From Kites through Cold War: The Evolution of United States Air Force Manned Airborne ISR

by

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About the Author

Lieutenant Colonel Tyler W. Morton enlisted in the Air Force as a Spanish Airborne Cryptologic Linguist in 1991. After serving five years as a linguist and accumulating over 2,000 flight hours on the RC-135 RIVET JOINT and E-3 AWACS, he completed a degree in Spanish from the University of Nebraska at Omaha and was commissioned in 1998. Following assignments at USEUCOM's Joint Analysis Center, NORAD-USNORTHCOM's J2 directorate, and a one-year stint at the Joint Interrogation and Debriefing Center in Iraq, he returned to the RC-135 community as the Assistant Director of Operations at the 97th Intelligence Squadron at Offutt AFB, Nebraska. In 2008, he was selected to stand-up and command the Air Force's first MC-12 PROJECT LIBERTY signals intelligence (SIGINT) detachment. Following his detachment command, he attended the Air Command and Staff College (ACSC) and, subsequently, the School of Advanced Air and Space Studies (SAASS). Following SAASS, he spent two years on the Air Staff in the Deputy Chief of Staff for Intelligence (A-2) Strategy Division where he authored *AF ISR 2023: Delivering Decision Advantage*. He is currently the Commander of the 488th Intelligence Squadron at RAF Mildenhall in the United Kingdom where he is responsible for the collection, processing, exploitation, and dissemination of RC-135 intelligence.

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Abstract

The fundamental purpose of this dissertation is to enable students of air power to understand and appreciate the evolution of manned airborne intelligence, surveillance, and reconnaissance (ISR) and the way it has fundamentally changed the conduct of warfare. The manner by which it evolved and its subsequent importance to today's militaries has significant contemporary relevance. As the United States advances into a new postwar era, evaluating the historical treatment of manned airborne ISR is important to informing current decisions. The historical tendency has been to drastically reduce intelligence forces following major combat operations. During the early 21st century, United States Air Force (USAF) airborne ISR grew considerably to match the requirements of the ground-focused conflicts it faced. Operations ENDURING FREEDOM and IRAQI FREEDOM demanded a tactically-focused airborne ISR force that the Air Force (AF) did not have when those operations began. Now that those conflicts have wound down with 'boots on the ground' minimized, the question that faces the AF ISR community is how to rebalance the airborne ISR force to best prepare for major contingency operations? Additionally, there has long existed a question of whether manned airborne ISR forces are more appropriately used as strategic intelligence collection platforms or if they are better suited to provide intelligence directly to warfighters. While this distinction may seem trivial to some, within the USAF airborne ISR community it is not. Tactical intelligence collection often requires distinct aircraft, and more importantly, distinctly trained personnel. As this dissertation will show, the necessity to maintain proficiency in both capabilities is of utmost importance. In addition to illuminating the evolution of airborne ISR, this dissertation seeks to fill an historiographical gap. Other authors have tackled aspects of this subject, but none have comprehensively approached the evolution. The hope is that by reading this dissertation, all will have a better-informed appreciation of the travails of airborne ISR over history and will use the past to inform future decisions.

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Introduction

ISR is operations; not just support to operations.
Lieutenant General David Deptula

Military commanders have long understood the role superior information plays in the formulation of military tactics and strategy. In preparation for his invasion of Canaan, Moses dispatched spies to "see what the land is like, and whether the people who live there are strong or weak, few or many."[1] Not long thereafter, the ancient Greek Demosthenes skillfully used spies and scouts to help secure victory in the Battle of Sphacteria.[2] In the American Revolutionary War, George Washington's vast spy network kept him apprised of British moves and undoubtedly contributed to American victory.[3] In the American Civil War, Confederate Brigadier General J.E.B. Stuart's failure to provide intelligence regarding the Union Army's movements left General Robert E. Lee blind in the opening days of the Battle of Gettysburg.[4]

While the intelligence provided in the above examples directly contributed to success or failure, the information in each was limited to what the spies and scouts could observe from the ground. For the majority of human existence, man's uppermost vantage point was limited to the highest piece of land he could find or the tallest tree he could climb. Chinese military leaders shattered that constraint sometime before Christ. While the dates and circumstances cannot be precisely determined, consistent documentation exists which chronicles Chinese use of man-lifting kites to scout enemy defensive positions and to provide visual reconnaissance to assist in attack planning. While these kites

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[1] *The Airman's Pocket Bible* (Nashville, TN: Holman Bible Publishers, 2004), 127.
[2] Thucydides, *The Landmark Thucydides*, ed. Robert B. Strassler (New York, NY: Free Press, 1996), 239-244.
[3] For further information on Washington's use of spies see Alexander Rose, *Washington's Spies: The Story of America's First Spy Ring* (New York, NY: Bantam Books, 2006).
[4] Stephen W. Sears, *Gettysburg* (Boston, MA: Houghton Mifflin, 2003), 139.

were a rudimentary form of gaining an elevated viewpoint, they proved the concept of flight and the value to be gained from a higher vantage point.

The kite proliferated from China and was the inspiration for many aviation engineers and architects through the years. In the late sixteenth century, the Swiss physician Johannes Jacob Wecker saw the kite as the key to enabling manned flight.[5] A student of aerodynamics, Wecker was certain he could reproduce the properties of kites to make a vehicle capable of carrying substantial weight. Others followed from across Europe with British, German, and Italian designers discussing kites and their potential use as man-lifting platforms. In the 1800s, British schoolteacher George Pocock designed and tested a kite that was able to lift cargo and people into the air. His book describing the uses of his new invention specifically mentions the kite's military applicability as an observation platform.[6]

While kites were instrumental in advancing engineering and theoretical ideas, they were principally a gateway to better things. By the time Pocock perfected his kite, the brothers Montgolfier had already changed the future of flight and particularly, airborne intelligence, surveillance, and reconnaissance (ISR). Their successful test of a hot air balloon on 4 June 1783 launched a new era of warfare. Within days, visionaries recognized the military utility of the invention and only four months after the initial flight, the Montgolfiers put the first balloon aeronaut in the air. No longer would man's view be restricted. The air provided the highest view and the ultimate reconnaissance advantage.

The new air vehicle offered many possibilities and shortly after seeing the balloon for the first time, many turned their thoughts to its military potential. While it had undoubtedly been considered by many, Frenchman André Giraud de Villette is often credited as the first to promote the balloon as an ISR

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[5] Lynn Townsend White, *Medieval Religion and Technology: Collected Essays* (Los Angeles, CA: Center for Medieval and Early Renaissance Studies, University of California-Los Angeles, 1978), 71.

[6] George Pocock, *A Treatise on the Aeropleustic Art, or Navigation in the Air by the Use of Kites or Buoyant Sails*, 2nd ed. (London, UK: Longman, Brown, and Co., 1851), 19-20.

platform.[7] In a letter written only four months after the first Montgolfier flight, Villette provided what can be considered the first documented advocacy for the use of balloons for ISR. Other Europeans followed with several advocating for the immediate incorporation of the balloon into their respective militaries. Many of the United States' Founding Fathers also showed an early interest. Having witnessed the first manned flight, Benjamin Franklin highlighted the balloon's potential for ISR, transport, and strategic bombing in his reports and letters. George Washington, Thomas Jefferson, James Monroe, and James Madison also took notice of the early balloon experiments with all four speculating about the military applicability.

While the American founders hypothesized, balloon engineers in Europe refined the early designs. These advances made the military use of the balloon a reality and on 2 June 1794 – a short ten years following its invention – the French Army conducted the first modern manned airborne ISR sortie when Captain Jean-Marie-Joseph Coutelle observed besieging Austrian and Dutch troops outside the city of Maubeuge.[8] The impact was immediate. French ground commanders relied heavily on the intelligence Coutelle provided as they planned their attacks and counterattacks. The first military use of the balloon as an ISR asset was an overwhelming success. Despite this, little was done to further advance the balloon's military utility in the first half of the nineteenth century. Napoléon Bonaparte's reliance on his cavalry for reconnaissance sidelined balloon ISR in the French Army and other nations saw little immediate need for its incorporation. A few used them sporadically during the first half of the century, but their impact was limited. Balloons would not again play a major military role until the American Civil War.

Following its initial setbacks, the Union Army was desperate for any advantage it could gain. In June 1861, self-taught aeronaut Thaddeus Lowe demonstrated the potential force enhancing power of airborne ISR to President

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[7] Frederick Stansbury Haydon, *Military Ballooning during the Early Civil War* (Baltimore, MD: The Johns Hopkins Press, 1941), 2.
[8] Ibid., 10.

Abraham Lincoln. Ascending in a balloon over the Columbian Armory in Washington, D.C., Lowe reconnoitered the surrounding area and, more importantly, reported what he saw directly to the President via a telegraph he had installed in the balloon. Lincoln recognized the potential immediately and ordered the Union Army to integrate the balloon into operations. After some initial growing pains, Lowe and fellow aeronaut John La Mountain provided airborne ISR to Union commanders for the first two years of the war. Their intelligence was unique and after skeptical ground commanders became convinced of its veracity, was in high demand. Unfortunately for the aeronauts – and the evolution of airborne ISR – Union finances were limited and as the war progressed balloons did not receive the funding to keep them flying. Additionally, in these early stages, the logistical problems associated with balloons were more than the wartime Union Army could abide. Despite this, airborne ISR had a foothold. The ability to see the enemy positions from the air and communicate that intelligence in real-time was a capability that armies greatly needed.

The balloons used in the Civil War were primarily static in nature. They were tethered to the ground which greatly limited their mobility and, as artillery improved, became easy targets. Additionally, warfare following the Civil War was increasingly mobile. While static balloons would continue to be used for airborne ISR through World War I, to be fully integrated into militaries, they needed to be able to move with the ground forces. To remedy this obvious limitation, inventors sought ways to improve the durability of the balloon, provide propulsion, and steer them. These improvements led to the dirigible airship which, at the time, seemed like the perfect airborne ISR platform. The dirigible's weaknesses would be exposed in the beginning days of World War I, but by that time, the airplane had already been solidified as the platform of choice for airborne ISR.

Airborne ISR growth was precipitous following the invention of the airplane and the navigable balloon. Armies around the world saw the value of the aircraft and early air power theorists contemplated ways to incorporate the new capability. Within four years of the success at Kitty Hawk, two future air power icons had already written about the potential military uses of aircraft. In papers

and lectures at the Army's Signal Corps School, then-Captain Billy Mitchell espoused the benefits of balloons for reconnaissance and the need to develop consistent air-to-ground communications.[9] Also at Leavenworth, then-Lieutenant Benjamin Foulois wrote about the Army's need to include aeronautics. In a bold and forward-thinking thesis, Foulois discussed aerial combat and the need for air superiority to enable airborne ISR.[10] Foulois – perhaps influenced by Mitchell – also wrote about the need to develop communications systems that would allow airborne platforms to rapidly pass information to the ground.

Despite the excitement in these early days, the United States Army did very little to advance airborne ISR. Ground armies were also modernizing and Army general officers elected to focus on the tried-and-true infantry rather than take a risk on what they considered an unproven capability. As a result, growth was slow and when World War I started, the United States had almost no airborne ISR capability. Fortunately, the United States was not the only nation growing air forces. In Europe, the French, British, Germans, Russians, and Italians all advanced airborne ISR during the years leading up to the war. For them, the need was palpable; most European nations knew or suspected war was imminent. The French took the early lead, but by 1914, all five nations had respectable capabilities that they used to significant effect in the early days of the war.

Early airborne ISR success in the war showed commanders the value of the new capability. On the western front in August 1914, British Royal Flying Corps (RFC) aircraft detected German attempts to outflank the British Expeditionary Force (BEF) and prevented almost certain disaster. The intelligence provided by the RFC gave British and French commanders the

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[9] Captain William Mitchell, "2nd Lecture on Field Signal Communications" (lecture, United States Army Infantry and Cavalry School, Department of Military Art, Fort Leavenworth, KS, May 1905), 15, http://cgsc.contentdm.oclc.org/cdm/ref/collection/p4013coll4/id/472 (accessed 15 September 2015).

[10] Benjamin D. Foulois, "The Tactical and Strategical Value of Dirigible Balloons and Dynamical Flying Machines" (thesis, United States Army Signal Corps School, 1 December 1907), 3, 168.68-14, AFHRA.

decision advantage they needed to counter the Germans and stop their advance toward Paris.[11] In the east, German airborne ISR returned the favor as it detected Russian Army formations near Tannenberg.[12] With the information the aircraft provided, German General Hermann von François was able to surround the Russian Second Army and eliminate it from the battle.

As the sides settled in to the trench stalemate that characterized the next phase of the war, ISR assets over the battlefields became ubiquitous. The unblinking eye of airborne ISR made it almost impossible for the adversaries to make any undetected moves. As the war progressed, in addition to the tactical intelligence airborne ISR was providing of the front lines, commanders began using their aircraft to range behind enemy lines to collect strategic-level intelligence. This new mission, combined with the already established artillery spotting role, helped further solidify airborne ISR as an integral piece of modern militaries as did the continued advance of airborne imagery technology and wireless communications.

Unprecedented success in World War I was followed by retrenchment and isolationism. A sweeping personnel drawdown combined with crushing world depression severely limited interwar ISR development with only the Germans advancing doctrine and equipment to match the war they expected to fight. Interwar airmen of the United States Army Air Corps (USAAC) and the Royal Air Force (RAF) focused almost exclusively on the development of the long-range bomber with scant attention paid to the simple fact that airborne imagery intelligence (IMINT) would be necessary to provide the targets for strategic bombing. As World War II began, airborne ISR forces had progressed very little. The exigencies of war, however, would demand a precipitous increase in airborne ISR.

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[11] Sir Walter Raleigh, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 1 (Oxford, UK: Clarendon Press, 1922), 316.
[12] Dennis E. Showalter, *Tannenberg: Clash of Empires, 1914* (Washington, DC: Potomac Books, 2004), 278.

When Germany invaded Poland in September 1939, neither Britain nor France possessed a significant military airborne ISR capability. The situation had deteriorated to such an extent that the United Kingdom had hired an independent journeyman to conduct airborne IMINT collection of targets in Europe.[13] When the war began, the British government ordered an immediate rearmament, but even war could not overcome the dire world financial situation of the time. When Germany attacked France in May 1940, little improvement had been made. Allied inability to provide airborne ISR left commanders virtually blind to German moves and undoubtedly contributed to the BEF's quick defeat and subsequent evacuation from Dunkirk. When Prime Minister Winston Churchill committed the RAF to a strategic bombing campaign in 1940, he asked for services that his bomber forces simply could not provide; the prewar doctrinal focus on strategic bombing had not been accompanied by the acquisition of airborne ISR assets – or the training of photo interpreters – that could provide the targeting intelligence necessary to strike effectively targets in Germany.[14] The British immediately sought to rectify the problem, but it would take time.

In the United States, the interwar air focus was also on strategic bombing. Like their British counterparts, airmen of the USAAF had developed bombing doctrine, but had not acquired or budgeted for airborne ISR assets with the range or capability to collect imagery of the targets they would ultimately be tasked to bomb.[15] In the early days of the war, they scrambled to obtain any targeting data they could on Germany and Japan. For Japan, there simply was none and for Germany, they turned to the British. Beginning in May 1941, the USAAF sent a series of officers to England to learn how to conduct air intelligence. These airmen absorbed as much as possible about airborne IMINT collection and photointerpretation and were able to bring their knowledge back to the United

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[13] Roy Conyers Nesbit, *Eyes of the RAF: A History of Photo-Reconnaissance* (Stroud, UK: Alan Sutton Publishing Limited, 1996), 63.
[14] Taylor Downing, *Spies in the Sky: The Secret Battle for Aerial Intelligence During World War II* (London, UK: Hatchette Digital, 2011), 34.
[15] Robert C. Oliver, "Military Intelligence MI-1-C" (lecture, ACTS, Maxwell AFB, AL, 3 April 1939), 248.5008-1, AFHRA.

States. Additionally, the British shared all available targeting data on Germany. While not comprehensive, when the VIII Bomber Command arrived in England in February 1942, its planners had enough material to start forming their strategic bombing campaign.[16] Finally, the British were instrumental in assisting the United States establish a signals intelligence (SIGINT) collection system. In summer 1942, American airmen began training at British SIGINT technical schools and learning the art of collection, processing, and dissemination. After graduation, most of these indoctrinated airmen helped establish the USAAF SIGINT Division (SID) while others went directly into British SIGINT collection sites to act as liaisons.

Beginning in 1940, airborne SIGINT was introduced when RAF airmen of the Blind Approach Training and Development Unit (BATDU) flew on specifically configured Avro Anson aircraft searching for German radio guidance beams.[17] Not long after, the British began conducting airborne electronic intelligence (ELINT) collection on specially configured aircraft. At about the same time, airmen in the Pacific began flying the B-17E and B-24D – which had been modified to include an ELINT collection capability – against suspected Japanese radar sites in the Aleutians. These aircraft were known as Ferrets as they flew close to enemy radar sites in an attempt to "ferret them out," an idiomatic expression that meant the aircraft were trying to get the radars to illuminate them which would allow the ELINT collection system to capture specific data about the radars. The Ferret flights were immediately successful with the first forays producing targetable data that was used by the Eleventh Air Force to attack Japanese radar sites.[18]

Airborne ELINT collection quickly spread to the European theater and by the second half of 1943, Ferret flights were probing German and Italian radars

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[16] Robert F. Futrell, "US Army Air Force Intelligence," in *Conduct of the Air War in the Second World War*, ed. Horst Boog (Oxford, UK: Berg Publishers Limited, 1992), 459-539.
[17] Martin Streetly, ed., *Airborne Electronic Warfare: History, Techniques, and Tactics* (London, UK: Jane's Publishing Company Limited, 1988), 124.
[18] Lieutenant Colonel John Andrews (former officer of the 404th Bombardment Squadron), interview by John H. Cloe (Alaskan Air Command historian), 9 September 1984, K239.0512-1537 C.1, AFHRA.

across the Mediterranean theater of operations. At about the same time, British officials first proposed the idea of extending their ground SIGINT coverage by placing linguists onboard the Ferret aircraft. In summer 1942, the plan became a reality when 162 Squadron of the RAF began flying with a linguist on board its communications intelligence (COMINT)-modified Bristol Blenheim bombers. Experimental at the beginning, the tactical – and ultimately strategic – value of airborne linguists quickly became apparent. Recognizing the incredible contribution the extended range added to the overall understanding of the Luftwaffe's tactics, techniques, and procedures (TTPs), in June 1943 the British implemented a program to include linguists on strategic bombing missions over occupied Europe.[19] As with most other SIGINT programs, the Americans quickly followed and by at least August 1943, the USAAF had started its own airborne linguist program.[20] By the end of the war, German- and Japanese-speaking linguists were accompanying USAAF bombers in both theaters. The intelligence they delivered was landmark. At the tactical level, the threat warning they provided aircrews saved countless lives. Even more important may have been the strategic information they contributed as post-mission analysis of Luftwaffe TTPs led to a myriad of changes in bombing techniques and formation flying.

Following World War II, the United States military again faced personnel drawdowns and budgetary constraints. This time, however, the threat posed by the Soviet Union (USSR) would permit American airmen to maintain a capable, though small, airborne ISR force. Through the second half of the 1940s, enterprising airmen advanced airborne SIGINT and IMINT capabilities as they struggled to develop intelligence on America's new foe. The paucity of information on Soviet strategic targets created a conundrum for the United States Air Force. It had been given the task of conducting strategic air warfare, but it had no

[19] "Minutes of a meeting held at Air Ministry on Thursday, 17th June, 1943, to consider the question of Airborne Interception of V.H.F. R/T," TNA, AIR 40/2717.
[20] Colonel William W. Dick, Air Adjutant General, Headquarters Northwest African Air Forces, to Air Officer Commanding-in Chief, Mediterranean Air Command, letter, 9 August 1943, in "Intelligence section: Signals: 'Y' service: investigation flights by American aircraft," document 10A, The United Kingdom National Archives (TNA), AIR 51/299.

intelligence capability that could provide the targeting information it needed. To remedy this, a myriad of modified bombers and transport aircraft – C-47s, B-17s, B-24s, and B-29s – conducted collection along the periphery of Soviet-controlled territories. The intelligence they gathered was useful, but to truly attack the Soviet Union and cripple its economic system, the USAF required more detailed targeting information.

As the United States was trying to redress its lack of information on the Soviets, war in Korea presented opportunity and another challenge for the Air Force. The opportunity was that President Harry Truman feared Soviet and Chinese involvement in Korea was a precursor to a bigger war and perhaps an attack on the United States. Because of this, he authorized a major increase in airborne ISR flights and even allowed direct overflight in some cases.[21] The challenge Korea presented the Air Force centered on the fact that during the years preceding the war, it had done little to advance its capability to provide airborne intelligence directly to tactical warfighters. Its focus had been on collecting strategic intelligence on the USSR and it was not prepared to shift emphasis when the war began. Through dogged determination and innovative thinking, however, over the course of the war it would ultimately develop capable dissemination systems for both airborne SIGINT and IMINT. Throughout the war, airborne IMINT played a critical role and in the latter half, airborne SIGINT became an important contributor.

As opposed to the responses following both world wars, after the Korean conflict airborne ISR was not gutted as it was to be the key – and sometimes only – provider of information on the USSR. Airborne SIGINT sorties along the periphery of Soviet-held territory and, beginning in 1956, U-2 IMINT flights directly over the USSR gave American policy makers the intelligence they needed to maintain the upper hand on their Soviet counterparts. U-2 flights over the USSR shattered the bomber gap myth and in 1962, gave the United States the

[21] R. Cargill Hall, "Postwar Strategic Reconnaissance and the Genesis of Corona," in *Eye in the Sky: The Story of the Corona Spy Satellites*, eds. Dwayne A. Day, John M. Logsdon, and Brian Latell (Washington, DC: Smithsonian Institution Press, 1998), 94.

advanced warning it needed to deflect a Soviet attempt to install nuclear weapons in the Western Hemisphere.

By the time American involvement in Vietnam began, it is safe to say that airborne ISR had transformed. As would be the case from that conflict onward, airborne ISR was called upon before any other major forces. By 1961, airborne SIGINT and IMINT assets were already in Southeast Asia collecting intelligence to help strategic and tactical decision-makers. In the earliest stages of the conflict, the United States Air Force Security Service (USAFSS) was already flying its RC-47 COMINT collector and Tactical Air Command (TAC) had deployed an SC-47 imagery platform.[22] Tactical reconnaissance (TACRECCE) was prolific throughout the war and airborne SIGINT provided the information American pilots needed to turn the tide during ROLLING THUNDER and LINEBACKER II. With programs like COLLEGE EYE, RIVET TOP, and TEABALL, the tactical delivery of airborne ISR direct to warfighters had truly come of age.

Again, after Vietnam, while other forces atrophied, airborne ISR continued to advance its capabilities. By the end of the Cold War, it had become an integral part of the joint force providing near real-time intelligence directly to the warfighter through both advanced tactical digital communication links and direct radio communications. The ultimate high ground had finally been conquered. The eyes and ears of the commander were extended to allow him to view, and hear, unprecedented levels of detail. Manned airborne ISR had completed its evolution. By starting at the beginning – with kites – this dissertation follows the course of manned airborne ISR evolution. It tracks the trials and tribulations, the ups-and-downs, the advances, and the setbacks over which it ultimately triumphed. Understanding the historical path will help future generations guide its use and continued development. As the United States faces

[22] Robert J. Hanyok, "Spartans in Darkness: American SIGINT and the Indochina War, 1945-1975," in *The NSA Period: 1952 – Present*, series VI, vol. 7, (Fort Meade, MD: Center for Cryptologic History, 2002), 242; Craig C. Hannah, *Striving for Air Superiority: The Tactical Air Command in Vietnam* (College Station, TX: Texas A&M University Press, 2002), 8.

a new postwar period, developing a complete comprehension of the past successes and failures will prove useful to future decision-making.

This dissertation is more than just an historical review of Air Force manned airborne ISR, however. The spread of airborne intelligence collection has been mind-bogglingly rapid particularly over the last 20 years. Today, at any given moment, there are dozens of ISR aircraft flying missions around the world. Scarcely over 100 years after the invention of the airplane and its incorporation into the various armed forces, airborne ISR has become truly ubiquitous. With such great proliferation, it is imperative that Air Force decision makers understand the path airborne ISR took to arrive at today's enormous capability. ISR is no longer simply support *to* operations, but often is the actual operation in and of itself. To help ensure airborne ISR remains in the place of prominence it has rightfully earned, historical analysis is imperative. With any luck, the study of airborne ISR's rich historical evolution will inform decision making regarding its future. As will be seen, ISR has often been the victim of budget cuts following major conflicts. The author hopes to prevent the past from repeating by presenting a thorough analysis that highlights the negative effects cutting ISR had on a nation's ability to rapidly collect intelligence when the next – almost always unexpected – conflict arose.

An additional goal of this dissertation is to show the incredible flexibility and innovative spirit that airmen of all types and nationalities have displayed over the centuries during the evolution of manned airborne ISR. In recent years, the USAF Chief of Staff, General Mark Welsh, has latched on to a concept first put forth in a RAND study from 2012. This "Over Not Through" narrative reminds Airmen of the historical legacy the service has regarding innovation. Airmen, the study posits, have always separated themselves by their ingenuity and desire to find better solutions to challenges…to go *over*, not *through* a problem.[23] This dissertation argues that the spirit of innovation applies to a much wider time

[23] Paula G. Thornhill, "Over Not Through: The Search for a Strong, Unified Culture for America's Airmen," RAND Occasional Papers Series (Santa Monica, CA: RAND Corporation, 2012), 8

expanse than the RAND study examined. Beginning with the earliest dreamers and designers, innovation has been the hallmark since the first Chinese airman was hoisted in a man-lifting kite to reconnoiter enemy strongholds. The innovative spirit is intrinsic to each airman, and consequentially, each manned airborne ISR success over time. Examining the people that made possible the evolution of manned airborne ISR is an important contribution of this dissertation.

Perhaps counterintuitively, airborne ISR also provides much more than intelligence. Another aim of this dissertation is to explore how. Throughout the Cold War, the power of the United States was often demonstrated by its ability to place manned airborne ISR aircraft off the coast of potential adversaries. While this sometimes resulted in death for the Airmen who were in the aircraft, it was also a valuable political tool for the United States government. The simple fact that the United States has the technological capability to dispatch aircraft across the globe is a stark deterrent to potential adversaries. Additionally, when conflicts begin that involve United States partner nations, often American airborne ISR assets are the first sign the government provides to show support for its allies. These 'show the flag' missions are often used as a reassurance that highlights United States interest to partner nations. This use of airborne ISR aircraft as a diplomatic instrument of power presents an interesting juxtaposition. Through the course of the dissertation, situations in which airborne ISR became a pawn in the greater geopolitical chess match are explored.

This study also evaluates the historical challenges presented by the requirement for airborne ISR assets to conduct strategic and tactical missions often with the same platforms and aircrews. In the years immediately preceding and following World War II, the delineation between the two types of missions was a positive step as it allowed the Army Air Corps the ability to designate aircraft and missions specifically to support strategic air warfare. As would be seen in the early days of the Korean War, the intelligence community's strategic focus on the Soviet Union had left little room for any other type of ISR. When ground and air warfighters in Korea asked for airborne ISR support, very little

was available and it took over a year before USAF airborne ISR was able to provide significant intelligence directly to those in harm's way. Following the Korean War, the heightened concern regarding the spread of Communism again drove the airborne ISR community to an almost singular strategic-level focus on the USSR and China. The lessons of Korea were lost – or ignored – and when the Vietnam War began, Airmen found themselves relearning tactics, techniques, and procedures that should have been codified and turned into doctrine. Proving their incredible flexibility, enterprising Airmen overcame the slow start and were providing truly world-class tactical ISR directly to warfighters by LINEBACKER II. Following Vietnam, airborne ISR returned to a primarily strategic focus. This time, however, the lessons of tactical ISR were remembered and practiced in joint and combined exercises. When Operation DESERT STORM began, airborne ISR was ready for the swing back to tactical support and performed magnificently.

