Terry Trippe Collection, Acc. No. XXXX-0179. "Separation Airmail Pay and Subsidy Statement of Juan T. Trippe, President Pan American World Airways, Inc. Before the Senate Committee on Interstate and Foreign Commerce," July 26, 1951, p. 11.

into the BOAC fleet in the late 1940s. For a time in 1949, there was a planned period where all BOAC service to North America would be carried by just four weekly Constellation flights. This decision would have left a shortfall of 2,800 kg of westbound mail from Britain each week.[82] R.W. Cole, a BOAC executive, did not entertain the idea of curtailing mail service but instead proposed that one of two options had to be pursued: either 20 seats to New York and 10 seats to Montreal had to be cut to leave space for the mail; or else one more weekly Constellation flight was needed. Cole's analysis carefully calculated every kilogram to maximize room for mail, with passengers given secondary if still great consideration. Cargo space on the Constellations was negligible in this assessment, totalling roughly 200 kg per week under either scenario.[83]

Air mail was primarily borne by scheduled flights, exclusively so for the first years after the war's end, but this changed in the late 1940s with the emergence of charters. A charter in this case refers to the reservation of an aircraft for use by a private group. These non-scheduled services transported mail just as their scheduled counterparts did. But while space for mail is assured on scheduled flights, charters were not bound by the same parameters. A charter might carry groups with exceptionally large luggage needs and so displace the room normally reserved for the mail. As a result, the British Post Office made a policy statement to address the potential

[82] The issue of space for mail was largely irrelevant for eastbound service. BOAC had permission to carry mail from Britain into North America but bilateral agreements in most cases restricted outgoing mail to that country's own airlines and so BOAC only carried about 100 kg of mail back to Britain per week. British Airways Heritage Centre, AW/1/6170, Part 10, "Atlantic Services, Services, 1949." BOAC memo from R.W. Cole, T.S. Eur. Area W. Div., to W. Eur. Area W. Div. Airways Terminal, "Cancellation of Liberator 603/604 Services," February 1, 1949.

[83] Cargo space on the Liberators came to about 1200 kg prior to their retirement and was not to be replaced by the meagre additional capacity available on the Constellations. Indeed, in Cole's assessment space should have been prioritized for mail and passengers and only any remaining weight allotment given over to cargo. *Ibid*.

shortfall: "[w]hen a scheduled service is blocked off as a charter flight, the normal complement of Post Office mail must be carried as if the aircraft were operating on a regular service."[84]

In the 1950s, each of BOAC's chartered flights routinely carried hundreds of kilograms of mail. In a single two-month period in 1951, there were seven diversions of mail onto BOAC's charters versus four onto other scheduled flights.[85] BOAC made a special effort that its charters would set aside at least 500 kilograms of cargo capacity for mail on transatlantic flights, out of a total cargo space of 7,500 kilograms for the average flight. To minimize the chance that charters would run out of room for mail, BOAC publicly claimed that the total cargo capacity of flights was 7,000 kilograms. Normally, the charter space allocation process was sufficient to give each passenger 30 kilograms for their belongings in addition to their own weight while still transporting 500 kilograms of mail by the estimates of the General Post Office in London.[86]

America's airlines dominated transatlantic service in the 1940s. Pan Am, Trans World Airlines (TWA), and American Overseas Airlines (AOA) combined carried 71.6% of passengers and 69.6% of transatlantic air mail to and from the United States in 1948. The nearest European rival was BOAC, which carried 12,981 passengers and 180,794 kg of mail compared to AOA's 48,376 passengers and 469,037 kg of mail, the smallest of America's three international carriers.[87] Air mail revenues for transatlantic service grew throughout the 1940s and 1950s. Pan

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[84] British Airways Heritage Centre, AW/1/6856, "Atlantic Services: Blocked Off Charter Services, Services Special Charter, 1951-1952". Letter from J.L. Udall, Sales Research Superintendent, to various, "North Atlantic Services – Blocked Off Flights," July 15, 1952.

[85] British Airways Heritage Centre, AW/1/6856, "Atlantic Services: Blocked Off Charter Services, Services Special Charter, 1951-1952". Memo from H.M. Harman, Reservations Superintendent, to various, "Carriage of Mail and Cargo on Charter Flights," July 5, 1951.

[86] The airline reasoned that, while some charters might on occasion require the entire cargo space, this was going to be infrequent enough that the lost room for mail would be tolerable. British Airways Heritage Centre, AW/1/6856, "Atlantic Services: Blocked Off Charter Services, Services Special Charter, 1951-1952". Letter from P. Graham Bell, Charter Superintendent, to various, "North Atlantic Charter Services," July 19, 1951.

[87] AOA was absorbed by Pan Am in 1950. Overall, America's airlines carried 153,983 passengers and 1,863,586 kg of air mail. The other European airlines included in the statistical summary were: Air France, KLM, Sabena, SAS, and Swissair. By some measures these airlines were quite competitive, carrying large cargo loads or having higher passenger loads per flight than their American competitors, despite lagging the US in overall volumes

Am received $79 million for all letters carried between 1946 and 1953; TWA was paid $43 million over that same time; and AOA netted $22 million up to 1950.[88] While Pan Am was the dominant carrier for American air mail throughout the 1950s, this fact masked a gradual decline: its share of American-borne transatlantic mail peaked at 58.2% in 1958 before falling to 44.1% in 1961. Even TWA experienced a decline from 48.6% in 1954 to 26.7% by 1961.[89]

The smaller slice of the lucrative pie for the two big American carriers was caused by the emergence of Seaboard & Western Airlines, an all-cargo airline based in New York that began service to Europe in 1955. Pan Am and TWA both opposed Seaboard & Western receiving mail contracts on the North Atlantic in 1959. The two older airlines stated that they each stood to lose over $1 million annually. If that prediction was accurate, the loss would push TWA's transatlantic service into a deficit as it had operated those routes at a $505,000 profit in 1957. Pan Am was in better shape with $12 million in profits on its transatlantic service.[90] Seaboard & Western countered that it sought mainly to carry overnight mail, which it could do as a cargo carrier as cargo airlines were not bound to the established schedules to which passenger services gravitated. Pan Am and TWA were typically unable to send off mail until morning flights, causing several hours' delay. The CAB's official ruling found that this was reason enough to

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in every category. British Airways Heritage Centre, AW/1/6170, Part 10, "Atlantic Services, Services, 1949." "Extract from Exhibit (Volume 1) Submitted by Pan American Airways Corporation Before the C.A.B. in the North Atlantic Route Transfer Case," March 1949.

[88] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession I, Box 519, Folder 9, "CAB Orders & Opinions Relating to Atlantic Division Air Mail Rates 1939-1964." Civil Aeronautic Board Docket No. 1706 et al., "Supplemental Order Fixing Mail Rates," Appendix no. 6, April 9, 1956.

[89] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession II, Box 267, Folder 15, "Transatlantic Route Renewal Case – 1962." "Staff Report on Proposed Transatlantic Route Pattern," Appendix K.

[90] TNA BT 245/872, "UK/USA Air Services Agreement: Designation of Seaboard and Western for all Cargo flights across the Atlantic, 1959-64." Folio 8A, United States of America Civil Aeronautics Board, "Docket No. 9252, Seaboard & Western Airlines, Inc.," April 7, 1959.

permit Seaboard & Western to perform this service.[91] Seaboard & Western's share of America's transatlantic air mail rose from nothing in 1957 to 29.2% by 1961.[92]

Canada was a smaller source of and destination for transatlantic mail than the United States, yet it provided a worthwhile target for airlines flying to and from Europe. TCA enjoyed growth in air mail revenues during the postwar era that approximated the growth of its American counterparts. Between 1951 and 1955 the total ton-miles of mail TCA carried increased by 19% and revenue climbed by 12.5%.[93] BOAC's profitable London-Montreal service fared far better in its 1958 service year thanks to air mail. While the route saw a smaller fraction of mail as a share of total cargo load than the New York-London route 7.5% versus 12.1% respectively, this amount proved to be more than enough to counterbalance the very low passenger load factors BOAC suffered at that time.[94]

The importance of air mail declined during the postwar years although it remained a major revenue stream. All airlines carried air mail since it remained profitable even after governments reduced the subsidy value of each letter. BOAC is an excellent example both of the importance of the service as well as its diminished role in later years. In 1947, with the first full year of peacetime operations completed, air mail brought in a third of the airline's earnings while passenger revenue accounted for somewhat more than half.[95] By 1972, mail represented less

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[91] The ruling further mentioned that assessments made by Pan Am and TWA were unsubstantiated by their own evidence or were otherwise lacking. *Ibid*.

[92] Special Collections, University of Miami Libraries, ASM0341. Records of Pan Am World Airways, Inc., Accession II, Box 267, Folder 15, "Transatlantic Route Renewal Case – 1962." "Staff Report on Proposed Transatlantic Route Pattern," Appendix K.

[93] Ashley, *The First Twenty-Five Years*, p. 42.

[94] Other factors weighed in the Britain-Canada route's favour. It had a smaller share of dead load than the New York route (16% to 28% respectively) and carried a higher fraction of cargo in addition to the mail than New York. The use of the prestigious Comet jet on the New York run gave that route a boost in popularity that makes direct comparisons difficult. British Airways Heritage Centre RS/1/10942 "Part 13: Atlantic Services, Services, 1959 Jan-June." BOAC memo from the Financial Comptroller to the Managing Director for the Chairman, "Profitability of U.K./Canada Route," January 15, 1959.

[95] The fiscal year ending on March 31, 1947, saw BOAC earn £11,547,513. Air mail accounted for £3,403,225 versus passenger ticket sales of £6,465,605. Freight accounted nearly all of the remainder, with small

than a tenth of total operational income whereas ticket sales climbed to roughly three quarters.[96] Leaving out inflation, by 1972 income from fares climbed to over 24 times their 1947 level while mail rose by a factor of just 5.[97] America's airlines, both international and domestic, similarly saw air mail (and cargo) account for just over a tenth of total revenue in 1969.[98]

Air Cargo Services on the North Atlantic

Air cargo, while also a major source of revenue for airlines, was not conceived as a subsidy but emerged as a natural outgrowth of air transport.[99] It was a niche service for cargo transportation compared to ground- and sea-based competition. Speed was the only real advantage air had over the other forms of cargo conveyance.[100] The low weight and size limits imposed by planes restrict air cargo to goods with a high value-to-weight ratio: perishable items (meaning items that must be transported quickly either to retain their value or because they need to be used in short order)[101], sensitive industrial or electronic items, gems and other expensive

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sums produced by excess baggage fees, charter services, and other "incidental revenue". British Airways Heritage Centre, Archive Box N647, "BOAC Reports and Accounts 1945-1950." D.S.S. MacDowall, "Annual Report and Statement of Accounts of the British Overseas Airways Corporation for the year ended 31st March 1947," p. 30.

[96] The actual numbers for the fiscal year ending on March 31, 1972, were £17,684,000 from air mail out of total revenue of £211,726,000, while diplomatic bags brought in £207,000. A further £29,899,000 came from other cargo. Passengers accounted for fully £156,301,000. British Airways Heritage Centre, Archive Box N647, "BOAC Reports and Accounts 1970-72." A.S. Goldingham, "British Overseas Airways Corporation: Annual Report and Accounts for the year ended 31st March 1972," p. 57.

[97] Calculations are derived from the figures listed in the previous two footnotes.

[98] Total scheduled airline revenue for 1969 was $8.791 billion, of which cargo was $974 million ($648 million from freight, $288 million from mail, and $38 million from other express services) against $7.646 billion for passenger services (about 87% of the total). David A. Swierenga and Mark W. Crandall, "Airline Revenues, Costs, and Productivity," in George W. James, ed. *Airline Economics* (Lexington, MA: Lexington Books, 1982), p. 3-4.

[99] Airlines carried cargo in small amounts during the Interwar era, with priority almost always given to air mail when space was available. In 1938, the total amount of air cargo carried worldwide totalled just 57,000 tons. Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 126. Cargo overtook mail in terms of RTK after the Second World War ended, reaching a nearly stable ratio of almost 4 RTK of cargo for each RTK of mail in 1950. *Ibid*., p. 228.

[100] William M. Caldwell IV, "Strategic Cargo Planning," in George W. James, ed. *Airline Economics* (Lexington, MA: Lexington Books, 1982), p. 211-2.

[101] Newspapers were among the first items carried in bulk by air due to their extremely time-sensitive value. As early as 1919, several major European airlines carried newspapers for rapid delivery. Live animals and

pieces of jewelry, and other similar categories. The high cost of air travel makes it uncompetitive as a carrier for lower value goods.[102] Thanks to the economies of scale on the North Atlantic, it was the cheapest region for international air cargo by the 1970s. On average, a shipment of goods weighing over 500 kilograms cost just 19 cents per ton-mile in 1973-4 on the North Atlantic as opposed to as much as 67 cents for international shipments within Europe.[103]

The limits of air cargo meant that the most goods would not be shipped by air. This left a constrained if profitable market for the aviation industry to cultivate. Boeing, when developing the 747, expected that the large new plane would be exceptionally well suited to tapping into the need for air cargo space. The 747s great width (19 feet, or 5.8 metres) was designed to accommodate two standard cargo shipping containers placed beside one another; the fact that this also leaves considerable room for passengers was merely a bonus.[104] Indeed, the 747 was conceived as a stopgap for passenger service since supersonic jets were anticipated to emerge a few years later. Cargo service on a large, relatively fuel-efficient jet was a key component of the 747's expected service life. After it was clear that supersonic passenger jets would not enter widespread service, the 747's role expanded further.[105] By Boeing's initial estimates, fully half of the 400 original 747-100 planes would be used for cargo. In fact, passenger service absorbed nearly all of the jumbo jets in the early 1970s. Not until the Oil Crisis of 1973 temporarily made

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fresh flowers were also highly time-sensitive items shipped by air to keep them in the best possible condition. Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 127-8.

[102] Stephen Shaw, *Air Transport: A Marketing Perspective* (London: Pitman Books Limited, 1982), p. 31-40.

[103] It should be noted that intra-European shipments traveled a much shorter distance than those crossing the Atlantic, and so fixed costs for any cargo shipment would distort the overall cost considerably. Nawal K. Taneja, *The Commercial Airline Industry: Managerial Practices and Regulatory Policies* (Toronto: D.C. Heath and Company, 1976), p. 271-6.

[104] Standard cargo containers are 8 feet (about 2.4 metres) high and 8 feet wide. Original plans for the 747 placed two cargo containers vertically stacked, and so designs stretched the hull vertically rather than horizontally. This was abandoned during the design phase in favour of the current configuration. The fact that this enabled a wide-body passenger seating configuration, with ample space for two aisles, was merely a bonus. Laurence S. Kuter, *The Great Gamble: The Boeing 747* (University, AL: The University of Alabama Press, 1973), p. 19.

[105] Martin W. Bowman, *Boeing 747: A History: Delivering the Dream* (Barnsley: Pen & Sword Aviation, 2014), p. 22-3.

the 747 less desirable for passenger traffic was it regularly used to haul cargo. A big secondary market grew to resell the planes as cargo carriers thereafter.[106] One exception to this was the 747-200M "Combi", designed for Sabena's transatlantic service. It split the cabin between cargo and passenger space to take advantage of the limited passenger market between Brussels and North America by maximizing the cargo value of each flight.[107]

There were also clear advantages to conveying goods by air rather than sea or land: it was unnecessary to use extensive packing or storage materials, and deliveries within hours meant that companies could save valuable time to make use of their resources.[108] On the North Atlantic, the United States and West European countries shipped a select few types of time-sensitive goods by air that made the best use of air cargo. The Americans primarily flew electronics, computers, machinery, films, and time-sensitive publications such as magazines, whereas the Europeans sent high value clothes and shoes, machinery, and electrical equipment.[109] In most cases, cargo flights had to contend with an unbalanced flow of goods from producing areas to consuming areas. Unlike passenger flights, cargo flights might fly back to certain regions (such as ones with a big industrial base) nearly empty due to limited demand for goods there.[110] But the overall dollar balance of trade from 1951-70 between Europe and North America was fairly even despite the disparate value of the goods they traded even as it grew from 7,700 to nearly 410,000 tonnes

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[106] *Ibid*., p. 147-9.

[107] Sabena originally placed orders for the 747 when it still expected to run regular service to its former colony, the Congo. After that market was clearly too small to justify the use of the 747, the Belgian airline asked Boeing to modify the cabin so that some space might be put to profitable cargo use instead. The 747-200M model was used thereafter by the Dutch airline KLM on its transatlantic runs as well. Joe Sutter and Jay Spencer. *747: Creating the World's First Jumbo Jet and Other Adventures from a Life in Aviation* (New York: Harper Collins Publishers, 2006), p. 214-7.

[108] *Ibid*.

[109] Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 222-3.

[110] Empty planes represented a lost opportunity cost: ideally, each flight should carry as much cargo as it could bear to maximize profits. By flying a plane to its destination with a negligible cargo load, the flight was wasting time, space, and fuel. Anming Zhang and Yimin Zhang, "A Model of Air Cargo Liberalization: Passenger vs. All-Cargo Carriers," *Transportation Research Part E: Logistics and Transportation Review* 38, no. 3-4 (May 2002), p. 179.

during that time.[111] Upwards of a tenth of all revenue realized by airlines in the early 1970s came from cargo shipments; a radical increase from the end of the war.[112] By 1979, air cargo amounted to 24 billion revenue ton-miles, with American carriers accounting for about a third of the total.[113] Although this figure was small compared to other forms of transportation, air cargo had considerable room to grow. Efficiency improvements, particularly in fuel and aircraft size, could drop prices close to that of truck travel (air freight was 82% more expensive) or train (102-149% more expensive depending on the train's configuration).[114] But high value-to-weight ratio goods were the only ones that made economic sense to ship by air.[115]

Since cargo became a big part of the North Atlantic aviation marketplace, setting cargo rates was an important part of that market. The determination of those rates caused a schism between Pan Am and the European carriers. The status quo of cargo rates set out several weight classes plus special price categories covering over 100 indexed commodities. These categories were fairly straightforward, with a basic price per kilogram for small loads and savings for heavier loads. There were three weight categories: one for cargo under 45 kg, a second for cargo between 45-500 kg at a 25% reduction per kilo, and one for cargo over 500 kg at 75% less per kilo.[116] In 1960, Pan Am wished to introduce bulk sales of cargo through consolidators to replace this, moving scheduled carriers out of the cargo business. Following several years of proposals by IATA airlines, there was a consensus that a new rate structure was needed.

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[111] Allaz, *History of Air Cargo and Airmail from the 18th Century*, p. 223.
[112] Taneja, *The Commercial Airline Industry*, p. 304.
[113] Nawal K. Taneja, *Airlines in Transition* (Lexington, MA: Lexington Books, 1981), p. 213.
[114] *Ibid*., p. 230-1.
[115] Even as recently as 2007, air cargo cost at least ten times more than ship-based transportation, and in some cases can be in excess of 75 times as much. According to information from Boeing, goods with a value above $16 per kilogram are considered valuable enough to ship by air. The average value per kilogram for goods shipped in 2006 was $59. Peter S. Morrell, *Moving Boxes by Air: The Economics of International Air Cargo* (Farnham, Surrey: Ashgate Publishing Limited, 2011), p. 24.
[116] British Airways Heritage Centre, RS/1/9601, Part 4, "North Atlantic Cargo Tariff Policy, Fares/Rates, 1956-1960." Memo from BOAC General Tariffs Manager, "North Atlantic Cargo Tariff Policy – Situation to be Considered by Special IATA Conference, Paris, 29.2.60," February 16, 1960.

Consolidators and charter cargo flights were to take over a central role in transatlantic cargo, cutting revenue for scheduled carriers by as much as half in the case of BOAC.[117] As new efficiencies were realized, both in aircraft technology and in corporate operations, the price of carrying cargo was almost constantly in decline. Between 1947 and 1969, the cost per tonne-kilometre dropped from 31.7 cents to 15.4 cents even excluding inflation (which made the decline even more pronounced).[118] The improving economics made it difficult for the protectionist European airlines to argue that the status quo ought to continue indefinitely.

Conclusion

The need for air mail payments to subsidize the airlines disappeared in the postwar era but its role in fostering airline growth in the first place was considerable. Without assurances of mail contracts, even mighty Pan Am might have struggled to turn a profit on its early transatlantic runs, and possibly would have made it hard to convince the aircraft manufacturers that there was a guaranteed market worth pursuing. BOAC would not have turned a profit in any year on the North Atlantic into the 1970s and beyond without the air mail incentives. Air mail was a useful government incentive as it made the airlines focus their energies on expanding into profitable areas that might otherwise have been put off until later, including long-distance travel. Air mail also led to the advancement of navigational aid technology and the network of support infrastructure that underpinned international air travel, which would have been far more difficult for the airlines of the 1920s to develop with their limited financial resources. The airlines' need for bigger, faster planes to carry air mail loads spurred aeronautical advances further still. Cargo services benefited from the drive for big planes, tapping into the high value-to-weight item niche

[117] At the time, BOAC earned an average of 37 pence per ton-mile (43 cents) on North Atlantic cargo, representing 163 cents per kilogram for New York-London service. *Ibid*.

[118] Shaw, *Air Transport*, p. 44-5.

markets to broaden air travel's usefulness and bring rapid transportation to new areas of service. Air mail and cargo services remain a valuable if smaller part of airline operations today, but they have made international air travel into the well-rounded and affordable service that people the world over can depend on to carry their goods speedily and safely.

Chapter Nine: Airline Routes and Government Regulation of Air Travel

Late in the Second World War, the Allied governments turned their attention to rebuilding the civil aviation order (as noted in Chapter Three). The ICAO and IATA were both created in response to the government drive to make international aviation easier and safer. The two international organizations did not resolve all outstanding issues pertaining to aviation, however, as bilateral agreements between sovereign countries still formed the cornerstone of air travel. The ICAO and IATA handed some of the detail work, regulating airfares and safety standards, but critical elements remained part of the bilateral agreements including how often flights could travel between two countries and which cities those flights could serve. Governments on both sides of the Atlantic shortly found, however, that the bilateral air agreements then being struck were unable to accommodate the realities of air travel in the postwar world. New forms of air agreement were needed to reflect commercial aviation's greater reach and capacity to carry passengers. Among the first of these agreements was the Anglo-American Bermuda Agreement, which in turn became the model for many other bilateral air service agreements. Examining these agreements, how they were interpreted, applied, and how they evolved over time, shows the complex issues at stake for the countries operating transatlantic services and how the international aviation regime itself changed. The preponderance of international air traffic began or ended in the United States or Europe, totalling 80% of all flights globally by IATA airlines, and flights directly between America and Europe accounted for 25% of those flights, making the North Atlantic exceptionally important to commercial aviation and the clearest place to note the impact of changing bilateral air agreements.[1]

[1] These numbers were valid as recently as 1977. Christer Jönsson, "Sphere of Flying," *International Organization* 35, no. 2 (Spring 1981), p. 283.

Through these air agreements governments sought not only to cooperate but to do so in ways that also protected their national carriers. Each new route required not only a new air agreement but also careful balancing of the needs of the local market and the airlines in both countries. No airline wished to serve a route that it could not compete on, and the transatlantic routes were a prized commodity no one wanted to squander. As fifth freedom air travel was often the cause of disputes between American and European airlines, an examination of how these disputes were handled illustrates the fundamental interests and strengths of the country lodging the complaint. Fifth freedom traffic rights also spurred protectionist measures to keep European airlines competitive against American competition, although even the United States used practices that can be considered protectionist. Several European airlines went so far as to consider merging with one another, to create a competitor airline on the scale of the big American transatlantic carriers. While this endeavour failed, it did show the lengths to which European fears of American dominance of the transatlantic market drove them.