The upcoming analysis will highlight the historic trend that has required ISR professionals to remain qualified to support both types – tactical and strategic – with little to no warning. The dissertation will show that the skill sets required – for both IMINT and SIGINT analysts – are very different. Few outside the AF ISR community understand or appreciate this. While current USAF ISR doctrine rightfully discusses the ability of ISR to provide strategic and tactical level ISR simultaneously, at the squadron level this requirement provides training challenges for the commanders and operations officers charged with providing airborne ISR forces.[24] The level and type of training required to produce strategic intelligence is vastly different from that required of tactical support forces. As will be seen, when collecting strategic intelligence, ISR airmen generally have ample time to analyze their collection to determine its accuracy. This allows for a more precise level of detail, but results in a slower process. With tactical intelligence, the opposite is true. The information collected often determines life or death for an aircrew or a soldier on the ground; the luxury of

[24] Air Force Doctrine Document 2-0, *Global Integrated Intelligence, Surveillance, and Reconnaissance Operations*, 6 January 2012, 1.

time is not on the side of the tactical intelligence collector as their intelligence must be delivered in near real-time. Each type – strategic and tactical – requires airborne ISR airmen of differing capabilities and mindsets. In times of constrained budgets and personnel, training such dissimilarities is problematic.

Finally, the requirement to prosecute both strategic and tactical airborne ISR will continue to stretch ISR airmen thin. The Cold War's singular focus caused a disproportionate skill set in the intelligence community. When called upon to provide tactical support directly to warfighters in Korea and Vietnam, airborne ISR struggled before eventually providing innovative solutions. Almost immediately following the Cold War, the United States became involved in the Middle East; a focus which has endured for the last 20 years. The conflicts in Iraq and Afghanistan caused another swing from the strategic focus of the Cold War to a tactical focus where airborne ISR was asked to deliver actionable intelligence and direct threat warning in near real-time. Following the withdrawal from Iraq and Afghanistan, the United States must assess where its airborne ISR force should place primary emphasis. The rise of global terrorism has created a dichotomy that will continue to challenge ISR leaders. The recent return of an old Cold War adversary and the narrowing of the United States' technological advantage has reminded Air Force intelligence leaders of the fundamental purpose of AF ISR which is to "provide an organization capable of furnishing adequate, timely, and reliable intelligence for the Air Force."[25] This need to prepare Joint Force Air Component Commanders (JFACC) for operations in contested environments is pitted against the demand for an 'unblinking eye' in the battle against violent extremist organizations. The former requires strategic intelligence while the latter requires tactical. As many leaders have recently commented, AF ISR has become disproportionately focused on the tactical fight in permissive environments and it will require significant work to ensure AF ISR can answer JFACC requirements. Foundational skills have undoubtedly

[25] "Key West Agreement, 21 April 1948," in Richard A. Wolf, *The United States Air Force: Basic Documents on Roles and Missions* (Washington, DC: Office of Air Force History, 1987), 163.

atrophied due to the focus on the tactical fight and rebuilding the core competencies of ISR professionals is a challenge that will take time. AF ISR strategists must consider this factor as they plot the ISR course of the future.

Historiography

The dissertation also serves to fill an historical gap. Surprisingly, the list of works that discuss the evolution of manned airborne ISR is thin. Indeed, no one book or paper exists that provides a comprehensive summary of airborne ISR such as that presented in this dissertation. Several prominent works do contain significant sections on airborne ISR. Larry Tart's two books, *The Price of Vigilance* and the five volume *Freedom Through Vigilance*, provide the most comprehensive review of manned airborne ISR dating from World War II, but his focus is almost exclusively on airborne SIGINT. *Piercing the Fog* – a compendium of essays edited by John Kries – briefly discusses World War II development of manned airborne ISR, but the treatment is only a minor fragment of a larger discussion on SIGINT and photointerpretation. Dr. Rob Ehler's fantastic history, *Targeting the Third Reich*, touches briefly on the development of airborne IMINT capabilities during World War II, but does not mention airborne SIGINT. Dr. John Farquhar's *A Need to Know* provides an outstanding description of the development of airborne ELINT, but only minimally discusses airborne COMINT and IMINT. R. Cargill Hall has written prolifically on various airborne ISR related aspects, but again, none of his works, albeit quite impressive and expertly researched, are comprehensive. In perhaps the best description of the early development of airborne SIGINT, Aileen Clayton's book, *The Enemy is Listening*, discusses the first placement of German linguists on American bombers and electronic intelligence (ELINT) aircraft in the Mediterranean campaign. Again, however, Clayton's description is only a small part of a larger narrative concerning the role of SIGINT in the war.

The author hopes to provide an important contribution to the body of literature by focusing on the historical evolution of manned airborne ISR and its

place in the overall history of air power. By cobbling together information from secondary sources with a large number of primary sources from the Air Force Historical Research Agency (AFHRA), the National Archives of both the United States and the United Kingdom, the Library of Congress, two presidential libraries, the Army War College, and declassified documents from the United States Air Force, National Security Agency (NSA), Central Intelligence Agency (CIA), and the 25th Air Force, the author hopes to present a study that will both educate and inform the ISR professional and interested historian. In this dissertation – particularly in the discussion regarding the creation of airborne linguists in World War 2 – are several primary resources that the author has not seen utilized in any other works on airborne ISR. This alone is a major contribution to the body of literature on the topic and to the general understanding of the history of air power.

Chapter Overview

History is replete with stories of man's desire to fly. Dreamers fantasized about flying long before man possessed the technological ability to build anything airworthy. For many, soaring above the earth was seen as an escape from the mundane life on earth or as a way to get closer to God. For others, the military advantages of being airborne were obvious. Today, many still believe manned airborne ISR began with French balloons in the late eighteenth century. This is simply not the case as it was the Chinese who were the first to build a successful flying craft and then put a man on it to observe his surroundings from the improved vantage point. Chinese success with kites proliferated to Europe and provided the aerodynamic solution that would enable future flight accomplishments. Chapter One explores this early period. By beginning with kites, the dissertation establishes the true birth of manned flight. The stories of the military application of manned kites illuminate the subsequent history of manned airborne ISR.

Chapter Two examines the invention of the balloon and tracks its early metamorphosis into an airborne ISR platform. Dating from shortly after its

inception, man saw the balloon's potential as a military force enhancer. Within weeks, visionaries, including several American Founding Fathers, were writing about the potential ISR utility of the balloon. The chapter analyzes the military proponents' thoughts on the uses of the balloon and examines how their ideas were put into action by their respective nations. By June 1794, the French military was employing the balloon for ISR in combat for the first time. Subsequent use by the Union Army in the American Civil War led to a greater appreciation of the potential for manned airborne ISR. In the early stages, aeronauts Thaddeus Lowe and John La Mountain conducted multiple sorties and collected unique information on Confederate movements in northern Virginia. Unfortunately, funding was lost and balloon ISR was abandoned. The two men had, however, proven the significant force enhancing power of manned airborne ISR. The chapter concludes with an examination of the challenges the static balloon presented in those early days and sets up the subsequent analysis of the development of navigable balloons and airplanes.

The first half of Chapter Three continues the examination of the development of the balloon. As the weaknesses of the static, or captive, balloon became apparent, balloon designers sought to make them mobile and navigable. The chapter highlights the various designs that ultimately resulted in the well-known German Zeppelin dirigible. The first half of the chapter concludes with an evaluation of the United States Army's integration of balloons and its first dirigible. The second half of Chapter Three focuses on the invention of the airplane and its subsequent adoption by militaries around the world. Major emphasis is placed on the early challenges of communicating from the aircraft to the ground as this one issue would continue to plague effective application of manned airborne ISR until at least the Vietnam War. The chapter includes secondary source material, but also provides perspective directly from the writings of many of the first air power advocates – Benjamin Foulois, Frank Lahm, Billy Mitchell, David Henderson, and Robert Brooke-Popham. As the chapter concludes, World War I is dawning; most major militaries have purchased airplanes and balloons, but have not incorporated them doctrinally.

Chapter Four focuses on manned airborne ISR's first trial by fire – World War I. Beginning with two early instances – The First Battle of the Marne and the Battle of Tannenberg – in which airborne ISR was a major contributor, the chapter follows its use and development throughout the war. When the war slipped into trench-based stalemate, manned airborne ISR became the unblinking eye that prevented freedom of movement for either side. This chapter is also where we first start to see delineation between the strategic and tactical use of airborne ISR assets. Before the stalemate of trench warfare, airborne ISR was used almost exclusively in a tactical role to provide near real-time information about the movement of enemy troops. When the lines stabilized, however, the role of ISR expanded to include strategic-level sorties deep behind the trenches. Visual observation and spotting for friendly artillery remained manned airborne ISR's main function, but forward-thinkers also saw the great value in anticipating what the enemy's next moves might be. The enduring challenge of air-to-ground communication is also explored further. While some wireless radio technology was employed, the various methods of passing the information from the airplane to the ground were unsatisfactory. Despite the challenges, through innovation, great strides were made. Airmen advanced the art of aerial photography significantly and the concept of a system of 'air intelligence' to provide aircrews with strategic and tactical warning was created. The chapter finishes by analyzing the United States' late entry into the war and the challenges it faced in trying to establish itself as an air power. American manned airborne ISR operations in Toul, Château Thierry, and St. Mihiel exposed mostly unproven aviators to a myriad of tests. Despite their inexperience, airmen – of all nationalities – performed exceptionally well during this first combat trial. Their innovative spirit and determination enabled them to overcome challenges and deliver timely intelligence to decision makers.

Chapter Five details the travails of airborne ISR during the interwar period and its meteoric growth during World War II. Despite the unquestionable positive impact it had during World War I, personnel drawdowns, budgetary limitations, and intra- and interservice bickering left airborne ISR unprepared when World

War II began. This chapter begins by examining interwar air power evolution of the major powers. All faced challenges, but only Germany truly developed an airborne ISR capability that was properly suited for the war it intended to fight. Britain and the United States pursued the concept of strategic bombing, but did little to advance the airborne ISR capability necessary to obtain the targeting information they would need. France did virtually nothing and when the war started had fallen so far that they were using Britain's contracted airborne IMINT to provide information on German intentions. When the war began, things changed quickly. By the Battle of Britain, the United Kingdom was already fielding an airborne ELINT platform and by 1942 had also developed an airborne COMINT capability. The United States followed the British lead and by 1943 were placing airborne linguists on B-17s and B-24s during bombing missions over occupied Europe. While the contributions of airborne IMINT during the war were essential to the successes of both sides, this chapter focuses primarily on the development of SIGINT capabilities as airborne IMINT has been thoroughly covered in various other studies. The discussion regarding the birth of airborne linguists in this chapter is unique. The author discovered many sources – primarily in the United Kingdom's National Archives – that illuminate the very beginnings of the airborne linguist capability. The chapter concludes with a brief summary of the incredible ISR evolution during this timeframe. From a relatively small airborne IMINT capability at the beginning of the war, the United States and United Kingdom finished the war with advanced airborne IMINT and SIGINT abilities.

Chapter Six's focus is the Cold War period. It catalogs United States Air Force manned airborne ISR's development immediately following the war and follows it through the eventual development of the U-2, SR-71, and RC-135. The main purpose of the chapter is to highlight the incredible flexibility that manned airborne ISR required during this period. It explains how the need to conduct strategic air warfare against the USSR drove the development of manned airborne ISR aircraft and tactics in the years immediately following World War II. It also examines the challenges presented by the focus on the USSR. When

wars erupted in Korea and Vietnam, the same Airmen who were collecting strategic information on the Soviets were asked to rapidly shift focus to a tactical environment. As will be explored, the requirements are different. Strategic-level ISR is methodical; its very nature allows for thorough analysis and skill development. Tactical-level ISR is by its very nature, time critical. The need to deliver threat warning directly to warfighters does not permit mistakes. The skills – and dissemination system – to do each are quite different. The chapter thoroughly explores these differences and again highlights the innovative Airmen that faced and, ultimately, overcame these challenges.

Another intent of Chapter Six is to demonstrate that even though post-World War II airborne ISR was built with a singular strategic focus, its Airmen were flexible enough to provide competent tactical support when called upon. The first case, the Korean War, shows that focus on the USSR created difficulty for airborne ISR early in the war. A lack of linguists, aircraft, analysts, and photo interpreters plagued initial efforts. After an early buildup period, however, airborne IMINT and SIGINT became major contributors. For IMINT, a rapid tasking and dissemination system was created that ensured imagery quickly arrived in the warfighters' hands. For SIGINT, enterprising ISR professionals developed a pioneering direct threat warning system that enabled American pilots to receive advanced notice of enemy aircraft locations and intent. The second example in Chapter Six looks at the Vietnam conflict. As opposed to Korea, the USAF entered Vietnam well prepared to provide tactical airborne ISR to ground and air commanders. Building on the lessons of the Korean War, Airmen developed a rapid imagery dissemination process and SIGINT professionals replicated the direct threat warning system they had established in Korea. This time, however, the system was fed by multiple types of airborne SIGINT platforms along with air and ground radar data – the ability to provide comprehensive near real-time intelligence directly to warfighters had come of age.

The dissertation concludes with a summary and a look at the future of manned airborne ISR. The rapid advance of technology and prolific spread of

remotely piloted aircraft (RPA) have caused some to believe that the human will soon be 'out of the loop' and the entirety of airborne ISR will be conducted via RPA. The author argues that while certainly valuable, RPAs are not a one-for-one substitute for traditional manned airborne ISR platforms. The enhanced situational awareness, decision making ability, and incredible flexibility that manned platforms contribute simply cannot be replicated by the RPA. While the author believes a mix of both types will continue, the conclusion is that manned airborne ISR has earned its position of prominence and will continue to be the first asset called upon in times of need.

Limitations and Scope

This work covers an extremely wide expanse of time. It begins in antiquity and stretches through the end of the Cold War. The idea was to provide as comprehensive an examination of the history of manned airborne ISR as possible. As mentioned above, one of the main aims of the dissertation is to fill a missing gap in the historiography. As such, the author chose to illuminate many of the lesser known historical events. For example, many, if not most, air power historians neglect manned kites. While few sources exist that explain the history, through a thorough review of those that have been written, a fairly comprehensive story can be told. As the dissertation proceeds, this theme continues. Much has been written about airborne IMINT, but the sections presented here regarding airborne SIGINT – and particularly the development of the airborne linguist capability – are mostly original.

While the early history of manned airborne ISR was a worldwide endeavor, following World War II and through most of the Cold War, manned airborne ISR was dominated by the United States, and the USAF specifically. Other countries developed a modicum of capabilities, but the unique economic position the United States found itself in following the war allowed it to significantly expand its manned capability. As such, the analysis of Chapter 6 focuses primarily on USAF ISR development during the Cold War. The global reach the Americans were able to achieve allowed the United States to conduct manned airborne ISR

around the globe. This ability was used repeatedly as a geopolitical power by the United States government and is a major focus of Chapter Six.

Two broader limitations also exist in the interest of length and scope. First, little is mentioned regarding the development of unmanned airborne ISR. The author is acutely aware of the lengthy history of RPAs, but chose to focus on manned airborne ISR primarily due to the ability to discuss the incredible ingenuity, innovativeness, and untiring spirit possessed by airborne ISR professionals. It is certain that Airmen of that ilk also existed in the RPA developmental history, but those stories are beyond the scope of this study. Additionally, the dissertation does not include an examination of the significant contribution made by space-based ISR assets beginning in the mid-1950s. As with RPAs, it is certain that satellite engineers faced many of the same challenges as their manned airborne ISR brethren, but due to length limitations, the author chose to remain focused on manned ISR.

Existing Literature and Source Review

As referenced in the 'Historiography' section above, many works exist related to the subject presented here. The limitation of the existing literature is that it almost always focuses on a single era, aircraft, or discipline within manned airborne ISR. Stitching together these various sources and stories has been a main aim of the work presented here. The dissertation includes an extremely wide variety of sources, but where possible, the author endeavored to find primary sources. As discovered throughout the course of research, many secondary sources are fantastic reads, but their historical accuracy is undermined, or at least made questionable, by their lack of primary source documentation. As such, where possible, this study looks for primary sources first and only uses secondary sources when absolutely necessary. The author's limited knowledge of foreign languages prevented the use of many primary sources; for these, the study relies on previous translations and secondary sources.

The first chapter's focus on early manned kites was difficult to research. Due to the simple fact that the early history occurred in the days before and closely after Christ, primary sources do not exist. Despite this, several secondary sources stood out. David Pelham's *The Penguin Book of Kites* contains stories regarding the Chinese use of kites in war. Likewise, Bernhard Laufer's comprehensive *The Prehistory of Aviation* details many of the stories explored in Chapter One. Harold Ridgway's *Kite Making and Flying* discusses the Chinese use of man-lifting kites and Clive Hart's *Kites: An Historical Survey* examines the kite's proliferation throughout Asia and eventually Europe. While these earlier sources mostly focused on the development of kites and only briefly mention the military use of kites, Lynn Townsend White's *Medieval Religion and Technology*, cites the first example of European thought regarding kites as the key for manned flight. His description of the Swiss physician Johannes Jacob Wecker's prediction that the aerodynamics of kites would eventually lead to airplanes is outstanding.[26] Beginning in the first half of the 19th century, the literature becomes more original and is easier to find. George Pocock – the inventor of the first purpose-built man-lifting kite in Europe – wrote a treatise on his invention in which he discusses the potential military uses of his device.[27] This next phase includes works by Octave Chanute and J.E. Hodgson. In *Progress in Flying Machines*, Chanute discusses Pocock's work and restates Wecker's assertion that kite aerodynamics could enable manned flight.[28] Hodgson's *The History of Aeronautics in Great Britain* – besides providing an extremely comprehensive history of early flight – also discusses manned kites in great detail.

As the 20th century dawned, kite design was dominated by Baden Fletcher Smyth (B.F.S.) Baden-Powell. Documentation of his various kite experiments is readily available, including an article from Baden-Powell himself titled "Kites: Their Theory and Practice." The next inventor to advance the kite was the

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[26] White, *Medieval Religion and Technology*, 71.
[27] Pocock, *A Treatise on the Aeropleustic Art,* 19-20.
[28] Octave Chanute, *Progress in Flying Machines* (New York, NY: The American Engineer and Railroad Journal, 1894), 175-176.

American-born, British-naturalized, Samuel Franklin Cody. As with Baden-Powell, documentation of Cody's efforts with manned kites are relatively descriptive and easy to find; referenced in this study is his original British patent titled, "Improvements in Kites and Apparatus for the same." Kite experimentation was also conducted in the United States Army. In 1896, Lieutenant Hugh Wise began a series of tests that proved the concept. Documentation of Wise's work is found in news articles from the time and in Wise's own words in a *Scientific American* article titled, "Flying in the Beginning: A Low-Key Account of High Adventure in 1897." The above authors provide the majority of the remaining material for the chapter with the exception of a brief review of German use of kites during World War II. In a little known program, the Kriegsmarine used the *Bachstelze* manned kite to extend the observation capability of U-Boats. This story is found in David Stevens' book *U-Boat Far from Home* and I thank Dr. Richard Muller for directing me to this little known corner of kite history.

Chapter Two's analysis of balloons leans heavily on the landmark work done by Frederick Stansbury Haydon. His *Military Ballooning during the Early Civil War* contains perhaps the most comprehensive chapter ever written on the history of early ballooning. Haydon's work along with Donald Dale Jackson's *The Aeronauts*, Hodgson's previously mentioned work, Edwin Kirschner's *Aerospace Balloons: From Montgolfier to Space*, and Lennart Ege's *Balloons and Airships* allow the story of early balloon invention and success to be told quite expansively. Following the Montgolfier success, thought turned to the military utility of the balloon. French and British thought on the subject was been well-documented in previous works (primarily by Haydon and Charles Frederick Snowden Gamble), but this dissertation presents the first comprehensive look at the American Founding Fathers' thoughts on the subject. Beginning only weeks after the first successful ascent, Benjamin Franklin, Thomas Jefferson, George Washington, and James Madison all opined on the future of the new platform. Fortunately, all four men were prolific writers and the story can be told by analyzing their own words. Franklin's letters of the time appear in *The Complete*

Works of Benjamin Franklin, Washington's in *The Writings of George Washington from the Original Manuscript Sources*, and both Jefferson's and Madison's in *The Papers of Thomas Jefferson*. Finding the references to balloons and their military uses buried in the thousands of letters and other correspondence of the Founders is challenging, but as one can see in Chapter Two, their views were prophetic and add much to the overall understanding of the thinking of the time.

Following the early period post-invention, the French militarized the balloon. The best sources for early French military use are Haydon, Ege, Peter Mead's *The Eye in the Air: History of Air Observation and Reconnaissance for the Army, 1785-1945*, and Basil Collier's comprehensive survey *A History of Air Power*. The next major phase of manned balloon ISR occurred in the United States. Attempts to use balloons during the Second Seminole War and Mexican-American War are documented in several primary sources from the United States National Archives. Haydon's history on military ballooning, Thaddeus Lowe's memoirs, and many primary sources provide the preponderance of the material for the analysis of airborne ISR during the Civil War. This mix of first-hand stories and primary source material helps illuminate the challenges these early aviation pioneers faced in their attempts to provide ISR to the warfighters.

Chapter Three begins by following the evolution of balloons in the post-Civil War phase. The focus in this period was on making the balloon more controllable and thus more practical for ISR purposes. Success is characterized by Germany's Count Zeppelin whose design ultimately provided the most stable, navigable airship. Primary sources in English are few through this period, but airship historian Douglas H. Robinson covers the subject quite comprehensively in his book *Giants in the Sky*. Collier and Richard Hallion's *Taking Flight: Inventing the Aerial Age from Antiquity through the First World War* also provide significant insight. At about the same time as Zeppelin achieved success, the United States Army became interested in the airship. Primary sources and memoirs from the early balloon pioneers Charles de Forest Chandler and Frank Lahm help describe the trials and tribulations of early ballooning in the American

Army. Again, the theme of innovation and the simple 'can-do' spirit is highlighted in these works.

After seeing balloon evolution through to the airship, Chapter Three turns to the invention of the airplane. As this subject has been covered comprehensively in several works of much greater magnitude, the chapter only briefly reviews the principal events and actors that made heavier-than-air flight possible and thus advanced the platform necessary for airborne ISR's evolution. Charles Walcott's "Biographical Memoir of Samuel Pierpont Langley" along with Charles H. Gibbs-Smith's *The Aeroplane: An Historical Survey* were quite useful for this phase of the analysis. Following the Wright Brothers' success, several early aviation pioneers wrote about the airplane and its potential for airborne ISR purposes. The writings of Frank Lahm, Billy Mitchell, and Benjamin Foulois provide the backbone for primary source analysis of this early phase. The next phase of the study follows the struggle of Airmen to convince the Army of the need to incorporate the aircraft – balloons and airplanes. Juliette Hennessey's fantastic work, *The United States Army Air Arm: April 1861 to April 1917* gives the best reflection of just how difficult it was to convince ground-minded Army commanders that the airplane was the next revolution in military affairs (RMA). To prove its value, Foulois' writings on the 1st Aero Squadron's creation and its support to General John Pershing's Punitive Expedition are extremely valuable. The chapter concludes by examining several other nations' efforts in integrating air power. David Herrmann's *The Arming of Europe and the Making of the First World War* is critical to understanding the thought process in Europe at the time. Sir Walter Raleigh and H.A. Jones' *The War in the Air* along with several primary source documents from the United Kingdom's National Archives explain the British side. French air power integration is best reviewed in James Davilla and Arthur Soltan's *French Aircraft of the First World War* and Lee Kennet's epic work, *The First Air War, 1914-1918*. Finally, German war preparation is most comprehensively covered in James Corum's *The Luftwaffe: Creating the Operational Air War, 1918-1940*, Corum and Richard Muller's *The Luftwaffe's*

Way of War: German Air Force Doctrine, 1911-1945, and General Erich Ludendorff's memoirs.

Chapter Four examines the aircraft's first true trial by fire, World War I. The topic has been covered extensively in secondary sources with Eric and Jane Lawson's *The First Air Campaign*; Kennett's *The First Air War*; Raleigh and Jones' *The War in the Air*; John H. Morrow Jr.'s *The Great War in the Air: Military Aviation from 1909 to 1921*; Eileen Lebow's *A Grandstand Seat: The American Balloon Service in World War I*; Herbert Johnson's *Wingless Eagle: U.S. Army Aviation through World War I*; Maurer Maurer's *The U.S. Air Service in World War I*; Professor I.B. Holley Jr.'s *Ideas and Weapons*; Robert Futrell's *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force, 1907-1960*; and Mead's *The Eye in the Air* standing out above the others. Professor Sam Hager Frank's dissertation, "American Air Service Observation in World War I" provided a surplus of sources and detailed information on the performance of airborne ISR – all nationalities and services – throughout the war. Additionally, this chapter's analysis leans heavily on the historical study of the Air Service's contribution edited by Colonel Edgar Gorrell; this particular history is the most comprehensive of all though it is difficult to locate. Fortunately, the author found an intact, complete version at the United States National Archives in Record Group 120.

Primary sources are abundant in this section of the dissertation with the personal writings of Brooke-Popham, Antoine-Henri Baron de Jomini, Field Marshal Viscount French, Ludendorff, Foulois, Mitchell, Lahm, Lewis Brereton, Frank Chandler, Mason Patrick, John Pershing, and Hugh Trenchard enlightening the understanding of the difficulties and successes of manned airborne ISR throughout the war. These personal accounts when combined with a large number of primary source documents from the United States National Archives, the British National Archives, the United States Air Force's Historical Research Agency (AFHRA), and the Library of Congress (LOC) tell a

comprehensive story of manned airborne ISR immediately before and during the war.

Chapter Five follows the postwar development of manned airborne ISR evolution and tracks its growth through the incredible successes of World War II. The first section of the chapter examines the immediate postwar years and analyzes how the various nations studied the lessons learned from World War I and incorporated – or ignored – the various revelations regarding manned airborne ISR. The first stage of analysis reviews the various postwar reports published by several of the warring nations with particular emphasis on the United States and Great Britain. Copies of the reports themselves were used when available and when not, thoroughly researched secondary sources provided a comprehensive understanding of the subject. Robert Futrell's *Command of Observation Aviation: A Study in Control of Tactical Airpower*, I.B. Holley's *Evolution of the Liaison Airplane, 1917-1944*, Maurer's *Aviation in the U.S. Army, 1919-1939*, Raleigh and Jones, and Anthony Cumming's *The Battle for Britain: Interservice Rivalry Between the Royal Air Force and Royal Navy, 1909-1940* provided the most detailed analysis from which the author could draw conclusions.

After examining the immediate postwar years, the chapter turns to how each nation dealt with airborne ISR during the interwar period. For the British and American perspective, the author relied on a myriad of primary sources from the National Archives of both countries and the AFHRA. Secondary sources of primary interest for this time period were F.H. Hinsley's *British Intelligence in the Second World War*; Roy Conyers Nesbit's *Eyes of the RAF: A History of Photo-Reconnaissance*; Wesley Frank Craven and James Lea Cate's *The Army Air Forces in World War II*; Corum's *The Luftwaffe*; and Williamson Murray's *Strategy for Defeat: The Luftwaffe, 1933-1945*.

The sources used to assess airborne ISR's performance in the war are too many to list here, but Robert Ehlers Jr.'s *Targeting the Third Reich*; Thomas Fabyanic and Robert Futrell's essay in *Piercing the Fog: Intelligence and Army Air*

Force Operations in World War II; John Farquhar's *Need to Know*; Alfred Price's *The History of US Electronic Warfare*; and Aileen Clayton's superb *Listening to the Enemy* supplemented the large number of primary sources that make up the majority of the information in the chapter. Through these, the author believes the analysis of the origin of airborne SIGINT is quite comprehensive. Many primary sources – particularly from the United Kingdom's National Archives – have not been used in other papers or books that the author could find. In one particular instance, the meeting notes from what appear to be the very first discussion on the topic of placing airborne linguists on bombers are included in the analysis of the topic. This abundance of new primary source documents allowed for a unique perspective on the creation of a capability – airborne language analysis – that remains one of the most important in today's airborne SIGINT community. Additionally, the source documents highlight the tactical and strategic importance of the work being done by the airborne linguists and the amazing 'can-do' spirit of those early pioneers. Post-mission reports along with meeting minutes combine to show the impact of the new capability.

Chapter Six examines airborne ISR performance during the Cold War, the Korean War, and the Vietnam War. The purpose of the chapter is to analyze primarily USAF airborne ISR's continued development throughout the Cold War years and to examine the two major occurrences when it was called upon to provide tactical-level intelligence directly to warfighters in Korea and Vietnam. The understanding of the USAF's strategic direction following the end of the war is shown through primary sources that include memoranda from the Carl Spaatz Papers which are located in the Library of Congress. The thinking of the first USAF Chief of Staff in this critical developmental period elucidates the overall understanding of this phase in the evolution of airborne ISR.

The chapter next looks at the first stages of postwar operational development. The dearth of intelligence on the Soviets was considerable, yet the USAF had been tasked to conduct strategic air warfare in the event of a direct confrontation with the Soviets. To acquire targeting data, the USAF instituted an aerial reconnaissance program, first in the Arctic and then in Europe, along the

periphery and even over Soviet-controlled territory. Farquhar's *Need to Know*, Fred Wack's *The Secret Explorers: Saga of the 46th/72nd Reconnaissance Squadrons*, Alwyn Lloyd's *A Cold War Legacy: A Tribute to SAC, 1946-1992*, R. Cargill Hall's various works, and a large number of primary source documents guide the analysis through this phase.[29]

After reviewing these early attempts to gain targeting information, the chapter shifts to the Korean War and the challenge it created for the Far East Air Force (FEAF). Suddenly tasked with providing tactical-level intelligence to ground and air warfighters, FEAF initially struggled. Where possible, the analysis used primary sources, but Futrell's essay, "A Case Study: USAF Intelligence in the Korean War," and his history *The United States Air Force in Korea*, comprehensively describe many aspects of the war and were quite valuable to provide overall understanding of FEAF's tactical IMINT collection. For the development of the tactical airborne SIGINT system, Larry Tart's *Freedom Through Vigilance: History of U.S. Air Force Security Service* along with James Farmer and M.J. Strumwasser's *The Evolution of the Airborne Forward Air Controller*, when combined with various primary sources, allowed for a thorough understanding of the improvements made throughout the conflict.

Following the analysis of the Korean War, the chapter shifts again to studying strategic intelligence collection. The next phase focuses on the development of the U-2 and leans heavily on Gregory Pedlow and Donald Welzenbach's previously classified, Central Intelligence Agency (CIA) historical document titled, *The CIA and the U-2 Program, 1954-1974*. This history along with Dino Brugioni's *Eyes in the Sky: Eisenhower, the CIA, and Cold War Espionage*, Chris Pocock's *Dragon Lady: The History of the U-2 Spyplane* and Curtis Peebles' *Shadow Flights: America's Secret War Against the Soviet Union* all explain quite comprehensively the U-2's creation and first operations.

[29] Fred Wack was one of the USAF's first airborne electronic warfare officers (EWOs). His book provides an excellent firsthand summary of early USAF airborne ISR operations in the Arctic.

Continuing the evolution of manned airborne ISR, the chapter examines USAF and United States Navy performance in the Cuban Missile Crisis. The writing on this incident is prolific, but little currently exists regarding the USAFSS' development of an airborne Spanish linguist capability in reaction to the requirement to provide airborne SIGINT collection and analysis. Using pre-established contacts, the author conducted an interview of one of the USAF's first airborne Spanish linguists, Mr. Segundo Espinosa, to help create a better understanding of the situation. This insight combined with recently declassified NSA, CIA, and USAFSS documents enable a unique description of the events surrounding the incident.

For the study of airborne ISR performance in Vietnam, the focus was on primary sources and declassified NSA documents. As much has been written on this topic, the author sought to find lesser known aspects of the story that would illuminate the great achievements of USAF manned airborne ISR Airmen. The section's focus on COLLEGE EYE, RIVET TOP, and Project TEABALL serve to highlight a few of the innovative solutions put in place during the conflict. The vast Project CHECO (Contemporary Historical Examination of Current Operations) reports helped with the comprehension of all three projects as did Robert Hanyok's recently declassified NSA study, "Spartans in the Darkness: American SIGINT and the Indochina War, 1945-1975." When combined with primary source documents and other declassified reports, the significant impact of the three projects toward mission success is better understood. For Project TEABALL, Major General Doyle Larson's personal papers provided by the 25th Air Force Historian were of significant importance as they gave unprecedented insight into the creation of the system that would ultimately deliver the type of tactical intelligence that airborne ISR pioneers had long envisioned.

Summary

The main purpose of this thesis is to understand the evolution of manned airborne ISR. Although it is primarily an historical piece, the manner in which airborne ISR evolved and its rise to prominence is critically important to today's

decision makers. As the USAF approaches a period of uncertainty regarding the future use of airborne ISR, many of the challenges will not be new. Hopefully by studying the trials and tribulations through the evolution of manned airborne ISR, this dissertation will help guide future choices. Fiscal austerity and doubt about potential adversaries will mark the next phase in our history. New challenges in the Middle East will require USAF manned airborne ISR to continue to provide tactical-level intelligence directly to warfighters, but the return of a Cold War foe also demands a level of strategic intelligence that will enable Airmen to execute air operations in contested environments if necessary. ISR Airmen have always been able to innovate and find solutions that have enabled them to succeed at both, but leaders need to give them the manpower and technology to do so.

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Chapter 1: Kites Start It All

What is called 'foreknowledge' cannot be elicited from spirits, nor from gods, nor by analogy with past events, nor from calculations. It must be obtained from men who know the enemy situation.
Sun Tzu

While it can never be determined exactly when man began to dream about flying, it is known that from at least the time we began to write and to draw, the idea of soaring above the earth was present and has been documented. Ancient stories contain characters and creatures who transport themselves through the air on wings. Throughout early history, countless dreamers conceived rudimentary wing designs and fantastical craft to replicate the birds and the characters of these legendary stories. Most, like the unknown author of Psalms 55:6, who wrote "Oh that I had wings like a dove! For then would I fly away…" simply desired to have the freedom of a bird, but many foresaw the potential military benefit of obtaining the "highest hill."[1] While the warrior's ability to see his enemy's movements had been restricted to what simple telescopes, geographic high points, or posts in trees could provide, flight held unlimited potential for military reconnaissance and surveillance.

Watching the birds carelessly float high above the earth prompted many dreamers to experiment with various attempts at early flight. From ancient visionaries like Daedalus to early experimenters like Heron of Alexandria, man has long endeavored to defeat gravity.[2] Most were simply trying to advance science, but many had grander visions. While technological advances would make heavier-than-air flight a reality in the late 19th and early 20th century, man's earliest dabbling with flight is known to have begun centuries before the

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[1] *The Holy Bible*, King James Version (Grand Rapids, MI: Zondervan Publishing House, 1983), 662.
[2] Donald Routledge Hill, *A History of Engineering in Classical and Medieval Times* (New York, NY: Open Court, 1984), 215.

Wright Brothers' success. In perhaps the earliest documented case of flight experimentation in the western world, in the fourth century B.C. the ancient Greek philosopher and mathematician, Archytas of Tarnetum, is said to have built and flown a wooden pigeon that was powered by the pressure of air escaping from a pig bladder concealed within.[3] Archytas' model's flight reportedly covered some 200 feet and was obviously unmanned, but it showed that flying was possible and spurred others to continue experimenting.

Archytas' pigeon was not the first craft to fly, however. Centuries earlier, the Chinese, and several other East Asian peoples, had successfully achieved flight with both manned and unmanned kites. While no one can determine with certainty when kite flying actually began, it is definite that kites hold great importance in man's quest for flight. Sir George Cayley, often described as the true inventor of the airplane, used kite design almost exclusively as he constructed his first glider in 1804.[4] Further underlining the importance of kites to the evolution of aviation – and ultimately manned airborne ISR – the British aviation historian Berthold Laufer cogently wrote, "A flying-kite may be defined as an aeroplane which cannot be manned, and an aeroplane may be defined as a kite which can be manned."[5] While the impending analysis will perhaps show Laufer's comment to be a bit incomplete, his message is clear: kites and airplanes are inextricably linked. By examining the history of the use of kites for military purposes, this first chapter will demonstrate that the fundamental ideas regarding the principles of aviation – and airborne reconnaissance – were first formed in the Far East and that kites made a significant contribution to the advancement of flight and airborne ISR.

The precise origin of the kite is undetermined. Most scholars agree the Chinese began the practice and all other kites are descendent from there, but

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[3] Aulus Cellius, *The Attic Nights of Aulus Cellius*, trans. Reverend W. Beloe (London, UK: St. Paul's Churchyard, 1795), 222-223, acquired online at http://archive.org/details/atticnightsofaul02gelliala, accessed 2 February 2013.
[4] Charles Harvard Gibbs-Smith, *Sir George Cayley (1773-1857)* (London, UK: Her Majesty's Stationery Office, 1968), 3.
[5] Berthold Laufer, *The Prehistory of Aviation* (Chicago, IL: Field Museum Press, 1928), 31.

others argue that Malaysia is the true birthplace of kiting.[6] Regardless of their origin, the militarization of kites and, likely, their first practical use is said to have occurred in ancient China sometime around 300 B.C.[7] Pinning down an exact date is difficult, but some historians believe the first true written reference to the military use of kites is by none other than the great Chinese war strategist Sun Tzu. In his *Art of War*, Sun Tzu discusses distributing propaganda leaflets behind enemy lines and the use of noise to confuse enemy soldiers.[8] Many believe the only way this could have been possible was through the use of kites.

While Chinese folklore is rich with fantastical tales of men who were able to fly as dragons and birds, there are also well-documented cases of Chinese kite flying for military purposes. Perhaps the most interesting is the story of General Han Hsin. In what could be the earliest use of kites for military purposes, while laying siege to an enemy palace likely sometime around 169 B.C., General Han Hsin is said to have flown a kite over the enemy walls in order to determine the distance from his forces to the fortress.[9] After the flight, the General used trigonometrical calculations based on the length of the kite string to determine the distance required to dig a tunnel under the walls of the palace. Using the kite line length as a guide, his sappers tunneled under the walls and surprised the defenders, ultimately winning the battle.[10]

In another story, in A.D. 549 the great Chinese warrior Kien-wen became perhaps the world's first signalman. Kien-wen was in the city of T'ai which was being besieged. Being unable to communicate outside the city, Kien-wen reportedly made a paper kite with a message, written in large letters, attached to it. He flew the kite so his countrymen outside the city would be made aware of the situation behind the walls. Interestingly, in what may be the first "anti-

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[6] Gilbert Totten Woglom, *Parakites: A Treatise on the Making and Flying of Tailless Kites for Scientific Purposes and for Recreation* (New York, NY: The Knickerbocker Press, 1896), 1.
[7] John Buckley, *Air Power in the Age of Total War* (London, UK: UCL Press Limited, 1999), 22.
[8] Martin J. Manning, *Historical Dictionary of American Propaganda* (Westport, CT: Greenwood Press, 2004), 183.Wes
[9] David Pelham, *The Penguin Book of Kites* (London, UK: The Penguin Group, 1976), 8.
[10] Lee Scott Newman and Jay Hartley Newman, *Kite Craft: The History and Processes of Kitemaking Througout the World* (New York, NY: Crown Publishers, Inc., 1974), 2.

aircraft" fire, archers of the besieging force unsuccessfully attempted to shoot the kite out of the sky.[11] A similar story exists from A.D. 781, in which Chang P'ei – a Chinese general – was defending the city of Lin-Ming against rebel forces. To alert his chain-of-command and request reinforcements when the city became surrounded, Chang flew a kite over the city as a signal. Again, enemy "anti-aircraft" archers tried to shoot the kite down, but were unsuccessful. Ultimately, Chang's effort worked as reinforcements arrived and the city was saved.[12]

The Chinese also used the kite in other military roles. In two documented instances, Chinese warriors used kites in the first airborne psychological operations (PSYOPS). In the first case, one group of warriors assigned to General Huan Theng flew kites over the forces of an invading army.[13] These kites had pieces of dried bamboo attached to them. When the wind blew through the bamboo, a sound similar to moans and screeches was created. According to the story, spies within the enemy camp had spread rumors that the noises were the voices of the gods declaring defeat for the invaders. As a result, the enemy fled in terror.[14] In the second event, at the Mongol siege of Kaifeng in the early thirteenth century, the besieged citizens attached messages to the tails of kites and released them over the Mongol lines.[15] The messages incited captured Kaifeng citizens to revolt against their Mongol captors which ultimately led to the Mongol defeat.

In addition to messaging and psychological operations, there are stories of the Chinese use of man-lifting kites to airdrop warriors behind enemy lines and to carry them over the walls of fortified cities.[16] While no date can accurately be determined for when this activity began, there are several documented cases of both usages. Finally – and of most relevance to this study – Chinese military

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[11] Laufer, *The Prehistory of Aviation*, 35.
[12] Ibid., 36.
[13] Pelham, *Penguin Book of Kites*, 9.
[14] Newman, *Kite Craft*, 2.
[15] Joseph Needham and Colin A. Ronan, *The Shorter Science and Civilisation in China,* vol. 4 (New York, NY: Cambridge University Press, 1994), 279.
[16] Harold Ridgway, *Kite Making and Flying* (New York, NY: Gramercy Publishing Company, 1962), 142.

commanders used man-lifting kites to scout enemy positions to determine the best avenues of attack and, remarkably, to escape captivity.[17]

It appears that from China, kites proliferated to the other nations of eastern Asia. According to Japanese legend, kite flying came to Japan from China in the 8th century A.D.[18] The Japanese military originally used kites to deliver messages, to measure distances (much like the Chinese story related above), and to airdrop supplies behind enemy lines. There also exist several Japanese stories chronicling the use of kites to fly men into and out of besieged cities, and to even provide airborne observation posts over enemy camps and fielded positions.[19] In one tale, man-flying kites were used to surveil enemy positions and provide unprecedented views of the enemy army which, when the intelligence obtained was subsequently used by war planners, allowed for a rapid defeat of the opposing forces.[20] In the story, Japanese engineers constructed a kite with a seat that allowed the observer to spy on the enemy camp and inside his castle.[21] Another famous story tells of the Japanese samurai warrior, Minamoto-no-Tametomo, who, in the 12th century, used a large man-flying kite to lift his son from Hachijo Island to the Japanese mainland.[22] These Japanese tales may seem fantastical, but the historical documentation suggests that many are indeed factual. Only 300 years ago, a Shogun forbade the construction of kites in his directorate after a local rebel leader used man-lifting kites to invade his palace.[23]

As in Japan, Korean warriors used the kite for military purposes. During the Goryo Dynasty (A.D. 918-1380), General Chue Yung was ordered to quell a farmer's revolt in a neighboring province. The general sailed to the region but

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[17] Ibid.
[18] Dorothy Perkins, *Encyclopedia of Japan: Japanese History and Culture, from Abacus to Zori* (New York, NY: Facts on File, 1991), 91-92.
[19] Laufer, *The Prehistory of Aviation*, 40.
[20] William Elliot Griffis, *The Mikado's Empire* (New York, NY: Harper and Brothers Publishers, 1876), 221.
[21] Woglom, *Parakites*, 2.
[22] Massaki Modegi, *The Making of Japanese Kites: Tradition, Beauty and Creation* (Tokyo, Japan: Japan Publications Trading Company, Ltd., 2007), 19.
[23] Clive Hart, *Kites: An Historical Survey* (New York, NY: Frederick A. Praeger, Inc., Publishers, 1967), 38.

was unable to disembark his men due to the region's high cliffs. Instead, he ordered his forces to build large kites to drop fire over the enemy fortifications and, possibly, used manned kites to land his forces on the cliff tops.[24] Another Korean folklore tells of General Gim Yu-Sin and his use of kites to take advantage of the Korean people's ancient astronomical beliefs and superstitions. In the story, the General was asked by his queen to quell a local rebellion. One evening, with his forces surrounding the rebel village, a star was seen falling from the sky. At the time, many Koreans believed a falling star was a bad omen, portending bloodshed and disaster.[25] The General, knowing the people – and his soldiers – would be nervous and uneasy until they saw the star ascend back to heaven, devised a plan. Using a kite, he constructed a mechanism that would lift a fireball high into the sky. When he launched the kite, his soldiers and the people saw the fireball and believed the star had returned to heaven. With morale restored, he was able to rally his forces and defeat the rebellion.[26]

From the Far East, the use of kites for military purposes spread through central Asia and ultimately to Europe. There are several suggestions that the ancient Greeks – including the aforementioned Archytas of Tarentum – used kites, but the most prominent kite historians seem to agree that the evidence is not sound enough to prove this.[27] While Greek kite use is uncertain, it is well-established that the Romans used kites – or kite-like craft – for various military-related purposes. First, following the final defeat of Dacia in A.D. 105, the Romans adopted the Dacian standard. The standard, a mostly hollow craft that more closely resembled a modern windsock than the common triangular-shaped kite of today, consisted of a pole-mounted dragon head trailed by a length of fabric.[28] These *dracos* – as the Romans called them – were used by the Romans to rally the troops, guide troop formations, cause terror in enemy formations, as

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[24] Wayne Hosking, *Kites* (New York, NY: Friedman and Fairfax Publishers, 1994), 8.
[25] Hart, *Kites,* 34.
[26] Ibid.
[27] For further information on possible ancient Greek kite use, see Hart, *Kites*, 61, and J.E. Hodgson, *The History of Aeronautics in Great Britain* (London, UK: Oxford University Press, 1924), 369.
[28] Hart, *Kites*, 63.

signaling devices, as guides to help archers determine wind direction and strength, and for ceremonies.[29] Over time, the use of *dracos* spread from Rome to most of Europe and the structure of these rudimentary kites evolved from being merely fabric fastened to a stick to become something that performed more closely like kites as we now know them. By the fourteenth century, European militaries had begun using cord instead of poles and the dragons appeared to float over the military formations.[30]

While these updated *dracos* were no longer flown with sticks, they were still not kites in the modern sense. Their serpentine structure created virtual wind tunnels that allowed the material to stay aloft; the science behind the aerodynamics of wing structure was not even considered. Determining an exact date for the introduction of kites as we now know them into Europe is problematical. Historians have extensively documented cases of early contact between European and Chinese sailors and European sailors' accounts of Chinese kites in their log books are quite numerous. These accounts, unfortunately, did not seem to translate to an adoption of Chinese kite design by Europeans. It does appear, however, that Middle Eastern peoples did indeed integrate Chinese style kites into some of their armies and even into children's recreational activities. The British aviation historian, Berthold Laufer, annotates an occurrence where Musaylima – a contemporary of the prophet Muhammad – was said to employ paper kites with musical bows attached in order to fool his adherents into believing he was communicating with the angels.[31] Laufer also quotes a story from the *Book of Animals*, written by an al-Jahiz. In this story, al-Jahiz mentions boys playing with "flags…made of Chinese carton and paper…"[32] Both of these references make it fairly clear that Chinese kites had, at a minimum, proliferated to the Middle East by at least the mid-9th century.

Unfortunately, this is where the trail of kite transition into Europe goes

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[29] Ibid.
[30] Hart, *Kites*, 64.
[31] Laufer, *Prehistory of Aviation*, 37.
[32] Ibid.

cold. The period between the ninth century and the early fourteenth century is almost devoid of kite references in European historical accounts. It can logically be assumed that Europeans and Arabs, living in such close proximity and having numerous conflicts and other interactions during this period, exchanged technologies. There is, however, little to no documented evidence of such technology transfer. For kites, this period was also a dark age.

While the actual date of kite adoption by European militaries cannot be determined, what seems to be fairly certain is that kites were being used by European militaries by no later than the mid-fourteenth century. In what is perhaps the earliest documented kite use in Europe, the English scholar Walter de Milemete, in a treatise written in 1326 for Prince Edward (later King Edward III), included an illustration that appears to show a pennon kite bombing a besieged castle.[33] The kite is similar in structural appearance to a *draco* kite, but in the illustration, three knights are shown holding a line connected to the kite. In the illustration, the kite appears to have either a cannon ball or some type of incendiary device attached to it. While we cannot be certain if this was an actual military implement or a fantastical vision of Milemete's, it is clear that at a minimum the idea of using kites for military purposes had proliferated into Europe by the first half of the fourteenth century. In addition to Milemete's illustration, there are German manuscripts dating to 1405 that show illustrations of what can only be described as hot-air kites.[34] In Conrad Kyeser's book about military technology, *Bellifortis*, there appear captioned kite drawings.[35] Kyeser's kites seem to be a cross between kite and balloon; they were shaped like the Roman *draco* kites and actually had lights inside them.[36] It appears that these kites were also used as military standards and they were

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[33] Pennon kites were similar in shape and structure to the *draco* kites; Walter de Milemete, *De nobilitatibus, sapientiis, et prudentiis regum* (Oxford, UK: Oxford University Press, 1913), 154-155. Document available online at: https://ia700402.us.archive.org/34/items/cu31924032172029/cu31924032172029.pdf (accessed 27 March 2016).
[34] Ridgway, *Kite Making and Flying*, 143.
[35] Pelham, *The Penguin Book of Kites*, 21.
[36] Ibid.

flown similarly to the kite from Milemete's illustration – with knights or horsemen flying them with cords.

While both Milemete's and Kyeser's references to kites come via illustrations, the first known written description of kites in European literature appears in *Magia Naturalis* written in 1589 by the Italian Giovanni Batista della Porta in his book on natural phenomenon.[37] In his book, Porta describes the making of a kite and discusses the aerodynamics that allow a kite to fly.[38] Though he never reveals the origin of his design, Porta's kite is quite sophisticated and very similar to Chinese designs.[39] Interestingly, in a preview of the aerodynamical link between manned flight and kites, Porta portends, "Hence may an ingenious man take occasion to consider how to make a man fly with huge wings bound to his elbows and breast."[40]

In 1582, the Swiss physician Johannes Jacob Wecker expanded on Porta's notion of kites being the impetus for manned flight. He directly quotes Porta and further describes his belief that the aerodynamics of kites hold the key for future manned flight.[41] Taking Porta and Wecker's thoughts further, in 1636, the German mathematician Daniel Schwenter authored *Deliciae physico-mathematicae*, in which he describes the kite as a three-dimensional device.[42] In his work, Schwenter provides an illustration of his kite and gives directions for its construction. The Schwenter kite appears to be a hybrid between the Roman *draco* designs and modern kites. Additionally, Schwenter provided an anecdote about a German sailor who was pulled into the Rhine River by an enormous kite. This tale apparently gave Schwenter the idea of using a kite for manned purposes.[43] Finally, the Jesuit priest Athanasius Kircher, writing in 1646 and

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[37] Needham, *The Shorter Science & Civilization in China*, vol. 4, 281.
[38] Lynn Townsend White, *Medieval Religion and Technology: Collected Essays* (Los Angeles, CA: Center for Medieval and Early Renaissance Studies, University of California-Los Angeles, 1978), 71.
[39] Hart, *Kites*, 70.
[40] Quoted in White, *Medieval Religion and Technology*, 71.
[41] Ibid.
[42] Gerry Barton and Stefan Dietrich, *This Ingenious and Singular Apparatus: Fishing Kites of the Indo-Pacific* (Norderstedt, Germany: Books on Demand, 2010), 237.
[43] Hart, *Kites*, 73.

again in 1665, describes the kite in greater detail and provides the best illustration of both its construction and design. In an elaborate description in his 1665 work *Mundus subterraneus*, Kircher clearly depicts a flying, three-dimensional kite that looks remarkably similar to today's kites.[44] Interestingly, Kircher also mentions that kites could be made of such size that they could lift men.[45]

As evidenced above, by the middle of the seventeenth century kites had spread throughout Europe and were even commonplace. In his epic poem, *Hudibras,* written between 1662 and 1678, the English poet Samuel Butler mentions kites twice with no particular point of emphasis, seemingly taking their use for granted.[46] By this time, at least in England, kites were commonly used to set off fireworks. In *Mysteries of Nature and Art*, along with multiple illustrations of kites, John Bate describes the use of kites for igniting fireworks.[47] Finally, Isaac Newton is said to have played – and even conducted rudimentary scientific experiments – with kites in his youth.[48] The kites in Bate's illustrations closely resemble the structure of today's kites and combined with the stories about Newton provide sound evidence that English kite making had clearly evolved past the *draco* by at least the mid-seventeenth century.[49]

While the use of kites for igniting fireworks and as children's toys is far from military application, the spread of kites during the seventeenth to nineteenth centuries is important as their popularity allowed a wider group of military-minded thinkers to include kites in their thoughts and dreams. During the eighteenth century, scientists began to use kites in meteorological

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[44] Ibid.
[45] Laufer, *The Prehistory of Aviation*, 41.
[46] Samuel Butler, *Hudibras, in Three Parts: Written in the Time of the Late Wars* (Glasgow, UK: Robert and Andrew Foulis, 1674), vol. II, chap. III, 194-195, http://www.exclassics.com/hudibras/hudibras.txt (accessed 27 March 2016).
[47] Interestingly, Bate never uses the word "kite" in his description. He explains precisely how to build one, but he does not name the device he is describing. For more see, John Bate, *Mysteries of Nature and Art* (London, UK: Unknown publisher, 1654), 101-102. Available online at: http://docs.lib.noaa.gov/rescue/rarebooks_1600-1800/TC160B371654.pdf (accessed 27 March 2016).
[48] Hart, *Kites*, 80.
[49] Pelham, *The Penguin Book of Kites*, 22.

experiments as they quested to learn more about the earth's atmosphere. The Scot, Alexander Wilson, is said to be the first of a long line of famous scientists who employed kites for this purpose.[50] Beginning in 1749, Wilson – and his partner Thomas Melville – conducted a series of weather experiments. In these tests, Wilson and Melville attached thermometers to the end of the kites in order to measure temperature differences based on altitude.[51] Wilson's early investigation was followed by perhaps the most famous scientific experiment in history; Benjamin Franklin's great electric kite experiment of June 1752.[52] Many others followed Wilson and Franklin; each expanding and refining both scientific experimentation and even the kite itself. Often, as will be seen in succeeding chapters, these kites provided the aerodynamic inspiration for many of the world's great aviation pioneers.

The scant historical information regarding the military use of kites during the eighteenth century is almost exclusively focused on scientific experimentation. It is not until the nineteenth century that we again see kites discussed as having military purposes. In 1825, an English schoolteacher named George Pocock developed and tested a system whereby he could tie a carriage to ropes attached to two large kites flown in tandem.[53] Using this system, Pocock was able to propel the carriage – carrying four to five passengers – at speeds of up to 20 miles per hour.[54] Also that year, Pocock developed and demonstrated the ability to use kite power to hoist both cargo and people into the air. In perhaps his most famous experiment, he demonstrated this principle when he lifted his daughter to a height of over 80 meters.[55]

Two years later Pocock published a book in which he outlines potential military uses for his carriage device, or Char-Volant as he later called it.[56] In *A*

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[50] Judi Slayden Hayes, *In Search of the Kite Runner* (Atlanta, GA: Chalice Press, 2007), 23.
[51] Hart, *Kites*, 81.
[52] Tom Tucker, *Bolt of Fate: Benjamin Franklin and His Fabulous Kite* (Cambridge, MA: Perseus Books Group, 2003), xvi.
[53] José A. Fadul, *Kites in History, In Teaching, and in Therapy* (Morrisville, NC: Lulu Press, Inc., 2009), 4.
[54] Pelham, *The Penguin Book of Kites*, 27.
[55] Fadul, *Kites in History*, 4.
[56] Laufer, *The Prehistory of Aviation*, 41.

Treatise on the Aeropleustic Art, or Navigation in the Air by the Use of Kites or Buoyant Sails, he described the carriage as being able to "…serve for floating observatories…" where an observer "…could watch and report the advance of the most powerful forces…mark[ing] their line of march, the composition of their force, and their general strength, long before he could be seen by the enemy."[57] Pocock also speculates about the use of his Char-Volant for troop movement describing the possibility that entire battalions of troops could be transported silently with his kites either to obviate the need for climbing or to invade well-fortified positions by circumventing the defenses.[58] Finally, Pocock describes the use of kites as additional sails for ships to provide auxiliary power and advocates their use in shipwreck situations. While Pocock certainly had some visionary ideas, there is no record of him having pitched any of them to the British military and it appears his book was simply an advertisement for his various inventions.[59] His inability, or lack of desire, to sell his product, combined with the unpredictability of the English winds effectively ended Pocock's experimentations.[60] However insignificant at the time, his work was studied and used by many of the great aviation pioneers who followed. In an 1894 summary of aviation history, the great Octave Chanute – who would later provide significant guidance to the Wright brothers – documented Pocock's works in a series of articles written for the American Society of Civil Engineers.[61]

Pocock's efforts marked the beginning of a series of kite experimentation during the latter half of the nineteenth century with much of the work directly contributing to the success of heavier-than-air flight by the end of the century. Pocock's experiments sparked the imagination of many aviation enthusiasts and attempts at manned kite flight grew in both number and seriousness.[62] Between

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[57] George Pocock, *A Treatise on the Aeropleustic Art, or Navigation in the Air by the Use of Kites or Buoyant Sails*, 2nd ed. (London, UK: Longman, Brown, and Co., 1851), 19-20.
[58] Ibid., 20.
[59] Fadul, *Kites in History*, 4.
[60] Hodgson, *The History of Aeronautics in Great Britain*, 371.
[61] For further information on Chanute's interest in Pocock's work, see Octave Chanute, *Progress in Flying Machines* (New York, NY: The American Engineer and Railroad Journal, 1894), 175-176.
[62] Hart, *Kites*, 106.