United States-Europe Routes

The approach taken to resolve disputes over capacity and which destinations to serve exposed a schism between the European countries on one side and the United States on the other that defined international aviation for decades. The divergent goals each camp had for civil aviation were plainly visible even during the latter days of the Second World War when the Allies struck new air agreements. Nearly every country adjacent to the North Atlantic either began or expanded service across the ocean following the end of the Second World War, with the United States emerging as the strongest economic power with the biggest airlines. European countries wanted to fly there above all other destinations. Governments fought hard for their flag

carriers to win those rights as the routes appeared to offer immediately profitable passenger volumes. Demand for the service was high even in 1945 and, with limited exceptions, each ocean-crossing route could support an airline's other needs such as expanding the airline's fleet or serving marginal routes. But it was not until 1946 that regular commercial services began. Civilian air travel across the North Atlantic in 1945 was mainly limited to state-approved passengers, primarily government officials or soldiers returning home. Even this relatively small group amounted to 30,000 passengers per month through the latter months of 1945. Commercial flights the following year brought over 100,000 civilian passengers in total.[2]

European countries had a strong wish to build air networks beyond their borders, with Britain boasting the largest of the European airlines. But the ambitions did not always align with the need. British plans for postwar civil air networks were limited compared to schemes dreamed up by the Americans, Soviets, and even the Germans, according to G.W. Redd of the British Foreign Office in 1944. Those other countries, in his assessment, offered grander visions for commercial air travel than the British vision that focused on linking up the empire with a basic service. He lamented the British tendency to think small compared to other countries. Redd was also concerned with how his country was being perceived. Other nationalities, particularly the Americans, spoke "contemptuously of the way we run even these emergency wartime services."[3] A poor civil aviation plan coupled with negative perceptions by foreigners could do serious harm to the international growth prospects of BOAC before it resumed regular

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[2] Marc L.J. Dierikx, *Clipping the Clouds: How Air Travel Changed the World*. (London: Praeger, 2006), p. 50-1.

[3] Redd argued that British priorities did not extend beyond the immediate combat effort. He suggested that as few as ten Liberators should be turned over to the Ferry Service to facilitate the transfer of people across the ocean, which he felt would be a small enough diversion as to not harm the war effort. In his opinion, it was this sort of single-minded focus on direct combat applications that would cause greater long-term damage to British civilian air capabilities. Redd had only good things to say about the quality of service offered by BOAC, who he understood to be operating the Ferry Service for the Royal Air Force. TNA FO 371/42620, File no. 468, 1944. Letter from G.W. Redd to D.D. Maclean, "Transatlantic Air Ferry Service," January 7, 1944.

service. Redd's criticism was mainly one of vision rather than capability, yet of the three countries he begrudged for their daring vision, only America succeeded to build a widespread international air network in the immediate postwar years.[4]

The relationship between the United States and Britain, given their prominence in the aviation sector, was a fundamental cornerstone of transatlantic flight. Nowhere else in the world was as obviously poised to serve as the axis around which international aviation would pivot. But in 1945, a permanent route agreement between America and Britain remained elusive. Both Britain and the United States failed to come to terms over fifth freedom traffic and route capacity. The Americans wanted to operate as many flights as they could manage, tapping into the growing demand for air travel to Europe. But the British were concerned that the big American airlines, untouched by war's ravages and with a head start on expanding their fleets, would wildly outcompete them for passengers. Air traffic between the two countries was therefore restricted to temporary, ad hoc agreements until a more permanent solution could be found to satisfy both parties.[5] The solution to this was the Bermuda Agreement, signed in 1946, and discussed in detail in Chapter Three. It set out a flexible framework that accommodated the American desire to operate a largely unrestricted number of flights to Britain as long as there was a demand for it that the British could not handle, while giving the British the right to halt any such American service with an *ex post facto* review if the service clearly exceeded America's

[4] West Germany was denied the right to operate an airline until 1955. This restriction was imposed upon the country as a condition of its Second World War defeat. In the years after 1955, its airlines never matched the scale of BOAC. The USSR, as with the British and Americans, had the resources to fly an extensive network of international air routes at least within Eurasia in the postwar era but focused its efforts on domestic air service. The Soviet flag carrier, Aeroflot, had virtually no international presence before the latter 1960s. For more on the details of the air programs of the Soviet Union and postwar Germany, see: Betsy Gidwitz, *The Politics of International Air Transport* (Lexington: Lexington Books, 1980); Dumitra Popescu, *Bilateral Air Agreements of Socialist Countries and International Law: A Comparative Study* (M.A. thesis, McGill University, 1970); David R. Jones, "The Rise and Fall of Aeroflot: Civil Aviation in the Soviet Union, 1920-91," in *Russian Aviation and Air Power in the Twentieth Century*, Robin Higham, John T. Greenwood, and Von Hardesty, eds. (London: Frank Cass, 1998), p. 87-116.

[5] "USA/Suisse: Accord aéronautique, complement," *Interavia* no. 1036, August 7, 1945, p. 8-9.

fair share of the passenger market. It was imperfect, but it was a solution that proved workable for decades.

Other countries set out air agreements with the United States that were just as contentious even if the stakes were smaller than the British-American case as when American and French officials held talks in 1944. The French were adamant on imposing limits on the number of flights from the outset. National security was their paramount concern as the French feared that large numbers of planes could be covertly used to transport troops at short notice. Competition with America's large carriers did not appear to worry the French authorities at the time, likely due to their focus on concluding the war. Deferring the authority to regulate air travel frequency to an international organization would, in their opinion, provide the best possible safeguard for future civil flight. But they did not seek to conclude any final agreement since the Chicago Conference between Allied countries, where all participants sought a common civil aviation system, was scheduled in the weeks ahead.[6] France and America struck a final air agreement and announced the new route arrangement in a press release on December 28, 1945. France was awarded two routes into the United States out of the five they had initially requested across the North Atlantic: one to New York and on to Washington, and another terminating in Chicago after a stop in Montreal (the Montreal-Chicago route was not affirmed until 1960). The United States received two routes in return: the first from Paris on to points in the Middle East, the second ran to Marseille after stops in Lisbon and Barcelona.[7]

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[6] Even the French recognized that a rigid quota system would have shortcomings: if the quota authority deemed 50 flights per week as the limit for all North Atlantic purposes and Denmark was allotted just one of those flights, the Danes would have to pool their share of the quota with another airline. A single transatlantic flight per week would be insufficient for a route to remain viable. NARA RG 197, Box 28, Folder "France International Agreement, F.A.T.D.," 1936-1945. Memo to Mr. Branch from Howard B. Railey, "Today's Discussions with the French Delegation," October 27, 1944.

[7] This agreement stemmed from the preliminary 1939 air agreement between the two countries that included limits on the number of flights each country was allowed to operate on designated routes. Although the route through Montreal to Chicago involved a third country, Canada, the agreement to serve the route was settled

The United States struck a series of new air agreements with other European countries up to 1945, including countries that had either been non-belligerents in the war such as Ireland, Switzerland, and Sweden, or smaller countries like Denmark and Iceland. All of those countries stood to benefit from closer ties with the superpower and had few reservations about granting fifth freedom traffic rights through their countries. Potential benefits from having American air traffic in their airports, bringing businesspeople and wealthy tourists even if they stopped only briefly on their way to other destinations, made it an easy decision. Most of these countries were part of a planned route network that would extend from the United States to as far as the Middle East.[8]

Belgium's government recognized that the United States was going to be a major destination once peace began. Transatlantic flights offered Sabena the prospect of bringing in substantial revenue and much-needed foreign currency at a time when Belgium badly needed these things. When Sabena resumed operations following the war it sought service to New York, with the first flight crossing the ocean in 1946. A regular air service agreement covering flights between Brussels and New York entered force in June, 1947. Yet Sabena had trouble competing: of the 13 airlines on the North Atlantic in 1959 it was the second smallest by number of flights. It needed subsidies to survive.[9] Even as the economics of its Brussels-New York route improved to break-even levels, Sabena's other North American routes fared poorly. In the latter 1970s, Sabena had passenger service to Montreal, Detroit, Chicago, and Atlanta, and its

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bilaterally between just France and the United States. It may have been offered in advance of permission to Air France from the Canadian government. NARA RG 197, Box 28, Folder "France International Agreement, F.A.T.D.," 1936-1945. Press release, December 28, 1945.

[8] Stops on this route were to be in Ireland, Paris, Switzerland, Italy, and Greece. "USA/Suisse: Accord aéronautique, complement," *Interavia* no. 1036, August 7, 1945, p. 8.

[9] Throughout the war, Belgium's government-in-exile planned for the airline's return but initially focused its international route network on restoring a link to its colony, the Congo, rather than transatlantic service. That changed as the war neared its end and the importance of the United States as a destination became evident to the airline's executives. Guy Vanthemsche, *La Sabena. L'aviation commerciale belge 1923-2001: Des origins au crash* (Brussels: De Boeck & Larcier, 2002), p. 128-9.

cargo service to North America accounted for 38.3% of its total worldwide cargo revenue, all of which lost money.[10] The prestige of flying the North Atlantic was too much for the airline to pass up even though it could not afford to sustain service there.

Some of these early postwar air agreements included rigid provisions that quickly became obsolete and cumbersome for one or both parties. The Irish-American air agreement of 1945 was one such case. It required that all American planes on transatlantic routes traversing Irish airspace land in Shannon. This did not include every American transatlantic flight since other routes bypassed Ireland to the north or south. But no other Irish airport was permitted as an alternate landing place for those planes. Shannon was the only Irish airport with facilities large enough to accommodate the big transatlantic planes at that time.[11] This provision created a perverse incentive for the Irish government to support that airport simply to protect its investment. Shannon could only be financially sustained by mandating stopovers there, according to Irish authorities consulted by the United States. Two other recently-concluded Irish air agreements with Britain and France contained the same provision. An American assessment suggested that the United States should simply wait until planes that could fly beyond Ireland were developed. This development would weaken the Irish position and force them to renegotiate lest they lose all American transit traffic.[12]

The requirement to stop at Shannon disadvantaged America's airlines by regularly forcing them to make burdensome, unnecessary detours. David Grey of the American delegation to the North Atlantic Route Service Conference in Dublin in 1946 claimed that "Ireland's interest

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[10] *Ibid*., p. 174.

[11] NARA RG 197, Box 46, Folder "Ireland U.S. Negotiations," 1945-1947. Letter from Livingston Satterthwaite to British Air Ministry Director General of Civil Aviation Sir William Hildred, April 30, 1946.

[12] NARA RG 197, Box 46, Folder "Ireland U.S. Negotiations," 1945-1947. CAB memo from Acting Director H.A. van Dorn, Economic Forum, to the Chief of the Foreign Air Transport Division, "Proposed Revision of the U.S.-Irish Bilateral Air Transport Agreement, May 27, 1946.

in aviation [was] primarily political rather than commercial". Ireland's government was not interested in generating revenue from the service, Grey argued, but rather had seized the chance to gain influence over the countries that had to set their planes down on its runways.[13] The validity of this assessment is dubious as Shannon was the site of the first (and very profitable) duty free airport shops in 1947.[14] TWA specifically requested a compromise to serve Dublin in addition to Shannon on its route between North America and Paris, which the Irish government refused. TWA then proposed an alternative plan. Shannon, TWA suggested, could remain the stopover city for through-flights bound for Paris while Dublin would be the stopping point for direct service to Ireland. The Irish refused the new proposal. It would have set the stage for Shannon's obsolescence if there was no need for foreign airlines to stop in the remote airport.[15]

Ireland dropped the provision that transatlantic flights had to stop in Shannon in 1957. The Irish government publicly acknowledged that planes made the stop solely because it was a legal requirement. The move may have been a bid to remain relevant in an age when planes could bypass the country's airspace altogether. As new aircraft had the range to fly around the country on a transatlantic hop, if the detour took less time than the stopover, few planes would alight in Ireland anymore. Countries that had argued against stopping in Shannon might even stop flying to Ireland altogether. The Shannon airport remained the country's only transatlantic stopping point, however, and was upgraded to accommodate the larger jets then about to enter the market.[16] It was not until 1973 that Ireland granted the United States permission to use

[13] NARA RG 197, Box 46, Folder "Ireland U.S. Negotiations," 1945-1947. Telegram from David Grey to the Secretary of State, "Impressions of the American Delegation to the North Atlantic Route Service Conference held in Dublin," April 10, 1946.

[14] "First Duty-Free Airport Projected for Shannon," *New York Times*, January 24, 1947, p. 10.

[15] NARA RG 197, Box 46, Folder "Ireland U.S. Negotiations," 1945-1947. Letter from Jack Frye to the Secretary of State, August 13, 1946.

[16] The investment at Shannon's airport exceeded £1 million and both strengthened and lengthened the main runway for jets. Dublin's airport remained smaller and was not as well developed for transatlantic flights in 1957. NARA RG 197, Box 46, Folder "Ireland-U.S. Nego.," November 1948- December 1958. Telegram from Second

Dublin Airport, which was upgraded in the 1960s to allow Aer Lingus, Ireland's national carrier, to fly transatlantic-capable planes. The Americans conceded some minor traffic rights to the Irish in exchange.[17] Ireland's influence over the North Atlantic was unique in that it was a small country that lay astride the main transatlantic air route. As such, it could leverage its location to gain some advantage over air agreements.

In contrast to the geographically useful Ireland, Italy was a major destination in itself for many of those transatlantic travelers and one that earned the particular focus of the United States. Italy's major postwar airline, Linee Aeree Italiane (LAI, later Alitalia), was formed in partnership with TWA in 1946. The American airline provided resources and expertise to get the new airline working in return for a 40% stake in the company, with the remaining 60% split between the Italian government and corporate interests. LAI had traffic rights into the United States as a part of the agreement that created the airline,[18] although it did not begin transatlantic flights until 1951.[19] Britain protested the deal since TWA's large stake in LAI gave the American carrier *de facto* control over the Italian airline and a near-monopoly on Italian air service. TWA President Jack Frye refuted the attack by pointing out that British air service was permitted in Italy despite his airline's strong association with civil aviation in Italy.[20] Close associations between American and European airlines were a natural outgrowth of the travel between the two lands, but the Italian case was unusual since Italy, as a former Axis power, had

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Secretary of the American Embassy in Ireland Raymond J. Barrett to the Department of State, "Improvements at Shannon Airport; Compulsory Stop Abolished," April 29, 1957.

[17] American planes still had to stop in Shannon on flights to Dublin but passengers no longer had to transfer to ground transportation or an Aer Lingus flight to complete the trip. Aer Lingus received the right to fly the same plane on service to Boston and Chicago, gaining some fifth freedom passenger traffic. "After 27 Years, U.S. Airlines Get the Right to Land at Dublin," *New York Times*, June 12, 1973, p. 6.

[18] NARA RG 197, Box 47, Folder "Italy Proposed Agreements-TWA," 1946. Agreement Drawn Up on 11th February 1946 Between the Italian Minister of Aeronautics, and the Transcontinental & Western Air, Inc. (TWA), February 11, 1946.

[19] NARA RG 197, Box 47, Folder "Italy Proposed Agreements-TWA," 1946. Trans-Atlantic Passenger Traffic of United States and Foreign Air Carriers 1946-1951.

[20] NARA RG 197, Box 47, Folder "Italy Proposed Agreements-TWA," 1946. *Evening Star*, "Byrnes Holds Up TWA Deal With Italy After Protest by British," April 23, 1946.

fewer resources with which to build an airline than the Allied countries. Generally, however, countries benefitted from close ties with the United States: it was the source of so much passenger traffic that it was impossible for an airline to ignore.

Canada-Europe Routes

Unlike the liberal-minded and massive American airlines, Canadian airlines lacked the clout to gain access to as many destinations. Instead, they steadily expanded their route networks through Europe from a combination of reciprocal agreements and geographic good fortune. They also exploited Canada's large immigrant population to build links with European nations as families started to fly to keep in touch, much as happened with American airlines. In contrast to the scale of American plans on one hand and the centrally-planned British network on the other, Canada sought to assemble basic transatlantic operations with little in the way of a guiding public strategy. The war had derailed Trans-Canada Airlines' (TCA) plans to extend existing service eastwards into Newfoundland and eventually link up with Britain.[21] After the war, TCA headed out alone, turning its back on prewar plans to build a transatlantic airline in partnership with Britain, Newfoundland, and Ireland.[22] Canada's wartime passenger air service, CGTAS (see Chapter Two), was built using TCA aviators and planes. With the war's end, the Canadian government returned all CGTAS resources to the civilian TCA. This included the transatlantic services CGTAS ran, which had logged over 500 Atlantic-spanning flights. In late 1945, TCA took over ticketing for CGTAS and offered round-trip flights for $675 between

[21] David Collins, *Wings Across Time: The Story of Air Canada* (Toronto: Griffin House, 1978), p. 8.

[22] Canada was one of four partners that, in 1935, agreed to develop a transatlantic-capable airline alongside Britain (which would own 51% of the airline), Ireland (owning 24.5%), and Newfoundland (Canada would own the remaining 24.5%). Canada's new independent streak was shared by South Africa and Australia, who by 1943 had all created viable international air services without British aid. Marc L.J. Dierikx, "Shaping World Aviation: Anglo-American Civil Aviation Relations, 1944-1946," *Journal of Air Law and Commerce* 57, no. 4 (Summer 1992), p. 799-801.

Montreal and London. Inheriting the mature service was valuable for TCA, allowing it to fly beyond the Americas for the first time.[23]

The final transfer of CGTAS resources to TCA took effect in 1947, making it one of just ten airlines offering a transatlantic service. Its had sufficient capacity for regular passengers as well as to carry a large additional load: TCA took part in a resettlement program in 1947-8 that brought 10,000 British immigrants to Ontario.[24] In spite of these advantages, TCA's transatlantic service had challenges as well. Immigrants relocating to Canada filled westbound flights but few travelers flew eastwards in the postwar era, producing low load factors on Europe-bound planes.[25] While TCA's original fleet of CGTAS planes, six converted Lancaster bombers, were replaced by North Star planes in 1946,[26] neither model had pressurized cabins. While comfort on military flights was optional, it was expected for civilian services. The planes had to fly low to maintain breathable and warm cabin conditions, making the planes less fuel efficient in the thicker air and more vulnerable to bad weather.[27]

TCA inherited a prestigious route, linking Montreal and London, but expanded its service into continental Europe gradually. Service to Paris and Dusseldorf began in 1951 and 1952 respectively, both as extensions of the existing London route. Toronto became TCA's second departure point for service to Britain in 1957. TCA served Brussels and Zurich in 1958 for the

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[23] During 1946, CGTAS racked up a further 600 ocean crossings as it served the general public. Collins, *Wings Across Time*, p. 28-9.

[24] "Canada/Grande-Bretagne: Nouveaux transports aériens d'immigrants," *Interavia* no. 1426, February 17, 1948, p.14.

[25] Charles Allan Ashley, *The First Twenty-Five Years: A Study of Trans-Canada Air Lines* (Toronto: Macmillan, 1963), p. 29-32.

[26] North Stars were Canadair-made variants on the Douglas DC-4 that used Rolls-Royce engines more powerful than the original model on which they were based. Larry Milberry, *The Canadair North Star* (Toronto: CANAV Books, 1982), p. 213-4.

[27] TCA's North Atlantic passenger numbers were 14,393 in 1947, 23,429 in 1948, 21,872 in 1949, and 17,340 in 1950. Traffic peaked in 1948 in part due to changes in the value of the Canadian dollar, making flights more expensive against foreign airlines, and increasing fares. Charter services for immigrants also competed with this service although the immigrant resettlement program concluded in March, 1949. Competition from KLM and Air France also cut into TCA's profits in the early 1950s after those airlines gained access to Montreal in 1950, offering customers alternatives to the Canadian flag carrier. Ashley, *The First Twenty-Five Years*, p. 29-32.

first time.[28] A Moscow route was first considered in 1954 but pressure from the Canadian government halted progress beyond the initial planning stages until 1964 after a thaw in relations. Following talks between TCA and the governments of both Canada and the Soviet Union, that route began operations in 1966. It suffered from very low passenger numbers and was cancelled in 1977 despite the later addition of a stopover in Copenhagen.[29] This was not unexpected: tourism was the main driver for commercial flight since the mid-1950s but was quite limited in the Soviet Union.[30] Unlike the bigger American or European airlines, TCA could not simply run routes into anywhere and expect sustainable passenger traffic. The failure of the Moscow route is proof that some transatlantic services, even between major population centres, are not guaranteed to succeed.

European airlines entered the Canadian market while TCA expanded into Europe on a reciprocal basis at the expense of Canada's share of bilateral traffic. SAS and Sabena gained the right to fly into Montreal in 1960, offering prospective passengers additional options when TCA's North Atlantic service profits were already stagnant. The airline also faced stiff competition from Air France.[31] The French airline had expanded rapidly following its postwar renaissance, with routes to New York beginning service in 1946 from Orly airport in Paris.[32] In 1960, Air France gained fifth freedom traffic rights to fly from Paris through Montreal and on to Chicago when neither TCA nor any other Canadian airline could fly the Montreal-Chicago route

[28] *Ibid*., p. 40-8.

[29] Philip Smith, *It Seems Like Only Yesterday: Air Canada, The First 50 Years* (Toronto: McClelland and Stewart, 1986), p. 266-7.

[30] In 1965, while the route neared implementation, there were just 1.3 million foreign visitors to the USSR and 1.2 million Soviet tourists traveled abroad. This included trips by all means and to all destinations, including by trips by ground to just beyond the border. While this number climbed to 4.4 million foreign tourists in the USSR by 1977 and 2.7 million Soviets going abroad, many of them would still not have flown and a very small fraction of them would have visited Canada. H.G. Trend, "Tourism: A Profitable Business for the Soviet Union," *Radio Free Europe Research* RAD Background Report/206 (September 22, 1978), p. 4.

[31] Smith, *It Seems Like Only Yesterday*, p. 199.

[32] Air France also quickly set up routes to destinations in South America, Africa, and Asia by 1947 in a bid to put itself in a strong position for international aviation quickly after the war's end. Geoff Jones, *Air France* (Midland Publishers Limited, 2008), p. 55-6.

at that time.[33] TCA lagged several European countries in receiving American clearance for Montreal-Chicago service. BOAC gained permission to fly Montreal-Chicago as a spur of the existing London-Montreal route in 1954[34] while Lufthansa acquired rights through Montreal and onto Chicago in 1958.[35] As West Germany was an important hub for civil aviation in Western Europe, so the deal may have improved TCA's prospects for expanding service in Europe. Although TCA weathered these challenges and built a wide-ranging airline, it suffered competition-based financial hardships and even considered a merger with British and Irish airlines to remain economically viable.[36]

Most European countries had a single airline for international services, a flag carrier, as opposed to the United States having both Pan American and TWA offer extensive international connections. The United Kingdom, with two international airlines, was the European exception. BOAC flew transatlantic, Asian, and African routes, while British European Airways (BEA) flew European routes.[37] Britain's two airlines did not always work towards the same end, however. BEA could carry passengers from London into Europe whether they arrived on a BOAC flight or TWA or TCA. BOAC Chairman Sir Miles Thomas complained that the airlines

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[33] TCA sought reciprocal fifth freedom rights through Paris on to Rome following Air France gaining Montreal-Chicago rights, but far fewer people would take advantage of TCA's service. Smith, *It Seems Like Only Yesterday*, p. 199.

[34] The actual introduction of this extension was delayed a couple of months until June of 1954 by CAB failing to quickly grant clearance. Following changes in the frequency of BOAC's route (increased from once to twice weekly in 1955 and replacing the first class service with tourist class), a direct London-Chicago was agreed to in 1956. This did not mark the end of London-Montreal service, merely that the London-Chicago route could be sustained without being strictly a spur of the earlier service. Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), p. 197.