1856 and 1868, French sea-captain Jean-Marie Le Bris experimented with a kite whose design he based on his observations of the albatross sea bird.[63] In one experiment, Le Bris attached a detachable chair to a horse's saddle. The chair was then attached by ropes to Le Bris' kite. When the kite gained enough altitude, Le Bris detached the chair and was lifted to a great height. Sometime during the experiment one of the lines broke from the carriage and Le Bris was dumped from his chair. Despite the accident, the concept was proven. Le Bris lost his prototype, but went on to conduct other tests – this time using ballast as the weight instead of himself.[64]

Other experiments during this time period focused on the potential use of kites as life-saving devices for shipwrecked mariners. In 1859, an Irish priest, Friar E.J. Cordner, designed a system whereby several kites were flown in succession on the same line until enough lifting power was generated to pull a shipwrecked sailor from either the sea or from his doomed ship.[65] In Cordner's design, a small basket or boat would be attached to the kites via a pulley system. One end of the ropes would be attached to the small boat while the other end was to be controlled by sailors remaining on the damaged ship.[66] Cordner apparently tested his design by transporting several people from rocks along the Irish coast to a spot inland.[67]

In another life-saving kite design, the Frenchman C. Jobert constructed a collapsible kite that was capable of carrying a line from a disabled ship to the shore. Jobert's kite was comprised of a cone situated above a plane surface. When set at an angle of exactly 30 degrees, the cone created a considerable amount of lift – easily sufficient to carry men from a damaged sea vessel to the shore.[68] In the event of a shipwreck, the sailors on board were to unfold the kite, send it aloft and then wait for the prevailing winds to turn to the shore before

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[63] Robert M. Kane, *Air Transportation* (Dubuque, IA: Kendall Hunt Publishing Company, 2004), 44.
[64] Pelham, *The Penguin Book of Kites*, 30.
[65] Chanute, *Progress in Flying Machines*, 177.
[66] Hart, *Kites*, 105.
[67] Hodgson, *The History of Aeronautics in Great Britain*, 372.
[68] Pelham, *The Penguin Book of Kites*, 31.

setting the kite angle at 30 degrees.[69] Despite the considerable interest in the maritime industry, both the Cordner and Jobert designs – and the other dozens of similar life-saving kites – were doomed to failure.[70] Without a dedicated method by which the kite could be controlled, navies at the time were hesitant to invest in the technology.

While Cordner, Jobert, and others were focusing on life-saving kites, the Engligh-born Australian aviation pioneer Lawrence Hargrave invented a new kite design that revolutionized aerodynamics and contributed directly to the subsequent achievement of heavier-than-air flight. Motivated by his desire to achieve manned flight, in 1884 Hargrave began a series of experimentation that resulted in his invention of the box kite in 1893.[71] Hargrave believed the flat kite could never be successful due to the instability caused by the single plane surface.[72] The box, or cellular, kite was unique in that it was superior in lift and provided much improved stability when compared to previous kite designs.[73] Such was the advancement provided by Hargrave's kite, that Chanute would incorporate the box kite's structure into his glider design – the model that would ultimately inspire the Wright brothers to success.[74]

As with the earliest kites, subsequent designers continued to improve on the designs pioneered by Pocock, Le Bris, Cordner, Jobert, and Hargrave. While the utility of their kites was generally not realized, the advances in their aerodynamic designs and techniques were. Pocock was revolutionary in his use of multiple kites. Le Bris' mastery of aerodynamics in his albatross design was

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[69] Chanute, *Progress in Flying Machines*, 181.
[70] In 1868, The Shipwrecked Mariners' Society offered a prize for "the best form of kite…for establishing a communication from a wreck on shore." Quoted in Hodgson, *The History of Aeronautics in Great Britain, 372.*
[71] Ridgway, *Kite Making and Flying*, 145.
[72] Percy B. Walker, *Early Aviation at Farnborough: The History of the Royal Aircraft Establishment,* vol. I, *Balloons, Kites and Airships* (London, UK: Macdonald & Co. Publishers Ltd., 1971), 103.
[73] Hargrave used the term "cellular kite" instead of box kite. For more on Hargrave's early designs, see Michael Adams, *Wind Beneath His Wings: Lawrence Hargrave at Stanwell Park* (Russell Lea, Australia: Cultural Exchange International Pty. Ltd., 2004), 57-60.
[74] Garry Jenkins, *Colonel Cody and the Flying Cathedral: The Adventures of the Cowboy Who Conquered the Sky* (New York, NY: Picador USA, 1999), 82.K

unprecedented. Cordner was the first to use multiple kites in succession and Jobert demonstrated kites' massive lifting power by simple manipulation of his cone design. Finally, Hargrave's box design and the aerodynamic data he collected on plane surfaces was instrumental to the follow-on work of Alexander Graham Bell, Octave Chanute, Samuel Langley, and the Wright brothers.[75] While these life-saving and man-lifting kite experiments were valuable to the overall development of kites and thus, aviation, none of them constructed their kites expressly for military ISR. There were a few inventors, however, whose main purpose was to enhance the military's reconnaissance capability. The final section of this chapter will examine several of these.

The first designer to successfully construct a reliable man-lifting kite with military ISR in mind was Captain Baden Fletcher Smyth (B.F.S.) Baden-Powell, of the Scot Guards.[76] Inspired by a boyhood love of kiting, in 1893 he began a series of experiments starting with a 36-foot high kite that was hexagonal in shape and had a surface area of approximately 500 feet.[77] Using twin lines for stability, Baden-Powell lifted men to an approximate height of 10 feet with his initial design.[78] His first foray into kiting produced a device that was considerably unstable, however, as it still used the single plane surface and not the more steady Hargrave box design. Additionally, his early kite designs still used a tail as in traditional kites. After trial and error, Baden-Powell discovered that his new design was actually more stable without a tail.[79] With what he deemed a sound concept, Baden-Powell continued refining his kite design and ultimately settled on a system consisting of four to seven sequentially superposed kites.[80] With this new arrangement, Baden-Powell was able to lift a man on multiple occasions to heights of at least 100 feet. In 1895, Baden-Powell patented this design – calling

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[75] Bell leaned heavily on Hargrave's design for his man-lifting kite experiments. Bell's starting point for his kite design has Hargrave's box kite. Laufer, *The Prehistory of Aviation*, 42.
[76] Hart, *Kites*, 109.
[77] Ibid.
[78] Pelham, *The Penguin Book of Kites*, 42.
[79] B.F.S. Baden-Powell, "The War Kite. Story of the Evolution of a Kite That Will Lift a Man," *McClure Magazine* 12, no. 6 (April 1899), 542-548.
[80] Laufer, *The Prehistory of Aviation*, 42.

it the *Levitor* – and demonstrated it to the British Association.[81]

Following his successful demonstration, Baden-Powell offered his design to the British Army. In his sales pitch, he outlined many of the various utilities for his kites identifying the primary military function of the *Levitor* as an observation post from which a man could watch enemy lines.[82] In a foreshadowing of a role that would be filled by static balloons, he additionally posited the possibility of using his kite to establish communications lines in areas where either the geography or the enemy made laying telegraph lines difficult. Further, Baden-Powell raised the possibility of employing kites "to lift a torpedo or large charge of explosive over a fortification…"[83] Additionally, he discussed the use of kites for aerial photography and purportedly provided some examples of images that he had taken from his kites. Finally, as Pocock had done so many years earlier, he lobbied for "kite power" to be used to sail ships and pull carts.

Ultimately, Baden-Powell was unsuccessful in persuading the British Army to officially adopt his kite, but an informal "kite corps" was established to pursue the idea further.[84] After approximately a year, the Army remained unimpressed with Baden-Powell's idea. This was based primarily on the British Corps of Royal Engineers' main balloon advocate, Colonel James Templer's analysis that "the practical difficulties of employing such devices effectively prohibited their use in war."[85] Templer's decision may have been influenced by his affinity for balloons, but he did publish a full report for the Royal Engineers' Committee in which he fully described the rationale for his conclusion.[86] The primary contributing factor of the rejection being the stability problem which Baden-Powell was never fully able to reconcile. Stubbornly, he had refused to

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[81] Pelham, *The Penguin Book of Kites*, 42.
[82] Hart, *Kites*, 110.
[83] B.F.S. Baden-Powell, "Kites: Their Theory and Practice," *Journal of the Society of Arts* 46 (19 November 1897-11 November 1898), 359-370.
[84] Bill Thomas, *The Complete World of Kites* (New York, NY: J.B. Lippincott Company, 1977), 31.
[85] Quoted in Hugh Driver, *The Birth of Military Aviation: Britain, 1903-1914* (Rochester, NY: The Boydell Press, 1997), 185.
[86] Driver, *The Birth of Military Aviation*, 185.

adopt the Hargrave box kite or admit its advantages despite his awareness of Hargrave's success.[87]

Undeterred by the dissolution of the "kite corps," Baden-Powell continued his kite experiments always with the ultimate goal of creating an official kite observation corps within the British Army. As a member of the Scots Guard, Baden-Powell went to South Africa during the Boer War and attempted kite testing there while deployed with the 1st Battalion Scots Guards.[88] While there he was able to construct several kites and made a couple of successful flights in which he hoisted observers to watch enemy lines.[89] While these tests had some success, Baden-Powell never showed any real practical use for them as his efforts were overshadowed by the almost immediate battlefield impact of the observers of the 1st Balloon Section.[90] Ultimately, Baden-Powell's future in kites was doomed to failure. His ideas for the utility of kites were sound, but his insistence on a flat design as compared to the Hargrave box design prevented his kites from ever providing any tangible service to the British Army. The British Army kept Baden-Powell as an aeronautical advisor for many years to come, but his opinions were forever tainted by his failure.

While Baden-Powell's kite experimentation advanced kiting and, more importantly, helped make the British Army aware of the potential value of manned airborne ISR, it was not until Samuel Franklin (S.F.) Cody – an American-born, naturalized British citizen – perfected a system of man-lifting kites that they became practical for military use. Having acquired significant wealth as an entertainer in the United States, Cody was able to turn what started out as a boyhood interest in aviation into what would become the first tangible use of kites for airborne ISR.

It is uncertain exactly when Cody began seriously experimenting with

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[87] Jenkins, *Colonel Cody*, 90.
[88] Driver, *The Birth of Military Aviation*, 185.
[89] Joseph J. Cornish III, "Go Fly a Kite," *Natural History*, April 1957, available online at: http://www.naturalhistorymag.com/htmlsite/editors_pick/1957_04_pick.html (accessed 27 March 2016).
[90] "The Balloon at the Front," *The Aeronautical Journal* (January 1900), 96-98.

kites, but it was likely sometime in 1900.[91] A showman in the United States before immigrating to England, Cody had no formal education, but he possessed a natural ability to understand and evaluate aeronautical and mechanical details.[92] Beginning with meteorological experimentation and attempts to achieve high-altitude flight, he built on and refined the Hargrave box kite design.[93] While there is no record of Cody and Hargrave corresponding, Hargrave was quite open with the design of his kite having published a complete description of his design – including exact dimensions and illustrations – in the British journal, *Engineering*, in October 1893 and it is highly likely that Cody studied Hargrave's design.[94] Cody's concept was to fly a series of Hargrave-inspired kites, one after the other on the same line, to provide the initial lift. After achieving a desired altitude, another kite, with a wicker chair attached below, would carry an observer up and down the kite line.[95] By the middle of 1901, Cody was content with his design – a winged variation of the Hargrave box – and in November 1901 he filed for a patent titling his request "Improvements in Kites and Apparatus for the same."[96]

Searching for a military customer for his new design, in February 1903, Cody sent a letter to the British Admiralty offering his patented "aeroplane" to His Majesty's Navy.[97] His initial offer was dismissed, but none other than Baden-Powell intervened on his behalf.[98] Baden-Powell convinced the Assistant Director for Naval Ordnance, Captain Reginald Tupper, that a kite demonstration would

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[91] Walker, *Early Aviation at Farnborough*, 104.
[92] Peter Mead, *The Eye in the Air: History of Air Observation and Reconnaissance for the Army, 1785-1945* (London, UK: Her Majesty's Stationery Office, 1983), 28.
[93] Hart, *Kites*, 149.
[94] Lawrence Hargrave, "Cellular Kites," *Engineering* 56 (27 October 1893), 523-524.
[95] Thomas, *The Complete World of Kites*, 31.
[96] Pelham, *Kites*, 52; British Patent No. 23,566 (20 November 1901), available online at: http://worldwide.espacenet.com/publicationDetails/originalDocument?CC=GB&NR=190123566&KC=&FT=E (accessed 3 April 2016).
[97] Cody consistently referred to his kites as aeroplanes until powered flight was achieved; Jenkins, *Colonel Cody*, 105.
[98] As mentioned earlier, Baden-Powell was a staunch kite advocate. Despite his own failures, it is telling that he was willing to intervene on Cody's behalf. His disdain for balloons and his belief that kites were ultimately better for the ISR mission likely led him to this decision.

be worthwhile.[99] On 12 March 1903, Cody conducted a small-scale demonstration for Tupper. Tupper was impressed and recommended a full examination of Cody's man-lifting kite system to his Royal Navy superiors.[100] Interestingly, in Tupper's recommendation, he opined that the most practicable use for the kite at sea would be in "reconnoitering."[101] Cody also received an important boost when then-Director of Naval Intelligence, Prince Louis of Battenberg, wrote a glowing review of Cody's kites based on a subsequent demonstration which the Prince attended. In his letter to the Admiralty, Battenberg recommended kites be pursued for both communication (wireless telegraphy) and reconnaissance.[102] Further, Battenberg requested additional tests to solidify his confidence in Cody's design.

At approximately this time, the Army also became interested in Cody's kites and a bidding war between the two services ensued. In a strange twist of events, Cody apparently grossly overestimated the importance of his kites to the services and asked far too much for the rights to his patent.[103] As a result, both services rejected Cody's offers and sought other options for their manned airborne ISR purposes. Fortunately for Cody, a comparable alternative did not exist and in 1904 he reached an agreement with the services for a temporary three-month contract. In February 1905, Cody reported for duty with the Royal Engineers to begin teaching the Army how to build and fly his kites.[104] By the end of the year, the Army was convinced of the value of the kite believing balloons would provide ISR in light winds and kites would be the preferred platform in strong winds.[105] In 1906, the War Office adopted Cody's system for Army observation and he was given status as an Army officer and made the chief kite

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[99] Again, Baden-Powell's influence here is remarkable. He had failed miserably in his own attempts to impress the Admiralty. For further on Baden-Powell's failures, see Walker, *Early Aviation at Farnborough*, 136.
[100] Jenkins, *Colonel Cody*, 105.
[101] Walker, *Early Aviation at Farnborough*, 136.
[102] Ibid., 139.
[103] Jenkins, *Colonel Cody*, 108.
[104] Ibid., 127.
[105] Walker, *Early Aviation at Farnborough*, 114.

instructor at Farnborough – the Army's home for aviation at the time.[106] While at Farnborough, Cody continued to improve his kites ultimately building man-lifting kites that could obtain altitudes of 3,500 feet and equip observers with cameras, telescopes, firearms, and telephone communications.[107] The kite would remain a viable part of British military equipment until only a few years later when the airplane proved to be a much better ISR platform.

At essentially the same time that Cody was advancing kites for military purposes in Great Britain, Lieutenant Hugh D. Wise of the United States Army Signal Corps was also experimenting with kites. Building on an idea given to him by his commanding officer at the time, Captain James Allen, in 1896 Wise began experimenting with various kite designs and quickly became one of the world's leading experts.[108] Initially planning to use kites as signal apparatuses, Wise quickly realized their potential as manned observation posts and dedicated himself to achieving successful man-lifting. After testing several models, Wise settled on the Hargrave box design and within a short period of time he had perfected a system that used a series of four Hargrave box kites flown in tandem.[109] Having learned about the failures of the kite designers who had gone before him, Wise was meticulous in his experimentation. He adopted an incremental approach whereby he would demonstrate success by lifting only weights before attempting to lift first mannequins and then ultimately himself.

During the fall of 1896 and early 1897, Wise conducted dozens of tests at Governor's Island in New York gaining the attention of an already "air-crazed" public. In October 1896, the *New York Times* ran an article documenting Wise's efforts "to demonstrate [the kite's] usefulness in military reconnoitre [*sic*]."[110] The *Times* piece catalogued many of Wise's experiments with both weights and

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[106] Pelham, *Kites*, 56.
[107] Will Yolen, *The Complete Book of Kites and Kite Flying* (New York, NY: Simon & Schuster, 1976), 51.
[108] James Wagenvoord, *Flying Kites* (New York, NY: The Macmillan Company, 1968), 58.
[109] Laufer, *The Prehistory of Aviation*, 42.
[110] "Kite May Carry a Man," *New York Times*, 9 October 1896.

mannequins and described his design in great detail.[111] After successfully demonstrating his system on dummies, Wise finally lifted himself to a height of approximately 42 feet in mid-January 1897.[112] In an interview following his successful ascension, Wise discussed his experiments and gave credit to Baden-Powell and Samuel Langley as having been most influential in his success.[113] Subsequent experiments resulted in increased altitude and by the end of 1897, Wise was hoisting both dummies and his fellow soldiers to heights of approximately 200 feet.[114] At the same time, Wise constructed another kite, this one was 18 feet in diameter and was specially configured to hold a camera and automatically take still images while airborne.[115]

Believing he had a stable design and photographic technology that would vastly improve the ability to conduct airborne ISR, Wise began a marketing effort to get the United States Army to incorporate his kites. His timing could not have been better. On 15 February 1898, the United States naval vessel U.S.S. *Maine* sunk in Havana, Cuba, and on 21 April, the United States declared war against Spain.[116] Wise immediately pitched the idea of using his kites to conduct ISR and signaling in support of ground forces in Cuba. The Army agreed and sent Wise – as part of the Ninth Infantry – to Tampa, Florida, to provide demonstrations for Army leadership.[117] At the time, the Spanish controlled Santiago harbor and the location of the Spanish fleet's flagship was unknown.[118] It was proposed that Wise's kites be flown beyond the harbor mouth to provide aerial photography of the harbor to help determine the location of the flagship.[119]

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[111] Intriguingly, the unknown *Times* author repeatedly used the term "aeroplane" to describe Wise's kite.
[112] Hugh D. Wise, "Flying in the Beginning: A Low-Key Account of High Adventure in 1897," *Scientific American* 147 (September 1932), 212-213.
[113] "First Kite Ascension," *The Deseret Evening News*, 22 January 1897.
[114] Wagenvoord, *Flying Kites*, 60.
[115] "Wise's Photographic Kite," *The Aeronautical Journal* (April 1898), 63-64.
[116] Edward F. Dolan, *The Spanish-American War* (Brookfield, CT: The Millbrook Press Inc., 2001), 9-29.
[117] Wagenvoord, *Flying Kites*, 63.
[118] C.E. Myers, "Aerial Navigation Problems," *Scientific American Supplement* 53 (January-June 1902), 21859-21860.
[119] Wagenvoord, Flying Kites, 63.

Wise successfully demonstrated both kite-based signaling and photography, but before his kites could be put to use, the United States Navy found the Spanish flagship in the harbor obviating the need for Wise's kite ISR.[120] While Wise's photographic kite was never used in the war, both the Navy and Army used his signaling kites quite extensively.[121] The demonstrated operational effectiveness in war, if nothing else, helped solidify the great potential of airborne ISR.

Other countries around the world developed kites for ISR purposes. Around the same time that Cody and Wise were developing their kites, experimenters in Russia developed a system of man-lifting kites that were to be used for observation, signaling, and life-saving. Lieutenant Nicholai Schreiber of the Russian Imperial Navy designed a man-lifting kite that consisted of six or seven Hargrave kites operating in tandem.[122] This system was nearly identical to Cody's except for one fundamental difference – Schreiber did not recognize the importance of the wings as had Cody. This oversight resulted in considerable instability in Schreiber kites and thus, they were quickly abandoned by the Imperial Navy after a number of fatal training accidents.[123] Another Russian officer, Captain S.A. Ulyanin of the Russian Imperial Army, developed a much more stable system that was adopted and used by the Russians to conduct airborne ISR at Port Arthur in the early days of the Russo-Japanese War of 1904.[124] Finally, the Japanese also used manned kites during the conflict to conduct ISR and to spot fire for Japanese naval shore batteries.[125]

Cody's success in Great Britain inspired the French to pursue kites for its armed forces. In 1909, the French Military Authorities sponsored a nationwide competition to encourage inventors to develop a kite-based, man-lifting observation system.[126] Captain Louis-Gabriel Madiot – who would go on to

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[120] Thomas, *The Complete World of Kites*, 33.
[121] "Eddy and His Kites," *The New York Times*, 2 July 1898.
[122] Hart, *Kites*, 150.
[123] Pelham, *The Penguin Book of Kites*, 58.
[124] Driver, *The Birth of Military Aviation*, 186.
[125] R.D. Layman, *Before the Aircraft Carrier: The Development of Aviation Vessels 1849-1922* (Annapolis, MD: Naval Institute Press, 1989), 85.
[126] Thomas, *The Complete World of Kites*, 33.

become the first Frenchman to fly an airplane – won the contest with a system of winged rectangular box kites which were very similar in design to Cody's.[127] Unfortunately, Madiot's design was never fully completed as he was tragically killed the following year in an airplane accident.[128] As a result, the French selected the very similar design of Captain Jacques-Théodore Saconney.[129] Saconney's kites used the Cody winged style and incorporated nearly the same mechanism for lifting the observer.

The majority of the countries that experimented with and adopted kites had abandoned them by the beginning of World War I. The Germans were one of the few exceptions. During that war, the Germans designed a manned observation kite for use in the Imperial Navy's submarine forces.[130] The design utilized a system of pulleys and winches that allowed an observer to hoist himself up the kite line after it had been launched. The observer could choose the altitude for best viewing, but German documentation of the system recommended 400 feet as the optimum viewing altitude.[131] By doing this, the submarine's field of view at sea level was increased from roughly five miles to approximately 25 miles. The genius behind this design was that the kite was not dependent upon winds to remain aloft as the submarine created sufficient speed under normal operating conditions. Unfortunately, this system did not permit the observer to descend quickly in the event an enemy spotted him as it used an enormous box kite design. This flaw led the Germans to develop other designs including one in which the observer actually sat in the kite itself. The design was more like a glider than a kite; to maintain level flight the observer balanced his weight on a wooden plank in the middle of the kite.[132] This design was more effective than the initial box design and the Germans used it throughout the

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[127] Hart, *Kites*, 150.
[128] Claude Graham-White and Harry Harper, *The Aeroplane: Past, Present, and Future* (Philadelphia, PA: J.B. Lippincott Company, 1911), 141.
[129] Pelham, *The Penguin Book of Kites*, 59.
[130] Hart, *Kites*, 150.
[131] Pelham, *The Penguin Book of Kites*, 76.
[132] Hart, *Kites*, 151.

war.[133]

The Germans also used modified kite designs in World War II. During the Battle of the Atlantic, as the tide began to turn against them, Kriegsmarine officers who had successfully used manned kites for ISR in World War I wanted a similar capability to enhance the effectiveness of their U-boats. In the interwar years, famed aircraft expert, Dr. Henrich Focke, had designed a kite that used a rotating blade to maintain flight while supporting an observation chair. Kriegsmarine officials were impressed with the design and ordered its production. Though it more closely resembled a modern helicopter, it was fundamentally a kite. The Germans produced an unknown number of these craft during the latter stages of the war and gave it military production number, Fa 330.[134] The *Bachstelze* ("Water-Wagtail"), as it was called, had auto-rotating blades that provided significant lift when it was pulled into a steady wind.[135] On a typical U-boat, the Germans stored the *Bachstelze* in two watertight cylinders in the aft part of the conning tower.[136] It could be assembled quickly – in as little as seven minutes – and could ascend to a height of approximately 50 feet.[137] The airborne observer sat on an improvised seat that rested against a lightweight aluminum frame. To launch the kite, the U-boat would turn into the wind to allow the craft to rise naturally. As the kite climbed, German submariners pulled a towing cable from a third container. This tether allowed the *Bachstelze* to extend the U-boat's viewing range to between 35 and 45 kilometers.[138]

Little is known about the extent to which the Germans employed these during the war. Their potential was great, but having a deployed *Bachstelze* prevented the U-boat from diving quickly if it was spotted. This appears to have limited their use to mostly remote areas and perhaps caused them to be used for

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[133] Thomas, *The Complete World of Kites*, 34.
[134] Jean-Denis G.G. Lapage, *Aircraft of the Luftwaffe, 1935-1945: An Illustrated Guide* (Jefferson, NC: McFarland and Company, Inc. Publishers, 2009), 383.
[135] Anthony L. Kay and John Richard Smith, *German Aircraft of the Second World War: Including Helicopters and Missiles* (London, UK: Putnam Aeronautical Books, 1972), 293-294.
[136] David Stevens, *U-Boat Far from Home* (St. Leonards, Australia: Allen & Unwin Pty Ltd., 1997), 10.
[137] Thomas, *The Complete World of Kites*, 34.
[138] Stevens, *U-Boat Far from Home*, 11.

self-preservation as opposed to intelligence gathering. In one documented account, U-862 used its *Bachstelze* on 30 May 1944 to provide added visibility when it was caught in a heavy fog bank off the Greenland coast.[139] Solidifying the notion that their use was limited, in October of 1944, the Germans traded the *Bachstelzen* from U-862 and U-196 to the Japanese for a Japanese *Reishiki* floatplane.[140]

The German experience in World War II effectively ends the kite's involvement in the evolution of manned airborne ISR. By that time, the modern airplane had obviated both the kite, and, as will be seen in upcoming chapters, the balloon. There were attempts to use kites for ISR after World War II, but they were few and of little consequence. Their impact on the evolution of ISR was, however, considerable. Kites were man's first ISR platform. From the Far East, across Asia and Europe, and over the Atlantic Ocean to the United States, before technology permitted, kites were man's best – and sometimes only – option to increase situational awareness. Over history, kite design evolved from rudimentary paper designs to Focke's gyrocopter of World War II. Almost as important as the desire to gain intelligence was the aerodynamic advances that resulted as a result of this evolution. Aircraft designers and visionaries leaned heavily on kite designs for the creation of gliders and ultimately powered aircraft. Without kites, it is likely that the arrival of the aircraft would have taken considerably longer. Cayley, Chanute, and the Wright brothers all used the mathematical principles discovered through the evolution of kite design as they constructed their gliders and aircraft.

Having thoroughly explored the development of kites as ISR platforms, the analysis now turns to the second platform in the chronological study of the evolution of manned airborne ISR – the balloon. Not initially conceived as an intelligence collection platform, it was not long after the first balloon ascension that enterprising minds realized the enormous potential the balloon possessed

[139] Ibid., 61.
[140] Ibid., 107.

for ISR. Shortly after that first flight, the French military incorporated balloons into its Army for ISR. From there, balloons expanded to the other armies in Europe and the United States. By the mid-nineteenth century, balloons had become a fixture on the battlefield. The following studies will show how the balloon furthered airborne ISR's evolution and ultimately contributed to both the success of the airplane and the development of ISR tradecraft that remains in use today.

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Chapter 2: Balloons – A Platform Enables the Next Phase of Airborne ISR Evolution

Nothing is more worthy of attention of a good general than the endeavor to penetrate the designs of the enemy.
Niccolo Machiavelli

The desire to obtain a better view of terrain and potential enemy movements led to the use of kites as ISR platforms. Beginning as simple man-lifters, over time kites became elaborately designed. They were, however, doomed from the start as they were inherently unstable and quite delicate. Heavy winds, rough weather, or well-directed enemy fire could easily preclude their use. Despite this, many nations used kites as ISR platforms and they had significant impact in several conflicts. The kite's shortfalls led others to seek better options for sustained flight and, eventually, for ISR purposes. Man's quest for enhanced information about the enemy took a major leap forward above a French field on 4 June 1783.[1] On that day, the brothers Montgolfier – Joseph and Etienne – conducted the first ever successful demonstration of the hot air balloon. While rudimentary in nature and using nothing more than burnt straw to provide the gas to lift the balloon, the Montgolfier craft ignited a flurry of experimentation with various balloon designs, fuel types, and payloads. Enhancements to the Montgolfier balloon eventually led to a stable aircraft that could carry a significant amount of weight and that could be controlled by a "pilot." This new platform enabled the next phase in the evolution of manned airborne ISR.

Many quickly recognized the military utility of this new invention. Years before his successful balloon launch, Joseph Montgolfier himself had envisioned the use of balloons as the vehicle to launch a surprise attack on English forces holding Gibraltar.[2] By the third Montgolfier flight, others began to advocate the

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[1] Frederick Stansbury Haydon, *Military Ballooning during the Early Civil War* (Baltimore, MD: The Johns Hopkins Press, 1941), 1.
[2] John Christopher, *Balloons at War: Gasbags, Flying Bombs & Cold War Secrets* (Stroud, UK: Tempus Publishing Ltd, 2004), 10.

potential military use of the balloon. Only ten years after the initial Montgolfier experiment the French military adopted the balloon and used it for airborne ISR in campaigns during and following the French Revolution. The invention, and subsequent use, of balloons in warfare was also to have a truly profound effect on aviation as the need to navigate the balloon led to the invention of the propeller and to the idea of applying engines to power the craft.[3] Balloon technology quickly expanded following the first few flights and rapidly proliferated to other nations. Kites had planted the idea in many military thinkers' minds, but balloons would make dedicated, purposeful airborne ISR a reality. Through an extensive examination of the evolution of the development and military use of balloons, this chapter will continue establishing the foundation for the paper's subsequent discussion of manned airborne ISR. While manned airborne ISR would not truly flourish until the advent of the airplane, as will be seen in this and the next chapter, balloons provided the first platform on which many of today's ISR technologies began. Airborne imagery intelligence (IMINT), signaling, airborne ISR tactics, ship-based air operations, and air-to-ground communications all had their birth on board the balloon.

The successful ascent of the Montgolfier balloon on 4 June 1783 was little more than a proof of concept. The Montgolfiers had been conducting small-scale balloon experiments in Joseph Montgolfier's apartments and were now ready to show the rest of the world what they had achieved.[4] The balloon was only 25 feet high, made of sackcloth and paper, and to obtain inflation the brothers placed the balloon on two poles perched above a bonfire of twigs and wool.[5] Though rudimentary in appearance and design, the arrangement worked and the balloon filled with air and floated to a height of approximately 3000 feet.[6] Despite the rather amateurish design of their craft, the balloon's flight created much

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[3] Charles H. Gibbs-Smith, *Aviation: An historical survey from its origins to the end of the Second World War* (London, UK: NMSI Trading Ltd, 2003), 28.
[4] Fulgence Marion, *Wonderful Balloon Ascents: or, The Conquest of the Skies. A History of Balloons and Balloon Voyages* (Madison, WI: C. Scribner & Co., 1870), 34.
[5] Christopher, *Balloons at War*, 11.
[6] Edwin J. Kirschner, *Aerospace Balloons: From Montgolfier to Space* (Fallbrook, CA: Aero Publishers Inc., 1985), 10.

excitement. The Montgolfiers had widely publicized the event and a large crowd witnessed this landmark in flight. Word of the Montgolfier success quickly spread and competitors with varying designs and fuel sources developed their own balloons. While this first Montgolfier balloon was unmanned, many speculated about the possibility of manned flight.[7] The competition that ensued drove the rapid advancement of the new invention with multiple inventors, scientists, and backyard tinkerers all trying to improve upon the Montgolfier design and to be the first to launch a man into the air.

One scientist who saw the Montgolfier balloon design and instantly knew he could improve upon it was the French physicist Jacques Alexander Cesar Charles. Within days of the Montgolfiers launching their balloon, Charles hired the Robert brothers – Anne-Jean and Nicolas-Louis – to construct the first hydrogen balloon.[8] Some 17 years earlier, the English physicist Henry Cavendish had demonstrated that hydrogen had different properties than other types of combustible air and that the gas was seven times lighter than atmospheric air.[9] Following his discovery, Cavendish suggested that hydrogen could be used to lift objects into the air, but he never pursued experimentation.[10] Charles had followed Cavendish's conclusions closely, but had not thought of a practical use for hydrogen. When he heard about the success of the Montgolfier balloon and the rudimentary fuel source, he immediately realized that hydrogen would be the perfect gas to provide lift for balloons. Teaming with the Robert brothers, Charles quickly produced the world's first hydrogen balloon and made preparations for its flight. On 23 August 1783, he and the Roberts arrived at Champ de Mars in Paris and began setting up for their flight.[11] At the time, creating hydrogen gas was a cumbersome process which involved pouring sulfuric acid over iron

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[7] Doris Simonis, ed., *Inventors and Inventions,* Vol. 4 (Tarrytown, NY: Marshall Cavendish Corporation, 2008), 1096.
[8] Manfred von Ehrenfried, *Stratonauts: Pioneers Venturing into the Stratosphere* (Cham, Switzerland: Springer Praxis Books, 2014), 32.
[9] Charles M. Evans, *War of the Aeronauts: A History of Ballooning in the Civil War* (Mechanicsburg, PA: Stackpole Books, 2002), 21.
[10] Kendall F. Haven, *100 Greatest Science Inventions of All Time* (Westport, CT: Libraries Unlimited, 2006), 75.
[11] Donald Dale Jackson, *The Aeronauts* (Alexandria, VA: Time-Life Books Inc., 1981), 14.

fillings. This procedure was quite slow and it took four days for Charles to fill his balloon. On 27 August 1783, he was ready and launched his craft.[12] The *Globe*, as Charles had named it, quickly climbed high into the sky – some 3000 feet in less than two minutes by some firsthand accounts – before bursting in flames and crashing to earth in an abandoned field outside the city.[13] Despite the destructive end to the demonstration, Charles considered it a complete success. He had proven that hydrogen allowed the balloon to rise much more quickly than the Montgolfier fuel source. He was convinced that hydrogen, once an easier production method was devised, would become the preferred fuel for balloons.

Both Montgolfier brothers were in attendance at Charles' successful experiment and, not wanting to lose their newfound notoriety, immediately began the next phase in the balloon 'space race.' Desiring as much publicity as possible, Etienne Montgolfier lobbied for and obtained permission to conduct the second balloon experiment in the presence of King Louis XVI and Queen Marie Antoinette at the Royal Palace in Versailles.[14] The brothers wanted this flight to be manned, but as many in the public had concerns about the safety of manned flight, the brothers decided to use animals as the first passengers. The oddity of the airborne animals added extra curiosity to an already popular spectacle. Additionally, one of Etienne's friends was the famous French wallpaper magnate Jean Baptiste Réveillion.[15] On Réveillion's suggestion, the Montgolfiers abandoned the sackcloth material and adopted cloth that had been treated with varnish. While these changes were generally aesthetic in nature and reflected the grandeur of the period, the varnish actually made the balloon much stronger and less likely to fall apart during flight – obvious improvements that helped encourage others to continue experimentation.

On 19 September 1783, scarcely three months after their first demonstration, the Montgolfier brothers arrived at the Palace of Versailles to set

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[12] Michael R. Lynn, *Popular Science and Public Opinion in Eighteenth Century France* (Manchester, UK: Manchester University Press, 2006), 125.
[13] Marion, *Wonderful Balloon Ascents*, 42.
[14] Simonis, *Inventors and Inventions*, 1097.
[15] Interestingly, the first Montgolfier balloon launch took place on land owned by Réveillon.

up their new, more elaborately designed balloon. This time, instead of suspending the balloon over fire, the fuel source was incorporated into the balloon design.[16] Additionally, as promised, the Montgolfiers prepared their balloon for the first animal flight in history. By attaching a wicker basket to the bottom of the balloon, the Montgolfiers flew the world's first known air cargo – a sheep, a duck, and a rooster.[17] The flight was a complete success. The balloon carried the animals to a height of approximately 1,500 feet and descended safely in a nearby wooded area.[18] In front of the King and Queen of France – among other dignitaries – the Montgolfiers had demonstrated the feasibility of carrying objects with balloons; the natural progression was for man to ascend next.[19]

On 15 October 1783 – scarcely four months after the first flight and less than a month after the first air cargo flight – the Frenchman Jean-François-Pilâtre de Rozier became the world's first known human being to ascend in a lighter-than-air craft.[20] These, however, were only flights in the loosest sense of the word. In reality, they were nothing more than tethered ascensions. The first untethered flight took place, with the French monarchs and the United States Ambassador to France Benjamin Franklin in attendance, on 21 November 1783, when de Rozier and French Army infantry Captain the Marquis d'Arlandes Francois Laurent flew for 25 minutes achieving a height of at least 500 feet.[21] While the men safely returned to earth, their flight, as documented by Benjamin Franklin, was harrowing. According to Franklin, "…the body of the balloon leaned over and seemed likely to overset. I was then in great pain for the men,

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[16] Evans, *War of the Aeronauts*, 23.
[17] Haydon, *Military Ballooning, 1.*
[18] J.E. Hodgson, *The History of Aeronautics in Great Britain* (London, UK: Oxford University Press, 1924), 15.
[19] American Founding Fathers Benjamin Franklin and John Adams were also present in the crowd.
[20] Haydon, *Military Ballooning,* 1.
[21] Franklin had also witnessed Charles' successful flight. As will be explored further, his being in Paris at this time was incredibly influential to the future of manned ISR. He wrote prolifically about the military use of balloons and the other possibilities this new invention provided.; Kirschner, *Aerospace Balloons*, 11.

thinking them in danger of being thrown out, or burnt…"[22] Despite the dangerous flight, these men flew untethered and as they continually had to provide fuel to the balloon to keep it aloft, they are often recognized as the world's first pilots.[23]

With men now flying through the air and having gained a new perspective of the land beneath them, thought quickly turned to the military utility of this new capability. Though foreseen over a hundred years previously by Italian monk and inventor Francesco de Lana, historians credit the Frenchman André Giraud de Villette with being the first early promoter of the use of aircraft to conduct manned airborne reconnaissance.[24] De Villette accompanied de Rozier during a balloon ascension two days after the latter's initial success. Following that flight, de Villette wrote a letter to *Le Journal de Paris* relating the events. In the account, de Villette provided what could be the first known, documented advocacy for manned airborne ISR, stating, "From that moment I was convinced that this apparatus, at little cost, could be made very useful to an army for discovering the position of its enemy, its movements, its advances, its dispositions, and that this information could be conveyed by a system of signals, to the troops looking after the apparatus."[25] The idea of using the balloon as a reconnaissance platform was thus publicly expressed within four months of its invention and five days after the first ascent by a human being.[26] Additionally, de Villette touched on a theme that would trouble generations of airborne ISR airmen for years to come – the ability to communicate from the airborne platform.

De Villette's initial musings on the military use of balloons were echoed

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[22] As quoted in Tom D. Crouch, *The Eagle Aloft* (Washington, D.C.: Smithsonian Institution Press, 1983), 31.
[23] Lennart Ege, *Balloons and Airships,* (New York, NY: Macmillan Publishing Co. Inc., 1974), 98.
[24] Egbert Torenbeek and H. Wittenberg, *Flight Physics: Essentials of Aeronautical Disciplines and Technology, with Historical Notes* (New York, NY: Springer, 2009), 5; Haydon, *Military Ballooning*, 2.
[25] Charles Frederick Snowden Gamble, *The Air Weapon: Being Some Account of the Growth of British Military Aeronautics from the Beginnings in the Year 1783 Until the End of the Year 1929, Volume 1* (Oxford, UK: Oxford University Press, 1935), 9.
[26] Haydon, *Military Ballooning*, 2.

and expanded upon by many other strategic thinkers. Less than a week after de Villete's article, the Englishman William Cooke hypothesized about the potential use of the balloon in war and made a case for the British military to adopt it for use in reconnaissance and long distance signaling.[27] Cooke believed the balloon could act as an early warning observation and communication post that could provide the Royal Navy with advanced warning of any impending invasions.[28] Additionally, Joseph Montgolfier himself had suggested the use of his balloons as both a method of communicating with the British military garrison at Gibraltar and as a vehicle by which the French could infiltrate troops.[29] The following year, an anonymous French author further explored the use of the balloon as an apparatus of warfare. This writer forecasted sweeping changes to warfare due to the invention of this new device. He also suggested a multitude of uses, including: reconnaissance, observation, map making, and interestingly, the use of captured enemy scouts to provide details on the location of their own armies.[30]

Englishman Thomas Martyn also wrote in great detail about what he foresaw as the most important use of the balloon. In a short book, Martyn detailed the use of balloons for reconnaissance and signaling, particularly at night. Martyn's vision is unique as he also discussed using balloons as part of naval fleets, or task forces. He saw the use of the balloon as a new way to communicate orders to ships in the task force. Martyn also proposed the feasibility of using pyrotechnics with balloons in a system of prearranged codes to pass messages from the task force's command and control ships.[31] In a day before wireless communication, the ability for all ships – or army units for that matter – to simultaneously receive orders from higher headquarters was

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[27] William Cooke, *The Air Balloon: Or a Treatise on the Aerostatic Globe, Lately Invented by the Celebrated Mons. Montgolfier, of Paris* (London, UK: Unknown publisher, 1783), 24-26.
[28] Justin D. Murphy, *Military Aircraft, Origins to 1918: An Illustrated History of Their Impact* (Santa Barbara, CA: ABC-CLIO, Inc., 2005), 7.
[29] Hodgson, *The History of Aeronautics*, 22.
[30] As cited in Gamble, *The Air Weapon*, 9.
[31] Haydon, *Military Ballooning*, 3.

extremely important.[32]

In addition to Martyn's work, in early 1784, an unidentified author published a pamphlet in England that proposed the use of balloons for ISR and long-distance signaling on land and at sea.[33] Echoing Cooke's vision, this author foresaw the balloon as an early warning platform for British forces. He also suggested that, before planning an attack, the army's commanding general could use the balloon to personally observe the enemy's forces. The author states that "…[the general] would have a bird's eye view of…everything…in the enemy's army…"[34] As will be seen later, Martyn's vision was prophetic; both the French Republic and the United States Army sent general officers aloft to do precisely what Martyn had described.

American thought regarding the use of balloons as instruments of war also began with the early Montgolfier demonstrations. Although Benjamin Franklin was in France as the United States' ambassador, he was also one of the United States' best, and most highly experienced, spies.[35] Having personally witnessed the de Rozier and d'Alarndes manned flight along with a 27 August flight conducted by Charles, Franklin put his experience as a spy to work and began passing detailed reports about the balloon along with his vision for the future. In a letter dated 30 August 1783, Franklin provided Sir Joseph Banks, President of the British Royal Society, with his initial reaction to balloon flight. In his first letter to Banks, Franklin described in great detail the balloon materials, fuel,

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[32] Thomas Martyn, *Hints of Important Uses to be Derived from Aerostatic Globes* (London, UK: Unknown publisher, 1784), 8.
[33] Christopher, *Balloons at War*, 15.
[34] Ibid., 16.
[35] Franklin had worked as an agent in Massachusetts during the early days of the American Revolution and was one of the founding members of the Continental Congress' "Committee of Secret Correspondence," which was an organization designed to covertly obtain supplies from abroad for the conduct of the Revolutionary War. For more on Franklin's spy work, see Edmund S. Morgan, *Benjamin Franklin* (New Haven, CT: Yale University Press, 2002). For information on the Continental Congress' "Committee of Secret Correspondence," see Ray Raphael, *Mr. President: How and Why the Founders Created a Chief Executive* (New York, NY: Knopf Doubleday Publishing Group, 2012), 36.

and payload.[36] In this initial missive, he highlighted the events surrounding Charles' successful flight and hypothesized about potential uses of the balloon. He guessed that in time people will "…keep such globes anchored in the air, to which…they may draw up game to be preserved in the cool, and water to be frozen when ice is wanted; and that to get money, it will be contrived to give people an extensive view of the country…"[37] Franklin's initial musings do not include speculation regarding the balloon's military utility, but they highlight the vast possibilities the balloon provided even in these earliest days of discovery. Franklin continued to follow the balloon's progress and in a letter to Dr. Richard Price – another member of the British Royal Society – Franklin commented that balloons had achieved the ability to carry a 1000-pound payload.[38]

Perhaps the increased carrying capacity of the balloon, combined with the fact that men were now flying in them, caused Franklin to ponder its military uses. In a subsequent letter to Banks, written on the same day he witnessed the de Rozier/d'Arlandes manned flight, Franklin speculated about various instances in which he saw balloons being valuable to armies. In this letter, he discussed the relatively low cost of the balloon as compared to the other military services. Additionally, and most importantly, he mentioned the possibility of "…elevating an Engineer to take a view of an enemy's army and works…"[39] He further discussed the potential to convey intelligence into or out of a besieged town and the ability to signal over great distances.

Franklin continued these initial thoughts about potential military uses of the balloon in a letter to the Dutch scientist Jan Ingenhousz. In this letter, Franklin made perhaps the first argument in the air power versus sea power debate when he stated, "Five thousand balloons, capable of raising two men

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[36] Benjamin Franklin to Sir Joseph Banks, letter, 30 August 1783, *The Complete Works of Benjamin Franklin*, vol. VIII, ed. John Bigelow, (New York, NY: The Knickerbocker Press, 1888), 328.
[37] Ibid., 332-333.
[38] Benjamin Franklin to Doctor Richard Price, letter, 16 September 1783, *The Complete Works of Benjamin Franklin*, vol. VIII, 359.
[39] Benjamin Franklin to Sir Joseph Banks, letter, 21 November 1783, *The Complete Works of Benjamin Franklin*, vol. VIII, ed. John Bigelow (New York, NY: The Knickerbocker Press, 1888), 377.

each, could not cost more than five ships of the line…"[40] Franklin's comments were meant to show the relative ease by which a country could invade another through the use of air power, but they are eerily similar to claims made by air power pioneers during the early twentieth century. Perhaps more importantly, Franklin also raised the possibility that the balloon could completely eliminate war. In the Ingenhousz letter, he postulated that the balloon could potentially convince leaders of the "folly of wars" due to the inability to defend against air attack.[41] These words, while Franklin's, could have just as easily been taken from a manuscript written by Giulio Douhet or Billy Mitchell.

In addition to Franklin, George Washington took notice of the balloon. In a letter to French General Louis le Begue Duportail, Washington mentioned reading about the French balloon in the newspaper.[42] In these early stages of balloon development, Washington was characteristically hesitant to put much stock in the development. In his letter, he tells Duportail, "…I do not know what credence to give as the tales related of them [balloons] are marvelous…"[43] Washington goes on to speculate about the use of balloons as transports stating, "…I suspect that our friends at Paris in a little time will come flying through the air…to get to America."[44] To further solidify Washington's interest in the subject, in a letter from his close friend, the Marquis de Lafayette, Lafayette tells Washington that Pierre Charles L'Enfant will fill Washington in on all the latest

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[40] Benjamin Franklin to Doctor Jan Ingenhousz, letter, 16 January 1784, *The Complete Works of Benjamin Franklin*, vol. VIII, ed. John Bigelow (New York, NY: The Knickerbocker Press, 1888), 433.
[41] Ibid., 433.
[42] General Duportail served under Washington during the Revolutionary War. He was an engineer and helped plan defensive fortifications. Additionally, he became one of Washington's most trusted officers and one of his leading strategists. For more information on Duportail, see Mary Theresa Leiter, *Biographical Sketches of the Generals of the Continental Army of the Revolution* (Cambridge, MA: Harvard University Press, 1889), 71.
[43] George Washington to Louis Le Begue Duportail, letter, 4 April 1784, in *The Writings of George Washington from the Original Manuscript Sources*, vol. XXVII, *11 June 1783 – 28 November 1784*, ed. John C. Fitzpatrick (Washington, D.C.: Published by authority of Congress, 1930), 387.
[44] Ibid.

news regarding balloons during his next visit to America.[45]

Thomas Jefferson also speculated about the potential military uses of the balloon shortly after its first demonstration. In a 28 April 1784 letter to his cousin, Doctor Philip Turpin, Jefferson provides a complete description of the French balloon experiments.[46] In the letter, he suggests several uses for the new invention, including: transportation of goods, traversing of dangerous territory, conveying intelligence into besieged places, and "…reconnoitering an army."[47] In another letter, this one to co-Declaration of Independence signee Francis Hopkinson, Jefferson discusses the use of balloons to circumvent maritime blockades and proposes landlocked countries use them to import goods.[48] In separate correspondence with James Madison and Doctor James McClurg, Jefferson discussed his excitement regarding the balloon.[49] In Madison's reply, he mentioned that he (Madison), after receiving Jefferson's letter, had been attempting to replicate the Montgolfier experiment but was unsuccessful in achieving the necessary lift to get the balloon to ascend.[50]

While Founding Fathers Washington, Franklin, Jefferson, and Madison were pondering predominantly non-kinetic military uses of the balloon, it was, surprisingly, the poet Philip Freneau who was perhaps the first American to discuss the use of the balloon as a true instrument of war. In his poem, *The Progress of Balloons*, Freneau – forecasting the future exploits of Billy Mitchell – wrote of a great French air armada attacking the British Navy from the air and

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[45] Marquis de Lafayette to George Washington, letter, 9 March 1784 in *The Papers of George Washington*, Confederation Series, vol. 1, *1 January 1784–17 July 1784*, ed. W. W. Abbot (Charlottesville, VA: University Press of Virginia, 1992), 189–191.
[46] Thomas Jefferson to Doctor Philip Turpin, letter, 28 April 1784, in *The Papers of Thomas Jefferson*, vol. VII, *2 March 1784–25 February 1785*, ed. Julian P. Boyd (Princeton, NJ: Princeton University Press, 1953), 134–137.
[47] Ibid.
[48] Thomas Jefferson to Francis Hopkinson, letter, 18 February 1784, in *The Papers of Thomas Jefferson*, vol. VI, *21 May 1781–1 March 1784*, ed. Julian P. Boyd (Princeton, NJ: Princeton University Press, 1952), 541–543.
[49] Thomas Jefferson to Doctor James McClurg, letter, 17 March 1784, in *The Papers of Thomas Jefferson*, vol. VII, *2 March 1784–25 February 1785*, ed. Julian P. Boyd (Princeton, NJ: Princeton University Press, 1953), 134–137.
[50] Reverend James Madison to Thomas Jefferson, letter, 28 April 1784, in *The Papers of Thomas Jefferson*, vol. VII, *2 March 1784–25 February 1785*, ed. Julian P. Boyd (Princeton, NJ: Princeton University Press, 1953), 133-134.

also discussed the British using balloons to bomb the United States in a future war between the two nations.[51] Frenau provided no specifics in his poem, but his foresight was visionary.

Following the Montgolfier and Charles successes, the French continued to experiment and advance balloon design. In the first several months following the initial flights, some French designers, hoping to capitalize on the low cost of the Montgolfier fuel system, constructed ever-larger balloons.[52] On 19 January 1784, in front of a crowd of 100,000 in Lyons, Joseph Montgolfier launched *Le Flesselles*, which measured 126 feet high and 100 feet in diameter.[53] *Le Flesselles'* maiden voyage was unique for several reasons. First, it was Joseph Montgolfier's first – and only – manned flight. The man who had invented ballooning and sparked the craze, had never flown. Second, due its massive size, *Le Flesselles* was able to carry seven people making it the first true passenger aircraft. Finally, it was the last balloon that the Montgolfiers were involved in designing. Following the flight, both brothers chose to pursue other interests.[54]

The Montgolfier brothers' retirement from ballooning did not slow the French balloon frenzy as experiments and advancements continued. On 2 March 1784, Jean Pierre Blanchard, who would later gain fame for his aerial exploits in the United States, made his first ascent in a hydrogen balloon launched from the Champ de Mars. On 4 June 1784, a Montgolfier-type balloon called *Le Gustave* took off from Lyon. This flight was particularly notable as it included the first female aeronaut – Madame Elisabeth Thible.[55] While both flights included important persons, they are also notable as during both, unsuccessful attempts

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[51] Philip Freneau, "The Progress of Balloons," in *The Poems of Philip Freneau: Poet of the American Revolution*, vol. II, ed. Fred Lewis Pattee (Princeton, NJ: The Princeton University Library, 1903), 276.
[52] As discussed earlier, the Montgolfier balloon burned materials that were readily available while hydrogen – the preferred fuel of the Charles balloon – was expensive and quite difficult to generate.
[53] Jackson, *The Aeronauts*, 27.
[54] Interestingly, Charles also retired from ballooning following his first flight. Both legends of ballooning had suffered unpleasant maiden flights – *Le Flesselles* burst into flames on landing and Charles endured the pain of barotrauma on both ascent and descent.
[55] Ehrenfried, *Stratonauts*, 32.

were made to direct, or drive, the balloon.[56] The problem of navigation – one that would continue to plague balloonists until the early twentieth century – even led the Academy of Lyons to offer a 50-livre prize for the best essay on the subject of the "…safest, least expensive and most effectual means of directing air balloons at pleasure."[57] The Academy received several essays, but none provided a practicable method.

The excitement surrounding the new discovery was not unique to France and the United States. News of the balloon experiments quickly spread to other European countries. Air enthusiasts and entrepreneurs – some working to advance flight and others simply seeking fame – began their own attempts at lighter-than-air flight. In Italy, under the direction of the Chevalier Paul Andriani, the brothers Gerli constructed and flew an improved version of the Montgolfier balloon.[58] In Scotland, sparked by his fascination with the balloon flights in France, James Tytler was determined to be the first Scot to fly. Following the newspaper descriptions of the Montgolfier balloon, Tytler built his own version. Following two unsuccessful attempts, he successfully achieved an unmanned tethered flight on 25 August 1784 and on 27 August he ascended untethered thus becoming the first Scottish aeronaut.[59]

In the beginning, the English were unsurprisingly apathetic, and even outright dismissive, regarding the importance of the balloon. The English-French rivalry was still alive and well during that time and the English did not want to give the French any credit for their invention. In fact, it was an Italian nobleman, not an Englishman, who successfully flew the first balloon over England. On 25 November 1783, Count Francesco Zambeccari launched a small hydrogen

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[56] As will be seen later, the inability to navigate these early balloons led to both propulsion and steering mechanisms; both advancements that helped make heavier-than-air flight possible.
[57] Jackson, *The Aeronauts*, 30.
[58] The Andriani improvements regarded the fuel system. In his design, the fire was placed above the mouth of the balloon opening. This allowed the pilot to throw fuel on the fire from a distance without risking injury. Hodgson, *The History of Aeronautics in Great Britain*, 17.
[59] Ian McDonnell, "Two hundred years of hot-air ballooning," *New Scientist*, 30 August 1984, 41.

balloon constructed of oil-silk from the Artillery Grounds in Moorfields.[60] On the very next day, a Swiss chemist, Ami Argand, who had worked with the Montgolfiers during their early experimentation, successfully demonstrated a hydrogen balloon for King George III at Windsor Castle.[61] This accomplishment was the impetus needed in England. King George became enamored and small balloons soon became commonplace in the skies around London.

Notwithstanding the newfound interest, it was several months after the Argand demonstration before any serious effort was made at achieving a manned ascension in England and nearly a year before success was actually attained. Following Argand's display, another Swiss entrepreneur, Chevalier de Moret, made the first attempt at manned flight.[62] In front of a large crowd, Moret tried to fill and ascend his balloon with no success. After three hours of waiting, the crowd grew impatient and destroyed the balloon.[63] The first Englishman to attempt manned flight was Doctor John Sheldon. Teaming with Blanchard, Sheldon attempted several ascensions in August of 1784, but was unsuccessful in each. Manned flight continued to elude the English until 15 September 1784 when an Italian named Vincenzo Lunardi successfully flew in a balloon launched from the Moorfields Artillery Grounds.[64] In front of a crowd estimated at 100,000 that included the Prince of Wales, Lunardi – along with a dog, a cat, and a pigeon – successfully took off in a hydrogen balloon constructed of silk.[65] It was not until the next month, however, when James Sadler, a young inventor and engineer, successfully flew a balloon from Oxford to the neighboring village of Islip that an Englishman actually achieved flight.[66]

Lunardi's success was followed shortly by that of Jean Pierre Blanchard.