[35] The Canadian government claimed that this was not a concession to the German airline, suggesting that it was a necessary precondition for TCA to receive fifth freedom traffic rights through Europe. NARA RG 197, Box 37, Folder "Germany," July 1955. Foreign Service Despatch from Transport and Communications Officer Philip S. Bogart, United States Embassy in Ottawa, to the Department of State, "Canada-West Germany Air Transport Agreement," December 10, 1958.

[36] Ashley, *The First Twenty-Five Years*, p. 56.

[37] Both BEA and BOAC entered commercial service on January 1, 1946, when the wartime ban on civilian flight in Britain ended. Along with British South American Airways, the airlines served different regions since the British government believed that this would offer the best service possible. Charles Woodley, *History of British European Airways: 1946-1972* (Pen and Sword, 2006), p. 12-4.

ought to work together for the common British good, although BEA was not obligated to do so.[38] Canada entered this small club of exceptions when Canadian Pacific Airlines (CPA) pursued routes spanning the North Atlantic. A division of Canadian Pacific Rail, CPA lacked the political clout of government-owned (and official Canadian flag carrier) TCA. As a result, TCA had an effective monopoly on Canadian transatlantic service with foreign airlines permitted routes into the country on a reciprocal basis. Nevertheless, CPA pursued ocean-crossing routes as early as 1945,[39] although a decade passed before the airline was awarded transatlantic service rights. Once the Canadian government awarded it permission to serve destinations in Europe, CPA built a modest route network in a few years. It began flights to Amsterdam in 1955, Lisbon and Madrid in 1957, and Rome in 1960. CPA even flew a route from Winnipeg to Britain in 1962.[40]

While Canadian and British airlines flew into one another's countries regularly from 1945 onwards, British access to Canadian cities was limited. The bilateral agreement between the two spelled out which cities were open for use. Montreal[41] and London were the termini for the Britain-Canada route and the agreement specified that each party could operate a certain number of flights to the specified cities. But Canada worried about losing its privileged access to its market by giving BOAC access to Toronto following a request by BOAC in 1949.[42] Montreal was the traditional hub of Canada's international air traffic but Toronto had a larger population of British descent. Furthermore, Ontario was the nation's industrial hub and the United

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[38] Bray, *The History of BOAC*, p. 195-6.

[39] A report in *Interavia* proposed that CPA might be able to leverage the heavy British investment in the company to partner with BOAC for transatlantic service. Failing that, CPA might be able to press the Canadian government to open the North Atlantic to competition. "Canada/Grande-Bretagne: Les Canadian Pacific dans le traffic aérien transocéanique?" *Interavia* no. 1042, August 21, 1945, p. 8.

[40] Ashley, *The First Twenty-Five Years*, p. 56-7.

[41] Although Toronto is the largest city in Canada today, it only overtook Montreal as the biggest in 1976. "Toronto Metropolitan Area Now No. 1 in the Land," *Globe and Mail*, May 19, 1977, p. 1.

[42] Bray, *The History of BOAC*, p. 183.

Kingdom did far more trade with Toronto than Montreal.[43] The case for a route linking London with Toronto was clear and BOAC made it a top priority over the years that followed. BOAC and its passengers were dissatisfied with the restricted access to Toronto. In the late 1940s and early 1950s, BOAC passengers to Toronto often had to wait in Montreal's Dorval airport when their flight from London landed early or find alternate means to get to Toronto when TCA flights were unavailable.[44]

The Canadian government withheld access to Toronto from BOAC for years even after high level talks between BOAC Chairman Sir Miles Thomas and C.D. Howe, Canadian Minister for Trade and Commerce in 1955. Howe cited the fact that Malton, Toronto's airport, was a domestic facility and could not permit the foreign airline. By giving the British permission to fly there, Howe argued, all other countries would have the right to fly there too TCA's loss.[45] Undermining Howe's point, TCA flew from Toronto to points in the United States and Mexico by 1957. It should be noted that even though these flights did not connect with Europe, they marked the beginning of international service from Toronto.[46] Toronto was a major terminus for passengers to and from Britain even without a direct connection. TCA routed flights from

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[43] In 1957, there were an estimated 3.1 million people of British ancestry in Ontario but under 500,000 in Quebec, with the numbers nearly perfectly reversed for people of French ancestry. With Toronto of roughly equal size to Montreal at that time, and with 45% of Britain's Canada-bound exports going to Toronto versus 9% to Montreal, it was difficult for the British to accept that the city was not an acceptable destination for BOAC. An appendix attached here assessed the value of specific routes both in service and those being sought after by the British Ministry of Transportation for Civil Aviation with one end in Canada: the United Kingdom-Toronto route was by far the most valuable of the 19 under consideration at £795,000 out of a total £2,344,600 for all routes combined (the next most valuable was Vancouver-Tokyo at £203,000). British Airways Heritage Centre, RS/1/9872, UK/Canada Bilateral Agreement, Geog. Canada, 1954-1960." Memo from L.E. Hough to M. Custance, Ministry of Transport & Civil Aviation, September 17, 1957.

[44] Passengers arriving in Montreal ahead of schedule had to wait four hours for their connection in at least one instance. The author of the memo here indicated that this was an unacceptably long period for air travelers in that era. British Airways Heritage Centre, AW/1/6178, Part 18 "Atlantic Services, Services, July-Dec 1953." Memo from D.I. Peacock, BOAC Fleet Manager, Stratocruisers & Constellations, to BOAC Operations Planning Manager, "Toronto," December 3, 1953.

[45] Bray, *The History of BOAC*, p. 183.

[46] British Airways Heritage Centre, "RS/1/9872: UK/Canada Bilateral Agreement, Geog. Canada, 1954-1960". Memo from L.E. Hough to M. Custance, Ministry of Transport & Civil Aviation, September 17, 1957.

Toronto through Montreal, redirecting a large amount of traffic that could have flown directly. Members of Britain's Ministry of Civil Aviation noted that they had some leverage over Canada if they decided to press for more favourable terms: TCA carried a many fifth freedom passengers into Europe at London and CPA throughout the British Caribbean. These officials felt that this was reasonable grounds to push for access to Toronto's market, which was the source of about 40% of British-bound air traffic from Eastern Canada in contrast to the remaining 60% that originated from Montreal.[47]

In 1959, BOAC again brought up its interest in flying to Toronto. TCA President Roy McGregor was adamantly opposed to opening the city to the British airline. He pleaded to the Canadian Transportation Board to renounce Canada's air rights to Prestwick rather than granting BOAC the right to fly to Toronto. By doing so, TCA would serve only one British destination, London, and make the British request untenable following the principle of reciprocal access to one another's cities. The Transportation Board refused to consider this, favouring the BOAC request.[48] Anglo-Canadian talks with both government and airline officials in May 1959 resulted in BOAC gaining rights to Toronto in exchange for TCA rights through London onto several points in Europe, Africa, and the Middle East.[49] BOAC was just one of several carriers that

[47] BOAC could fly into the Canadian cities of Montreal, Vancouver, and Gander (grandfathered in as part of the service to Newfoundland when it was a separate entity and a strategically necessary stop for most planes to refuel) but faced severe limitations of other destinations for regular service since they were not covered under the existing air agreement. Since Britain controlled points across the world in 1957, this put it in a position to exercise leverage over the reluctant Canadian government to open more cities to BOAC. Some of the points in question spanned the Caribbean and Pacific Ocean that were still directly under direct British authority at that time. *Ibid*.

[48] TCA managed to exchange the new BOAC service for access rights to Hong Kong as well as pooling transatlantic flight revenue, reflecting common practice in Europe. Ashley, *The First Twenty-Five Years*, p. 49; Smith, *It Seems Like Only Yesterday*, p. 196-8.

[49] The cities TCA fought for were Rome, first and foremost, followed by Zurich, Vienna, Tel Aviv, and Cairo (it had also requested but gave up requests for Brussels, Athens, Calcutta, Delhi, Tokyo, and Shanghai). TCA estimated that it stood to lose about $1.3 million on traffic diverted to BOAC between Toronto and London plus another $700,000 on Toronto-Montreal traffic. This was based on 50 passengers per week. Canadian requests that Britain forego fifth freedom traffic between Canada and Caribbean countries in exchange were ultimately abandoned. British Airways Heritage Centre, "RS/1/9872: UK/Canada Bilateral Agreement, Geog. Canada, 1954-

sought access to Toronto, but the Canadian government refused permission to fly into Malton Airport to Air France, Lufthansa, Alitalia, Sabena, SAS, Swissair, and TAP until after 1971.[50]

It proved easier for BOAC to establish a route between Manchester and Canada. Many Canadians had emigrated from the Manchester area, and a steamship service already ran from there to Canada.[51] Those ships were used primarily by working class immigrants and so did not necessarily represent a fair basis for the need for air travel. But families wishing to visit relatives plus the business links between the two locations represented a major new revenue stream.[52] The route did not prove popular initially. In 1962, on the second BOAC flight from Manchester to Montreal, there was just one passenger who paid $240 for her ticket against the total cost of $3000 for the flight.[53] After a brief suspension of service, the route resumed operations in 1966.[54] By 1970 BOAC operated flights to Manchester as part of a route that also ran to Prestwick, which reduced the chance that the single destination would fail to attract sufficient passenger numbers.[55] Canada was a much smaller market for European airlines but one that still

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1960". Memo from J.R. Stainton, BOAC General Manager Western Routes, to BOAC Central Planning Manager, "Points of Interest from the U.K./Canadian bilateral discussions in Ottawa, May 5/8th," May 15, 1959.

[50] The Canadian Department of Foreign Affairs used access to Toronto as a bargaining chip in negotiations with other countries. Peter Pigott, *Air Canada: The History* (Toronto: Dundurn, 2014), p. 103-4.

[51] Manchester's airport was already served by Sabena, giving Canadians and people from Manchester a link through New York for a slightly higher fee than a routing through London or Prestwick that they were taking advantage of. Adding to BOAC's need to act quickly, CPA was in the process of setting up a route between Vancouver and Amsterdam with a stopover in Manchester that they might, in time, turn into a passenger stop. British Airways Heritage Centre, RS/1/10934, Part 5, "Atlantic Services, Services, 1955 Oct-Dec." BOAC memo from Sales Planning Supt. West B.W. Bampfylde to G.S. McDougall, Sales Manager, Canada, "Manchester/Canada Services," November 10, 1955.

[52] In addition to the ticket cost, immigrants could only carry a small amount of luggage without incurring excessive air cargo fees. Air travel between Manchester and Canada would therefore mainly serve tourists and business travelers. British Airways Heritage Centre RS/1/10934, Part 5, "Atlantic Services, Services, 1955 Oct-Dec". BOAC memo from G.S. McDougall, Sales Manager, Canada, to Sales Planning Manager B.W. Bampfylde, "Manchester/Canada Services," November 18, 1955.

[53] "What Next? Lone Passenger Served by Crew of 10 on Canada to U.K. Flight," *Globe and Mail*, August 7, 1962, p. 2.

[54] "More flights laid on, but seats still scarce on Atlantic routes," *Globe and Mail*, May 24, 1966, p. B10.

[55] Flights from Manchester ran to Montreal and, by 1970, Toronto as well. The addition of a Canadian destination suggests that the initial problem with filling seats on this service was temporary either due to a lack of publicity or a weak local economy that recovered soon thereafter. "Flights to, from U.K. cancelled by wildcat," *Globe and Mail*, July 1, 1970, p. 48.

represented a worthy destination. European immigration to Canada provided a close bond between the peoples of Europe and Canada that made transatlantic service between the two worth pursuing in its own end.

Fifth Freedom Traffic

The right to carry passengers between two foreign countries was a tantalizing prospect for American airlines operating in Europe. Passenger planes lacked the range to fly directly along every transatlantic route immediately after the war, so it was necessary to refuel in an intermediary city along the way and, while there, it made sense to exchange some passengers. It represented an entirely new market for passenger services provided that the rights could be secured; something that few European countries were willing to accept following the Second World War. As their airlines were rebuilding and could barely offer basic services for several years, the idea that the United States' big and fully operational airlines wanted to take away their passenger market represented a potential disaster for their bottom lines.[56] Yet many European countries were given reciprocal access to the American market in return in the air agreements they signed, and with Canada in many of their bilateral agreements. While the Europeans feared American competition during the postwar years, the American airlines were concerned about European competition just as much by the 1950s and 1960s.

The United States government greatly desired to develop links with France after the war concluded. It tried to assuage French fears of American dominance of civil aviation. American

[56] Some of the smaller European airlines worried that they would be outcompeted by bigger European neighbours. Sabena objected to multilateral agreements proposed at the Chicago Convention that included fifth freedom provisions since that risked making Belgium's populace Sabena's only source of passengers. Bigger countries might be able to absorb the loss of passenger traffic or expect to make up the difference by extensive route networks, but in 1944 Sabena had no assurance it would carry large loads of passengers. Vanthemsche, *La Sabena*, p. 107-10.

officials offered assurances that American airlines would not seek to operate routes that ran exclusively within Europe. Instead, they claimed that it was a fair compromise for American airlines to fill seats on spur routes following transatlantic flights (i.e. passengers disembarking in Paris from New York might be replaced by passengers seeking to fly from Paris to Rome).[57] To sweeten the deal, American officials proposed to lease France enough transatlantic-capable planes to allow regular service to begin in 1946. French civil servant Jean Monnet pointed out that the planes were offered at greatly reduced rates, calculated to cost France about $1.76 million for 220 planes that would normally have cost over $28 million. France needed to establish its presence in the North Atlantic quickly as the new planes gave France a major boost at a time when its domestic economy was in disarray.[58]

Franco-American talks reflected America's aspiration to establish a network of airline routes throughout Europe quickly after the war's end. The United States government was intent on building air links to as many European capitals as possible, yet the realities of air travel required that its planes stop in cities like Paris whether for fuel or simply to maintain adequate passenger numbers on each leg of the route before continuing into the continent. The State Department, however, was reluctant to permit reciprocal French air routes through the United States into Latin America. It objected to the extensiveness of the routes sought by the French government on the grounds that the United States stood to lose valuable passenger traffic to Air France, even though it pushed the French for rights into Europe that would draw passengers away from Air France in the same manner. Jefferson Caffery, the American Ambassador to

[57] NARA RG 197, Box 28, Folder "France International Agreement, F.A.T.D.," 1936-1945. "Note on Aviation by Dr. Jean Monnet," September 20, 1945.

[58] The American offer included 20 C-54Bs at $960,000 and 200 C-47s at $800,000, assuming the highest suggested price. The total length of the loan was to be five years starting from 1946 and costs would be amortized over the length of the lease. Monnet also suggested that should France either build its own planes or seek British planes instead that there would be a delay of perhaps several years until French air capabilities would reach the level that the loan represented. NARA RG 197, Box 28, Folder "France International Agreement, F.A.T.D.," 1936-1945. "Note on Aviation by Dr. Jean Monnet," September 20, 1945.

France, suggested that permitting French fifth freedom traffic to places such as Mexico City could give American fifth freedom requests through France into Europe greater legitimacy. In light of France's geographical importance for American airlines seeking to travel across Europe, Caffery felt that it behooved the State Department to acquiesce to the French wishes.[59]

Paris soon became a hub for European air travel even among American airlines. A majority of TWA's European passengers flew on its services entirely within Europe rather than on its transatlantic routes. During September 1949, fifth freedom passengers, those using TWA to fly between two points outside of the United States, accounted for 1,799 out of the 3,354 paying customers on flights through Paris. The most popular destinations from Paris on TWA were Rome, Cairo, and Athens, which accounted for over half of the fifth freedom passenger traffic combined on that airline.[60]

Airlines are commercial enterprises: they carry passengers and goods for a price to fund their services and to generate profits. But most European countries directly supported and in many cases owned their domestic airlines.[61] These airlines operated under a different philosophy than privately-run and predominantly American airlines. Governments were willing to boost tourism even if bringing the tourists meant that their airline operated at a loss, as foreign currency and tourist spending could be even more valuable. Some European countries ran routes

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[59] NARA RG 197, Box 28, Folder "France International Agreement, F.A.T.D.," 1936-1945. Telegram from Ambassador Jefferson Caffery to the Secretary of State, November 3, 1945.

[60] Of the eleven fifth freedom destinations listed by TWA carried during September 1949, only Gander was located in North America and accounted for just 16 passengers. The principal value of the fifth freedom passenger traffic was to Rome (331 outbound, 216 inbound), Cairo (400 outbound, 115 inbound), and Athens (130 outbound, 127 inbound). The remaining seven destinations were located in Europe, Asia, and Africa. NARA RG 197, Box 28, Folder "France – U.S. Negotiations III," January 1948-August 1950. Letter from TWA's Assistant to the Chairman of the Board J.L. Weller to Sydney B. Smith, Civil Aeronautics Board, May 17, 1950.

[61] Even by 1979, the biggest European airlines were wholly or majority-owned by their state governments. Aer Lingus (Ireland), British Airways, and Sabena (Belgium) were 100% state-owned; Air France and Alitalia were 99% owned by their governments; Lufthansa was 82% owned by West Germany; KLM 78% the Dutch; and Air Inter was 50% owned by France. Paul Stephen Dempsey, *European Aviation Law* (London: Kluwer Law International, 2004), p. 2.

that were unprofitable mainly for political reasons.[62] In one instance, the Dutch government requested American permission for KLM to run a route between Los Angeles and Curacao through Mexico City in 1948: an analyst with the CAB determined that the route's only value was in building Dutch prestige.[63] The tendency to run service regardless of demand impacted the North Atlantic market as well by the mid 1950s. Some European airlines ran redundant transatlantic services, while American airlines flooded the market with ever more seats. This excessive competition plagued airlines, undercutting profit margins.[64] William K. Hitchcock, the American Civil Air Attaché in the London Embassy, recognized the overcapacity problem in 1955. Pan Am planned to augment service to Europe that summer, from 22 to 35 flights to London per week, flights to Brussels up from 3 to 9, and Amsterdam from 1 to 10. Hitchcock worried that the Europeans would see the jump as a threat to their own services and might react by adding yet more capacity. He concluded that the transatlantic market was saturated by the American airlines, with the European airlines lagging behind with outdated planes.[65]

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[62] In one example, SAS ran service into Lapland despite the very low passenger numbers in order to support the tourist sector there. John Lewis McGoldrick, "Regulation of Service Competition in International Air Travel," *Harvard International Law Journal* 8, no. 1 (Winter 1967), p. 83-4.

[63] The value in a Los Angeles-Curacao route was one of prestige: it would link KLM's routes in the East Indies with those in the West Indies. The route would likely face political challenges from the stopover in Mexico City since the Mexican government was far from certain to grant permission to operate there. NARA RG 197, Box 79, Folder "UK," 1948. Memo from Civil Aeronautics Board Economic Bureau Director Sydney B. Smith to the Chief of the Foreign Air Transport Division, "Reconsideration of the United States Position Concerning the Proposed Revision of the British Routes in the Bermuda Agreement, and Consideration of the Desirability of Resuming Negotiations for a Bilateral Agreement with the Netherlands," January 12, 1948, p. 10.

[64] American airlines were singled out as being especially bad about flooding routes with excess capacity. G. Howard Conklin, "The Airline Industry: Correlations between Major CAB Policy Changes and Airline Earnings," *Financial Analysts Journal* 27, no. 1 (January-February 1971), p. 40.

[65] It is interesting to note that the telegram also included mention of the use of DC-7B planes. These were 70-seat aircraft set for the tourist-class flights, in addition to the DC-6Bs already in operation. The newer DC-7Bs were considered noteworthy since their use offered a "dramatic" way of taking market share from TWA on the North Atlantic market. NARA RG 197, Box 82, Folder "United Kingdom-US Negotiations X," January 1955-May 20, 1955. Telegram from American Civil Air Attaché in the London embassy William K. Hitchcock to the Department of State, "Civil Aviation: Pan American Summer Schedules," no. 2143, January 27, 1955.

America's commercial aviation sector was uniquely massive, so fifth freedom passenger services were merely a bonus for America's airlines rather than a core service.[66] But American carriers did not dominate international air travel as thoroughly as they did domestic services, with 25.6% of international revenue passenger kilometres (RPK)[67] and cargo ton-kilometres were flown by the United States' airlines in 1971.[68] In contrast, international travel was crucial for Europe's airlines. For them, domestic service alone would have been impractical as the small geographic size of most European countries meant that most such flights would be short, and therefore could take longer and cost more than other means of transportation. Each fifth freedom passenger that flew on an American airline in Europe was one that did not use a European airline, undercutting the European share of the market. IATA Secretary General Daniel Goedhuis cited 500 kilometres as the minimum distance at which air travel was competitive.[69] The amount of time passengers lost waiting at an airport is similar for flights of any duration and

[66] In 1971, 57.9% of all domestic flights by RPK plus cargo ton-kilometres were flown in the United States; all other countries' domestic services combined accounted for the remaining 42.1% (Canada accounted for 2.6%, Japan for 2.3%, and France for 1.0%). The only other country with domestic air service remotely as big as that in the United States was the Soviet Union. In 1971, Soviet domestic air travel accounted for 26.1% of all kilometres offered on its domestic route network even though it had only 1.7% of international route kilometres. No other country's domestic service exceeded even 3% of the global RPK total. European Commission Archives, BAC 130/1983 no. 381, p. 346 Commission des Communautés Européenes, "Mise a jour des annexes I et II de la Communication de la Commission au Conseil en date du 19 juillet 1972 intitulée: 'Les action de politique industrielle et technologique de la communauté à entreprendre dans le secteur aéronautique'," December 21, 1972, p. 12.

[67] "Revenue passenger kilometres" (RPK) is a term for the total distance traveled by all paying passengers on a given subset of flights. A flight with 100 passengers traveling 1,000 km would accumulate 100,000 RPK, being the product of passengers multiplied by the distance of the flight (100 x 1,000 = 100,000). Long distance flights and larger planes will therefore increase this figure for an otherwise identical number of flights.

[68] In addition to the United States, three other countries managed to achieve between 5% and 10% of the total international air market by kilometres traveled: Britain, France, and West Germany. *Ibid*. Tourism in general was not as common in the Soviet Union as it was in Europe or North America, and was far less likely to take place using air travel let alone to leave the country. Robin Higham, John T. Greenwood, and Von Hardesty, "Introduction," from *Russian Aviation and Air Power in the Twentieth Century*, Robin Higham, John T. Greenwood, and Von Hardesty, eds. (London: Frank Cass, 1998), p. 15.

[69] D. Goedhuis, "The Role of Air Transport in European Integration," *Journal of Air Law and Commerce* 24 (1957), p. 276.

so has the largest impact on short flights.[70] Short flights also incur the same airport fees as longer ones, so fixed airport costs are more acutely felt. Less efficient small aircraft, whose smaller passenger capacity make them better suited for short flights, are also occupied for less time on short trips. These factors maximized the impact of fixed costs ultimately borne by passengers.[71]

It is worth noting that as the traditional definition of a short-haul flight is anything less than 1,000 nautical miles (1,853 km),[72] any flight less than 500 kilometres is short in the extreme. Bearing out this point, in 1965 only 8% of all trips over 200 kilometres within Western Europe were by plane as opposed to train or car, rising to 16% for voyages over 500 kilometres.[73] Airlines typically operate short-haul routes at a loss: in 1981, Western European routes between 200 and 400 kilometres earned 3% less than they cost to operate. Profitability improved with distance, peaking on routes between 1,400 and 1,600 kilometres with a 20% margin.[74] Furthermore, European travelers were far more likely to fly for business than for pleasure. Un-competitiveness in the highly regulated European airline market made flying less attractive than other means of transportation.[75] With few domestic air routes in Europe longer

[70] Time spent at an airport going through security, check-in, and awaiting luggage at a baggage carousel can add hours to a trip. For a voyage of under 500 kilometres, this might account for half of the time that ground-based car or train trips might take when traveling between the same destinations, even before accounting for the flight time. For yet shorter trips, planes are disproportionately less practical except cases where a destination is otherwise quite inaccessible due to unfavourable geography (highly mountainous terrain, undeveloped wilderness, islands etc.). Pierre Merlin, *Le transport aérien: situation et perspectives*, (Paris: Presses Universitaires de France, 2002), p. 77-80. Getting to and from an airport is similarly disadvantageous for short-haul passengers who may have to travel to the outskirts of town (and pay for a taxi or to park their car). By driving instead, prospective air travelers could drive door-to-door, and in many major cities they could take a bus or train directly between city centres. Stephen Shaw, *Air Transport: A Marketing Perspective* (London: Pitman Books Limited, 1982), p. 28.