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[60] Sir Walter Raleigh, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force* (Oxford, UK: Oxford Clarendon Press, 1922), 8.
[61] John J. Wolfe, *Brandy, Balloons, & Lamps: Ami Argand, 1750-1803* (Carbondale, IL: Southern Illinois University Press, 1999), 10.
[62] Ege, *Balloons and Airships*, 101.
[63] Vincent Lunardi, *An Account of Five Aerial Voyages in Scotland* (London, UK: J. Bell Bookseller to His Royal Highness the Prince of Wales, 1786), 15.
[64] Hodgson, *The History of Aeronautics*, 18.
[65] Lunardi, *An Account of Five Aerial Voyages in Scotland*, 31-38.
[66] Basil Collier, *A History of Air Power* (New York, NY: Macmillan Publishing Co., Inc., 1974), 6.

A Frenchman who had traveled to London in September 1784 to experiment with balloons, Blanchard would ultimately become the world's first professional aeronaut and showman. After his initial success in October 1784, Blanchard conducted numerous experiments and traveled extensively plying the balloon trade. In addition to being credited with inventing the parachute, he is noted as being the first person to successfully ascend in Holland, Belgium, Austria, Poland, the Czech Republic, Switzerland, and Germany.[67] And, as will be seen, he conducted the first successful aerial voyage in the United States.

On 30 November, Blanchard and his financial backer, American Doctor John Jeffries, conducted a successful flight of several hours over the suburbs of London.[68] Following this flight, Blanchard decided to become the first man to attempt a balloon flight across the English Channel.[69] Arriving at Dover Castle on 17 December, Blanchard began to set up the launching area and he and Jeffries waited for favorable winds for their landmark journey to France. On 7 January 1785 the weather finally cooperated and, in a voyage that almost prematurely ended in the water several times and took over four hours to complete, Blanchard and Jeffries, became the first men to fly across the English Channel.[70] Interestingly, Blanchard was already wrestling with the idea of propulsion and navigation; on this cross-Channel flight, he brought oars and wings to provide extra thrust.[71]

In the young United States, the Founding Fathers' interest in ballooning prompted early attempts to replicate French success. Doctor John Foulke, a surgeon and member of Philadelphia's American Philosophical Society was the first American to document experimentation with the hot-air balloon. Foulke,

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[67] Hodgson, *The History of Aeronautics*, 19-20.
[68] Jeffries, whose Tory leanings had caused him to flee the Colonies during the American Revolution, bankrolled Blanchard's entire balloon operation. In return, Jeffries asked that he be allowed to fly with Blanchard to conduct meteorological experiments.
[69] Charles Coulston Gillespie, *The Montgolfier Brothers and the Invention of Aviation, 1783-1784* (Princeton, NJ: Princeton University Press, 1983), 120.
[70] Roy Conyers Nesbit, *Eyes of the RAF: A History of Photo-Reconnaissance* (Stroud, UK: Sutton Publishing Limited, 1996), 1.
[71] E. Charles Vivian, *A History of Aeronautics: The Evolution of the Aeroplane* (New York, NY: Harcourt, Brace, and Co., 1921), 200.

having recently finished his medical studies in Paris, had observed the Montgolfier and Charles balloons firsthand.[72] In correspondence between Thomas Jefferson and Francis Hopkinson from May 1784, Hopkinson states, "We have been amusing ourselves with raising Air Balloons made of paper."[73] He goes on to write, "The first that mounted our atmosphere was made by Dr. Foulk [*sic*]."[74] These experiments were quite rudimentary in nature as Hopkinson states the balloons "…rose twice or perhaps three times the height of the houses and then gently descended…" but they show that Americans were working on balloons of their own within a year of the first successful launch.[75]

Foulke quickly built a strong reputation in Philadelphia and in May 1784 he offered a lecture on the subject of pneumatics. In the newspaper advertisement for the lecture, Foulke promised to explain "the properties of inflammable, nitrous, and fixed airs," to exhibit "a great variety of aerostatic globes," and to suggest "the uses to which the Montgolfier's ingenious discovery may be applied."[76] Coincidentally, George Washington was also in Philadelphia, at the time presiding over the first national assembly of the Society of Cincinnati.[77] With his interest having already been piqued by the news he had heard from Paris, Washington planned to attend Foulke's lecture. Unfortunately, the demands of the assembly prevented him from attending, but the mere fact that a man of Washington's importance sought to attend the lecture is testament to how important the topic of balloons had become.

Though Foulke moved on to other interests following his initial involvement, his successful experiments and informative lectures prompted

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[72] William F. Trimble, *High Frontier: A History of Aeronautics in Pennsylvania* (Pittsburgh, PA: University of Pittsburgh Press, 1982), 5.
[73] Francis Hopkinson to Thomas Jefferson, letter, 12 May 1784, in *The Papers of Thomas Jefferson*, vol. VII, *2 March 1784–25 February 1785*, ed. Julian P. Boyd (Princeton, NJ: Princeton University Press, 1953), 245-246.
[74] Ibid.
[75] Ibid.
[76] Advertisement, *Pennsylvania Journal*, 12 May 1784 in Sidney I. Pomerantz, "George Washington and the Inception of Aeronautics in the Young Republic," *Proceedings of the American Philosophical Society* 98, no. 2 (April 1954): 131-138.
[77] Frank E. Grizzard, *George Washington: A Biographical Companion* (Santa Barbara, CA: ABC-CLIO, Inc., 2002), 288.

some members of the American Philosophical Society to seek the advancement of balloon flight in America. In an 11 June 1784 meeting of the Society, a motion was made by Doctor John Morgan to support "an effort to send up a large air balloon."[78] At the following meeting, on 19 June 1784, Morgan read a paper that he had compiled summarizing the status of the air balloon and its potential use for transport and reconnaissance.[79] Though the Society members ultimately voted against pursuing balloons as a Society-sponsored project, several individual members remained involved. On 19 June 1784, Hopkinson wrote an editorial to the Philadelphia-based newspaper the *Pennsylvania Packet*. In the article, he advocates for continued balloon experimentation and calls for the launching of "a large, elegant air balloon."[80] Also listed in Hopkinson's article are the names of 85 Philadelphians who were backing the project out of what Hopkinson called their "love of science and the honor of their country."[81]

Notwithstanding the strong support, the Hopkinson effort never materialized. Instead, the credit for the first manned flight in the United States goes to a thirteen-year-old boy, Edward Warren. In a classic case of being in the right place at the right time, Warren volunteered to ascend while he was in attendance at a balloon demonstration being conducted by Maryland entrepreneur Peter Carnes on 24 June 1784 in Baltimore.[82] Carnes, who by all accounts was grossly obese, was attempting to ascend himself, but the balloon he had built would not take off due to his weight.[83] As Carnes did not want to disappoint the assembled crowd who had all paid two dollars to witness the event, he allowed Warren to ascend in his place. The flight was a success and

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[78] Minutes of Meetings of the American Philosophical Society, 11 June 1784, in *Proceedings of the American Philosophical Society* (Philadelphia, PA: McCalla & Stavely Press, 1884), 126.
[79] Minutes of Meetings of the American Philosophical Society, 19 June 1784, in *Proceedings of the American Philosophical Society* (Philadelphia, PA: McCalla & Stavely Press, 1884), 126.
[80] Quoted in Sidney I. Pomerantz, "George Washington and the Inception of Aeronautics in the Young Republic," *Proceedings of the American Philosophical Society* 98, no. 2 (April 1954): 131-138.
[81] Quoted in Trimble, *High Frontier*, 6.
[82] Evans, *War of the Aeronauts*, 26.
[83] Edita Lausanne, *The Romance of Ballooning-The Story of the Early Aeronauts* (New York, NY: A Studio Book, 1971), 15.

Carnes began plans for an untethered flight to be conducted in Philadelphia.

Carnes, who, like most of the early aeronauts was primarily in ballooning for the money, advertised the Philadelphia exposition heavily. To help ensure non-paying spectators could not see his launch, he planned to ascend from the city's prison yard where the high walls would restrict visibility.[84] On 17 July 1784, in front of thousands of spectators, he made his attempt. Unfortunately, before the balloon was able to clear the prison walls, a gust of wind pushed the balloon into the wall knocking Carnes from the basket. The balloon continued rising to about 1,000 feet where it burst into flames and crashed back to earth.[85] The crowd was unsurprisingly frustrated by Carnes' misfortune and a small riot erupted as many demanded refunds for their tickets. Carnes' failure curbed America's appetite for ballooning for almost a decade. There was very little progress from 1784 until late 1792. Thomas Jefferson's interest continued with his creation of a Balloon Club at his alma mater William and Mary in 1785, but the club primarily studied aeronautics and did not conduct practical experiments.[86] It took the arrival of seasoned showman Jean-Pierre Blanchard and his promise to demonstrate how far the balloon had come to reenergize the American interest.

Blanchard's arrival in the United States in the fall of 1792 was much heralded throughout Philadelphia. His European exploits were widely known and the Philadelphia newspapers tracked his every move. Blanchard also took every opportunity to maximize the financial gain from his impending balloon demonstration. He sought out President George Washington, Secretary of State Thomas Jefferson, the French Ambassador Chevalier Jean Ternant, and the Governor of Pennsylvania Thomas Mifflin asking each to attend the demonstration.[87] Jefferson was particularly enthusiastic about Blanchard's presence. In a letter to his daughter Martha, dated 31 December 1792, he

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[84] Lou Harry, *Strange Philadelphia: Stories from the City of Brotherly Love* (Philadelphia, PA: Temple University Press, 1995), 29-30.
[85] Trimble, *High Frontier*, 6.
[86] Evans, *War of the Aeronauts*, 27.
[87] Pomerantz, *George Washington and the Inception of Aeronautics*, 136.

advised Martha of Blanchard's arrival and upcoming exposition.[88] Additionally, Blanchard strategically selected the location for his launch just as Carnes had done. By choosing the Walnut Street Prison in downtown Philadelphia, he could ensure none but paying customers would be able to view the launch.[89]

On the morning of 9 January 1793 with a crowd of thousands in attendance – including President Washington and future presidents John Adams, Thomas Jefferson, James Madison, and James Monroe – Blanchard arrived to an enormous spectacle, including marching bands and cannon fire. A general feeling of great expectation emanated from the crowd. Ever the showman, Blanchard carried with him a flag that had the United States stars and stripes on one side and the French flag on the other.[90] He made his way through the crowd and located President Washington. After receiving a handshake from the President, Blanchard – along with a small dog – climbed into the balloon and took off from the prison yard.[91] Blanchard's balloon rose without any problem and he flew untethered for approximately 45 minutes before landing in a clearing near Woodbury, New Jersey, some 15 miles away. Local farmers who had witnessed Blanchard's descent returned him to Philadelphia where upon arrival he went to see President Washington to provide details of his journey.[92] After years of unsuccessful attempts, a man had finally ascended in an untethered balloon in the United States. Even though it was a Frenchman who had successfully flown, the United States was finally an air nation.

Despite the excitement surrounding the invention of the balloon and its rapid spread through Europe, most experimentation remained in the civilian realm. Though visionaries had speculated about the potential military uses of the balloon, armed forces across the globe did not quickly incorporate the new

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[88] Thomas Jefferson to Martha Jefferson Randolph, letter, 31 December 1792, in *The Papers of Thomas Jefferson*, vol. XXIV, *1 June-31 December 1792*, ed. John Catanzariti (Princeton, NJ: Princeton University Press, 1990), 806.
[89] Jackson, *The Aeronauts*, 46.
[90] Jean-Pierre Blanchard, *The First Air Voyage in America: January 9, 1793* (Bedford, MA: Applewood Books, originally published in 1793 by Charles Cist), 15.
[91] Trimble, *High Frontier*, 7.
[92] Blanchard, *The First Air Voyage in America*, 27.

capability. It was not until the outbreak of the French Revolution and its subsequent wars that militaries would finally begin realizing some of the dreams of the early air power theorists. After overthrowing King Louis XVI, the young French Republic was desperate to employ any means that would help it keep its loose hold on power. Internal disputes, general discontent, and the ever-present threat of war from hostile neighbors contributed to the revolutionary government's willingness to expand its military capability in novel ways. Early in 1793, balloon expert Louis Bernard Guyton de Morveau highlighted to the future director of the French Armies, Lazare Carnot, the "infinite usefulness" of balloons to French military forces.[93] On 14 July 1793, the *Commission Scientifique* – which had been chartered to search for methods that might help the new government overcome its military shortfalls – reported that captive balloons should be supplied to the armies of the Republic for reconnaissance.[94] In fall 1793, de Morveau formally proposed the use of balloons as observation platforms to the French Committee of Public Safety.[95] Additionally, at approximately the same time, Joseph Montgolfier began advocating for the use of balloons as bombers and proposed a bombing plan to break the siege of Toulon.[96]

After hearing the persuasive arguments of de Morveau and Montgolfier, on 25 October 1793, the French government passed an act that ordered both the further examination of the utility of using balloons in the army and the construction of a balloon for experimentation.[97] The balloon, which was to be used by the Army of the North, was to be a hydrogen balloon costing no more than 50,000 livres.[98] Scientists-cum-aeronauts Jean Marie-Joseph Coutelle and Nicolas Conté were placed in charge of the project and constructed what can be arguably called the world's first aircraft expressly built for military purposes.[99]

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[93] Quoted in Haydon, *Military Ballooning During the Early Civil War*, 5.
[94] Peter Mead, *The Eye in the Air: History of Air Observation and Reconnaissance for the Army, 1785-1945* (London, UK: Her Majesty's Stationery Office, 1983), 14.
[95] Ege, *Balloons and Airships*, 106.
[96] Thomas Hippler, *Bombing the People: Giulio Douhet and the Foundations of Air-Power Strategy, 1884-1939* (Cambridge, UK: Cambridge University Press, 2013), 3.
[97] Haydon, *Military Ballooning*, 6.
[98] Christopher, *Balloons at War*, 17.
[99] Ege, *Balloons and Airships*, 106.

By November the men had finished building the balloon and support equipment and were ready for field-testing.

To help prepare the Army for the balloon's incorporation, on 4 November, Coutelle left Paris to meet with the Commander of the Army of the North, General Jean-Baptiste Jourdan who was at the time commanding French forces in the besieged town of Maubeuge.[100] Understandably, Jourdan was not eager to try new innovations in the middle of a siege and he and his staff were skeptical and dismissive. One staffer thought Cotelle was a spy and another stated, "A battalion is needed more than a balloon."[101] Despite the initial cold shoulder, Coutelle continued his advocacy for the balloon and eventually convinced Jourdan of its potential as an airborne reconnaissance platform. The two men agreed that further experiments needed to be carried out before balloons were brought to the battlefield.[102] With that, Coutelle returned to Paris where he was given space at the Chateau de Meudon, which had been designated as a Military Trials location, to construct balloons and to train new aeronauts on their use.[103] Meudon thus became the world's first military aeronautical establishment and Coutelle the world's first military instructor pilot.[104]

Over the winter of 1794, Coutelle and his team built balloons and conducted multiple demonstrations to help prove the balloon's utility. Members of the Committee of Public Safety visited Meudon and tasked Coutelle to prove that he could both observe movement at a distance and offload the intelligence in near-real time. With minimal input from the French military, Coutelle devised a system whereby messages were sent to the ground either by signal flag communications or by lowering written messages in small bags weighted with sand.[105] Through his continued testing of altitude and balloon occupancy, by

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[100] Hugh Driver, *The Birth of Military Aviation: Britain, 1903-1914* (Rochester, NY: Boydell & Brewer Inc., 1997), 148.
[101] Marion, *Wonderful Balloon Ascents*, 212; Jackson, *The Aeronauts*, 76.
[102] Christopher, *Balloons at War*, 18.
[103] Mead, *The Eye in the Air*, 13.
[104] Driver, *The Birth of Military Aviation*, 148.
[105] Christopher H. Sterling, ed., *Military Communications from Ancient Times to the 21st Century* (Santa Barbara, CA: ABC-CLIO, Inc., 2008), 13.

March 1794, Coutelle had perfected the world's first military observation balloon, *L'Entreprenant.* After significant experimentation, Coutelle settled on 1,700 feet as being the exact altitude to maximize the effectiveness of the handheld telescope used for observation and was convinced that two people – one to observe the enemy and the other to drop the messages from the balloon – was the optimum crew complement.[106] On 29 March 1794, having witnessed a display of the balloon and having finally been convinced of its potential as an airborne ISR platform, the Committee of Public Safety passed an act creating a balloon corps in the French Army.[107] Three days later, on 2 April 1794, the same committee established the corps' first company; the *Première Compagnie d'Aérostiers.* With this move, the world's first airborne reconnaissance outfit was born and Coutelle was commissioned into the French Army as a captain becoming the world's first airborne ISR unit commander.[108]

Along with the authority to operate balloons, the Committee of Public Safety established tactical objectives for the balloon corps. These objectives required the balloon corps to "put at the disposal of the general all the services that can be furnished by the art of aeronautics: (1) to clarify the enemy's marches, movements, and plans; (2) to transport quickly signals previously agreed-upon with the major generals and commanding officers in the field; (3) finally, as circumstances required, to distribute public notices in territory occupied by the despots' henchmen."[109] While the first two are commonly recognized missions of the early balloons, the third, distribution of propaganda, is unique and shows the extent of French thinking about the various utilities of the balloon. Of note, there is no mention of using the balloons as bombers. Whether the French simply had not tested the concept or whether the idea had not evolved is unknown. What can certainly be ascertained, however, is that the

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[106] Murphy, *Military Aircraft*, 8.
[107] Robert P. Broadwater, *Civil War Special Forces: The Elite and Distinct Fighting Units of the Union and Confederate Armies* (Santa Barbara, CA: Praeger, 2014), 64-65.
[108] Robert Jackson, *Army Wings: A History of Army Air Observation Flying 1914-1960* (Barnsley, UK: Pen & Sword Aviation, 2006), 8.
[109] Arnold van Beverhoudt, *These are the Voyages* (St. Thomas, VI: Lulu Press, 1993), 115.

initial military use of the balloon – and thus the aircraft – was for airborne intelligence purposes.

Scarcely a week after the balloon company's establishment, the French government dispatched it to Maubeuge. Austrian and Dutch troops were still besieging the city and the French hoped to gain a tactical advantage by using balloons to locate enemy positions. This time Jourdan accepted the *Première Compagnie* into his Army of the North and actively worked with Coutelle to maximize the balloon's impact.[110] After establishing his equipment and operating location, on 2 June 1794, Coutelle conducted the first documented airborne ISR mission in history.[111] As hoped, from his high elevation, Coutelle was able to provide accurate locations of the Austrian and Dutch armies surrounding the city. In subsequent days, Coutelle conducted numerous sorties and provided unprecedented information about the enemy's locations, artillery emplacements, earthworks, and working parties.[112] Of particular note is Coutelle's fifth flight. On this sortie, enemy artillerymen aimed their cannons skyward in an attempt to shoot down Coutelle's balloon, *L'Entreprenant*.[113] Coutelle narrowly avoided disaster as the 'flak' was fairly accurate. During one salvo, cannonballs straddled the basket in which Coutelle was riding with one flying over his head and another grazing the basket below his feet.[114] In an act of bravado that foreshadowed the exploits of many pilots to come, Coutelle shouted, "*Vive la République*" in the direction of the enemy gunners as his balloon rose away to safety.[115] While ultimately unsuccessful at stopping Coutelle's reconnaissance, these anonymous Dutch or Austrian artillerymen had become the world's first anti-aircraft battery.[116]

With Coutelle's first flights having demonstrated the balloon's great force

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[110] Richard P. Hallion, *Taking Flight: Inventing the Aerial Age, from Antiquity Through the First World War* (New York, NY: Oxford University Press, 2003), 64.
[111] I say first flight documented mission here as I believe this is the first time a military directed an airborne ISR asset to specifically collect intelligence; Haydon, *Military Ballooning*, 10.
[112] Mead, *The Eye in the Air*, 14.
[113] Marion, *Wonderful Balloon Ascents*, 215.
[114] Hallion, *Taking Flight*, 64.
[115] Jackson, *The Aeronauts*, 78.
[116] James D. Crabtree, *On Air Defense* (Westport, CT: Praeger Publishing, 1994), 2.

enhancing ability, the French moved the *Première Compagnie* to Charleroi.[117] Over the next several days, the intelligence gained during Coutelle's flights revealed the location of Austrian fighting positions and their battle preparations. During these flights, Jourdan's adjutant, General Antoine Morlot, accompanied Coutelle to observe firsthand what Coutelle was seeing. In what could be considered the world's first airborne intelligence preparation of the environment (IPOE), Jourdan's staff directly used the intelligence information gained from airborne ISR to plan for the upcoming Battle of Fleurus. During the battle, fought on 26 June 1794, Coutelle remained aloft for nearly ten hours and reported extensively on the movements of the Austrian army. General Morlot was once again airborne with Coutelle and would receive written questions from the ground commanders via a cable that Coutelle hauled into the basket.[118] In a remarkable display of the potential of intelligence-driven operations, the French command directed its movements that day almost entirely based on the intelligence being provided by *L'Entreprenant*.[119] The first use of a purpose-built military ISR aircraft in combat had been an overwhelming success. The *Première Compagnie* was joined shortly after Fleurus by the *Deuxième Compagnie* and both served throughout the revolutionary period.

In 1797, Napoléon Bonaparte agreed to include a balloon company in his Egyptian expedition. Unfortunately, the balloon did not see military action and was only used once in a demonstration designed to impress the native population.[120] Ultimately, the balloon and all related equipment were lost at sea during the Battle of the Nile and Coutelle's company was never able to show the future emperor the advantages of balloons. Never a champion of new technology, when Bonaparte returned to France in 1799, he disbanded the balloon corps effectively ending France's potential aviation dominance.[121]

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[117] Collier, *A History of Air Power*, 8.
[118] Jackson, *The Aeronauts*, 8.
[119] Collier, *A History of Air Power*, 8.
[120] Michael R. Lynn, *The Sublime Invention: Ballooning in Europe, 1783-1820* (Abingdon, UK: Routledge Publishing, 2016), 101.
[121] Gunther E. Rothenberg, *The Art of Warfare in the Age of Napoléon* (Bloomington, IN: Indiana University Press, 1978), 123-124.

Remarkably, despite their proven value to ground commanders, the military use of balloons did not proliferate as widely as would be expected. Napoléon's reliance on his cavalry for reconnaissance and other leaders' attempts to emulate Napoléon's methodology is one likely reason. Another is that early airmen – like many of their successors – oversold the value of the balloon. As enthusiastic as Douhet or Mitchell, Coutelle perhaps could be called the world's first air power zealot. In his desire to show the benefits of his device, Coutelle was known to forget he was at war. On one occasion, he even paused a reconnaissance sortie to demonstrate the balloon and the handling of it to enemy Austrian officers.[122]

Following the Napoléonic Wars, the use of military balloons was sporadic at best. The lengthy period of peace between the great powers resulting from the 1815 Congress of Vienna is the most likely reason. Nations were simply exhausted from war and were not aggressively developing new technologies. Balloons were used more for sport than as implements of war. While the pace of military-based ballooning slowed during the 1800s, there are a few notable instances of innovation. In England, in 1803, Major John Money published a tract titled a *Short Treatise on the Use of Balloons and Field Observators in Military Operations.*[123] In his paper, Money discussed the effectiveness of French airborne observers in the Battle of Fleurus and advocated for the balloon's incorporation into the British Army. In yet another foreshadowing of things to come, Money's overreach and tact were a detriment to his balloon advocacy. He made extravagant, unsubstantiated claims regarding the balloons even speculating that the British could have won the American Revolutionary War had they employed balloons properly and lamented that the "old" British generals would never welcome new advances into the Army.[124]

The Danes also dabbled in balloons during the early nineteenth century.

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[122] Ege, *Balloons and Airships*, 107.
[123] Steven D. Culpepper, *Balloons of the Civil War* (St. Damascus, MD: Penny Hill Press Inc., 1994), 11.
[124] Walter J. Boyne, *The Influence of Air Power Upon History* (Gretna, LA: Pelican Publishing, Inc., 2003), 397.

In 1807, they attempted to break a British naval blockade of Copenhagen by bombing the British fleet from the air using a dirigible, or steerable, balloon.[125] The propulsion device was poorly designed, however, and the project ended in failure. Russia's first foray into military ballooning occurred in 1812 during Napoléon's campaign into Russia when Alexander I hired a German engineer to construct a balloon capable of carrying 50 men and large quantities of explosives.[126] The plan was to fly the balloon over the French camp where observers would identify Napoléon's headquarters and bomb it, thus ending the war. Unfortunately for the Russians, similar to the Danish design, the propulsion and steering mechanism were ineffectual and the balloon never left Saint Petersburg.

As with other militaries around the world, the United States Army was also extremely slow to embrace the balloon despite its proven success. Following the Blanchard flights in Philadelphia, there were only two serious attempts to integrate the balloon into Army operations. The first occurred during the Second Seminole War in 1840. As the war had dragged on for several years while the government struggled to forcibly displace the Seminole tribe from Florida to Oklahoma, many individuals provided ideas designed to improve the Army's operations. In September of 1840, Colonel John Sherburne made a suggestion to then Secretary of War Joel Poinsett that Sherburne claimed would "end the war before the expiration of the current year."[127] Sherburne's plan involved deploying an experienced balloonist with the Army units who were searching for the Seminoles. In Sherburne's plan, the balloonist would conduct airborne search missions after the Seminoles had camped for the night. Armed with a pair

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[125] Murphy, *Military Aircraft*, 9.
[126] Alfred Hildebrandt, *Airships Past and Present*, trans. W.H. Story (New York, NY: D. Van Nostrand Company, 1908), 138.
[127] Information on Sherburne is scarce, but he apparently had experience with Native American tactics having served on a negotiation delegation to the Cherokee Nation in November 1837. General T.S. Jesup to the Honorable Joel R. Poinsett, letter, 10 November 1837, in Asbury Dickens and John W. Forney, eds., *American State Papers,* vol. VII, *Military Affairs* (Washington, D.C.: Gales and Seaton, 1861), 887; Colonel John H. Sherburne to the Honorable Joel R. Poinsett, letter, 8 September 1840, Records of the Adjutant General's Office, Record Group (RG) 94, File 284, National Archives and Records Administration (NARA).

of binoculars and map, the balloonist was to annotate the Seminole camp locations on the map and provide the information to the ground commander.[128] Reflecting the government's desperation to end the Seminole War, Poinsett answered Sherburne the next day promising to consider his plan.[129] Delivering on his promise, Poinsett conferred with the overall Army commander for Florida operations, General Walker Armistead. Armistead refused to use the balloons, citing the dense terrain and the difficulty of balloon inflation.[130] Poinsett subsequently notified Sherburne that his plan was not feasible and that the Army would not implement it.[131]

Sherburne was not the only person interested in finding Seminole Indians with balloons. On 12 October 1840, Frederick Beasley, a prominent Pennsylvania clergyman and balloon enthusiast, sent a letter to Poinsett in which he suggested, "…a small number of balloons, under the direction of skillful and experienced aeronauts, will serve to communicate any desirable intelligence from one part of that country to another."[132] Beasley's suggestion was nothing more; his idea had none of the details that Sherburne had worked out and there is no record that Poinsett considered the idea or even answered Beasley's letter.

The second discussion regarding the military use of balloons came during the Mexican-American War. A Pennsylvania aeronaut named John Wise – who would later gain great notoriety for long distance balloon voyages and scientific experimentation – proposed a scheme in which a balloon would be used to bomb the San Juan de Ulúa fortress in Veracruz, Mexico.[133] On 22 October 1846, in an open letter to the United States government published in a Philadelphia

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[128] Michael G. Schene, "Ballooning in the Second Seminole War," *The Florida Historical Quarterly* 55, No. 4 (April 1977): 480-482.
[129] The Honorable Joel R. Poinsett to Colonel John Sherburne, letter, 9 September 1840, Records of the Adjutant General's Office, RG 94, File 284, NARA.
[130] The Honorable Joel R. Poinsett to Colonel John Sherburne, letter, 28 January 1841, Records of the Adjutant General's Office, RG 94, File 284, NARA.
[131] Ibid.
[132] Reverend Frederick Beasley to the Honorable Joel R. Poinsett, letter, 12 October 1840, Records of the Office of the Quartermaster General, RG 92, Box 87, NARA.
[133] Charles D. Ross, *Trial by Fire: Science, Technology and the Civil War* (Ann Arbor, MI: White Mane Books, 2000), 186-187.

newspaper, Wise detailed his plan to use a captive balloon to drop 18,000 pounds of explosives on the fortress from a mile in the air.[134] As some before and many after, Wise's zealotry regarding the effectiveness of air power was apparent. In the letter he states, "With this aerial war-ship [*sic*] hanging a mile above the fort…the castle…could be taken without the loss of a single life to our army and at an expense that would be comparatively nothing to what it will be to take it by the common mode of attack."[135] After receiving no response from the government, on 10 December 1846, Wise followed up with a letter directly to the Secretary of War, William Marcy. In this letter, Wise lamented what he called the "incredulity and prejudice" that he perceived most have regarding new ideas.[136] Additionally, Wise attempted to refute any of the possible arguments that could be brought up regarding his plan. There is no record of the Secretary acknowledging the letter and the plan appears to have not advanced beyond the nascent stage.[137]

While balloon progress was extremely sluggish during the 1800s, there were two notable advances that contributed significantly to the continued evolution of manned airborne ISR. The first was the introduction of aerial photography. As with their success in balloons, it was again the French who were the first to experiment with photography from the air. In 1849, Colonel Aimé Laussedat of the French Army Corps of Engineers investigated the feasibility of taking pictures from kites and balloons.[138] Laussedat's experiments were unsuccessful as managing the chemicals and bulky equipment required for photography at the time were more than he could overcome, but his work paved

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[134] John Wise, *Through the Air: A Narrative of Forty Years' Experience as an Aeronaut* (Philadelphia, PA: To-Day Printing and Publishing Company, 1873), 389.
[135] Ibid.
[136] John Wise to the Honorable William L. Marcy, letter, 10 December 1846, Records of the Office of the Secretary of War, RG 107, File 107.2.1, Correspondence, NARA.
[137] I thoroughly poured through all related files and folders at the National Archives and could not find any record of Marcy acknowledging Wise's letter or idea.
[138] James S. Aber, Irene Marzolff, and Johannes B. Ries, *Small-Format Aerial Photography: Principles, Techniques, and Geoscience Applications* (Amsterdam, NL: Elsevier, 2010), 3.

the way for further research.[139] Another Frenchman was the first to prove that aerial photography was possible. In 1858, Gaspard Félix Tournachon began a series of attempts to produce photographs from a balloon and by the middle of that year had become the first person to take and develop a photograph from the air.[140] Throughout 1858, he continued refining his technique and by early 1859 had had enough success that he convinced the French government to fund his work.

At the same time, American aeronauts were also experimenting with aerial photography. On 13 October 1860, Boston photographer J.W. Black – aloft in a balloon piloted by Samuel A. King – took the first ever successful photographs from an air platform in the United States.[141] Flying at 1,200 feet over the streets of Boston, Black photographed significant sections of the city. While extremely rudimentary in nature, these photographs proved the concept of aerial photography and further expanded thought regarding the missions of the balloon. With aerial photography, military thinkers began to regard the balloon as more than just a tactical asset. If balloons were able to penetrate behind enemy lines and return safely with pictures of the enemy's military and industrial complexes, their photographs would be of immeasurable strategic value.

The second major improvement to the balloon's ISR capability was the development of the electric telegraph. Terrestrial-based telegraphy had been steadily improving throughout the nineteenth century and many aviators saw the telegraph as a potential solution to the age-old air-to-ground communications problem. As previously examined, passing information from an aloft balloon had been a nagging problem for the early aeronauts. As the balloons went higher in altitude, the problem was exacerbated as the ability to see the signal devices from the ground was hampered by both the greater distances and by the wind. Likewise, the Coutelle-designed system for dropping messages from

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[139] Roger E. Read and Ron Graham, *Manual of Aerial Survey: Primary Data Acquisition* (Caithness, UK: Whittles Publishing, 2002), 2.
[140] Boyne, *The Influence of Air Power on History*, 402.
[141] John A. Tennant, ed., *The Photo-Miniature: A Monthly Magazine of Photographic Information, April 1903-March 1904,* vol. V (Harrisburg, PA: Mount Pleasant Press, 1904), 154.

the balloon was marginally effective as it required a significant amount of time to raise and lower the messages from the balloon. Often, balloon observers would not be able to adequately communicate the intelligence gained until after the sortie. To become a true force multiplier, communications from and to the observer on the balloon had to be improved. Placing a wired telegraph on the balloon was an instantaneous upgrade to this process as wired telegraphy allowed the observer to communicate in near real-time with ground commanders. The observer was then able to report what he saw and to receive requirements directly from the ground as the battle occurred. Dynamic tasking became possible as the observer's ability to view targets of real-time importance became feasible. These improvements – airborne photography and the telegraph – helped solidify the balloon as a feasible ISR platform.

While both new technologies would have long-term ramifications for airborne ISR, aerial photography was not fully explored by the military for decades following Black's successes.[142] The same cannot be said for the aerial telegraph. In the first month of the American Civil War, Thaddeus S.C. Lowe, a self-taught aeronaut who had gained fame for his attempts at transatlantic balloon flight, convinced one of his financial backers, Murat Halstead, to write a letter to then Secretary of Treasury, and close friend to Halstead, Salmon Chase.[143] In the letter, Halstead advised Chase of the need to establish a balloon corps in the Union Army and for Lowe to be its commander.[144] Desperate for any advantage at the early stage of the war, Chase immediately discussed the prospect with then Secretary of War Simon Cameron. As there were other aeronauts also offering their services to the Union – including the aforementioned John Wise – Chase promised to continue to push for Lowe in

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[142] Professor Haydon devotes several pages of his book to this very subject. He systematically refutes several claims regarding Union and Confederate use of aerial photography during the war. With such a solid argument, I found it of little utility to rehash the subject. For further information, see Haydon, *Military Ballooning*, 329-335.

[143] Gail Jarrow, *Lincoln's Flying Spies: Thaddeus Lowe and the Civil War Balloon Corps* (Honesdale, PA: Boyds Mills Press, Inc., 2010), 7.

[144] Murat Halstead to Thaddeus S.C. Lowe, Letter, 14 May 1861, Thaddeus Lowe Papers, American Institute of Aeronautics and Astronautics, Aeronautics Archives, Container 82, Manuscript Division, Library of Congress (LOC).

Cabinet-level meetings.[145] Chase was ultimately successful and convinced Cameron to attend a Lowe-led demonstration of the military value of balloon observation.[146]

Lowe's plan was to show those in attendance how aerial observation worked by viewing the Union troops who were marshalling all around the greater Washington D.C. area. He planned to ascend to various altitudes and, by using binoculars and telescopes, report on the size and disposition of the Union forces. The second facet of Lowe's display was to be unique, however. On this ascension he planned to bring a trained telegrapher along with a telegraphic set including a transmitter and receiver. Lowe intended to demonstrate how quickly the details viewed from the balloon could be relayed to the ground via the telegraph. As any telegrapher on the ground could plug into the ground-based telegraph network, the balloon-derived intelligence could then be communicated in near real-time to any distant location. Lowe intended to show that the long-held problem of balloon-to-ground (and vice versa) communication had been solved thus refuting one of the strongest arguments against the full integration of the balloon into the Army.[147]

As Lowe prepared for the demonstration, Chase continued to lobby on his behalf ultimately securing a face-to-face meeting for Lowe with President Abraham Lincoln.[148] On the evening of 11 June 1861, the President and Lowe met. During the meeting, Lowe described in great detail the workings of the balloon and the expected intelligence gain from its use. Lowe must have been persuasive as Lincoln approved his plan and allocated $250 to cover the costs of

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[145] Salmon Chase to Murat Halstead, letter, 20 May 1861 in Thaddeus S.C. Lowe, *Memoirs of Thaddeus S.C. Lowe: My Balloons in Peace and War*, ed. Michael Jaeger and Carol Lauritzen (Lewiston, NY: The Edwin Mellen Press, 2004), 69.
[146] Lowe, *Memoirs of Thaddeus S.C. Lowe*, 70.
[147] Ibid., 73-80.
[148] W.D. Garragher to Thaddeus S.C. Lowe, letter, 11 June 1861, Thaddeus Lowe Papers, American Institute of Aeronautics and Astronautics, Aeronautics Archives, Container 82, Manuscript Division, LOC.

the upcoming demonstration.[149]

Lowe spent the next week preparing for the exhibition and on 17 June 1861 on the grounds of the Columbian Armory the experiment took place. Lowe's balloon, the *Enterprise*, ascended with several powerful telescopes, signal flags, and most importantly, the telegraph set which was connected via wire to the communication line running between the War Department and the White House.[150] At an altitude of 500 feet, Lowe stopped the ascension and had his telegrapher compose the first message ever sent by electric telegraph from the air.[151] In his message – sent to the White House – Lowe told President Lincoln that he was able to see an area of nearly 50 miles and that he could observe all the surrounding Union encampments.[152] Lincoln was pleased with the results and ordered the *Enterprise* be brought to the grounds of the White House for further examination.

That evening Lowe and the President continued their discussion regarding the potential of the balloon. This time Lowe expanded his advocacy to include the potential use of the balloon for directing artillery fire.[153] Lowe and the President talked deep into the night and by the end of the conversation, Lowe was convinced that the President had decided to "form a new branch of the military service."[154] On the next day Lowe conducted further ascensions. Of note, during one of his flights, Lowe attempted to observe and report on Confederate preparations at nearby Fairfax Court House and Vienna. While he was able to see both locations, nothing of significance was noted in this first ad hoc ISR

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[149] Professor Joseph Henry to Simon Cameron, letter, 21 June 1861, Thaddeus Lowe Papers, American Institute of Aeronautics and Astronautics, Aeronautics Archives, Container 82, Manuscript Division, LOC.
[150] Haydon, *Military Ballooning*, 174.
[151] "Military Telegraph Stations in Balloons," *The Telegraphic Journal and Electrical Review* 11, no. 248 (26 August 1882): 141-142.
[152] Thaddeus S.C. Lowe to President Abraham Lincoln, telegram, 16 June 1861, *The Abraham Lincoln Papers*, Library of Congress, online, http://memory.loc.gov/mss/mal/mal1/103/1031300/001.jpg (accessed 23 July 2015).
[153] As will subsequently be seen, directing artillery fire would become the balloon's – and indeed one of airborne ISR's – primary purpose during the First World War. Lowe, *Memoirs of Thaddeus S.C. Lowe*, 61.
[154] Ibid.

flight.[155]

The American press was also impressed with the balloon and its potential. While many American military men undoubtedly appreciated the immediate tactical value of the balloon, the most insightful reports can be found in the newspapers immediately following Lowe's demonstration. The introduction of the telegraph was of particular interest to many with one author writing, "What is new and valuable in…Lowe's experiments is the combination of the telegraph with the balloon; observations made at the scene of operations can instantaneously be transmitted to him [the commanding general] and the orders based upon them received back with equal rapidity…"[156] Another writer stated, "With this telegraph apparatus and the means of making an aerial reconnaissance, a general may be accurately informed of everything that may be going on…he may also direct the aerial observers to those areas of greatest interest."[157] These authors immediately recognized the importance of near real-time air-to-ground communications and the newfound dynamic tasking ability the telegraph enabled. With the introduction of the aerial telegraph – though still wired to the ground and not wireless – the enduring problem of rapidly communicating intelligence was at least partially mitigated. The advantages over the previous systems of flag signaling or weighted message dropping were obvious and greatly increased the expectations of the value of balloon ISR.

It did not take long for the Union Army to ask for Lowe's services. On 19 June 1861, Brigadier General Irvin McDowell, commander of the Department of Northeastern Virginia, sent a request for Lowe to ascend from Falls Church to take observations of the surrounding Confederate positions and activity.[158] On 22 June 1861, Lowe arrived at McDowell's headquarters and shortly thereafter ascended in what was the United States Army's first tasked military ISR flight.[159]

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[155] Haydon, *Military Ballooning*, 176.
[156] Editorial, *New York Herald*, 20 June 1861.
[157] Editorial, *New York Herald*, 19 June 1861.
[158] Brigadier General Irvin McDowell to Captain Whipple, telegram, 20 June 1861, Office of the Chief of Engineers, Topographical Bureau, War Department Division, RG 77, File 323, NARA.
[159] I say 'tasked military ISR flight' here because Lowe was brought to McDowell's headquarters for the expressed purpose of conducting airborne ISR and because he received what would now

Over the next several days, Lowe conducted multiple sorties. While he was unable to discern the level of Confederate troop activity in the region, on one flight a member of the Topographical Engineers, Major Leyard Colburn, was able to sketch a map of the surrounding area. The map was reported to be incredibly accurate and it drew praise from Brigadier General Daniel Tyler who was then commanding a brigade at Falls Church. After reviewing the map, Tyler telegraphed McDowell praising balloon ISR and relaying his faith in its future utility.[160]

The next month was extremely difficult for Lowe. Despite the President's support, entrenched Army dislike for innovation ensured Lowe met roadblocks at every turn as he tried to build the nascent air arm of the Union Army. Repeated rebuffs at the hands of Lieutenant General Winfield Scott – the Commander of all Union forces – led Lowe to ask Lincoln to personally intervene. On 26 July 1861, Lowe and the President arrived at the War Department to meet personally with General Scott. In this meeting, Lincoln informed Scott that Lowe was organizing an "Aeronuatics Corps for the Army" and that Lowe was to be its "Chief."[161] The President directed Scott to ensure Lowe had the backing he needed for success and with that order, Thaddeus Lowe became the first Air Corps chief in United States Army history.[162]

Lowe was not the only civilian aeronaut serving the Union Army. A New Yorker named John La Mountain, who had gained pre-war fame for his long distance balloon flights with John Wise, had also offered his services.[163] In two lengthy letters to Secretary of War Cameron, La Mountain detailed his extensive

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be called 'essential elements of information (EEIs)' from McDowell. These EEIs would be the things that McDowell was most interested in knowing.

[160] Brigadier General Daniel Tyler to Brigadier General Irvin McDonald, telegram, 24 June 1861, Department of Northeastern Virginia, War Department Division, RG 77, File 323, NARA.

[161] Lowe, *Memoirs of Thaddeus S.C. Lowe*, 65.

[162] Interestingly, Lowe's organization remained civilian and was not incorporated into the Army chain of command. Lowe was neither given a commission. He was paid the equivalent of an Army colonel, but did not enter active duty service. This relationship would prove problematic for both Lowe and his main rival, John La Mountain.

[163] Alfred F. Hurley and William C. Heimdahl, "The Roots of U.S. Military Aviation," in *Winged Shield, Winged Sword: A History of the United States Air Force*, vol. I, *1907-1950*, ed. Bernard C. Nalty (Honolulu, HI: University Press of the Pacific, 2003), 4.

knowledge of balloon history and practice, advocated for balloons to be used as airborne ISR platforms, and relayed his qualifications.[164] While La Mountain's letters are persuasive, there is no record that Cameron read them or took any action.[165] Not having the political connections that Lowe did, it appeared La Mountain's significant balloon experience would not be used by the United States Army. That was, however, until Major General Benjamin Butler read about La Mountain's pre-war exploits and learned of his desire to volunteer his services. On 10 June 1861, Butler sent a letter to La Mountain offering him employment as an aerial observer and urged him to report to Fort Monroe, Virginia, as soon as possible.[166] Fort Monroe was of great strategic importance to the Union as it provided a fortified area from which operations could be launched into the heart of Confederate Virginia. Unfortunately for Butler, the area was surrounded by Confederate forces and Butler was unable to determine their size, disposition, or exact locations.

Upon receiving Butler's request, La Mountain eagerly accepted and began preparations to transport his ballooning equipment from New York to Virginia. On 23 July 1861, he arrived via ship at Fort Monroe and began preparing for his first ISR sortie. On the evening of 25 July, La Mountain ascended and attempted to begin satisfying Butler's essential elements of information (EEI). Unfortunately, the weather did not cooperate and it was not until 31 July that he was able to collect any significant intelligence. On that day, he climbed to an altitude of approximately 1,400 feet and identified multiple previously unknown Confederate camps.[167] La Mountain was able to reconnoiter the camps and estimate the number of Confederate forces in each. With Lowe having been unable to detect any enemy activity during his flights in June 1861, it can be

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[164] John La Mountain to Simon Cameron, letter, 1 May 1861 and 7 May 1861, Secretary of War, War Department Division, Records of the Office of the Secretary of War, RG 107, File 107.2.1, Correspondence, NARA.
[165] The author looked through all files in NARA relating to the subject and could not find any indication that Cameron replied or acknowledged La Mountain's letters.
[166] Major General Benjamin Butler to John La Mountain, letter, 10 June 1861, Benjamin F. Butler Papers, Box 3, LOC.
[167] Jackson, *The Aeronauts*, 86-87.

argued that La Mountain's sorties give him the distinction of being the first American airman to provide effective airborne ISR to a ground force commander.

Butler ordered daily ascents from Fort Monroe and even authorized one launch from a steam propelled gunboat, the USS *Fancy*, a maneuver that foreshadowed aircraft carrier operations of the twentieth century.[168] In addition to the historical significance of the ship-based ISR sortie, La Mountain benefited from the mobility provided by the ship. He was able to direct the vessel to areas that enabled him to gain a better view of the enemy territory. This resulted in greatly enhanced intelligence and planted the seed in La Mountain's mind for the further evolution of balloon ISR; he realized that static, or captive, balloon ISR was greatly restricted by the lack of mobility and that to be a true force enhancer, the ability to navigate the balloon would have to be perfected.

On 10 August, La Mountain conducted two ascensions after which he provided a definitive accounting of the strength of Confederate forces in the Fort Monroe vicinity. In his report to General Butler, La Mountain gave a thorough description of all the Confederate camps in the area and even provided a sketch of where they were located in relation to Fort Monroe.[169] Additionally, he was able to see the port at Norfolk and report the location of two Confederate vessels that he assessed as ready for combat.[170] During these and his many other missions he accurately identified dozens of Confederate artillery emplacements, camps, and movements that would have gone undetected without his reporting. General Butler was thoroughly satisfied with the results and reported the significance of the added intelligence to his superiors in the War Department. In a report to General Scott, Butler stated, "I hereby inclose [*sic*] a copy of a report of reconnaissance of the position of the enemy made from a balloon…The enemy has retired a large part of the forces to Bethel, without making any further attack

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[168] Christopher, *Balloons at War*, 33.
[169] John La Mountain to General Benjamin Butler, report, in Colonel E.D. Townsend, ed. *War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, series III, vol. III (Washington, D.C.: Government Printing Office, 1899), 600-601.
[170] Ibid.

on Newport News."[171] La Mountain's ISR had provided Butler the decision advantage he needed to determine that Fort Monroe was not in imminent danger of attack. Butler was thus able to focus his forces on other objectives in the area.

Following his successes at Fort Monroe, La Mountain concentrated his efforts on conducting balloon ISR sorties without a tether. With his experience flying off the USS *Fancy*, La Mountain knew the intelligence he could gain from free flight would be much better than that collected from the captive balloon. This was not an original idea as John Wise had previously written about the subject. Wise based his musings on theory, however, while La Mountain had practical experience.[172] Using his knowledge of the prevailing winds in the area, La Mountain devised a method by which he could free fly on the westerly winds to overfly Confederate locations. After observing all he could see, he would ascend into the predominate easterly wind and return to Union-held territory. La Mountain's system had obvious flaws, but when the weather conditions were favorable, he was able to demonstrate the plan's feasibility. On 15 October 1861, he conducted his first sortie using free ascension. This first flight was of little intelligence value, but the simple fact that he could indeed use the winds to control his flight location proved the concept and prompted several Union generals to request balloon ISR.

On 18 October, at the request of Brigadier General William Franklin, then in command of a division stationed at Cloud's Triadelphia Mill, three-and-one-half miles west of Alexandria, La Mountain conducted a free flight ISR sortie over Confederate locations.[173] This sortie was of much greater consequence and resulted in significant intelligence for the Union. During the sortie, La Mountain observed: a Confederate artillery emplacement numbering six to ten guns within firing range of Franklin's position; an encampment of approximately 1,200 men; multiple locations where the Confederates were beginning earthwork

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[171] Benjamin Butler to General Winfield Scott, letter, 11 August 1861, Benjamin F. Butler Papers, Box 7, LOC.
[172] John Wise, editorial, *Lancaster Daily Evening Express*, 17 July 1861.
[173] Evans, *War of the Aeronauts*, 130.

construction; and, the absence of previously reported rebel troops at Fairfax Station.[174] Unfortunately, General Franklin did not fully believe La Mountain's report. Like many airborne ISR skeptics, Franklin could not accept that La Mountain had actually seen what he recounted. In a report to his superior, Major General McClellan, Franklin stated, "It is likely Mr. La Mountain observed Occoquan Creek, only 14 miles from our position."[175] History has proven that La Mountain's observations were accurate, however. In a 1 October 1861 meeting with his generals, Confederate President Jefferson Davis had indeed ordered the construction of an artillery works at Aquia Creek.[176] Franklin's inability to value the accuracy of La Mountain's intelligence reporting prevented Franklin from ordering an attack on the location. Franklin was not the first general to ignore intelligence, nor would he be the last, but this example shows the great challenges that intelligence professionals faced as they tried to convince Army leadership of the veracity of their airborne-derived intelligence.

Despite La Mountain's ISR successes, his entrepreneurial relationship with the Army led to his ultimate downfall. Without Army funding, he was unable to conduct routine maintenance on his two-balloon fleet; both balloons deteriorated over time and eventually became unserviceable. La Mountain lobbied for funding, but with Lowe having been appointed the Chief of the Balloon Corps, La Mountain was unable to convince the Army to provide the money he needed. After numerous attempts – and a vitriolic feud with Lowe – La Mountain abandoned his efforts. On 19 February 1862, General McClellan officially dismissed La Mountain from service to the Union.[177]

While La Mountain was delivering valuable intelligence during his sorties, Lowe was in Philadelphia overseeing the construction of the first two military

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[174] John La Mountain to Brigadier General William Franklin, letter, 21 October 1861, Records of United States Army Continental Commands, RG 393, File 393.2, Records of Divisions 1837-1907, Division of the Potomac 1861, NARA.
[175] Brigadier General William Franklin to Major General George McClellan, letter, 19 October 1861, Papers of General George B. McClellan, Box 1:5, LOC.
[176] *War of the Rebellion*, series III, vol. III, 254.
[177] Assistant Adjutant General to Colonel John Macomb, letter, 19 February 1862, Letterbook, Army of the Potomac, vol. I, entry 1408, 671-672, LOC.

balloons designed explicitly for United States Army use – the *Union* and the *Constitution*. Costing $1,200 each, the Union Army's new balloons were reportedly a sight to behold. According to one newspaper article from the time, "Each displayed its given name in bold, large lettering. The *Constitution* was adorned with a large portrait of George Washington, together with a spread eagle in colors. The *Union* bore the Stars and Stripes. Even the baskets were painted with white stars against a bright blue background."[178] Lowe had spared no expense or time in the building of these new balloons; in under a month from the time he was appointed Air Corps Chief by Lincoln, the balloons were ready to see action on the front lines. During this time, Lowe had also greatly improved the method for creating hydrogen gas in the field. His ingenious creation of a horse-drawn hydrogen generator allowed the balloons to be transported and readied for action much more quickly.[179]

The Army of the Potomac wasted no time in putting Lowe's new balloons into combat. On 28 August 1861, at the behest of General Irvin McDowell – then commanding an Army division – Lowe traveled to Fort Corcoran near Alexandria.[180] On the afternoon of 29 August, the *Union* conducted its first ISR mission. Lowe remained aloft for approximately one hour and observed Confederate movements as well as entrenching operations.[181] Lowe's identification of over 1,000 enemy forces and two artillery guns pointed in the direction of Union-held positions provided McDowell with the decision advantage he required as he planned future assaults. Lowe had proven beyond any reasonable doubt that he could keep the enemy lines under observation for sustained periods of time while providing highly valuable intelligence to Union Army decision-makers. According to Lowe's own flight logs and reports, he conducted ascensions on 23 of 34 days from the first *Union* sortie on 29 August

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[178] Quoted in Eugene B. Block, *Above the Civil War: The Story of Thaddeus Lowe, Balloonist, Inventor, Railway Builder* (Berkeley, CA: Howell-North Books, 1966), 62.
[179] Haydon, *Military Ballooning*, 247-248.
[180] Captain Whipple to Major Woodruff, letter, 28 August 1861, Correspondence and Issuances, Headquarters of the Army of the Potomac 1861-1865, RG 393, Microfilm 2096, NARA.
[181] Thaddeus Lowe, report, 29 August 1861, *War of the Rebellion*, series III, vol. III, 260.

through 30 September 1861. Additionally, he typically conducted multiple ascensions each day and flew consecutively from 29 August through 9 September.[182] In a remarkable mirroring of today's insatiable demand for ISR, following the *Union*'s initial sortie, Army generals' requests for Lowe's airborne ISR became more than the aeronaut could satisfy. High-ranking Union officers – including McClellan himself – accompanied Lowe on his ascensions; not unlike today's obsession with the video streaming from remotely piloted aircraft (RPAs), observing Confederate movements and preparations first-hand hooked the Union generals on airborne ISR.[183] By the end of September, Lowe had acquired the funding for five additional balloons to help satisfy the new demand. On 1 October 1861, he left Fort Corcoran and returned to Philadelphia to oversee construction of the *Washington, United States, Intrepid, Eagle,* and *Excelsior.*[184]

Lowe continued conducting balloon ISR for the Union Army into early 1863. His Balloon Corps provided valuable intelligence in several of the war's most important battles, but as the war progressed, money tightened and Lowe found it increasingly difficult to obtain the supplies and men he needed to maintain operations. His civilian status was also a detriment as without a chain of command through which he could route his requests, his pleas for funding and men often went unanswered by the Army bureaucracy. Additionally, Lincoln's continual firing of Union generals ultimately removed all of Lowe's main supporters from positions of prominence. The political backing Lowe had enjoyed at the beginning of the war evaporated. The final straw for Lowe was the subordination of his organization to the Corps of Engineers in April 1863.[185] The Army's Chief Engineer, Captain Cyrus Comstock, took control of the Balloon

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[182] These figures were compiled through an examination of Lowe's reports from *War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, series III, vol. III. Lowe provided comprehensive reports on nearly every sortie he conducted during this time period. It is clear that he intended to document everything with the intent of proving the value of the new capability.
[183] Thaddeus Lowe, report, 8 September 1861, *War of the Rebellion*, series III, vol. III, 260.
[184] Ege, *Balloons and Airships*, 115.
[185] Special Orders, No. 95, Headquarters of the Army of the Potomac, 7 April 1863, Cyrus B. Comstock Papers, microfilm, Box 1, General Correspondence and Related Material, Reel 1, LOC.

Corps and immediately began making sharp cuts including firing half of Lowe's assistants and slashing Lowe's pay by 40 percent.[186] After an unsuccessful attempt to circumvent Comstock's decisions, Lowe resigned. The Union Army tried to continue balloon ISR without Lowe, but no one had the expertise to make the results worth the effort. By the end of 1863, the Balloon Corps was dissolved.

While both sides used balloons during the American Civil War, the platform itself proved to be more trouble than it was worth.[187] The delicate nature of the balloon and the extreme difficulty in conducting field operations required a dedicated, well-funded effort. Despite the excellent intelligence the balloon provided, at the time, neither side had the money or expertise to make balloon ISR viable. Additionally, as the ability to actually fly the balloon, that is to control its location, had not been perfected, aeronauts remained either tethered to the ground or, in La Mountain's case, took considerable risk to free fly. This limited mobility often prevented true in-depth examinations of an enemy's location and led to aeronauts making the 'best guess' they could as to enemy composition and location. Also, as artillery effectiveness increased, flying a balloon over one's own encampment was often more liability than benefit as tethering a balloon provided the enemy a perfect aiming point. Finally, despite Wise's improved hydrogen production method, inflating the balloon remained a cumbersome, lengthy process that required considerable logistical support. For these reasons, balloons did not contribute to battlefield success during the American Civil War as had been hoped.