[71] Goedhuis, "The Role of Air Transport in European Integration," p. 276.

[72] Bill Gunston, *Airbus*. (London: Osprey, 1988), p. 108-9.

[73] European Commission Archives, BAC 129/1983 no. 550, p. 261-2. Question écrite no 251/68 de M. Cousté à la Commission des Communautés européennes, Objet: Transports aériens en Europe.

[74] Generally, the shorter routes were considered a necessity for airlines since they provided a valuable feeder service for the longer, more profitable routes. Profit margins counterintuitively decrease for very long routes, with a loss of 5% on routes over 1,800 kilometres. Richard Pryke, *Competition among International Airlines*. (Brookfield, VT: Gower Publishing Limited, 1987), p. 19-21.

[75] *Ibid*., p. 262.

than 500 kilometres, only international flight offered European airlines growth opportunities. In 1958 over 68% of total EC air traffic by RPK was international, and in 1968 the proportion rose to nearly 88%. For Ireland, Scandinavia, and the internationally-focused British airlines who remained outside of the Common Market, the share of international traffic was 77% in 1958, comparable to the EC numbers at 87% in 1968.[76] European airlines were particularly sensitive to the loss of passengers to fifth freedom traffic because of their dependence on international travel, as noted by these figures. The Europeans were considerably motivated to protect their airlines as the big American airlines could compete the Europeans right out of the market.

Aviation Protectionism

Most European countries were highly supportive of their flag carriers, many of which were too small to be competitive in the global market. Those countries tended to regard their airlines as public utilities and a vital public service that had to be supported regardless of the cost.[77] This fostered protectionism that in a globalizing world meant opposition to the American preference for a lightly regulated global marketplace. Governments, including America's, without exception gave their airlines at least some form of direct or indirect subsidies, such as the air mail fees paid to airlines as noted in Chapter Eight. Subsidies often gave an airline an edge abroad where their services might not be cost effective otherwise. When such aid was coupled with the potential instability that a free and unregulated commercial air system might

[76] European Commission Archives, BAC 3/1978 no. 1479, p. 315-6. Commission of the European Community, "Actions à entreprendre dans les domaines de la navigation maritime et de la navigation aérienne (Projet de Communication de la Commission au Conseil)", Communication de M. Bodson, 28 May, 1970, Annexe I p. 13-4. As recently as 2006, the total domestic operations of European airlines accounted for less than a tenth of RPK and accounted for less than one third of all passengers. Association of European Airlines, *Association of European Airlines: Yearbook 07*. (June 2007), p. 62.

[77] There were other advantages to publicly owned airlines: they would be protected from competition as other airlines entered the market, they had guaranteed support in hard economic times, and the market was regulated to guard against rising or falling prices (price collusion and price wars, for example). James Patrick Hanlon, *Global Airlines: Competition in a Transnational Industry* (Oxford: Butterworth-Heinemann, 1996), p. 28-35.

engender, there was no logical alternative than to protect a national airline. A sudden drop in demand for air travel could doom a small airline without government support.[78]

Protectionism shaped aviation throughout the postwar era. According to Christer Jönsson, a rational airline market, allowed to evolve without government intervention, would eventually consolidate many small airlines into a few larger carriers as smaller airlines were inefficient and so would be weeded out through competition and service rationalization. In Jönsson's ideal scenario, these consolidations might lead to airlines owned in partnership by several small and otherwise uncompetitive countries akin to the Norwegian-Swedish-Danish airline SAS. While airlines within the United States went through this process in the interwar era, producing a few competitive and large carriers, this was not the case elsewhere. Non-financial considerations, such as prestige or regular access to remote regions, often swayed governments to prop up their airlines regardless of profitability. Governments intervened to keep their flag flying abroad, protected from direct exposure to international competition.[79]

Subsidies alone could not assure that passenger numbers on European carriers remained competitive against America's airlines. Both Pan Am and TWA were larger than other North Atlantic airlines. As such, they could carry more passengers and earn greater revenues than the European carriers. By 1950, the French government was considering a mandatory pooling arrangement between Air France and Pan Am, according to David K.E. Bruce, the American Ambassador to France. If enacted, the French airline would receive a share of revenue from all passengers on Pan Am flights serving France. Pan Am would lose its competitive advantage over the French airline but would have guaranteed access to France. Bruce believed that the French government took the matter seriously enough that they considered abrogating the air

[78] Stephen Wheatcroft, *Aviation and Tourism Policies: Balancing the Benefits* (London: Routledge, 1994), p. 20.

[79] Jönsson, "Sphere of Flying," p. 293-4.

agreement with the United States if a solution to the volume imbalance was not found in the near future.[80]

Even the United States employed protectionism. It differed from European support for their flag carriers as the American government typically focused on giving its airlines some competitive advantage. In one case, beginning in 1946 the United States restricted foreign airlines' transatlantic flights to New York; no other American city was open to them. This sheltered domestic airlines from foreign competition while encouraging the use of America's own international airlines for foreign flights.[81] Its two big airlines[82] did not directly compete with one another on the North Atlantic in the 1940s. Each served different European cities although both served London and Paris. The American government effectively divided Europe into separate zones where Pan Am and TWA each enjoyed a monopoly of sorts.[83] In 1950, Pan Am had the right to fly through Paris and onto Rome while TWA could operate through London onto Frankfurt. Both airlines had similar capacity limits. In the estimation of *La Vie des transports*, an aviation trade journal, continental Europe's airlines had a bigger concern with respect to competing with the American airlines. Britain's BOAC had new Constellations and Stratocruisers that could compete with the quality and quantity of Pan Am and TWA service but

[80] NARA RG 197, Box 28, Folder "France – U.S. Negotiations III," January 1948-August 1950. Telegram from Ambassador David K.E. Bruce to Secretary of State Deak, August 30, 1950.

[81] Only Swissair received permission to fly to another city, Chicago, beginning in May 1949. The American airlines received the right for a Geneva-New York service in exchange, Geneva being the European headquarters of the United Nations. Dierikx, *Clipping the Clouds*, p. 51.

[82] Only Pan Am had CAB permission to fly transatlantic routes prior to 1945. On June 1, 1945, the CAB enacted the *North Atlantic Route Case*, opening the market up to both TWA and American Overseas Airlines (which merged with Pan Am in 1950) despite Pan Am's objections. This move was designed to accommodate demand for an expected boom in transatlantic air service. Partly to mitigate excessive competition, each airline was permitted to fly into certain areas exclusively. Marc L.J. Dierikx, "Shaping World Aviation: Anglo-American Civil Aviation Relations, 1944-1946," *Journal of Air Law and Commerce* 57, no. 4 (Summer 1992), p. 820-2.

[83] Bilateral agreements generally did not spell out which airline was permitted to fly between the two countries, detailing things such as the cities to be served and the flight frequency. It was up to the countries involved to determine which entity was to actually serve the route. Since most countries had just one airline that could fly international routes this was not a matter that arose often in the early postwar era except in the United States. NARA RG 197, Box 28, Folder "France – U.S. Negotiations IV," September 1950-December 1950. Press Release from the American Embassy in Paris, December 12, 1950.

most of the European airlines had smaller or less competitive planes. It was already difficult for European airlines to both compete against each other and the big American carriers, but harder still when Pan Am and TWA were sheltered from competition against one another.[84]

The huge capacity Pan Am offered after its merger with American Overseas Airways in 1950 made it by far the world's biggest international airline. Air France was thereafter in a particularly unfavourable competitive position as Pan Am alone carried an absolute majority of passenger traffic between France and the United States. The French government protested that the Americans should cap Pan Am and TWA to 70% of the total passenger load between their two countries, leaving 30% for Air France. Fifth freedom traffic on the route through Paris into Rome and destinations beyond was cited as proof that the American airline would garner sufficient revenue even with such a capacity limit.[85] France's biggest bargaining chip with the United States was its ability to limit the frequency with which America's airlines could enter and transit French airspace. Paris was not merely a desirable tourist destination but also a critical hub for international air travel. In the latter 1940s, France feared that fifth freedom air traffic threatened Air France's ability to operate even direct routes: their objections focused on flights linking Paris to other European destinations. The French government claimed that it agreed with the principles set out in the Bermuda Agreement in 1946, loosening frequency controls for longer services only.[86]

Henri J. Lesieur, an Air France official, stated that French assertiveness towards the Americans reflected growing confidence in light of the national postwar recovery. France

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[84] NARA RG 197, Box 28, Folder "France – U.S. Negotiations IV," September 1950-December 1950. Telegram from the American Embassy in Paris to the State Department, "Translation of article appearing in *La Vie des Transports* of September 2, 1950," September 7, 1950.

[85] NARA RG 197, Box 28, Folder "France – U.S. Negotiations IV," September 1950-December 1950. Telegram from the American Embassy in Paris to the Secretary of State, "No. 1795," October 5, 1950.

[86] NARA RG 197, Box 79, Folder "UK" 1948. Bureau of Economic Regulation, Foreign Air Transport Division, "Postwar International Aviation Policies," November 9, 1948, p. 18-9.

acceded to the earlier bilateral agreement with the United States from a position of weakness. By 1950 that was no longer the case and "the French feel keenly that they should be accorded by the U.S. the treatment of at least a junior, if not an equal, partner in international air transport".[87] The French government exercised this confidence during talks with the United States in 1957. It pressed the Americans for the right to use the "polar route", a northerly passage that passed over the Atlantic and Arctic oceans and a valuable link between Europe and America's west coast. The French government asserted that it was only fair to permit Air France the right to additional American destinations as Pan Am and TWA already operated routes from the American west coast to Paris and so exercised a monopoly on that passenger traffic. Underscoring the French push for the new route, its airline carried fewer passengers across the North Atlantic than the American carriers.[88] A similar case arose when the British looked to begin polar route service in 1955. The CAB gave BOAC permission to serve either San Francisco or Los Angeles and made it clear to Germany and Scandinavia that only one of those two cities would be open to their airlines. The United States was concerned with limiting foreign air service to the west coast.[89] In 1957, America's CAB predicted that giving Air France polar route access was a mixed bag for the American carriers. As it would provide the French airline with an estimated 63,418 transatlantic passengers against America's 147,421 in that year, the United States would remain far ahead. However, American airlines would earn $29.6 million on that service against Air

[87] NARA RG 197, Box 28, Folder "France – U.S. Negotiations V," January 1951-Feb. 28, 1951. Memo of Conversation, "U.S. – French Civil Aviation Relations," October 24, 1951.

[88] NARA RG 197, Box 32, Folder "United States – France Consultation," October 14, 1957. Memo from CAB Chief, International Division, to the CAB Associate Director, Bureau of Air Operations, "U.S.-France Consultation," October 9, 1957.

[89] The Germans and Scandinavians were explicitly refused the right to serve both west coast cities on the grounds that even the British were only allowed access to one. Permitting British access to both risked setting the precedent of opening up both cities to additional foreign airlines. Even granting air rights to the west coast was contingent on receiving access to a new route of equivalent value to the United States in return from the partner country. NARA RG 197, Box 86, Folder "United Kingdom-U.S. Negotiations XVI," January 1, 1958-December 31, 1958. Telegram from Herter, Acting, to the American embassy in London, "British Air Carrier Service to the United States West Coast," A-25, July 11, 1958.

France's $19.8 million despite the latter's far smaller passenger volume. This was not grounds to dismiss the French request but it underlined the route's greater value to Air France than to TWA and Pan Am.[90]

All of these routes were exchanged on a carefully negotiated basis, as were other deals of this nature. The goal was to find a balance between the needs and interests of both parties. When one country gained an advantage on the North Atlantic routes, there were often other regions where routes could be offered to rebalance the scales. On a governmental level these sorts of agreements could be quite equitable, but the affected airlines often felt differently. In Air France's polar route case, TWA and Pan Am objected on the grounds that although they both flew the polar route under the existing bilateral air agreement, the new terms could see Air France profit without a new, reciprocal route for them into France. It should be noted that neither American airline saw another route into France worth pursuing. Pan Am suggested that the French request would be acceptable if France expanded fifth freedom rights to points within Europe and onto the Middle East, plus access to French territories in the South Pacific. The CAB supported this approach.[91] Air France was finally granted use of the polar route in 1959, serving either San Francisco or Los Angeles. America's airlines won the right to serve several French Pacific territories on a reciprocal basis with Air France, including a route between Hawaii and Tahiti or New Caledonia. The Americans also won access to points in the Near East.[92]

Lufthansa, the German carrier, attracted similar anti-competitive forces from the United States civil aviation sector. Unlike most of Western Europe's major airlines, Lufthansa did not

[90] NARA RG 197, Box 32, Folder "United States – France Consultation," October 14, 1957. "Estimated exchange of economic benefits of United States and French carriers under the air transport agreement, twelve months ended June 30, 1957," September 25, 1957, p. EB-1.

[91] NARA RG 197, Box 32, Folder "United States – France Consultation," October 14, 1957. Memo from CAB Chief, International Division, to the CAB Associate Director, Bureau of Air Operations, "U.S.-France Consultation," October 9, 1957.

[92] NARA RG 197, Box 36, Folder "France-U.S. Negotiations, XIII," January 1-July 31, 1959. Press Release from the Department of State, August 27, 1959.

exist until well after the war's end due to punitive restrictions placed on a defeated Germany in the peacetime settlement. The Allies sought to prevent Germany from obtaining any war-potential material, including aircraft, until political mechanisms were in place to ensure their peaceful use. By 1952, with the Western powers (Britain, France, and the United States) in charge of the Federal Republic of Germany turning their attention to the Soviet Union as the primary threat to peace, they consented to a German return to the skies.[93] Between 1952 and 1955 German pilots trained in England and German ground crews worked with the Dutch on KLM operations, preparing for the day that Lufthansa would be permitted to fly again.[94] The close association with KLM reflected the heavy involvement by the Dutch airline in West Germany. Prior to Lufthansa's return to service in 1955, KLM had the most extensive air services in West Germany and carried passengers and cargo into and through the country.[95] By 1954, America and Britain provided Lufthansa with planes and, within months, West Germany had a viable airline once again.[96]

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[93] West Germany was granted (almost) full sovereignty in 1955. Since it was seen as a valuable partner in the Western world, it was allowed (among other things) the right to strike air agreements with other countries. "Average German Affected Little," *New York Times*, May 6, 1955, p. 4. Reflecting the shift in perception, the Soviet Union and its allies were put on a list of countries with whom Western countries would not trade war-potential materials whereas West Germany was welcomed as a trading partner. The effectiveness of this trade barrier was debatable but the intent made clear the shift in attitudes toward the (West) German nation. See: Jeffrey A. Engel, "The Surly Bonds: American Cold War Constraints on British Aviation," *Enterprise & Society* 6, no. 1 (2005), p. 1-44; Michael Mastanduno, "Trade as a Strategic Weapon: American and Alliance Export Control Policy in the Early Postwar Period," *International Organization* 42, No. 1, The State and American Foreign Economic Policy (Winter 1988), p. 121-50; John R. McIntyre, "The Distribution of Power and the Inter-agency Politics of Licensing East-West High-Technology Trade," in *Controlling East-West Trade and Technology Transfer: Power, Politics, and Policies*. Gary K. Bertsch, ed. (Duke University Press, 1988), p. 97-133; William A. Root, "Trade Controls That Work," *Foreign Policy*, No. 56 (Autumn 1984).

[94] NARA RG 197, Box 37, Folder "Germany," January-June 1954. Foreign Service Despatch from Deputy Director, Office of Economic Affiars, John W. Tuthill of the High Commission in Germany, to the State Department, "Development of a German Airline," June 11, 1954.

[94] "Germans Get Air Rights," *New York Times*, July 15, 1955, p. 32.

[95] Dierikx, *Clipping the Clouds*, p. 50.

[96] The Americans and British competed with one another to sell their planes to the large West German market. NARA RG 197, Box 37, Folder "Germany," January-June 1954. Foreign Service Despatch from Deputy Director, Office of Economic Affiars, John W. Tuthill of the High Commission in Germany, to the State Department, "Development of a German Airline," June 11, 1954.

West Germany struck permanent bilateral air agreements with partners on both sides of the Atlantic after its 1955 return to service, including France, Britain, and the United States.[97] It was allowed to begin general commercial service on April 1, 1955, with full commercial service on May 15. The Germans bought four Constellation planes from the United States for transatlantic operations. A month of experimental service during May 1955 was followed by full commercial operations on June 1.[98] Pan Am made its desire for Lufthansa to fly into the United States known in a letter to the CAB in advance of the German return to flight. Allowing the German airline access to New York, Boston, and Chicago meant Pan Am could retain access to eight cities across West Germany on a roughly reciprocal basis, fostering a good working relationship with a vital European market. This deal, which included fifth freedom access beyond Germany into other European destinations, provided good growth potential for Pan Am despite competition from Lufthansa.[99] The German-American air agreement was ratified by the United States in July, 1955. An article in the *New York Times* claimed that Pan Am was opposed to it, at least in public. United States Senator George Smathers publicly decried the State Department "giveaway" of rights and privileges to Lufthansa worth $75 million against a "gain" of only $1.5 million for new rights accorded to American airlines. In point of fact, the $75

[97] "Germans Get Air Rights," *New York Times*, July 15, 1955, p. 32.

[98] Full traffic rights for technical stops on transatlantic service had already been cleared with Ireland, the Benelux trio, and Switzerland. NARA RG 197, Box 37, Folder "Germany," January-May 1955. Aide-Memoire from the Diplomatic Mission of the United States in the Federal Republic of Germany to the Department of State, March 17, 1955.

[99] Pan Am's desire to serve so many German cities reflected the lack of a single dominant city there. The eight German cities were Frankfurt, Dusseldorf/Cologne/Bonn, Hamburg, Munich, Stuttgart, Nuremberg, Bremen, and Berlin, the last of which was geographically separate from West Germany and represented additional political challenges for regular service. All transatlantic routes included stopovers in intermediate points as necessary, including at Shannon and Gander. Pan Am notably pointed out that it was the only American airline to serve Germany (except for a TWA line into Frankfurt), and it opposed any TWA expansion into Germany. NARA RG 197, Box 37, Folder "Germany," January-May 1955. Letter from Pan American Airways Vice President Russell B. Adams to the Civil Aeronautics Board, May 27, 1955.

million Lufthansa would earn came from what were reciprocal air rights for services across the North Atlantic that it had been unable to exploit until then.[100]

The American airlines most vociferously objected to Lufthansa's fifth freedom access through the United States and onto points in Latin America and the Caribbean. Unusually for an air agreement of such scope, the German airline could operate into any points south of the United States to a technically unlimited degree. America's airlines feared losing market share in the western hemisphere, where they had previously enjoyed privileged access to a sheltered segment of the global aviation market.[101] The potential losses were small. A 1955 CAB study found that fifth freedom traffic through Germany provided America's airlines 22,730 passengers during 1953-4 whereas Germany was estimated to have a traffic potential of 3,132 passengers through the United States into Latin America. On balance, the American carriers drew away far more passengers from the Lufthansa than they stood to lose in turn.[102] These route exchanges created a backlash. By the early 1960s, both the American public and private sectors were concerned with the relative decline in American aviation's dominance. The situation was severe enough that the agreements with foreign countries and airlines began to be re-examined to more strongly favour American interests.[103]

In some cases, actors other than airlines or governments employed measures that, while not strictly protectionist, favoured domestic airlines or slowed the growth of air travel. European

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[100] Notably, the polar route (to either San Francisco or Los Angeles exclusively) was accorded to Lufthansa despite its absence from previous discussion in State Department documents. Additionally, the German airline was permitted to fly routes into New York, Boston, Philadelphia, and Chicago (via Montreal). Alvin Shuster, "Air Pact Signed by U.S. and Bonn," *New York Times*, July 8, 1955, p. 42

[101] The American airlines protesting the Lufthansa deal were: Eastern, National, Braniff, Panagra, and Pan American. NARA RG 197, Box 37, Folder "Germany," July 1955. U.P. Ticker, July 8, 1955.

[102] NARA RG 197, Box 37, Folder "Germany," July 1955. Civil Aeronautics Board, "Report to the Senate Committee on Interstate and Foreign Commerce Concerning the United States-West Germany Air Transport Agreement," July 22, 1955, Appendix II-III.

[103] John C. McCarroll, "The Bermuda Capacity Clauses in the Jet Age," *Journal of Air Law and Commerce* 29, no. 2 (Spring 1963), p. 117-8.

airports charged landing fees that were typically over twice as much as those in the United States, according to a 1953 report by Air Research Bureau Secretary-General Bo Björkman. The cost increased with the size of the plane, reflecting both the greater passenger numbers and increased expense of accommodating the bigger aircraft. European airports, however, sometimes imposed service charges far in excess of the actual cost.[104] Björkman noted that the New York area airports, unlike the European airports, charged lower rates while providing all aircraft services at no additional charge. Some European airports even passed the extra costs directly to the passengers through increased ticket prices to offset the extra expense. These fees came at a time when air travel realized regular efficiency improvements that translated into cost reductions of about 4% per year. Björkman suggested that cutting these landing rates would help boost air travel in Europe.[105] His call was echoed in 1967 by both the ICAO and IATA. They argued that fees based solely on an aircraft's weight should be employed regardless of its point of origin, nationality of the carrier, or how long the inbound flight had been.[106]

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[104] There was not a direct correlation between the size of the fee and the size of the plane; the fees were roughly correlated to match the larger service costs. Smaller airports tended to charge higher fees overall, which was not particularly relevant for transatlantic flights since those airports could not typically accommodate the bigger planes used on that route. International flights, however, often incurred a higher rate at European airports through much of the twentieth century. The services offered to justify the costs included air traffic control, landing facilities, room for the plane for a specified time, use of a gate or terminal, and takeoff facilities. Rigas Doganis, *The Airport Business* (London: Routledge, 1992), p. 63-5; TNA BT 245/526, "European Civil Aviation Conference: 1st session - 1954, (notes from 1955-6)." Bo Björkman, "Introduction of passenger charges in Europe," November 30, 1954, 7B.

[105] Landing fees for Convair 240, DC-3, DC-4, and DC-6 were listed for London, Paris, Amsterdam, Brussels, Zurich, Copenhagen, Frankfurt, La Guardia (New York), and Newark (near New York). The two New York airports plus Amsterdam offered the lowest rates at $5.50 for the DC-5, $8 for the Convair 240 ($9 in Amsterdam), $14 for the DC-4 ($15 in Amsterdam), and $19 for the DC-6. The other European airports had varying rates but were consistently twice the rate (or higher) of those listed for New York. The most extreme example was in Paris and Copenhagen where DC-6 landing fees cost $54. *Ibid*.

[106] Basing airport landing fees on a plane's weight was not universally seen as a solution. While it offered a simple formula for airlines to determine a flight's cost, it failed to account for other costs associated with servicing different aircraft models and other maintenance minutia. There was also no detailed plan in the ICAO's call for common, universal fees, so airports that adopted the ICAO recommendations in later years in fact charged rates that were consistent to that airport alone but could often be wildly different than those found abroad. Doganis, *The Airport Business*, p. 71-7.

Air Union: A Failed Experiment

In 1958 European airlines conceived of Air Union;[107] a plan to merge together into a single carrier on a scale that could effectively compete with dominant American airlines. The new airline was in essence a protectionist measure taken by the airlines themselves, in contrast to government-orchestrated protectionism widely practiced in Europe.[108] The European Community's (EC) six original member states' airlines - France, West Germany, Italy, Belgium, the Netherlands, and Luxembourg - all joined talks to gauge how feasible and desirable this new airline might be. Merging several airlines, each from a sovereign country with its own legal systems into just one commonly-owned airline was not a step to take lightly.[109] Official statements made following the modestly successful first round of negotiations in June 1959 sought to open Air Union to any countries wishing to join. Air France President Max Hymans stressed that the group was not a supranational club run by Western Europe's governments.[110]

Air Union was inspired by the partnership between Norway, Sweden, and Denmark behind the Scandinavian Air Service (SAS); an internationally owned and operated airline that shared resources between all three member countries.[111] By taking advantage of economies of scale and pooling resources, substantial efficiencies could be realized. In January 1959, when preliminary Air Union talks were underway, most of the participating airlines already used similar aircraft and engines. Pooling spare parts and maintenance facilities for use by all parties

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[107] Air Union was originally called Europair. The change was made at the suggestion of Air France's president Max Hymans to keep the door "open for the adherence of other airlines, possibly from outside Europe." Competition itself was considered a problem to overcome, so the fewer competitors the better. "Progress with 'Europair'," *Flight International*, April 10, 1959, p. 504; "Europair Becomes Airunion," *Flight International*, June 5, 1959, p. 787.

[108] Sveinn Vidar Gudmundsson, "Mergers vs. Alliances: The Air France-KLM Story," *Social Science Research Network Electronic Journal* (June 2014), p. 5.

[109] All but one of the six EC member states were involved in the Air Union talks; Luxembourg's airline lacked transatlantic air capabilities. European Commission Archives, CEAB 10 no. 586, p. 22-6. Direction générale des transports, "Rapport de synthèse concernant les problems poses par la creation d'Air Union, 1958-63" p. 7-11.

[110] J.M. Ramsden, "Air Union Facts and Figures," *Flight International*, June 19, 1959, p. 823.

[111] J.M. Ramsden, "Year of the pool agreement," *The Times*, September 9, 1960, p. 12.

would cut costs.[112] If handled properly, Air Union could have given European airlines the economies of scale to match those in the American market. The EC member governments prioritized making their airlines compatible with one another through standardization of the aircraft fleets and equipment.[113]

Preliminary talks concerning the creation of Air Union focused on combining and rationalizing the operations of the participating airlines on the lucrative North Atlantic route between Europe and North America. Effective competition with the United States was the priority. Overcapacity could be trimmed immediately by limiting the number of planes operating on the North Atlantic, reducing costs and increasing profitability quickly. Early discussions also sought to pool fuel and servicing stations at all global facilities.[114] But the Air Union project was not designed to absorb all facets of civil aviation. All domestic operations were to remain the purview of the national airlines; only international operations would be affected by the pooling of resources.[115] Even then, some international routes were circumscribed due to particular national and colonial interests and were not to be pooled. France was to retain a monopoly on operations in its African colonies, while Belgium's Sabena would hold exclusive rights to fly domestic services in the Belgian Congo.[116] This latter point proved contentious as all of Sabena's international services were supposed to fall within the Air Union framework.[117]

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[112] J.M. Ramsden, "Air Europe," *Flight International*, February 27, 1959, p. 304.

[113] Stephen Dearden, "Air Transport Regulation in the European Union," *European Business Review* 94, no. 5 (1994), p. 15-6.

[114] "European Foursome," *Flight International*, May 29, 1959, p. 756.

[115] "Adenauer to Discuss European Air Unity In De Gaulle Talks," *New York Times*, August 19, 1962, p. 153.

[116] "Europair Becomes Airunion," *Flight International*, June 5, 1959, p. 787; Vanthemsche, *La Sabena*, p. 149-51.

[117] The problem with Sabena flights within Congo were that it flew what amounted to a domestic service within another country, technically violating the principles of Air Union. "Air Union by November," *Flight International*, March 11, 1960, p. 353.

The impulse to unify against American competition was the driving force behind the Air Union project but each country had distinct reasons for pursuing it. Italy and West Germany eagerly embraced the philosophy of European cooperation in the postwar era. Historian Hans-Liudger Dienel suggested that Lufthansa and Alitalia, the airlines of the two main European powers defeated in the Second World War, were open to compromises in aviation in much the same way as they were with broader European integration. They had been punished by the Allies and were prohibited from operating airlines until the 1950s. Further cooperation through direct integration in the form of Air Union, they believed, would improve their standing.[118] The spirit of compromise waned as talks dragged on and circumstances changed. Many French colonies gained independence in the early 1960s, weakening the French position on its claim for exclusive service rights there. This weakened support from the fast-growing Lufthansa and Alitalia, which no longer saw a need for permanent exclusivity. France backtracked and won a concession to be the sole operator to fly in former French possessions for just seven years.[119]

The Air Union project ran into more serious trouble soon after regular talks began. Long term international growth was the central metric for calculating the Air Union ownership share for each member airline. The estimated growth rates of the four participating airlines, which from 1959 included Air France, Lufthansa, Sabena, and Alitalia, was forecast to reach a stable level after ten to fifteen years, sometime in the early 1970s. The predicted level the basis for each airline's final, permanent share of the combined airline. These figures would in essence permanently set the ratio of ownership over and revenue-sharing within Air Union.[120] Dutch airline KLM was involved in the earliest stages of talks but its managers, dissatisfied with their

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[118] Hans-Liudger Dienel, "Seeking for Partners: Lufthansa's International Collaboration 1953-2000," *www.econ.upf.edu/ebha2004/papers/4B3.doc, last accessed: June 11, 2015, p. 2-3.*

[119] "Delay in E.E.C. Air Union talks," *The Times*, July 10, 1964, p. 13.

[120] J.M. Ramsden, "Air Union Facts and Figures," *Flight International*, June 19, 1959, p. 823.

expected share in the new airline, pulled out of talks in May 1959.[121] A more severe dispute over the shares arose less than one year later. Alitalia and Lufthansa underwent a period of growth far in excess of the forecasts soon after share ratios were set. They claimed that Air Union ought to reflect the new reality with a bigger share for each of them.[122] The original ownership ratio had been set in 1959 at 34% for Air France, 30% for Lufthansa, 26% for Alitalia, and 10% for Sabena. Those ratios assumed some growth for Alitalia and Lufthansa over the years ahead but less than the actual amount that the young German and Italian airlines would have. While Air France held 52% of the international traffic share in 1963, its ratio was dropping rapidly, though talks held that year produced an increase in the airline's share by two points to 36% at Alitalia's expense. The Air Union program reflected reality less and less. Not all of the news was bad. KLM, which left talks over a share believed to have been 28%, considered rejoining the project in 1963 at a reduced 20% share. This reflected a perception held by European airlines that Air Union was inevitable. Unfortunately for the project, Air Union's importance did not necessarily mean that the airlines saw the project as a worthy endeavour in its own right, merely that it was the only option for survival.[123]

These were only the first of several kinks in the plan to unify airlines in Europe. Airlines split between sovereign countries could only initiate negotiations for a merger: international business partnerships need government approval. In 1960, the Air Union partner airlines involved their respective governments, slowing progress. Initial legal discussions suggested that a straightforward treaty between participants would be enough to move forwards.[124] As Air France and Sabena, however, both operated under special legislation by their respective

[121] J.M. Ramsden, "Setback for Europair," *Flight International*, May 8, 1959, p. 650.
[122] "Air Union by November," *Flight International*, March 11, 1960, p. 353.
[123] "Air Union and France," *Flight International*, January 24, 1963, p. 134.
[124] A draft Air Union agreement was completed earlier that year that could have served as the basis for a final agreement if adopted. "Air Union's Inaugural Postponed," *Flight International*, January 15, 1960, p. 90.

governments, it required additional government involvement in and control over the unification process to ensure national interests were respected, slowing progress further. French President Charles de Gaulle went so far as to suspend the Air Union progress until Air France received a guarantee that it would be the sole airline with service to former French colonies in Africa, a point of pride for the airline and the country. Lufthansa was eager to proceed with the project by 1962 and pressed German Chancellor Konrad Adenauer to meet with de Gaulle in order to find a compromise.[125] De Gaulle gave the organization his blessing that November after inserting clauses enshrining government controls over the new company.[126]

The additional changes de Gaulle imposed caused consternation among the other Air Union members. Governments, previously uninvolved in Air Union's planned operations, suddenly had control over its domestic operations. Up until that point only international flights were to fall under Air Union's jurisdiction, which made this a major encroachment into economic sovereignty. Furthermore, the new plan required that Air Union should only use European-made planes. While three of the airlines used French-made Caravelles, Lufthansa had several Boeing 727s on order.[127] This complicated the regular operations of the other airlines. They did not wish to surrender that level of operational independence.[128] Soured by the new restrictions that Air Union promised, the airlines became more apprehensive of pursuing closer integration. Talks flagged thereafter and little progress was made throughout most of 1963. Moribund Air Union talks were restarted at the behest of noted Eurofederalist and former Belgian Prime Minister Paul-Henri Spaak in November 1963. Foreign ministers from each EC member met several times over the months that followed, seeking to push through an

[125] "Adenauer to Discuss European Air Unity In De Gaulle Talks," *New York Times*, August 19, 1962, p. 153.
[126] "De Gaulle Approves," *Flight International*, November 1, 1962, p. 699.
[127] "Air Union and France," *Flight International*, January 24, 1963, p. 133-4.
[128] Richard E. Mooney, "Talk of Air Union Revived in Europe," *New York Times*, April 24, 1965, p. 58.

intergovernmental agreement that might revive Air Union's flagging fortunes.[129] In spite of Spaak's efforts, meetings in 1964 and 1965 met with limited success. The countries could not come to mutual agreements over their share of international traffic quotas or method of equipment selection.[130] This disagreement proved to be the ultimate stumbling block for Air Union. In 1965, a final round of talks intended to resolve the nature of government control over the airline and divide national shares in it failed and the project was abandoned.[131] No government was willing to surrender sovereign control of their airline without severe caveats, and few could get past the perpetual problem of assigning a permanent share of ownership.[132]

Since Air Union was explicitly designed in reaction to American competition, the Federal Aviation Agency (FAA)[133] assembled a study to determine what America ought to expect should Air Union become a reality. Existing fifth freedom traffic was found to favour European airlines on flights through the United States more than American ones through Europe (a major reversal of the situation in the 1940s and 1950s where America's airlines carried Europeans widely throughout Europe). This made it unlikely that Air Union member states would seek to create new cabotage rules. All Air Union members were also deemed likely to continue purchasing American-made planes except Air France where pro-French policies made American aircraft sales difficult.[134] The new airline would also have been competitive against the American carriers, as the Europeans hoped. In 1963, Air Union countries carried a combined 571,243

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[129] European Commission Archives, BAC 144/1992 no. 517, p. 29. Commission of the European Economic Community, "Note sur l'état actuel des negotiations relatives à AIR UNION," M. Schaus, February 12, 1965, p. 2. *Archives Historiques de la Commission* (1965), BAC 144/1992 no. 517, p. 29.

[130] Edward T. O'Toole, "Europe Air Union," *New York Times*, June 28, 1964, p. XXI

[131] European Commission Archives, BAC 3/1978 no. 1479, p. 274-5. Commission of the European Community, "Actions à entreprendre dans les domaines de la navigation maritime et de la navigation aérienne (Projet de Communication de la Commission au Conseil)", Communication de M. Bodson, 28 May, 1970, p. 41-6. *Archives Historiques de la Commission* (1961-70), BAC 3/1978 no. 1479, p. 274-5.

[132] Vanthemsche, *La Sabena*, p. 147-9.

[133] The Federal Aviation Agency was renamed to the Federal Aviation Administration in 1966.

[134] NARA RG 237, Box 1. Federal Aviation Agency, Office of International Aviation Affairs, "Air Union: A Staff Study," October 1964, p. 2-3.

transatlantic passengers against 898,158 for both of the main American transatlantic airlines.[135] Although Air Union failed, it proved that a united European airline represented a threat to the big American carriers. Pan Am and TWA actually considered a merger with one another in 1962 to remain competitive in light of the potential new competition.[136]

Conclusion

If governments turned the North Atlantic into an aviation highway during the Second World War, then their postwar efforts expanded it into a multilane superhighway. It was cobbled together from a complex and evolving series of international agreements and compromises yet efficiently managed to carry millions of passengers daily. That feat is a tribute to the importance of the North Atlantic air corridor both to the countries supporting it as well as to civil aviation as a whole. Certainly nowhere else in the world saw such diplomatic effort spent to build and maintain air travel, nor did those other routes impact the shape of flight so significantly. The ultimately abandoned Air Union project could only have been conceived to support transatlantic flight for nowhere else in the aviation sphere represented such a vital interest to so many countries. Yet in spite of the barriers to travel that were dropped as the route matured, protectionist measures remained. Subsidies, often subtle, survived as governments sought to bolster their flag carriers against competition. But overall, the multitude of state actors cooperated and worked towards their mutual interest in building and maintaining the busiest international air route in the world.

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[135] The breakdown included KLM, which had left the initial round of talks in 1959 and returned in 1963. In 1963, each airline carried the following number of transatlantic passengers: Air France 163,264; Alitalia 134,264; Lufthansa 147,662; KLM 63,558; Sabena 62,687. The American carriers were on a similar scale to Air Union even when taken separately, however: Pan Am 539,015; TWA 359,143. NARA RG 237, Box 1. Federal Aviation Agency, Office of International Aviation Affairs, "Air Union: A Staff Study," October 1964, p. 22.

[136] Joseph Carter, "Air Pool in Europe is Problem in U.S.," *New York Times*, July 7, 1962, p. 42.

Chapter Ten: Tourism, Airfares, and Charters

Air travel in the interwar years was largely the preserve of the wealthy, as airfares were well outside the reach of the average European or North American. Travel across the North Atlantic was limited to ships until 1939, and the first transatlantic flights that year cost more than any but a few could afford. But the postwar era marked a radical shift in travel patterns. Millions of middle class people sought leisure trips abroad, and the airlines were eager to tap into the market they represented. The airlines realized that they had to expand rapidly to remain competitive on the crowded North Atlantic, site of the most lucrative ocean liner business, and to offer bigger, faster planes to carry these passengers. But they also had to operate these services profitably, a serious problem for European airlines that lacked the economies of scale enjoyed by their American counterparts. By the 1950s, the European airlines were willing to concede to American pressure and lower airfares, opening the market to the masses. Tourists flew in ever greater numbers as prices dropped, and even more so as non-scheduled charter flights became a viable option. Charters in particular reshaped the transatlantic air market, forcing competition between the scheduled carriers to new heights and flooding the North Atlantic with seat capacity. The ultimate beneficiaries of this were the passengers who could finally expect to buy a ticket at a low price and cross the North Atlantic with ease.

Transatlantic Tourism Shifts to the Air

Transatlantic tourism was not an option for most of the general public in the postwar years. Europeans generally could not afford expensive leisure travel at all. North Americans, however, had avoided the worst hardships and had considerable disposable wealth and comprised the vast majority of ocean-crossing tourists. As aircraft technology improved in the

1950s, flights became faster and more affordable for the average person. But in the late 1940s, air travel was the sole preserve of the wealthy or those traveling for business. Reduced rate "excursion" tickets offered in 1948 were still far costlier than typical tourists could afford, with most being bought by business travelers. Tourists by and large continued to travel by sea at that time. Air traffic volumes therefore did not grow because of the new rate: existing passengers simply began to pay the lower price.[1] Actual prices offered by BOAC at the excursion rate between London and New York in 1948 were £116 ($467[2]) compared to the normal fare of £156, a 25% reduction.[3] IATA's Director General Sir William P. Hildred remarked on the improvement during IATA's 1951 general meeting. He pointed out that, in 1950, an average American factory worker could purchase a transatlantic ticket after spending the equivalent of 260 hours of salary as opposed to the 540 hours it would have taken that same person in 1947.[4] Hildred held this up as an example of how air travel was within reach of the average man while failing to note that 260 hours of labour equalled 7.5 weeks of 8 hour working days; far in excess of what a working man would consider affordable. This was certainly an improvement, but not one that mattered to middle income families.

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[1] British Airways Heritage Centre AW/1/2882, "Transatlantic Excursion Fares, Fares & Rates, 1948-49." BOAC memo from W. Bray, Sales Controller, to Manager, U.K. Region, "Atlantic Excursion Rates," November 22, 1948.

[2] This calculation from British pounds into American dollars was made using historical exchange rate data for 1948 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[3] British Airways Heritage Centre AW/1/2882, "Transatlantic Excursion Fares, Fares & Rates, 1948-49." BOAC memo from R.W. Cole to M.Eur. Area W.Div. Airways Terminal, "Atlantic Excursion Fares," November 24, 1948.

[4] Hildred also noted that costs for the basic resources and services needed for flight were rising during this time but were more than offset by greater efficiencies realized by the airlines. Ticket prices could therefore go down even as the prices for all the goods and services behind commercial flight increased. Joan H. Stacy, "International Air Transport Association," *Journal of Air Law and Commerce* 18, no. 4 (Autumn 1951), p. 438. A major source of these efficiencies came from improvements in the planes being flown. From the 1930s to the 1950s, commercial planes were entering the market boasting ever-better operating costs thanks to larger cabins, faster speeds, and more fuel efficient engines. This period of constant improvement ironically came at a time of few innovations in aviation technology but rather one where the technology and design behind the planes was refined extensively. R. Miller and D. Sawers, *The Technical Development of Modern Aviation* (New York: Praeger Publishers, Inc., 1970), p. 128.

Appealing to the general public was not possible for airlines in the latter 1940s. A round-trip flight between New York and London was $630 in 1948, whereas Americans vacationing in London on a typical two-week trip spent $400-600 on all expenses other than transportation. One option to attract these frugal travelers was to offer an "inclusive tour" price. A reduced airfare would be couched in a single price for an all-inclusive package including accommodation and activities upon arrival. These packages were popular among ship-based travelers. But airfares were kept artificially high through IATA rate regulations. Cutting the rates in this way risked calling attention to the possibility of permanently reducing airfares which European airlines saw as anathema. The airlines simply saw no viable course of action for the time being; they needed to await more profitable times before they attempted to cut prices.[5]

In 1951, Pan Am produced a study that argued for reduced "tourist" transatlantic airfares to cater to Americans who could afford perhaps $1,000 for a vacation but did not have enough time to sail to Europe. Assuming a $405 round trip ticket, as Pan Am sought, these tourists could fly to Europe by the thousands. An estimated 940,800 American families had the spending power and inclination to spend at least $1,000 on such a vacation. If they had only two weeks of vacation per year, as many Americans did, air travel suddenly opened up an entirely novel option for these people.[6] According to a BOAC memo in 1951, about 95% of future tourist class passengers were expected to be people who would not otherwise have taken a plane for their transatlantic voyage.[7] In 1953, American political scientist Robert Strausz-Hupé echoed the

[5] British Airways Heritage Centre AW/1/5896, "Tourist Traffic, Passenger, 1946-53." BOAC memo from H.A. Viles, U.K. Sales Superintendent, to A.S.C., Stratton House, "Atlantic Tourist Traffic," April 22, 1948.

[6] British Airways Heritage Centre AW/1/6193 Part 1, "Atlantic Service – Tourist Class, Services, 1951". Pan American Airways, "Proposed Transatlantic Fare and Service Policy 1951-1952," May 4, 1951, p. 4-5.

[7] Of the remaining 5% of tourist class passengers, an even 2.5% was expected to be diverted from sea travel while the other 2.5% was predicted to be diverted from higher class air service. BOAC's sales department recommended that the tourist class have entire planes to itself rather than splitting a cabin between two classes. The older DC-4 planes were put forward for this purpose. British Airways Heritage Centre AW/1/6193 Part 1, "Atlantic

unprecedented nature of this form of leisure for the common man: "[a]ir travel allows a time budget for trips that no other means of transportation can rival. The average traveler with a month's vacation is no longer restricted to travel in his local and national surroundings."[8]

Airlines catered to the desires of tourists to ever greater degrees throughout the 1950s and 1960s. Prices declined and new routes opened constantly between the cities of Europe and North America. But with American tourists forming the largest bloc of travelers, it behoved airlines to find new ways of tapping that particular market. One particular avenue was exploited by Iceland's national carrier. Americans were not particular about where they flew to when they visited Europe. They were quite willing to fly to an airport a (relatively) short distance from their final destination if doing so would save them money, seeing the continent as a "region" that could be easily explored after landing at an arrival "point".[9] Loftleidir[10] (Icelandic Airlines) took advantage of this for as a non-IATA airline it was not constrained by IATA's pricing regime. Americans could therefore purchase very cheap tickets from Loftleidir to travel from New York to Luxembourg with a stopover in Reykjavik and take cheap land transportation onward.

Service – Tourist Class, Services, 1951". BOAC memo from R.M. Barton, Sales Planning Supt. West, to G.M.I.A., "North Atlantic Tourist Policy," July 10, 1951.

[8] This did not guarantee that any working class family could afford a transatlantic vacation for the foreseeable future. The passage continued by noting: "Even the low tourist rates are still high enough to cause the average member of the middle- and lower-middle-income groups to think twice before venturing on a two weeks' spree to Paris." The article contained the prophetic following passage as well on the subject of future air tourism potential: "If past trends of air-travel economics are valid indications of future developments, then it is a foregone conclusion that, ten to twenty years hence, an annual vacation abroad will be well within the range of the average American worker's pocketbook and time budget." Robert Strausz-Hupé, "Aviation and International Co-Operation," *Annals of the American Academy of Political and Social Science* 299, Air Power and National Security (May 1955), p. 139-40.

[9] Land transportation around Europe was comparatively cheap compared to the extra cost of flying directly to the final destination on an IATA carrier. It was also quite easy for Americans to rent a car or take a train from Luxembourg onwards to several other countries within hours, including to several major cities. Americans often drove for hours on vacations within their home country; the prospect of visiting several countries over the same timeframe would have represented a tantalizing prospect. For an American looking to cut down on the cost of a vacation while still seeing the world, this would be an easy sale. John A. Hannigan, "Unfriendly Skies: The Decline of the World Aviation Cartel." *The Pacific Sociological Review* 25, no. 1 (Jan 1982), p. 117-8.

[10] Loftleiðir is the proper spelling of the airline's name in Icelandic, however in most other (English) sources the name is anglicised to the similar-looking Loftleidir. For consistency's sake, this latter spelling will be used in reference to the airline.

Luxembourg was not an IATA member and so had no concerns with permitting Loftleidir to fly there. This was a very profitable loophole for circumventing the high prices other airlines imposed to reap huge passenger volumes.[11] Luxembourg benefitted from this arrangement quite handsomely too. Americans, who had not often ventured out of their way to see the small country, soon became one of its largest sources of international tourists.[12]

The value that bargain-seeking American tourists could bring to the relatively small Icelandic airline was substantial if tapped. Despite this, the Icelandic Aviation Board (IAB) did not grant Loftleidir permission to lower its prices below IATA rates immediately. The airline already offered flights from Iceland to both Europe and North America. This spurred tourist development in Iceland itself but, acting as a bridge between the two continents, Loftleidir saw the prospect of tapping into the lucrative Europe-North America market provided it could make tourists see the stopover in Iceland as cheap enough to be worthwhile.[13] Loftleidir was not a member of IATA so it was not bound to its rate-setting mechanism. But there were other considerations that the IAB had to take into account. In 1962, when the airline first submitted its request to cut rates by forty percent on transatlantic summer services, the IAB refused for fear of upsetting the Germans. Both Loftleidir and Flugfelag, Iceland's two airlines, served Hamburg in West Germany, and the Germans "followed IATA decisions very strictly," according to IAB

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[11] The idea of Europe as a "region" is critical for this strategy. If American tourists saw Europe as a series of isolated "points" that were hard to travel between, for whatever reason, there would be little value in flying to a single smallish country on another continent. This was not the case: although each country around Luxembourg was completely sovereign, Western Europe was a relatively united "region" in that it was not difficult to cross its borders and the cost of traveling those distances was low. Hannigan, "Unfriendly Skies," p. 117-8.

[12] Many Americans visiting Luxembourg by flying Icelandic also traveled far afield since a single day's drive put roughly half of Western Europe in reach from there, but they would still be spending some of their money in Luxembourg at the beginning and end of their trips if only to eat or rent a car. Those who stayed in Luxembourg longer still were a significant bonus for the previously overlooked country. By the 1980s, Luxembourg's government actively supported Icelandic's activities in recognition of the fact that about half of all hotel rooms occupied by Americans staying in Luxembourg were sold through Icelandic. Richard V. Smith, "Tourism's Role in the Economy and Landscape of Luxembourg," *Tourism Management* 13, no. 4 (December 1992), p. 423-6.

[13], Gunnar Thór Jóhannesson, Edward Hákon Huijbens, and Richard Sharpley. "Icelandic Tourism: Past Directions – Future Challenges," *Tourism Geographies* 12, no. 2 (June 2010), p. 287.

chief Agnar Kofoed-Hansen. It did not behove the government agency to approve one deal, no matter how lucrative it might appear, if it jeopardized existing services elsewhere.[14] The IAB determined that the move to cut rates was in the country's interest and approved the rate drop. Within three years Loftleidir had carved out three percent of the transatlantic passenger market, a major coup for the small airline. Its low-cost business model proved so successful that SAS began to mimic the Icelandic program.[15] The decision, however, meant that Loftleidir had to be creative about its operations. At the rates it was offering, few countries would permit a transatlantic flight that circumvented IATA regulations that their own airlines followed. As such, separate tickets were printed for each flight between Europe and Iceland and between Iceland and North America.[16]

Unlike Loftleidir, most IATA member airlines had route networks that included quieter, loss-incurring runs that were effectively subsidized by busier services like the North Atlantic. Robert Britton, a former travel agent, believed that Loftleidir avoided this shortcoming since it mainly flew the transatlantic service, passing the savings on to the passengers.[17] But Britton also believed that there was value lost for tourists who accepted the cut-rate tickets. They had to fly

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[14] The value of the proposed cuts in airfare was not listed in dollars but would have been from 4814 to 2882 Icelandic Kronur for one way travel and from 8665 to 5188 Icelandic Kronur round-trip. At a rate of 43 Kronur to the dollar in 1962, this equalled $112 down to $67 for one way travel and $202 down to $121 for round-trips. This appears to be a typo: previously listed summer rates for one way flights in the summer were priced in dollars at $358.20. Calculating the actual value based on the given figure in dollars suggests that the actual amounts would have been $358.20 down to $214.92 one way and $644.75 down to $386.85 round-trip.This was considerably cheaper than competing airlines were offering, and well below what IATA would permit. NARA RG 237, Box 5, Folder "IATA Rates," July 1, 1959-May 15, 1963. Memo from the American Embassy in Reykjavik to the Department of State, "Government Denies Loftleidir Request to Cut Fares to Luxembourg," January 12, 1962.

[15] "Tiny Icelandic Airline Nation's No. 1 Company," *New York Times*, January 15, 1965, p. 62.

[16] The United States government, although aware of the dubious rate cutting decision, felt compelled to allow Loftleidir to continue operations into America due to the strategic value of the American air base in Keflavik. It was unwilling to risk losing access to the strategically useful base. M.L.J. Dierikx, *Clipping the Clouds: How Air Travel Changed the World*. (London: Praeger, 2006), p. 90.

[17] Britton also noted that IATA's detractors sometimes called the organization a cartel for keeping prices higher than market forces alone would dictate. He offered a nuanced rejection of this interpretation since it ignored the crucial role that robust route networks played in keeping air travel relatively cheap for all distances, and the place that IATA had in maintaining such a wide network. Robert A. Britton, "Fare Deals from Scheduled Airlines: A Primer for Migratory Geographers," *Journal of Geography* 77, no. 4, (April 1978), p. 138.

direct into only a handful of destinations while he believed that extended stopovers offered tourists opportunities to take in the sights in a wider range of destinations at little extra cost.[18] Britton's views on how a tourist might wish to travel could well have been limited to a minority of prospective air passengers, but they offer some justification for the more onerous system of fares and regulations of the IATA system.

American tourists were the main driving force behind Loftleidir's success. They were more likely to travel the North Atlantic by air than Europeans,[19] and the United States was the most populous country with an airline serving that region. Americans' higher disposable incomes and inclination to vacation abroad could not be matched by Europe while the continent was recovering from the devastation of the Second World War. By the latter 1960s, however, European countries were catching up quickly to the United States in terms of quality of life and income levels.[20] Reflecting this rise, an estimated 500,000 Britons flew to the United States in 1970, while France, West Germany, and the Scandinavian countries likewise produced more America-bound tourists. Many Europeans specifically turned their attention to the transatlantic air market to save money on their vacations. Despite the cost of the flights, it was possible for a European traveler to expect cheaper accommodation in Miami than in the French Riviera, making a North American voyage an affordable vacation option.[21]

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[18] Full-price tickets provided additional protections in case of changes to the buyer needed to change their travel date. Discount tickets were often non-refundable and carried fixed dates. *Ibid*. p. 139.

[19] More Americans traveled the North Atlantic by air in every year of the 1950s and 1960s than Europeans, averaging 60-65% of all people to fly across the ocean in a given year during most of that range (peaking at 71.6% in 1955). Even when sea travel was included, Americans outnumbered European travelers with an average of 61.7% of all people who made the crossing over that era. Nawal K. Taneja, *A Model for Forecasting Future Air Travel Demand on the North Atlantic* (Cambridge, MA: Massachusetts Institute of Technology, Flight Transportation Laboratory, 1971), p. 16-9.

[20] Both Americans and Europeans were becoming wealthier during that era, with more people entering the $6,000 an up income threshold that appeared to correlate strongly with an ability to afford a vacation involving air travel (for 1962 dollar values). *Ibid*., p. 21-4.

[21] "A Look At The North Atlantic In The '70s," *Air Transport World*, May 1967, p. 76.

By the 1960s, hordes of average citizens crossed the Atlantic as tourists. This ironically came after tourist class fares were phased out in 1960 in favour of the even cheaper economy class ticket prices.[22] The 1960s marked the emergence of international tourism as a major sector of the global economy, with commercial aviation at the forefront. Tourism (domestic and foreign) grew by 15% per year in wealthy countries, accounting for $40 billion by 1966. Roughly 30% of that figure, about $12 billion, was spent on transportation alone. International travel represented a slightly more modest $9 billion, or three quarters of the total travel spending.[23] International travel grew rapidly and reached a global total (including developing countries) of $20 billion by 1971.[24] Several smaller countries, mainly in Europe, counted tourism as a major component of their economy by the 1970s.[25] The United Nations recommended that measures to boost tourism should be encouraged for this reason, pointing in particular to the 27% increase in passenger traffic following IATA's 20% transatlantic rate cut in 1964.[26] The scale of tourism had grown to be such a significant part of the global economy that Christer Jönsson described it, including air travel, as "the largest single world trade item after

[22] The abolition of tourist fares took effect on July 1, 1960, with salespeople given advance notice not to sell at that rate four months in advance. British Airways Heritage Centre RS/1/10944 "Part 15: Atlantic Services, Services, 1960". BOAC memo from S.C. Kelland, General Tariffs Manager, to the Planning Manager, Western Routes, "I.A.T.A. Conference – Paris," February 29, 1960.

[23] NARA RG 237, Box 8, Folder "UN Conference on International Travel and Tourism." United Nations Economic and Social Council, "International Travel and Tourism, Report to the Secretary-General," February 1, 1966.

[24] Jerrold Scoutt, Jr. and Frank J. Costello, "Charters, the New Mode: Setting a New Course for International Air Transportation," *Journal of Air Law and Commerce* 39, no. 1 (1973), p. 21.

[25] Indeed, their small size could be attractive for North American tourists seeking the novelty of crossing several national boundaries in succession. Borders can be attractions in their own right. European borders were not merely close together but also offered North American travelers unique opportunities to sample adjacent cultures in short distance from one another. For more on this, see: Dallen J. Timothy, *Tourism and Political Boundaries* (New York: Routledge, 2001).

[26] NARA RG 237, Box 8, Folder "UN Conference on International Travel and Tourism." United Nations Economic and Social Council, "International Travel and Tourism, Report to the Secretary-General," February 1, 1966.

petroleum".[27] Even larger countries such as Spain owed much to tourist spending: international visitors purchased three-quarters of all Spain's merchandise exports in 1969.[28]

The airlines were even more dependent on tourism for profitability. Airlines that flew the North Atlantic were no exception. The share of people flying across the ocean for business purposes declined from close to 100% in the 1940s to a relatively paltry 18% of American and 27% of British air passengers by 1973; tourists made up the remainder.[29] But while tourist ticket fees supported the airlines, they spent their money in a far less consistent way than business travelers. As businesspeople bought their tickets with little regard for the cost since their employers paid the bill, they traveled in numbers that remained relatively constant all year. But vacationers were sensitive to seasonal price drops since they were flexible with the timing of their trips. Tourists often postponed or cancelled trips if the costs increased. Businesspeople represented a comparatively small core of customers so airlines became sensitive to the needs of the tourist market.[30]

In many senses, airlines transformed completely between the days following the end of the Second World War and the early 1970s. They had new fleets boasting fast jets with large cabins, new routes extending to dozens of destinations on both sides of the Atlantic, and, most importantly, their customer base grew from thousands to millions. With the growing disposable wealth of the average person in both North America and Western Europe, airlines had a ready market to tap into. Coupled with the rapidly declining cost of carrying passengers thanks to the

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[27] Christer Jönsson, "Sphere of Flying: The Politics of International Aviation," *International Organization* 35, no. 2 (Spring 1981), p. 275-6.

[28] Scoutt and Costello, "Charters, the New Mode," p. 21.

[29] John Mutti and Yoshitaka Murai, "Airline Travel on the North Atlantic: Is Profitability Possible?" *Journal of Transport Economics and Policy* 11, no. 1 (January 1977), p. 47.

[30] Ticket prices varied seasonally as well as day-to-day. Airlines charged higher rates during days where higher traffic volumes were expected or lower rates when passengers were predictably scarce. This smoothed out demand by spreading it out over the year (and the week), easing the pressure during busy travel times and filling seats that would otherwise be empty. *Ibid*.

new planes, it was possible for even marginal transatlantic carriers to offer discounted rates and turn a profit. Tourism went hand-in-hand with air travel.

Regulations and Fares in the Postwar Era

The passenger market became the driver of transatlantic (and international) flight, but it was not the first or indeed only influence over aviation. Governments were instrumental to the construction of the North Atlantic civil air system. Their resources made it possible for airlines to fly safely across the ocean. Transatlantic air travel in the interwar era was defined by experimental flights and logistical studies backed by government resources, while the war years saw state actors build infrastructure and fund technological innovation. The postwar years, in turn, saw the growth of a broad commercial market, with governmental regulation and management at the forefront. In this latter phase, countries around the North Atlantic region struck or rewrote bilateral air agreements, haggled over the minutia of flight frequencies, and fought constantly over airfares. With commercial air service between North America and Europe primed to boom in the postwar years, no country intended to be cut out of what it considered to be its fair share of this prestigious, modern market.

America's commercial aviation sector was in the strongest position both before and during the war. This did not make American aviation officials complacent as they looked to the future. In 1936, American Director of Air Commerce Eugene L. Vidal made the case for his country to assert itself quickly and forcefully, saying "[w]e don't want to see happen to aviation what happened to shipping."[31] He referred to the dominance of foreign shipping lines that served American ports. It was therefore essential for America to push for at least 50% of the United States-Europe air travel market, a share that it might retain indefinitely. Vidal correctly foresaw

[31] "Vidal Promises Two Atlantic Flights a Week," *New York Herald Tribune*, March 10, 1936, p. 16.

that the European countries would compete over the other 50%, undercutting their positions while making America's relative position stronger.[32] During the war, airlines had been pulled into the war effort to supplement air force fleets and their personnel, and so paying passengers were unable to fly across the ocean. But as the Second World War neared its end, Pan Am planned for the commercial development of that air corridor in earnest. Despite running its commercial transatlantic service for the general public for two years, when America entered the war and the airline joined the war effort, the airline carried just dozens of passengers per week. With the war over, Pan Am estimated that there was a market for over one million transatlantic air passengers in the first postwar year. The airline hoped that it would carry over half of that volume, perhaps 5,000 paying customers per week in each direction, especially if it could cut ticket prices.[33]

The big prize for transatlantic air service was the New York-London route. BOAC consistently put New York at the centre of its American routes. When it considered flying into Boston in 1948, the city was only looked at as a stopping point along the New York-London route rather than a terminus in its own right. Even Aer Lingus, the Irish national airline, preferred to link its first transatlantic route to the larger American city over Boston in spite of Boston's substantial Irish population since "Boston never could be more than a supplement to New York". To both airlines, the high average wealth in New York and its sheer size (by far the

[32] *Ibid*. It is worth noting that the United States had just two airlines (Pan Am and TWA) operating into Europe during most of the 1940s-60s. This limited competition between America's airlines while putting stress on European airlines, each of which was slicing up a pie of roughly equal size. While European airlines would complain that they competed with massive American airlines that flew across Europe, they were often limited to flying only to a few destinations in the United States and often could carry American passengers just to their own country. For a more detailed analysis, see the section below on fifth freedom traffic.

[33] This initial estimate may have relied on the optimistic assumption that Pan Am would be allowed to reduce its New York-London fare. Prior to America's entry into the war the transatlantic rate was $570; Pan Am hoped to cut this to as low as $167 in the immediate future. "USA: Trafic aérien international, projets," *Interavia* no. 958, January 25, 1945, p. 9-10.

biggest American city) made it the clear choice.[34] This is not to say that a route to Boston was unlikely to be profitable. In 1950, BOAC estimated annual revenue on a London-Boston route of £108,000 ($302,400) with one weekly flight (twice weekly during the summer) against costs of about £18,815 ($52,682).[35] Air service between Europe and Boston, or any other North American city, was simply a smaller draw than New York.[36]

By the late 1940s, dozens of flights criss-crossed the Atlantic Ocean every week and the demand for air travel climbed steadily. There were enough planes available to offer even more services if enough passengers could be found to fill the seats. Pan Am vocally supported cutting fares to expand the passenger pool. But before Pan Am could drop airfares it ran afoul of protectionist measures. Most European governments protected their domestic carriers, many of which were rebuilding their fleets, against the highly competitive American airline. Pan Am began testing the waters in late 1945, as noted in Chapter Three, when it sought to cut its New York-London price to $275.[37] Pan Am's size and ambitions provoked British anxiety. In the

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[34] An interesting interpretation of the literal and figurative value of Boston is seen in this quote: "Boston is undoubtedly the most Irish city in the world outside of Ireland but a higher percentage of its Irish population are in a lower income group than is the case in New York where a higher percentage are living in good conditions. New York, therefore, is a far better traffic generating point for Irish clients than Boston." British Airways Heritage Centre, AW/1/6170, Part 10 "Atlantic Services, Services, 1948." BOAC memo from I.N. MacA. Campbell to the U.K. Sales Supt., "Services – Eire to Boston," December 5, 1949.

[35] Expenses for each flight were assumed to be about £70 for the operational costs and another £230 per flight for the Boston station costs. British Airways Heritage Centre, AW/1/6172, Part 12 "Atlantic Services, Services, July-Dec 1950." BOAC memo from Commercial Planning Manager J.J. Tyrrell to General Manager Commercial, "Calls at Boston," July 28, 1950; the calculations from British pounds into American dollars were made using historical exchange rate data for 1950 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[36] There is an important caveat to the importance of a heavily-used route. Passengers are often routed through a common transatlantic departure point to maximize the load factor on each flight. This reduces the number of flights needed to carry all passengers to their final destinations. It is far easier to gather two or three hundred people in one city for a single transatlantic flight than to fly dozens of planes carrying ten or twenty people each. This can exaggerate one city's importance with respect to traffic data: it may have simply been the most convenient hub to route those flights through. Some records for transatlantic service do not record the entire route each passenger travels, merely the total number on a single route. While this does not diminish the importance of hub cities it bears noting that cities such as New York enjoy a far larger volume of transatlantic passengers due to this practice. Mahlon R. Straszheim, "Airline Demand Functions in the North Atlantic and Their Pricing Implications," *Journal of Transport Economics and Policy* 12, no. 2 (May 1978), p. 180-1.

[37] "USA/Grande-Bretagne/France: Guerre de tarifs" *Interavia* no. 1090, December 11, 1945, p. 8.

eyes of the British Board of Trade, Pan Am and America's international airlines in general "never lost sight of their goal of dominating world air transport in the same way as [Britain] for many years dominated the seas".[38] Without fare controls to level the playing field, American carriers threatened to wildly outcompete their European counterparts on the international market.

Even as transatlantic air travel boomed, important changes still remained before ocean-spanning flights could be seen as routine by the general public. Into the 1950s, the middle classes retained the view that any travel by air was beyond their means. Flight was widely seen as the preserve of the wealthy or the stuff of science fiction.[39] The North Atlantic remained the preserve of more affordable ocean liners. Several articles in the aviation trade magazine *Flight International* proposed that IATA ought to promote plane travel as a regular method of rapid transportation; that it was fast and (without underselling the experience) dull. To that end, BOAC tried to draw out the large but as of then untapped market of less affluent travelers by introducing cheaper transatlantic "tourist" class fares in 1951.[40] Ironically, BOAC had opposed the idea of cut-rate tourist fares the previous year. Each seat filled with a passenger that paid less than the standard fare represented a loss of revenue. The immediate postwar years were hard on the airline as it had difficulty generating revenue on most of its services up to 1950. Only by 1950, with BOAC operating modestly profitably, albeit still with government subsidies, did the airline consider a new fare bracket acceptable.[41] The other European airlines similarly accepted

[38] The essence of this quote is a telling interpretation of British fears towards American aviation dominance. The United Kingdom had been an unrivalled maritime power for centuries, militarily and commercially, and it bristled at the idea of another country stepping to the forefront of a similar space such as it had done. TNA BT 245/871, "UK/USA Air Services Agreements Other Matters: Designation of Seaboard and Western for all cargo flights across the Atlantic, 1955-9". January 16, 1956, minute 33.

[39] Dawna L. Rhoades, *Evolution of International Aviation* (Burlington: Ashgate Publishing Company, 2008), p. 25.

[40] Frank Jackson, "The New Air Age," p. 177-8.

[41] BOAC's commercial manager claimed that it was a bad idea to offer reduced rates until BOAC was in a stronger competitive position, with a network of routes served by planes equal to the quality of those used by America's airlines. British Airways Heritage Centre, AW/1/6172, Part 12 "Atlantic Services, Services, July-Dec

the new ticket price as long as they were not unreasonably cheap. The cut-rate tickets came with reduced comforts. These included reduced baggage capacity, a basic meal service (although $4 would buy anything on the full-airfare menu),[42] no bar service, a fee for ground transportation between city centres and airports,[43] higher-density seating (seat pitch was reduced from 40 inches to 34 inches, still more than today's 30-32 inch economy seat pitch),[44] a higher passenger-to-crew ratio (the same number of crew served a bigger passenger contingent yet still offered a better ratio that economy service today), and other changes intended to realize cost savings while increasing load factors.[45]

Once the transatlantic operators agreed to offer tourist fares, it was necessary for them to find a rate acceptable to all parties. All of the affected airlines were party to IATA's common price regulations: no airline could fly the route at a fare it alone decided so that no one would push any other airline out of the market. The price had to meet with unanimous approval. Pan Am championed a lower figure than other airlines found palatable: $225 for round-trip summer travel.[46] European carriers wanted a higher figure. BOAC was willing to live with a price of about $275. BOAC assumed that tourist rates of $275 would yield profitability assuming a 62%

1950." BOAC memo from J.W.S. Brancker, General Manager Commercial, to Members of Management Panel, "North Atlantic Policy 1950/56," December 15, 1950. As discussed in Chapter One, European carriers were subsidized by their governments to boost competitiveness. This did not curtail the drive for profitability since the airlines were pushed both internally and from their governments to operate without the need for public funds.

[42] Paul J.C. Friedlander, "Report from a Flying Tourist," *New York Times*, May 11, 1952, p. X17.

[43] Baggage allowance was 20 kilograms as opposed to the 30 kg allowed for first class tickets. Stacy, "International Air Transport Association," p. 439.

[44] Seat pitch is the airline industry term for the distance between the back of a passenger's seat and the seat in front. David T. Courtwright, *Sky As Frontier: Adventure, Aviation, and Empire* (College Station, TX: Texas A&M University Press, 2005), p. 130.

[45] The memo and attached note here stated that these were critical elements of tourist rate tickets, partly to increase the capacity on flights at the reduced price (offsetting lost revenue) and partly to differentiate the quality of the two ticket classes. The full-price tickets had to appear to offer premium service or else they would not attract buyers. British Airways Heritage Centre AW/1/6193, Part 1, "Atlantic Service – Tourist Class, Services, 1951". BOAC memo from J.W.S. Brancker, General Manager International Affairs, to Members of the Management Panel, February 8, 1951.

[46] Winston Bray, *The History of BOAC, 1939-1974* (Camberley, Surrey: The Wessex Press, unpublished), p.193.

load factor, a reasonable figure at that time.[47] Pan Am agreed to a compromise amount of $270 beginning on May 1, 1952 after pressure from the other airlines.[48]

Reduced fares dovetailed with a broader policy between the United States and its European partners to bolster tourist travel in the latter 1940s and early 1950s. Sea and air travel were subsidized to encourage Americans to travel to Europe. In France, tourist facilities were given preferential access to rationed goods to bolster the fledgling tourist sector.[49] The introduction of tourist fares in 1952 immediately proved highly popular, producing a surge in transatlantic passenger numbers.[50] In its first full year from May 1, 1952, 13.5% of all BOAC passengers traveled on tourist prices. This figure grew to 53.3% for the year beginning on May 1, 1955; a trend reflected industry-wide.[51] BOAC at one point even ran out of tourist class seats on its London-Montreal route during the summer of 1954, while TCA, KLM, and Air France ran short of space.[52] Tourist class ticket sales were not evenly balanced between all airlines: BOAC flew fewer tourist class passengers to the United States than America's airlines flew to Britain. The American airlines were able to take better advantage of tourist prices thanks in part to the larger American passenger market that wished to fly on one of their national carriers. While

[47] BOAC had to complete the rearrangement of cabin seating on its Constellations (at a cost of £350,000) that would have the planes accommodate up to 68 passengers but was otherwise ready for the tourist service. *Ibid*.

[48] Pan Am jumped the gun during the rollout of tourist ticket prices. At one point it advertised transatlantic tourist rates of $250 without actually receiving IATA permission and before it could actually operate such flights. It is not clear whether this price listing was a tactic to test public interest, as a negotiating tactic to confront other IATA members with a fait accompli, or simply an error by Pan Am's marketing department. *Ibid*.

[49] This policy was partially in response to settling the imbalance of payments between France and the United States. By encouraging Americans to visit France and spend their dollars there, France gained hard currency to repay American loans. Pan Am played a key part in this, promoting travel to European recipients of Marshall Plan funding, and pushing hard for reduced tourist rates. The effect on tourist travel was positive: in 1950, 264,000 Americans visited France, climbing to 792,000 in 1960, and 1.35 million in 1970. Christopher Endy, *Cold War Holidays: American Tourism in France* (Chapel Hill, NC: University of North Carolina Press, 2004), p. 4-8; 42-54.

[50] W.M. Wallace, "The Influence of Price on the North Atlantic Airline Market," *Journal of Air Law and Commerce* 30, no. 4 (1964), p. 369.

[51] Bray, *The History of BOAC*, p. 198.

[52] BOAC's Canadian Sales Manager felt that the only solution to the bottleneck at Montreal was to route passengers through New York, where some tourist class capacity remained unfilled. To McDougall, the only alternative was to hope that "a Strat[ocruiser] can be produced out of thin air" to carry the extra traffic. British Airways Heritage Centre, RS/1/10945, "Atlantic Services – Tourist Class, Services, 1954-1958." Memo from G.S. McDougall, BOAC Sales Manager, Canada, "Tourist Services – Montreal/London," May 31, 1954.

BOAC flew 43% of the tourist class flights[53] in 1953-4, it carried just 30% of the passenger traffic. These figures declined to 42% and 20% respectively the following year.[54]

Economy prices, a third price bracket below even that of tourist rates, proved highly effective at drawing passengers. It produced a similar jump in transatlantic passenger numbers when introduced in 1958. Cheaper tickets boosted the transatlantic passenger volume by 26% that year while America's domestic traffic failed to grow.[55] But the arrival of jets in 1958 changed the passenger market considerably. With far more seats available than ever before, load factors fell and most airlines operated at a loss. IATA raised regular transatlantic rates in an effort to restore profitability and cut return service discounts from 10% to 5%.[56] One important consequence of this was the creation of a liberal charter market that would come to redefine the transatlantic market, as noted below.[57] This lowest price tier offered a solution to the low capacity that afflicted North Atlantic airlines during the 1960s. By that time, all IATA member airlines agreed that high fares were to blame, so the airlines reached a consensus in 1963 to further cut economy rates in the hope of attracting a larger clientele.[58] IATA later moved to

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[53] Most flights at this time were single-class rather than mixed as with modern planes. This practice was common enough that tourist passenger numbers can be tracked closely by the number and capacity of tourist flights. British Airways Heritage Centre, RS/1/10930, Part 1, "Atlantic Services, Services, 1954." BOAC Draft Minute from R.M. Barton, Airways Terminal, to General Sales Manager, "Study of North Atlantic Results for the current Financial Year to Date and Recommendations for Increasing Sales 1955/6," November 3, 1954.

[54] Total tourist rate ticket sales between Britain and the United States favoured the Americans (62% were sold there with another 4% sold in Canada; Britain sold just 29% with Continental Europe selling another 5%). The lower share of BOAC tourist traffic was credited to the older Constellations used on the service while other airlines rolled out newer stock. BOAC carried a roughly equal share of passengers flying first class despite lagging on tourist ticket sales (first class transatlantic British sales totaled 44% with Continental Europe accounting for another 6%; America sold 47% with Canada selling the remaining 3%). *Ibid*.

[55] Wallace, "The Influence of Price on the North Atlantic Airline Market," p. 369.

[56] America's airlines preferred to lower rates instead to draw additional passengers but did not oppose the rate increase, preferring to let IATA take responsibility for the move. The CAB would have opposed the change had it not been pressured by the State Department, which was more concerned with good relations with Europe than with airline competitiveness. Hannigan, "Unfriendly Skies," p. 118-21.

[57] Jönsson, "Sphere of Flying," p. 285.

[58] European Commission Archives, CEAB 10 no. 586, p. 105-9. IATA, no. 35 "Informations: Conferences de trafic," October 1963, p. 1-5. Final rates were not set at the 1963 Strasbourg IATA Conference but first class fares of $400 and economy fares of $210 (rising to $255 in the peak season), plus a round-trip excursion rate of $300 for New York-London, served as the baseline for a final agreement. Several European airlines expressed

reduce economy prices modestly in 1964, with off-peak round-trip economy rates seeing the biggest drop.[59]

The economy fare reduction proved successful immediately following their introduction on April 1, 1964. Passenger numbers for Pan Am and TWA rose during periods when the cut prices were available, typically during mid-week service. Year-on-year comparisons bear this out. While there was only a 5% increase in passengers in the first quarter 1964 over the first quarter in 1963, the second quarter (beginning on April 1) saw a 42% jump from the previous year; the largest increase in 12 years.[60] Since the economy seats were offered during specific times of the week and year, their impact distorted traffic. Load factors increased on mid-week flights at the expense of the weekends. Winter services also suffered since the cheapest flights were available during the tourist-heavy summer. Tourists with flexible vacation schedules and limited budgets booked their trips to maximize their savings, so the new rates distorted the travel market by encouraging tourists to buy more tickets during the busy season.[61]

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reservations with the final price structure, although none of them outright refused to accept price reductions on the magnitude proposed. NARA RG 237, Box 5, Folder "IATA Rates #2," May 16, 1963-November, 1963. Memorandum of Conversation, "Exchange of Views on U.S. and Italian Positions on IATA Air Fares, November 18, 1963.

[59] The cheapest round-trip economy ticket cost just $399 compared to $484.50 for regular economy tickets. Mark A. Welge, "Impact of Technology on IATA Ratemaking: Problems Prognostications Proposals," The *George Washington Law Review* 39, no. 5 (July 1971), p. 1184-5.

[60] There was only a 7% climb in passenger numbers in all of 1963 over 1962, and the data for the first quarter of 1964 was in line with the expected natural increase in passengers absent the price cut. Load factors also increased by 21% on the two US carriers, with a jump in profits to 44% from 33% compared to the same quarter in 1963, and a 16% climb in revenue-passenger-miles. NARA RG 237, Box 123, Folder 5800-2 "IATA", 1964. Office of Policy Development, "North Atlantic Air Traffic and Fares," September 21, 1964.

[61] NARA RG 237, Box 123, Folder 5800-2 "IATA", 1964. Civil Aeronautics Board, "Statement on Rates and Fares to be Negotiated by the IATA Traffic Conference at Athens – October 1964," October 7, 1964, p. 4-6. High load factors on the North Atlantic could be between 60-65%: above this range there was a risk that too many people would try to fly at the same time, using all available seats and crowding those purchasing a ticket late into taking their flights at another time. An extreme case on the North Atlantic, Icelandic Airlines had a load factor of 76% year-round. It maintained this figure by refusing a large number of passengers due to the excess demand for its limited available seats. Planes in this situation still flew with empty seats but did so on less desirable routes or at unpopular times. Mahlon R. Straszheim, "The Determination of Airline Fares and Load Factors: Some Oligopoly Models." *Journal of Transport Economics and Policy* 8, no. 3 (September 1974), "The Determination of Airline Fares and Load Factors," p. 268-70.

Price-conscious tourists would wait for a bargain before buying a ticket. For routes more lightly regulated than the North Atlantic, discount ticket prices were often sold at a loss. This was done with the expectation that business travelers would make up the difference by buying full price tickets since their trips were made regardless of short-term price considerations.[62] Economy prices on the New York-London route were suboptimal as roughly half of all seats were sold below cost to attract passengers and fill otherwise empty seats. The costs were borne instead by those whose travel itineraries were not flexible, such as business people or last-minute ticket buyers, who paid more for their seats. In essence, the economy travelers had their tickets subsidized by the full price ticket buyers.[63] Economics professor Mahlon R. Straszheim noted that between 1948 and 1973 there was indeed a strong trend towards these economy fares, leaving only a small core of business and government travelers willing and able to pay the higher prices. He concluded that demand for first class tickets was largely inelastic, whereas the vast majority of passengers who were time rich and money poor would avoid the additional cost.[64] Indeed, business class, a new tier just below first class introduced in 1978,[65] soon formed the cornerstone of commercial flight. These highly profitable seats were marketed towards wealthier businesspeople and came to account for 12% of ticket sales and 28% of revenue on those

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[62] Business travelers often do not bear the cost of their trips and so will generally pay whatever price is asked of them. This is often higher than the market price for the seat on a given trip, effectively giving a subsidy to the cheaper tourist tickets: "airlines tend to over-charge those passengers who buy standard full-fare tickets and often under-charge those who buy discount tickets". Richard Pryke, *Competition among International Airlines*. (Brookfield, VT: Gower Publishing Limited, 1987), p. 5, 21-5.

[63] Richard M. Smithies, "The Changing Demand for Air Transport: The North Atlantic Case," *Journal of Transport Economics and Policy* 7, no. 3 (September 1973), p. 243.

[64] Straszheim, "Airline Demand Functions in the North Atlantic and Their Pricing Implications," p. 183-4.

[65] The business class appeared as the Airline Deregulation Act entered force. The Act, passed in the United States in 1978 to remove government control over airline prices, had a drastic impact on airline pricing as the carriers (both American and foreign) quickly dropped fares on routes to retain market share during a period of high overcapacity. This race to the bottom proved difficult for many of the big airlines to afford for years to come; the details of which lie beyond the scope of this study. For more on this, see: Nawal K. Taneja, *The International Airline Industry: Trends, Issues, and Challenges* (Lexington, MA: Lexington Books, 1988).

flights.[66] The inflation-adjusted price of all ticket classes in 1958 were cheaper than either first class or business class tickets in 2008 for a typical transatlantic flight, although the cheapest economy seats in 2008 were far cheaper than the most affordable ones in 1958.[67]

These cheaper ticket options ate into first class ticket sales that were the only available option prior to 1952. First class ticket sales grew by just over 10% annually from 1946 to 1951, but this proved unsustainable when the cut rate options appeared and total sales underwent a secular decline throughout the latter 1950s. Improving aircraft technology made the additional cost unattractive to those merely seeking rapid transportation between Europe and North America. The reduced creature comforts offered by cheaper ticket classes were tolerable to most passengers who now expected to spend a few hours in flight rather than most of a day.[68] Bearing out this point, while as many as 750,000 people might have purchased a first class ticket in 1962, only 210,000 actually did so thanks to the more affordable rates. The news was hardly bleak for the airlines: 1.8 million people chose to fly entirely because of these rates. Dr. W.M. Wallace, an analyst, found that this tiered rate structure provided an additional $226.8 million in 1963 between all transatlantic airlines, more than offsetting the decreased first class ticket sales.[69]

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[66] Pan Am introduced the new business class on its 747s since the big plane had room to fully separate the different classes. Business class was specifically positioned to be superior to economy class while stopping short of rivalling first class service. Each major airline soon introduced a similar seat class comparable to that on Pan Am's planes (and each with its own distinct name). John T. Bowen, Jr., "A People Set Apart: The Spatial Development of Airline Business Class Services," from *International Business Travel in the Global Economy* edited by Jonathan V. Beaverstock, Ben Derudder, James Faulconbridge, and Frank Witlox, (Burlington: Ashgate, 2010), p. 11-3.

[67] Sample prices are based on IATA rates from 1958 while the prices for today were taken from British Airways listed price for service between London's Heathrow and New York's JFK. Perhaps most strikingly, the range of prices was far smaller in 1958: the most expensive first class ticket was $2900 against an economy price of $1500 (prices adjusted for inflation), or less than double the cost. By 2008, the least pricey ticket was just $698 (under half the inflation-adjusted cost as in 1958 for bare-bones service) but a first class seat went for a staggering $16,337, or 23.4 times more, not to mention that it was nearly six times as costly as it was fifty years earlier. *Ibid*., p. 21-2. Simply put, airfare deregulation introduced in 1978 cut prices on discount tickets but not on the full price first class fares. Marc S. Mentzer, "The Elusive Low Cost Carrier Effect in the Trans-Atlantic Airline Market," *Journal of Aviation Management and Education* 2 (2013), p. 3.

[68] Wallace, "The Influence of Price on the North Atlantic Airline Market," p. 369-70.

[69] The study assumed a seat-mile value of $0.09 for first class tickets compared to $0.06 for economy and charter flight rates. In 1962, examining only air routes traversing the North Atlantic, there was a "revenue loss" of $205.2 million for first class against a "revenue gain" of $432 million for all other ticket sales. The "loss" was the

Airlines and passengers both benefited. By adapting to the diverse needs of people from all walks of life, the airlines gave millions of people the opportunity to travel across the Atlantic and to turn a profit by doing so.

Charters

Perhaps the most transformative event for the North Atlantic air corridor in the 1960s, second to the rise of jet travel, was the profusion of charter services. Prior to the 1950s there were extremely few charter flights: scheduled air service was the only way to fly without special government permission. Transatlantic charters were only allowed as a supplement to scheduled service when airlines could not accommodate every passenger.[70] There were two main reasons for this. First, international airlines were mostly government-owned agencies. It did not befit a government to give lucrative international air rights away to another entity when their chosen instrument, the flag carrier, stood to lose out on that revenue. Second, international flight up until the latter 1940s required states to agree to each flight in advance through rigid bilateral agreements. The situation began to change in 1949. A student group totalling about 2,500 people wanted to fly to Rome and Tel Aviv. They were granted an exception from the usual fares for scheduled international air services due to the special nature of their voyage. As there was simply not enough room on the scheduled carriers to accommodate them, so five planes from two non-scheduled carriers were granted permission to make the trip.[71]

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value of the first class tickets that would have been sold had no other ticket options been available, not taking into account the retained value of tickets sold at the lower rates so that they could be examined separately. Gradual cost reductions per seat-mile meant that even this reduced ticket rate was increasingly favourable to airline performance over time. *Ibid*.

[70] Lucile Sheppard Keyes, "The Transatlantic Charter Policy of the United States," *Journal of Air Law and Commerce* 39, no. 2 (Spring 1973), p. 216-8.

[71] The fee for the charter service ended up being $350 per person. In comparison, the regular tickets at that time cost $630 for a shorter New York-London round-trip. Jack M. Goldklang, "Transatlantic Charter Policy – A Study in Airline Regulation," *Journal of Air Law and Commerce* 28, no. 2 (Spring 1961-1962), p. 100-1.

In 1950, the following year, America's CAB explicitly permitted a handful of charter flights for pilgrims to attend the upcoming Holy Year in Rome. The CAB also detailed a short list of other groups that could make charter flights for similar reasons: they had to belong to a common religious, educational, or charitable association. This would only apply during the summer season, from June to September of 1950, and charter requests had to be filed by March 1, 1950. CAB member Harold A. Jones pointed out that there was no guarantee that everyone claiming membership to these groups was actually a member. Many of them might turn out to be bargain-seekers who just wanted to avoid high prices. Jones noted that there was no mechanism to verify whether charter passengers were actually party to the group officially chartering the plane, or if the group even existed except to claim the discount.[72] The 1950 charter service was only the beginning. In 1951, the CAB also permitted charters for domestic American service. It also outlined several expectations and duties that the airlines offering the charter flights had to follow to prevent abuses of the new system.[73]

The CAB had difficulty ensuring that those requesting charter services represented groups with acceptable reasons for chartering a flight to Europe. The chartering party had to belong to a group or organization small enough to be distinct from the general public, lest anyone in the general population claim membership to receive the discounted charter rate. A

[72] The skepticism towards people who might abuse charter prices was not directed against the airlines. The big American transatlantic carriers (Pan Am, TWA, AOA) were tacitly considered to be innocent partners in such situations even though they stood to gain additional revenue from carrying passengers on the additional flights. Despite the potential for people to take advantage of the cut-rate prices, the objection did not suggest how to improve the system to prevent such abuses or offer any data about how big a problem this might be. British Airways Heritage Centre, AW/1/2881, "Trans-Atlantic Charter Activities, Fares and Rates, 1949-1951." Harold A. Jones, "Minority Comment on Board's Statement of Policy on Transatlantic Travel in 1950," December 6, 1949.

[73] Scheduled carriers could provide chartered planes under tight restrictions. These rules included that the airline derive no more than 2.5% of its revenue plane-miles from such service. The definition of charter flights listed obvious restrictions (that a group chartering a flight had to have a common interest) and detailed certain expectations for duties that the chartered plane had to fulfil. Cargo space had to be set aside, for example, so that the airline did not deliver less than it was expected to. Other countries were keenly interested in how the new charter arrangement would influence flight in the United States since they might adopt that system themselves and wished to understand what to expect. NARA RG 197, Box 30, Folder "ICAO." *Aviation Report* Vol. 1, no. 10, June 5, 1951, p. 43.

1951 BOAC memo illustrated the problem. American college students would count as an acceptable party under CAB rules as long as they came from the same academic institution and shared an itinerary while in Europe; students from other colleges could not join them. Religious adherents were acceptable in general since they tended to have very well articulated plans for their visits, often on a pilgrimage. Teachers' groups and war brides were noted as a group so broadly defined as to be almost indistinguishable from the general public and so were unacceptable.[74] The obvious arbitrariness made it difficult to regulate the nascent charter service. Potential abuses were unlikely in the early 1950s since it still required a great deal of coordination to charter a plane and receive government clearance.

The initial wave of non-scheduled transatlantic flights during the 1950s was small. The CAB did not wish to antagonize IATA by circumventing its price controls for the scheduled airlines. IATA struggled to find the best response to charters, as scheduled carriers sometimes ran out of available seats during busy travel periods. In 1951, IATA decided that the airlines ought to rent additional planes during peak seasons in anticipation of the 1952 tourist fare introduction.[75] The situation changed in 1955 when the CAB liberalized regulations on charter flights in response to growing American demand for flexible, low cost transatlantic air travel,[76] and to offer additional seats to make up for the shortage during the summer peak season. The charters remained popular even after the introduction of economy fares in 1958: scheduled economy round-trip New York-London service was $450, while the charter on the same route

[74] In one extreme example, a group of German singers chartered a Pan Am flight from Buffalo, New York, to London. Upon arrival, fourteen members turned out to be Italians on their way to Rome. This case was described here as a "racket" of the type that charters were prone to attracting. British Airways Heritage Centre AW/1/2881, "Trans-Atlantic Charter Activities, Fares and Rates, 1949-1951". BOAC memo from Commercial Planning Superintendent H.M. Clarke to Fares & Rates Manager, February 26, 1951.

[75] Goldklang, "Transatlantic Charter Policy," p. 105-6.

[76] The CAB claimed tourist fares were too expensive and pursued charters as an alternative for those who might not otherwise be able to fly. Keyes, "The Transatlantic Charter Policy of the United States," p. 218-9.

could be $200 cheaper.[77] Charters, sometimes part of "inclusive tour" packages alongside hotel and sightseeing itineraries, grew out of the irregular intra-continental services (trips entirely within Europe or North America) established in the early 1950s. The need for charters of this type (aside from the "affinity group" charters restricted to special interest groups) was formally recognized in 1956 when West European countries signed the Paris Agreement. The Agreement permitted non-scheduled flights to destinations that "have no reasonably direct connection by scheduled air service", for example an isolated location with a small population to which paying customers might vacation. These flights were originally intended to serve Europeans flying to other areas of the continent. When similar legislation was passed in the United States in 1962 the intention was likewise domestic in scope. Non-scheduled flights were not supposed to compete with scheduled international traffic. By the mid-1960s most charters remained intra-continental in character,[78] yet charters had carved out a substantial chunk of the transatlantic market: by 1960, charters accounted for 11% of all flights over the North Atlantic.[79]

When the CAB loosened charter rules in 1966, it opened the door to unscheduled flights to any destination. This included the largest wide-body planes or even a chartered block of seats within a scheduled flight, so even small groups could charter passage across the Atlantic. Americans traveling to Europe could save a lot of money when charter flights were combined with plans involving ground travel by car, rail, or backpacking. European airlines failed to close this loophole in existing air laws. Along with American and other global airlines, the European

[77] During hearings in 1955, the CAB found that the scheduled airlines simply could not accommodate everyone that sought to fly to Europe during the summer. Only by allowing charters to pick up the slack would there be enough seats. Goldklang, "Transatlantic Charter Policy," p. 109-10, 117.

[78] The Paris Agreement transformed air travel: by 1971, fully half of all international flights within Europe were charters, principally "inclusive tour" packages. The majority of these routes ran within a single continent and mainly ferried people to warmer climes: Northern Europe to the Mediterranean, the American mainland to Hawaii. Smithies, "The Changing Demand for Air Transport," p. 231-5.

[79] Charter flights across the North Atlantic increased by 50% year on year from 1957 to 1960. The low prices were attractive to all budget-conscious travelers. Goldklang, "Transatlantic Charter Policy," p. 99.

carriers instead created a more complicated pricing structure. The new arrangement tended to reserve lower prices for advance bookings while last-minute ticket buyers were penalized with a higher rate. Incentivizing early bookings was helpful since airlines could make informed decisions about whether a chartered flight might carry more passengers than the scheduled service it replaced. Airlines also "cheated" the new system by offering reduced charter fares to boost their own passenger numbers: the cut prices were not covered by IATA's pricing structure so it was easy to undercut competitor's prices in this way.[80]

Initially, international charter flights were run by scheduled airlines. A chartered flight took the place of a scheduled flight to keep the total number of flights in line with bilateral agreement limits. These "blocked-off charters" enabled the airlines to redirect their aircraft towards potentially untapped passenger groups. It behoved the airlines to carefully consider where and when to fly blocked-off charters: BOAC found that transatlantic flights taken out of regular service during the summer hurt its profitability.[81] This strict balance only applied to scheduled airlines, so when regulations were loosened in the 1960s, new, charter-only "supplemental" airlines emerged to serve the market. American supplemental carriers grew from 17% of all charter-flight passengers in 1963 to 44% in 1967 at the expense of Europe's scheduled airline charters, which dropped from 73% to 29% of the unscheduled market over the same interval.[82] The new charter airlines got their start in large part by purchasing the aircraft sold off by major scheduled airlines. These aircraft were still airworthy but no longer top-of-the-

[80] Groups as small as 40 could book seats on a scheduled flight at the reduced rate. Andres F. Lowenfeld, "A New Takeoff for International Air Transport," *Foreign Affairs* 54, no. 1 (October 1975), "A New Takeoff for International Air Transport," p. 41-3.

[81] Transatlantic flights were not allowed to be repurposed for charters eastbound between May and July or westbound between July and October. British Airways Heritage Centre, RS/1/10932, Part 3, "Atlantic Services, Services, 1955 April-June". BOAC memo from Sales Contracts Manager R.J. Walden, "Transatlantic Charters 1956," May 27, 1955.

[82] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". "Passenger traffic between Europe and the USA with particular reference to the UK-US routes," Folio 35, paragraph 1.5.

line, some of which included the first operational civilian models following the war. Britain was the first European country where these discount charter airlines emerged, giving the country a brief head-start on both European and transatlantic inclusive tour services. As the United States entered the inclusive tour market this lead disappeared even as the British retained their foremost position on the intra-European market.[83]

By the late 1960s transatlantic charters were almost entirely "affinity group" services, accounting for about 90% of all charter services. As was the case when charters were first approved in the early 1950s, several criteria had to be met: passengers had to be part of the "affinity group" at least six months prior to departure and pay the same rate; the group was not allowed to advertise its service; and was supposed to serve a function other than simply sightseeing (i.e. pilgrimages were acceptable). Despite these stipulations, it was common for the affinity group service to be used for sightseeing trips using a superficial pretext to qualify as an affinity group. The remainder of charters were for students, military, or "own use" for groups above a minimum size threshold.[84] Affinity group charters grew quickly and were attractive to transatlantic travelers since they were by far the cheapest category of air travel available. Fully 12% of all London-New York travelers flew on charters in 1965, where charter prices ranged from £60-£85 ($168-238[85]) for a return ticket. Non-peak economy rates, paid by another 27% of passengers, started at £142/10 ($398).[86]

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[83] TNA BT 245/1151, "USA transatlantic charter policy - CA2(2) consideration, 1964-6." Loose minute, note from A.G. Mansie to Mr. Green, February 2, 1965, 66C. The older planes were less comfortable and slower than newer models, which went hand-in-hand with the concept of cheaper service providing less comfort and convenience. Bargain hunters were less inclined to care about creature comforts than saving money.

[84] The smallest acceptable size for "own use" groups depended on the destination and purpose of the trip. Smithies, "The Changing Demand for Air Transport," p. 235-6.

[85] This calculation from British pounds into American dollars was made using historical exchange rate data for 1965 from the website: http://www.measuringworth.com/datasets/exchangepound/result.php.

[86] Other price categories for the New York-London route were all-inclusive tour rates of £96/6 (a further 39% of the passenger market), economy peak fares of £173/2 (16% of passengers), and first class tickets that cost £254/11 (6% of passengers). TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic

While they were wildly popular, using charter services was a complex endeavour for passengers. To qualify for affinity group or even the more common inclusive tour rates, the flight could not be advertised or publicly promoted.[87] As noted above, charter passengers also had to belong to a club of any kind as long as there were fewer than 20,000 members, a number so high as to be virtually meaningless as an exclusionary criterion. Even the spouses of club members could come on these trips.[88] Finally, as long as the voyage and its itinerary were logged at least six months in advance, there were no further legal restrictions.[89] These weak restrictions were sufficient to allow hundreds of thousands of people to fly across the North Atlantic at bargain rates. Transatlantic air travel was no longer the exclusive domain of the wealthy. Literally anyone with a week of vacation time and some disposable money could fly to another continent.

This transformation came at a cost to the established aviation order. Regular service by the scheduled airlines continued to grow while the charters expanded but their bottom lines were hurt. Between 1960 and 1971, scheduled IATA airlines saw average annual passenger growth rates of a respectable 15% on Europe-North America routes, primarily in the less profitable economy class. Charter flights by IATA airlines grew at 29% per year over that time, accounting for nearly 1/3 of all passengers by 1971. Non-IATA charter services grew fastest of all: an

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Inclusive Tour Charter Flights, Part A, 1968-75". "Passenger traffic between Europe and the USA with particular reference to the UK-US routes," Folio 35, table 5B.

[87] The lack of advertising was to discourage the general population from partaking in the reduced rates if they were not truly part of the groups. This was to keep people flying at the higher rates charged to regular passengers. Jean Robertson, *Sunday Times*, "Charter flight mysteries," February 9, 1969.

[88] Examples of acceptable groups included cat-breeding enthusiasts or employees of a company. By the late 1960s the exclusionary criteria were a fig leaf to cover the fact that anyone could fly on a charter. *Ibid*.

[89] This was only the case in Britain, America, and Canada. Other countries were less sympathetic to charter services and imposed further limitations, albeit ones that were still fairly modest. *Ibid*.

average of 56% per year, from 30,000 passengers to over 2.4 million by 1971.[90] European scheduled airlines were more vulnerable to the impact of charters than their North American counterparts and saw their share of transatlantic passenger traffic decline.[91] This is not to say that the scheduled airlines shrank since they often grew in absolute passenger volume, but that they were less competitive than their nimbler charter competitors.

The total number of charter flights was large by the late 1960s yet remained far smaller than the number of scheduled flights. In 1967, transatlantic charter flights to and from Britain by independent British operators numbered 670 one-way trips, 207 with the United States, 413 with Canada, and 50 with the West Indies.[92] BOAC flew a further 155 charters, 54 with America, 100 with Canada, and 1 with the West Indies.[93] American non-scheduled flights exceeded these figures but not overwhelmingly so. Pan Am flew 167 flights to and from Britain to TWA's 84, but the majority were held by smaller carriers that performed 572 flights for a total of 823 by all United States operators. Canada contributed another 386, with Air Canada and Wardair (a charter airline) contributing nearly half each. All other airlines flew a total of 554 flights into Britain that year.[94] This amounted to an average of seven one-way flights per day; enough to make a dent in the total passenger market.[95] Scheduled services still captured the great majority of passengers even as their market share fell. Europe-United States flights (excluding Loftleidir) carried 3.1 million people in 1964 growing to 5.3 million by 1968. Of that, charters carried only

[90] Passengers on non-scheduled flights totaled 198,200 in 1960 out of IATA's 2,011,200 overall; by 1971 they carried 3,462,900 passengers out of 11,257,100. This represents an increase from 9.9% to 30.8% of all passenger traffic across the North Atlantic. Smithies, "The Changing Demand for Air Transport," p. 237-9.

[91] European Commission Archives, BAC 3/1978 no. 1479. Commission des Communautes Europeens, "Actions a entreprendre dans les domaines de la navigation maritime et de la navigation aerienne (Projet de Communication de la Commission au Conseil)", Communication de M. Bodson, 28 May, 1970, p. 289.

[92] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Loose minute by E. Bennett, March 20, 1968.

[93] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Loose minute by M.A. Gray, March 21, 1968.

[94] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Folio 24.

[95] Smithies, "The Changing Demand for Air Transport," p. 237-9.

14.2% of the total in 1964, which climbed to 17.3% in 1968. American charters grew the fastest among the unscheduled providers but mostly took traffic from other charter services.[96]

Countries tolerated charters to varying degrees informed by their perception of air service as a public good or a challenge to state agencies. The United States generally supported them, as both the CAB and Supreme Court upheld charter operations against the wishes of scheduled airlines.[97] This is not to say that the CAB permitted all charter services to the United States. In 1967 it denied German charter airline Condor the right to serve America on the grounds that it was wholly owned by Lufthansa. The CAB ruled that this ownership arrangement effectively gave the scheduled airline, which already offered charter flights to the United States, a non-IATA surrogate with which it could circumvent IATA rules. Condor rebutted that it was a separate legal entity despite Lufthansa's ownership of all Condor's outstanding stock but failed to convince the Americans.[98] Several European countries, especially France, Spain, and Portugal, wished to prohibit all affinity group charters and inclusive tour package flights out of fear for the well-being of their flag carriers.[99] In 1969, the European Civil Aviation Conference (ECAC) members broadly agreed that inclusive charter tours should not grow unmanaged whether carried by IATA or non-IATA airlines. By that time there were still too few of the flights to devise a firm and consistent policy including all members, and several countries

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[96] TNA BT 245/1132, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part B, 1968-75". Working Paper prepared by the Institut du Transport Aérien for the European Civil Aviation Conference, "Development of Traffic and Capacity Offered on the North Atlantic," September 1969, p. 4-5.

[97] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Confidential memo from R.F. Prosser, British Embassy in Washington, to R.R. Goodison, Board of Trade, April 22, 1968, 21B.

[98] TNA BT 245/1348, "U.K./U.S.A. Policy and Procedure with Regard to non-Scheduled Flights, 1964-7." Bureau Council Roy Pulsifer of the Civil Aeronautics Board, "Application of Condor Flugdienst G.m.b.H. for a foreign air carrier permit pursuant to the Federal Aviation Act of 1958, as amended. Docket 17233: Brief of the Bureau of Operating Rights to Examiner Edward T. Stodola," January 6, 1967, Folio 3.

[99] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Confidential memo from R.F. Prosser, British Embassy in Washington, to R.R. Goodison, Board of Trade, April 22, 1968, 21B.

prohibited any such service to their territory. Generally, however, the ECAC members felt that a system of tariffs and frequency controls were the best solution available.[100] In between the opposing American and protectionist camps sat several other countries. These included Britain, the Netherlands, and Switzerland, which were all willing to accommodate charters under controlled circumstances. This latter group generally believed that non-scheduled flights either could not be successfully stopped or else that they could be profited from if handled carefully.[101]

R.F. Prosser, a member of the British Embassy in Washington, espoused this latter view. He believed that Britain stood to benefit if it accepted inclusive tours while many other countries (France in particular) shut them out. If this happened on a sufficiently large scale, it could redirect the ever-larger tourist flows towards Britain.[102] On a similar note, Sir Giles Guthrie of BOAC argued that excessive limits on inclusive tour charters risked driving cost-conscious American tourists to other European destinations that were more amenable to the discount air services. Guthrie was conscious of the potential harm inclusive tours could do to his airline's bottom line but was resigned to the fact that charters were not simply going to go away.[103] The impact charters had on the British economy, bringing tourist dollars, argued in their favour in spite of the harm to the flag carrier. A preliminary analysis offered by B. Mitchell of the Association of European Airlines suggested that charters were a slight net gain for the British

[100] TNA BT 245/1132, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part B, 1968-75". Letter from G. Lanchin at the British Board of Trade to Managing Director of Lloyd International Airways Ltd. K.M. Macleod, "North Atlantic Inclusive Tour Charter Flights," October 15, 1969.

[101] TNA BT 245/1131, "European Director Generals of Civil Aviation Trans-Atlantic Inclusive Tour Charter Flights, Part A, 1968-75". Confidential memo from R.F. Prosser, British Embassy in Washington, to R.R. Goodison, Board of Trade, April 22, 1968, 21B.

[102] *Ibid*.

[103] TNA BT 245/1151, "USA transatlantic charter policy - CA2(2) consideration, 1964-6". Letter from Sir Giles Guthrie, BOAC, December 9, 1965, 44.

economy. American-operated inclusive tour charters drew £15 away from Britain's airlines for each passenger they carried but those tourists spent an extra £12 to £28 in Britain.[104]

The impact of charter flights was so great that overcapacity on the North Atlantic in 1975 "was equivalent to 15,000 empty Boeing 747 round trips".[105] Annual capacity numbers show that the load factor on transatlantic flights, which was 64.2% in 1960, hit a low of 49.1% in 1963. This was the time when charters began to emerge as a large part of the market. Between 1963 and 1974 the market corrected somewhat as the total load factor climbed again to 55-60%, but this still represented 7.4 million empty seats in 1973 alone.[106] The regular airlines feared that they were losing their competitive edge as a recession plagued the tourism industry while passengers flocked to the cut-rate charters. IATA talks between the North Atlantic airlines to find the best way to address the matter was inconclusive but some favoured fare reductions.[107] Pan Am and TWA both underwent a period of severe cutbacks and layoffs. Pan Am laid off nearly 1/3 of its staff between 1969 and 1976 and reduced its available seat-miles by over 13% while TWA imposed similar cuts.[108]

Despite how lucrative transatlantic service had been for airlines in the past, the Oil Shock of 1973, which drove up fuel prices, and subsequent inflation, which reduced middle class spending, meant that most carriers lost money on it in the early 1970s, including Pan Am, TWA, and many European airlines. Some of the hardest-hit carriers took the drastic stop of halting

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[104] The additional amount spent depended on the length of their stay but, except for those visiting for the shortest interval, this was a net gain for the national economy. TNA BT 245/1348, "U.K./U.S.A. Policy and Procedure with Regard to non-Scheduled Flights, 1964-7". B. Mitchell, "Transatlantic Inclusive Tours: Relative Importance of tourist and airline earnings to the Balance of Payments," March 30, 1967, 69A.

[105] Jönsson, "Sphere of Flying," p. 286.

[106] Three years between 1963 and 1974 saw load factors below 55% but not significantly so. Lowenfeld, "A New Takeoff for International Air Transport," p. 43-4.

[107] John C. Leslie, "International Air Transport Association: Some Historical Notes." *Journal of Interamerican Studies and World Affairs* 13, no. 3/4 (July-October 1971), p. 337.

[108] Pan Am reduced staff numbers from 39,386 on December 31, 1969 to 26,954 on February 15, 1976. Straszheim, "Airline Demand Functions in the North Atlantic and Their Pricing Implications," p. 191-2.

their North Atlantic routes. This was not a decision to be taken lightly for airlines won those rights through difficult negotiation that sometimes lasted years, and prestige alone made the run among the most valuable in an airline's network. They simply could not afford the otherwise profitable service at the prices they had been forced to accept. Pan Am cut service to Paris and some southern European destinations, TWA dropped its Frankfurt run, and European airlines scaled back on flights to the cities on America's west coast.[109] Some airlines adapted to the new market by shifting resources into the charter sector. This shift allowed an airline to remain within IATA's fare structure while retaining passenger volume, albeit at a reduced rate on the charters. Airline profitability therefore suffered even among those offering non-scheduled service.[110]

Another critical adaptation to charter service was the introduction of promotional fares. These were scheduled service tickets for transatlantic travels at specific times for predetermined lengths. One case was the price offered for trips of between 29 and 45 days at a heavy discount. By liberalizing and introducing a flexible, multi-tiered pricing structure, the scheduled airlines managed to recapture some of their market share. By 1973, three years after this model was adopted, promotional tickets accounted for 57.4% of all transatlantic passengers. Most importantly, many of these were passengers that would otherwise have traveled on charter flights and would have been lost despite the negative revenue they represented.[111] The scheduled

[109] Pan Am lost $80 million in 1974 while TWA lost $47 million, requiring both of the American giants to trim their loss-leading but prestigious services. European carriers had similar losses during that time. Lowenfeld, "A New Takeoff for International Air Transport," p. 44-5.

[110] Mutti and Murai, "Airline Travel on the North Atlantic," p. 50-1.

[111] The average length of an American trip to Europe dropped from 66 days in 1950 to 45 days by 1963, after planes overtook ships as the main method of transatlantic travel. The reduced time spent abroad meant that Americans spent less on average than before, and that those who did make the trip may have only been able to afford it because of the lower fares on offer. The average amount spent on a European trip peaked at $1,533 in 1957 before dropping to $965 in 1968 including the cost of transportation. Taneja, *A Model for Forecasting Future Air Travel Demand on the North Atlantic*, p. 35-7; Straszheim, "Airline Demand Functions in the North Atlantic and Their Pricing Implications," p. 186-90.

airlines swallowed a bitter pill to stay relevant. They competed in a changing market by giving up the protections they had carefully built up and dropped their prices in a variety of ways. Most passengers flew for lower prices than ever before, bringing transatlantic air travel to the masses.

Conclusion

Thanks to the myriad airlines competing for passengers in the 1970s, millions of people could quickly and affordably pick up a ticket and travel across the North Atlantic. Tourists obliged the airlines by turning away from the ocean liners that had offered them their only option for transatlantic transit up to 1939. By the 1970s, ocean liners were obsolete for transatlantic travel as the new technology supplanted the old. The airlines were helped by the contentious introduction of ever cheaper fares, first tourist and then economy rates, as American airlines wore down European fears of open competition. The entrance of charters, although disruptive, made the transatlantic market extremely attractive to a wider segment of the population. The average passenger was the beneficiary of a race to the bottom for fares, with cheaper flights appearing with great frequency throughout the postwar years. With both scheduled and unscheduled flights offering ever larger numbers of people regular service across the North Atlantic from the 1950s through the 1960s, air travel had truly become a routine and widely accessible enterprise.

Conclusion

When Alcock and Brown landed in Ireland after their historic transatlantic flight in 1919, they proved that the North Atlantic was no longer a barrier to aviation: the ocean could be crossed by air. Their transatlantic flight also showed that the North Atlantic was unwelcoming for regular air travel. Even after carefully choosing the best weather conditions for their journey they still flew through clouds that blocked their view of the ocean below and the stars above. They could not tell whether they were heading in the right direction or even if they were flying level. No one could help them if they encountered real trouble. So while they managed to make the crossing, their flight had also proved that the North Atlantic represented a tough match for the planes of the day. Regular air travel also sorely needed a system to support aircraft in transit above the ocean before anything like passenger services would be possible. Technological advances offered solutions to both of these problems as long as the money to pay for them was forthcoming, but few private groups could offer more than token financial assistance as the aircraft and the support infrastructure grew exponentially more expensive to develop and operate. This dissertation showed that government involvement in nearly every level of transatlantic aviation was critical in giving quasi-private businesses, the airlines, the means to make this important step.

Air travel across the North Atlantic seemed destined to become a pivotal part of the international aviation network from the earliest days of commercial air travel. The myriad ships that constantly plied the waters of the Atlantic in the early twentieth century proved that there was a huge market in passenger and cargo traffic to tap into. Even during the era of ocean liners, the region was defined by the latest technology. The busy waters attracted the best and fastest ships to make the ocean crossing as attractive as possible. Certainly no other region spurred

technological innovations as much as the North Atlantic both during the era of steamships and of air travel that surpassed and supplanted it. Technological disruption was a constant feature of transatlantic travel as new modes of travel competed with one another for supremacy: intense technological competition between flying boats, landplanes, and even airships allowed the strengths and weaknesses of each one to be studied. But it was not free enterprise that drove the development of the big planes. Even Pan Am, which pushed for the development of the Boeing 314 to make the first commercial flight a reality, subsisted on air mail contracts throughout the 1930s.

This dissertation proved that government money was behind every aspect of transatlantic development, directed towards building ground facilities for the aircraft, deploying networks of navigational aids, expanding networks of radio transmitters, building weather stations and funding meteorological research, exploring and documenting the expansive region, and boosting demand for new technologies to improve the range and speed of aircraft, all with a mind to make the North Atlantic a place that their airlines would soon safely be able to fly. Even the legal framework for transatlantic air travel needed to be sorted out at the government level, to open this "cosmopolitan commons", where parties shared common access to the North Atlantic airspace through a series of bilateral agreements. The European airlines were state-owned entities, but the American government found subtle ways to indirectly support its airlines with what amounted to subsidies by another name. The free market needed a hand to get started on the North Atlantic in the interwar era.

With the beginning of the Second World War, commercial traffic on the North Atlantic became too risky and was halted. Military air traffic took precedence over private flight, and airlines were drafted into the war effort. Ultimately, the war effort advanced transatlantic flight

considerably. The weather stations, airfields, and radio facilities around the Atlantic were improved or expanded as vast sums of government money were directed towards making transatlantic flight safer and more reliable. Aeronautics industries in the United States and Britain similarly benefited from government largesse to produce planes by the thousand, many of which had transatlantic range. The beefed-up aeronautics sectors were more than suited to the postwar needs of aviation, especially for transatlantic air travel. The bombers built (mainly in America) were often adaptable models that could be converted to civilian needs once the war ended, giving the United States a huge advantage in postwar civilian aircraft production and turning out affordable planes for airlines the world over. The airlines of the United States, Canada, and Britain inherited transatlantic-proven fleets, a windfall that they could not have expected had they not been so closely tied to government programs. This dissertation showed that the state involvement in aviation was a huge benefit to the airlines and to the American, Canadian, and British aeronautics companies in particular.

After the Second World War, countries in both North America and Europe began to make use of the investments made to improve the infrastructure and aircraft technology as their airlines took to the North Atlantic skies. Those countries depended on a system of bilateral agreements that had to be redesigned for the needs of postwar aviation, when planes had much longer ranges and greater capacity than in the interwar years. The creation of the ICAO and IATA helped to manage the rapid expansion of international air travel after 1945 as they offered the governments and airlines, respectively, the forums to harmonize the detailed work underlying flight operations, regulations, airfares, and other services that commercial air travel depended upon. Even these two organizations were not entirely up to the task of making international flight acceptable to all parties, prompting the Bermuda Agreement in 1946. By satisfying (at least

moderately) the needs of the two main parties on the busy North Atlantic, the Bermuda Agreement was widely heralded as a guide for future air agreements between all other countries and served as the template for thousands of agreements that followed. The two international groups and the Bermuda Agreement had serious shortcomings, and all of them evolved over the course of their existence, but they were largely responsible for shaping air travel around the world and all of them were formed with transatlantic air service firmly in mind.

The planes that served on the North Atlantic following the war offer a subtler example of government involvement in aviation. Certainly the British at first and the Airbus and Concorde groups later had considerable government backing, and indeed would have been inconceivable without such assistance. And it was the Europeans that first introduced commercial jets and supersonic aircraft. But the vast majority of the planes and nearly every model used for transatlantic service up to the 1970s were American, built by private industries for private airlines. The American market was very well suited to foster such an industry, with a large and wealthy population widely dispersed across a continent yet within a single economic marketplace. But this conceals America's considerable state backing of its aeronautics industry. Military contracts and space exploration brought billions of government dollars annually to the same companies that developed and built the commercial airliners. It took European companies decades just to rebuild from the war, so it was natural that it took longer for them to realize that they needed to look beyond their borders and unite with one another to realize the economies of scale that the Americans exploited for their own advantage. Good aircraft were built by both Americans and Europeans but neither was able to do so without considerable government assistance.

All the government efforts to build infrastructure in support transatlantic flight paid off handsomely. The knowledge base built up before and during the Second World War made the North Atlantic a well understood place, with weather conditions known as well as anywhere in the world and thoroughly explored by 1945. Plus, the weather stations, air traffic control systems, and even a fleet of weather ships served air travel across the North Atlantic around the clock. Flights were able to depart from North America to Europe or vice versa secure in the knowledge that they were well prepared to handle any likely contingency along the way. As impressive as the normalization of air travel across the ocean was, the degree of cooperation between countries on both continents was equally significant. The countries shared their weather data freely with one another for the benefit of all. The weather ships, run by the ICAO, took this even further: the ships were all run by navies or coast guards of the various participating countries but worked together under international auspices to support air travel. Air traffic controllers in several countries were always tracking one another's planes and handing them off by the hundreds every day using the most sophisticated technology. These illustrate Paul Edwards' theory of infrastructural globalism whereby sophisticated infrastructural systems can be far more effective on the largest scales. This dissertation showed that the North Atlantic could not have been traversed with such ease had the countries of the region not pooled their resources and collaborated to make the region safe.

It was government support for the aeronautics industry, infrastructure development, and often directly for the airlines themselves that made the North Atlantic safe for regular air travel. European companies were openly supported by their governments. Their airlines sometimes flew routes at a loss or were saddled with uneconomical domestic-made planes for purely political reasons, but they were guaranteed financial support in lean times. But the unrestricted

competitive marketplace championed by the United States, whose big airlines and aeronautics companies dominated the postwar era, was made possible in part by considerable state efforts. The American government used its clout as the biggest source of foreign aid and tourist dollars to win favourable air agreements. Its airlines would have been far less competitive on the North Atlantic market had the United States been more conciliatory towards its war weary European counterparts when it negotiated its postwar bilateral agreements.

Boeing, Lockheed, and Douglas made by most accounts best planes on the market but earned lucrative military contracts that cross-subsidized their research and development programs on a scale that European countries could not match. The European partnerships that created Airbus and Concorde may have been publicly backed throughout their existence but they were more openly so than the American firms they competed against. Even as deregulation swept through the airline sector in the latter twentieth century and the European aeronautics firms consolidated to economically compete with the United States, it is fair to say that no one country or group of countries ever competed in a truly free market. This dissertation showed that a truly free and competitive market in the capitalist sense was not in evidence on the North Atlantic: states closely managed or protected their national businesses.

All of those efforts were spurred on because the value of transatlantic travel was evident from the earliest days. No other region was as important to international air travel as the North Atlantic. Every country in the twentieth century wanted to have an airline, and every airline in Europe and North America wanted to fly on the North Atlantic. It boasted the biggest volume of passengers, the most revenue for airlines with mail and cargo services alone worth millions of dollars daily, served some of the largest and most renowned cities, and offered airlines a prestige that could not be found by flying anywhere else. Airlines put their best planes on those routes,

carrying their passengers in the most state-of-the-art planes available. Planes were specifically built with transatlantic range in mind to tap into the burgeoning passenger market. But these were all done with the aid of public money rather than the natural development of free enterprise in a lightly regulated market. Governments heavily invested money and resources to assemble the infrastructure needed to get the planes across the ocean quickly and safely, and subsidized their carriers when they could not turn a profit there in order to retain that essential link. Those governments also fought for bilateral air agreements that opened the routes to their own airlines without handing over too much business to their foreign competitors. The North Atlantic was the only place in the sphere of aviation that merited so much attention, effort, and resources. For good or ill, transatlantic air travel depended on government involvement that defined air travel the world over.

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