The ability to see the enemy positions and communicate that intelligence was, however, a requirement that armies greatly needed. The rapidity of the balloon's maturation during the preceding century was remarkable. From nothing more than a drawing board concept in the late eighteenth century, the balloon became an instrument of war by the turn of the next. The evolution

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[186] Cyrus Comstock to Thaddeus Lowe, letter, 12 April 1863, *War of the Rebellion*, series III, vol. III, 303.
[187] The Confederates also attempted balloon ISR, but their efforts were sporadic and yielded little-to-no intelligence value.

started by the Montgolfiers that June day in 1783 had given mankind the platform that so many had dreamed of and foreseen. Within days of its invention, forward thinkers had begun to postulate on the new craft's military use. These early visionaries included commoners, scientists, physicists, and even the Founding Fathers of the United States. First and foremost, the primary military purpose remained airborne ISR, but dreamers also foresaw the balloon as a bomber; transport aircraft; command and control platform; communications relay; and psychological operations (PSYOP) distribution platform.

Within ten years of its creation, the balloon got its first opportunity to prove the value of airborne ISR. French generals used the intelligence they gained from balloon reconnaissance – sometimes firsthand – to help craft their strategy during the wars following the French Revolution. Other nations got involved and by the opening of the American Civil War, several had tested the balloon for ISR, bombing, and propaganda leaflet distribution. During the American Civil War, the aeronauts of the Union Army achieved several 'firsts.' Though not integrated into the chain of command, Thaddeus Lowe became the first air commander in United States Army history. During his time, Lowe revolutionized air-to-ground communications by placing a telegraph on the balloon and was the first to direct artillery fire while airborne – a mission that would become one of the primary World War I roles of both the balloon and the aircraft. Lowe's rival, John La Mountain, launched a balloon from a ship and became the first aeronaut to successfully conduct non-tethered balloon ISR.

These aeronauts had advanced airborne ISR from little more than a dream to a true force multiplier. The intelligence they provided gave decision makers the extra awareness they needed to make sound choices and to better craft strategy. Unfortunately, as this paper will continue to highlight in subsequent chapters, each time the United States finished a war, there was little effort to capture the lessons learned from ISR or to ensure the advancement of the TTPs. Following the conclusion of the Civil War, Americans were exhausted and had little desire to maintain a large Army let alone advance what many considered unproven, untested innovations. Budgets were slashed following the Civil War

as the country's attention focused on healing the wounds the War had caused. For the next several decades, little happened in the field of airborne ISR. A modicum of capability was maintained, but as the nation returned to conflict in the Spanish-American War, the lessons had truly been lost. It would be the inability to find and report on the enemy in that conflict that would help lead to the next evolutionary phase in the airborne ISR story – the dirigible balloon and the airplane.

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Chapter 3: Balloons and Aircraft Mature for War

What are the functions of the man who goes aloft in an aeroplane? First, to fly the machine; but he has to fly that machine for the purpose of getting information; information on the enemy on which his commander can act.
Capt Paul W. Beck, 1913

The experience of the French Revolution and the American Civil War demonstrated the vast potential value of airborne ISR. For the first time in history, ground commanders received near real-time tactical intelligence from unprecedented vantage points. The captive balloon provided the ability to see enemy tactical activity close to the front lines while John La Mountain's free flights had provided strategic-level intelligence deep behind enemy lines. This new ability to detect both enemy disposition and intent resulted in an insatiable demand for the capability. Combining the balloon with the telegraph and aerial photography made the continued development of airborne reconnaissance imperative. Despite this, the balloon's lack of maneuverability severely hamstrung its effectiveness as an ISR platform. Its shortcomings were so great that Generals Napoléon Bonaparte[1] and Ulysses S. Grant disbanded the balloon corps in their respective armies after relatively short periods.[2] These limitations drove air-minded inventors to seek balloon advances. The value of airborne-derived intelligence had been proven, but the platform had to be improved. Attempts at progress generally took two directions; designers either sought to modify the balloon or attempted to create heavier-than-air craft. This chapter will examine both paths in the pre-World War 1 period. The balloon's evolution resulted in dirigible airships and the heavier-than-air riddle was solved in 1903

[1] F. Stansbury Haydon, *Military Ballooning During the Early Civil War* (Baltimore, MD: The Johns Hopkins Press, 1941), 14-15.
[2] James W. Williams, *A History of Army Aviation: From Its Beginnings to the War on Terror* (Fort Rucker, AL: US Army Aviation Museum, Inc., 2005), 11.

with the Wright brothers' success. As will be seen, the balloon's limitations, even after it became navigable, continued to prevent its full incorporation into military service. The airplane, on the other hand, would solidify its value as an ISR collector and airborne communications relay platform. By analyzing the development of each platform and their prewar trials, this chapter will continue following the evolution of manned airborne ISR. As will be seen, the airplane's advantages over the balloon – both captive and dirigible – established it as the platform of choice for most of the world's militaries; a choice that would ultimately lead to the manned airborne ISR fleet of today.

The static nature of the first balloons was identified as a shortcoming shortly after their invention. In October 1784, the famed English writer, Samuel Johnson, stated, "We now know a method of mounting into the air, and, I think, are not likely to know more. The vehicles can serve no use till we can guide them."[3] Rather than abandon the balloon due to its limitations, however, inventors sought ways by which they could both propel and steer as they floated through the air. Shortly after Johnson's statement, two French abbots, Miolan and Janninet, also recognized the problem and created a balloon that had four portholes with shutters around each.[4] Using a design first proposed by Montgolfier himself, the abbots placed portholes at the rear of the balloon to allow hot air to escape during flight, thus propelling the balloon forward. The men also devised a mechanism by which a pilot could steer the balloon as it propelled forward by using large oars. The balloon, enormous at 70 feet in diameter, was unfortunately never tested as an impatient crowd destroyed it on 11 July 1784 after waiting over ten hours to watch its maiden flight.[5]

The Miolan and Janninet design – though never operationally tested – motivated other inventors to pursue navigable, or dirigible, balloons. A wide

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[3] Doctor Samuel Johnson to Doctor Richard Brocklesby, letter, 6 October 1784 in George Birkbeck Hill, ed., *Letters of Samuel Johnson, LL.D.* vol. 2 (New York, NY: Harper & Brothers, 1892), 421.
[4] Charles H. Gibbs-Smith, *The Aeroplane: An Historical Survey* (London, UK: Her Majesty's Stationary Office, 1960), 89.
[5] Charles H. Gibbs-Smith, *Aviation: An Historical Survey from Its Origins to the End of the Second World War* (London, UK: Her Majesty's Stationary Office, 1960), 32.

variety of manually operated propellers, fans, enormous wings with hand-operated oars for "rowing," sails and rudders, aerial paddle wheels, and many other similar devices were attempted in the pursuit to control and propel a balloon's flight. All of these inventions were failures with most not leaving the design floor; the form of the balloon and the lack of power was more than these early inventors could overcome. It would take a radical change to the shape of the balloon to further its evolution.

In 1784, a French mathematician and engineer, Lieutenant Jean-Baptiste Marie Meusnier, having witnessed the Montgolfier balloon flights, realized that to be steerable – and thus to be positioned in areas advantageous to the army – a balloon needed to be elongated similar to a sea-going vessel.[6] Meusnier also recognized that to be truly navigable, the balloon would need to be powered in some type of horizontal, vice vertical, fashion. The power for Meusnier's balloon came from three propellers rigged to hand cranks that 80 men would hypothetically turn from a carriage suspended under the balloon.[7] Unfortunately, Meusnier perished in the wars with Prussia following the French Revolution and never built his envisioned craft.[8] His ideas, however, inspired others. His concept for streamlining the balloon's shape ushered in the dirigible airship – a platform that would bridge the gap between the balloon and the airplane.

In 1850, building on Meusnier's vision, French clockmaker Pierre Jullien constructed and demonstrated a cylindrical model airship with two airscrews driven by a clockwork mechanism.[9] Jullien's model piqued the interest of French engineer and inventor Henri Giffard who improved the aerodynamics of the Jullien model and installed a small steam engine in the balloon's basket to

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[6] Alvin M. Josephy, Jr., ed., *The American Heritage: History of Flight* (New York, NY: American Heritage Publishing Co., 1962), 41.
[7] Douglas H. Robinson, *Giants in the Sky* (Seattle, WA: University of Washington Press, 1973), 2.
[8] Richard P. Hallion, *Taking Flight: Inventing the Aerial Age from Antiquity Through the First World War* (New York, NY: Oxford University Press, 2003), 82.
[9] Basil Collier, *A History of Air Power* (Oxford, England: Macmillan Publishing Co., 1974), 8.

provide power.[10] The genius in Giffard's design was the way he captured the steam and engine exhaust. By combining the two and routing them to the rear of the balloon via a ventilation system, he was able to produce forward thrust which augmented the relatively small engine.[11] On 24 September 1852, Giffard flew his airship from the Paris Hippodrome to a nearby suburb becoming the first man to truly pilot a steerable aircraft.[12] While Giffard's airship was technically dirigible – demonstrated by the circles Giffard made in the sky with the balloon – the craft only attained a speed of six miles-per-hour in almost completely wind-free air.[13] If future dirigibles were to be truly navigable, more power would need to be added to ensure the lightweight craft could counter any winds. Giffard attempted to improve his design, but was unsuccessful and it was not until the late nineteenth century that the dirigible balloon truly advanced.[14]

With Jullien and Giffard having apparently solved the design riddle, inventors next focused their attention on building engines that could produce sufficient power to drive the airship forward despite any prevailing winds. In 1871, Henri Dupuy de Lôme – at the behest of the French government – constructed a navigable airship powered by a single four-bladed propeller driven by eight people turning hand cranks.[15] Despite the rudimentary design, the airship had a successful maiden flight on 2 February 1872, but as with previous low-powered engines, the manpower provided by the hand cranks was not sufficient to move the airship at more than six miles-per-hour.[16] In October of 1883, the Tissandier brothers, Gaston and Arthur, twice flew an airship powered by electricity over short distances.[17] Their design idea suffered the same fate as

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[10] Alfred Hildebrandt, *Airships Past and Present*, trans. W.H. Story (London, UK: Archibald Constable and Co. Ltd., 1908), 48.
[11] Hallion, *Taking Flight*, 83.
[12] Lennart Ege, *Balloons and Airships* (New York, NY: Macmillan Publishing Co. Inc., 1974), 112-113.
[13] Collier, *A History of Air Power*, 10.
[14] Ege, *Balloons and Airships*, 113.
[15] Peter W. Brooks, *Zeppelin: Rigid Airships, 1893-1940* (Washington, DC: Smithsonian Institution, 1992), 19.
[16] Charles Dollfus, *Balloons* (New York, NY: Orion Press, Inc., 1960), 79.
[17] William Earl Johns, *Some Milestones in Aviation* (London, UK: John Hamilton Ltd., 1935), 57.

that of Giffard; the power source simply could not provide enough horsepower to consistently propel the airship in difficult winds.

All of these attempts had been led by civilian engineers with no military connections. In 1877, fearing they would fall behind in a field they had created, the French Government reactivated its balloon school, *École Nationale Aérostatique.*[18] Captains Charles Renard and Arthur Krebs were named the lead engineers. Believing the basic airship design to have already been solved, the men focused their attention on creating a lightweight engine for aeronautical use.[19] Following several years of experimentation and failure, in 1884, they created an eight horsepower electric motor that was powered by chromium chloride batteries.[20] On 9 August of that year, Renard and Krebs conducted the first trial flight of their airship, known as *La France*. The men found they were able to navigate their airship and ultimately returned to the same spot from which they had launched.[21] This 23-minute flight marked the first "round trip" sortie in airpower history and, while power was still a limiting factor, showed that militaries could potentially be able to place future ISR aircraft in advantageous positions and return them to base.[22]

While Krebs and Renard made significant advances in engine design, major drawbacks still restricted lighter-than-air craft. First, up to this point, all airships were of either a non-rigid or a semi-rigid type.[23] Armies recognized that for the airship to be a viable reconnaissance asset, it would need to be much more durable than the then-current designs. While air-to-air warfare had not been envisaged, threats from the ground were of enough significance to warrant serious concerns about the flimsy design of non-rigid and semi-rigid balloons. As had been shown in the American Civil War, artillerymen could bring down

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[18] This was the same school the French first created in 1793 to focus on designing balloons and training aircrews for the wars following the French Revolution.
[19] J.E. Hodgson, *The History of Aeronautics in Great Britain: From the Earliest Times to the Latter Half of the Nineteenth Century* (London, UK: Oxford University Press, 1924), 37.
[20] Robinson, *Giants in the Sky*, 2-3.
[21] W. Le Conte Stevens, "Recent Progress in Aerial Navigation," *The Popular Science Monthly*, July 1885, 305-306.
[22] Johns, *Some Milestones in Aviation*, 57.
[23] Ege, *Airships and Balloons*, 129.

balloons with only a few well-aimed shots.[24] Additionally, airships remained slaves to the winds and could not be considered completely dirigible; early airmen simply could not consistently fly where they wanted. With increased mechanization occurring in ground forces worldwide, airborne ISR platforms had to be able to move with the ground forces. Fortunately, inventors discovered solutions to these problems as the twentieth century dawned.

The man to tackle the durability problem of the airship most effectively was the Hungarian David Schwartz. Having conceived the idea of using aluminum as the primary material, Schwartz began building the world's first rigid airship in 1895.[25] Schwartz' design was revolutionary using both an aluminum skin and lightweight aluminum tubes in the interior to provide stability. The maiden – and last – flight of his rigid airship was conducted on 3 November 1897 near Berlin.[26] Launched on an extremely windy day, the flight was disastrous. After takeoff, high winds buffeted the airship and the inexperienced pilot was unable to maintain control. In his attempts to do so, he dislodged the steering assembly which resulted in the balloon crashing to the ground.[27] While unsuccessful, the venture did prove that a metal – and thus more durable – airship was at least capable of leaving the ground.

While progress was made regarding the durability of airships, the problem with power remained. In 1887, German inventor Gottlieb Daimler began to experiment with a gasoline engine design.[28] In 1888, he and balloon enthusiast Dr. Karl Wölfert began collaborating on an airship that was powered by one of Daimler's gasoline-powered engines. The first Daimler engine was small – producing only two horsepower – but it proved that gasoline engines could deliver sufficient power to provide propulsion.[29] Over the next nine years, Daimler and

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[24] Shane Mountjoy, *Technology and the Civil War* (New York, NY: Chelsea House, 2009), 113.
[25] Sir Walter Raleigh, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force* (London, UK: Oxford University Press, 1922), 55.
[26] Guy Hartcup, *The Achievement of the Airship: A History of the Development of Rigid, Semi-Rigid, and Non-Rigid Airships* (North Pomfret, VT: David & Charles, 1974), 63.
[27] Collier, *A History of Air Power*, 16.
[28] Raleigh, *The War in the Air*, 55.
[29] Hallion, *Taking Flight*, 89.

Wölfert modified and improved the design of both the engine and the airship. Finally, on 12 June 1897, the inventors conducted a public demonstration of their airship and now six horsepower engine.[30] Upon launch, the balloon rose rapidly to over 3,000 feet altitude and almost immediately burst into flames killing all on board including Wölfert. This experiment – like so many before it – was a disaster and did little to demonstrate the feasibility of a gasoline-powered engine.

To prove the need for the combustible engine, sustained, safe flight was required. Alberto Santos-Dumont, a Brazilian living in Paris, achieved this. Between 1898 and 1902, Santos-Dumont built and successfully flew ten airships all powered by gasoline engines similar to the ones built by Daimler.[31] While his airships were small, ever more capable engines drove them, with a 20-horsepower engine powering his sixth dirigible.[32] Despite the small carrying capacity of his airships, his four years of safe flying finally demonstrated the utility of the lightweight gasoline engine and paved the way for increased airship and engine size.

Building on Santos-Dumont's work, the French engineer Henri Julliot made the next major contribution. In 1902, he built a 187-foot long semi-rigid airship, named *La Jaune,* which was powered by a 40-horsepower engine – the largest engine yet attempted.[33] Between the early winter of 1902 and summer 1903, Julliot completed over 30 successful flights, on one occasion covering 61 miles at an average speed of 22 miles an hour.[34] His record of safety and aerial achievements finally convinced the French government of the value of air power; Julliot's benefactors – the Lebaudy brothers – donated *La Jaune* to the government and in return received a contract to construct three additional airships for the French army – the first aircraft to be specifically purchased from

[30] Collier, *A History of Air Power*, 15.
[31] Robinson, *Giants in the Sky*, 4.
[32] Alberto Santos-Dumont, *My Air-ships* (New York, NY: The Century Co., 1904), 198.
[33] David C. Cooke, *Dirigibles That Made History* (New York, NY: G.P. Putnam's Sons, 1962), 18.
[34] Joseph Lawrence Nayler and Ernest Ower, *Aviation: Its Technical Development* (Chester Springs, PA: Dufour Editions, 1965), 17.

a non-government entity by any government.[35]

Following Julliot's success, the armed forces of most of the leading powers – including the United States – experimented with and eventually adopted airships for naval and military reconnaissance.[36] The last question to be answered was whether the non-rigid, semi-rigid, or large rigid designs would prevail. Julliot had proven the semi-rigid design, but the non-rigid balloon still had its proponents and militaries around the world would continue to advocate for and use the non-rigid balloon through the Second World War.[37] The rigid airship, however, had not been conclusively proven and Schwartz' failure was the freshest memory in people's minds. German Count Ferdinand Adolf Heinrich von Zeppelin set about to change opinions regarding the rigid airship.

Count von Zeppelin was a volunteer observer during the American Civil War and had been assigned to the Balloon Corps under Thaddeus Lowe.[38] His time in America sparked his interest in balloons and upon his return to Europe he determined to make Germany a leader in aeronautics. In 1874, von Zeppelin began to sketch out his vision. In a diary entry from March of that year, he described three maxims for successful airships: large size, superior power for propulsion, and a body made up of separate gas cells.[39] Over the next 15 years, von Zeppelin's acumen with airships grew and he began to gain notoriety for his expertise. His obligatory service to the military prevented him from actually building any airships, however, and it was not until 1890, following his forced military retirement, that he was able to fully devote himself to aeronautics.[40]

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[35] Cooke, *Dirigibles That Made History*, 18.
[36] Juliette A. Hennessy, *The United States Army Air Arm: April 1861 to April 1917* (Washington, DC: Office of Air Force History, 1985), 15.
[37] For further information on US Army Air Corps balloon advocacy, see Otto P. Weyland, "Training Program for Observation Aviation" (study prepared for the Air Corps Tactical School, Maxwell AFB, Alabama), 14 May 1938, 248.262-29, Air Force Historical Research Agency (AFHRA).
[38] Walter E. Burton, "The Zeppelin Grows Up," *Popular Science Monthly* 115, no. 4 (October 1929): 26-28, 162-163.
[39] Michael Belafi Belafi, *The Zeppelin*, trans. Cordula Werschkun (Barnsley, UK: Pen and Sword Books Ltd., 2015), 14.
[40] The Count had written a letter that was critical of Prussian control of the military. Those in control did not like his viewpoint and forced him to retire. W. Robert Nitske, *The Zeppelin Story* (London, UK: Yoseloff Publishing, 1977), 46.

After his release from the military, von Zeppelin began raising funds for his airship projects and in 1896, incorporating the advice of renowned engineer Doctor Ing Müller-Breslau, began to perfect his ideas.[41] Zeppelin's design was unique in that it combined Schwartz' aluminum-based hull and framework with the proven capacity of the Daimler gasoline-powered engine. Additionally, Zeppelin's airships were enormous as compared to those of previous designers; LZ-1 (Luftschiff Zeppelin I) was 420 feet long – nearly three times as long as Julliot's *La Jaune* – and was powered by two 16-horsepower engines.[42] On 2 July 1900, LZ-1 had its maiden flight.[43] While fraught with difficulties, the first flight was largely successful and proved the concept of rigidity and combustible engine power. Over the next decade, Zeppelin improved on the design of his airships and continually added increasingly powerful engines.[44]

Following Zeppelin's successful demonstration of LZ-3 in October 1906, the German government became interested in the rigid airship.[45] When asked to present a proposal, Zeppelin – like so many airmen before and after him – oversold its capabilities. In a letter to the Imperial Chancellor dated 1 December 1906, Zeppelin claimed, "…I can demonstrate the possibility of constructing airships with which, for instance, 500 men with full combat equipment can be carried for the greatest distances."[46] Zeppelin's claim was complete embellishment. At the time, LZ-3's maximum capacity was only 11 persons.[47] Despite his obvious exaggerations, the German government was convinced that the rigid airship had military value and granted Zeppelin half a million marks to continue his work.[48]

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[41] Interestingly, Müller-Breslau had previously denied von Zeppelin's application for Army funding on the basis of perceived flaws in his design. Belafi, *The Zeppelin*, 20.
[42] Robinson, *Giants in the Sky*, 23.
[43] Guillaume de Syon, *Zeppelin!: Germany and the Airship, 1900-1939* (Baltimore, MD: The Johns Hopkins University Press, 2002), 23.
[44] Collier, *A History of Air Power*, 18.
[45] De Syon, *Zeppelin!*, 32.
[46] Quoted in Robinson, *Giants in the Sky*, 33.
[47] Ibid., 32.
[48] E. Charles Vivian, *A History of Aeronautics: The Evolution of the Aeroplane* (New York NY: Harcourt, Brace, and Co., 1921), 354.

With each subsequent airship, Zeppelin improved his design adding speed and carrying capacity. The German War Ministry, however, felt Zeppelin was not advancing quickly enough and in 1909 requested higher altitude and greater speed from his airships. For his part, Zeppelin was not interested in the German government's military aspirations and was instead determined simply to bring glory to Germany by making it the world's leader in aviation. Zeppelin's uncooperative attitude caused the War Ministry to look to other designers to inject competition into the airship business. The brilliant naval architect, Johann Schütte, became Zeppelin's main competitor. Schütte believed Zeppelin's designs were too rigid and made significant improvements to the airframe's elasticity by replacing Zeppelin's inflexible design with a more pliable wood-based structure.[49] The German government ordered multiple airships from both men and at the dawn of World War I they had eleven aircraft ready to conduct both long-range reconnaissance and bombing.[50]

Following LZ-1's success, the British government began to worry about the development of German air power. Due to this consternation, Great Britain instituted a crash program to bring its airship capabilities to the same level as the Germans. On 4 August 1903, the War Office allocated 2,000 pounds for the construction of a dirigible balloon.[51] Progress was slow, but by 1907, Colonel John Edward Capper, Superintendent of the Royal Balloon Factory at Farnborough, had achieved moderate success. Working with Samuel F. Cody of manned-kite fame, Capper constructed the first British semi-rigid airship, the *Nulli Secundus*.[52] On 5 October 1907, the *Nulli Secundus* conducted a successful maiden flight which was followed by incremental advances. Experimentation and development continued and by 1912, Capper was producing semi-rigid airships that would see service in the upcoming war.

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[49] Cooke, *Dirigibles That Made History*, 32.
[50] Robinson, *Giants in the Sky*, 68.
[51] Percy B. Walker, *Early Aviation at Farnborough: The History of Royal Aircraft Establishment*, vol. 1, *Balloons, Kites, and Airships* (London, UK: Macdonald & Co., 1971), 178.
[52] Ces Mowthrope, *Battlebags: British Airships of the First World War* (Phoenix Mill, UK: Sutton Publishing Ltd., 1997), 8.

The British were not content with semi-rigid airships. They continued following Zeppelin's experiments and concluded that to keep pace they would also need to develop rigid airships. In 1909, the Royal Navy commissioned a Zeppelin-type airship and by 1911 had built Naval Rigid Airship Number 1 – or *Mayfly* (its unofficial name) – a 500-foot behemoth.[53] Unfortunately, the ironically named *Mayfly* never did. In yet another example of the difficulty in designing and maintaining airships, wind destroyed the aircraft while it was on the ground waiting its first flight.[54] The disaster did not deter the British from continuing to pursue the rigid airship, however, as their Navy and Army attachés in Berlin continued to report on German aviation advances.[55] The British continued their airship program and by the end of the First World War, they had built no fewer than 226 airships primarily for naval reconnaissance and countermining operations.[56]

Late nineteenth century aviation development in the United States lagged behind the efforts of the European powers. Isolationist and protected by vast oceans, the United States was simply not interested in – nor did it see the need for – developing air power. Despite the low national interest, the United States Army Signal Corps recognized the need for air power and lobbied for funding.[57] Signal Corps officers had observed European airship development and worried the United States would fall behind. In 1896, Signal Corps Captain W.A. Glassford published an essay titled "Military Aeronautics" in which he implored his fellow Army officers to consider an immediate investment in the dirigible balloon.[58] In his article, Glassford discussed the tactical employment of ISR balloons and even foreshadowed work with airborne telegraphy. Written at a time

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[53] Ian Castle, *British Airships 1905-30* (Oxford, UK: Osprey Publishing, 2009), 12.
[54] Norman Friedman, *Fighting the Great War at Sea: Strategy, Tactic and Technology* (Barnsley, UK: Seaforth Publishing, 2014), 99.
[55] Matthew S. Seligman, *Spies in Uniform: British Military and Naval Intelligence on the Eve of the First World War* (Oxford, UK: Oxford University Press, 2006), 253.
[56] Mowthrope, *Battlebags*, xxiii.
[57] Hennessy, *The United States Army Air Arm*, 15.
[58] Captain W.A. Glassford, "Military Aeronautics," *Journal of the Military Service Institution of the United States* 18 (May 1896): 562.

when cavalry troops still provided the vast majority of the Army's reconnaissance, his essay was predictably met with considerable skepticism and even outright contempt from his contemporaries.

While it would be over a decade before the Army would take Glassford's advice, his essay underlines the efforts by some officers to get the Army involved in aeronautics. Shortly after creation of the Signal Corps, its first Chief, Brigadier General Adolphus Greely, began discussing the need for an aeronautical service. In his 1892 report to the War Department, Greely argued the need for airborne observation and backed Samuel Langley's aviation research.[59] Subsequent Signal Corps chiefs continued the discussion and finally on 1 August 1907, the Army created an Aeronautical Division.[60] This first effort at acquiring air power for the Army was modest at best. One officer – Captain Charles de Forest Chandler – headed the new division and was charged with managing all matters related to "military ballooning, air machines, and all kindred subjects."[61] In November 1907, after considerable lobbying from Signal Corps Chief, Brigadier General James Allen, the Army finally agreed to allocate $25,000 for the purchase of an experimental non-rigid dirigible balloon.[62] Following a short bidding process, the Army gave the contract for its first powered aircraft to one of the United States' early balloon pioneers, Thomas S. Baldwin.[63] The long wait was over; the United States Army was finally entering the aviation race.

On 20 July 1908, Baldwin delivered his airship to Fort Meyer, Virginia, where future air power legends Benjamin Foulois, Frank Lahm, and Thomas Selfridge received a short course in airship pilot training and tested the craft for suitability.[64] Measuring 96 feet – small compared to Zeppelin's 400-foot behemoth – Baldwin's airship met the minimum standards the Signal Corps had

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[59] Annual Report of the Chief Signal Officer, Brigadier General Adolphus Greely, United States Army, to the Secretary of War, 1892, 23.
[60] Chief Signal Officer of the Army, Brigadier General J. Allen, War Department, Office of the Chief Signal Officer, Memorandum No. 6, 1 August 1907.
[61] Ibid.
[62] Charles de Forest Chandler and Frank Purdy Lahm, *How Our Army Grew Wings* (New York, NY: Arno Press, 1979), 111.
[63] Hurley and Heimdahl, "The Roots of U.S. Military Aviation," 12-13.
[64] Hennessy, *The United States Army Air Arm*, 16.

established and was accepted as Signal Corps Dirigible Number 1 on 28 August 1908.[65] Following further tests, the Army sent the airship to Fort Omaha, Nebraska, where it had established a dirigible balloon school and hydrogen manufacturing plant.[66] Shortly after the move, Lahm and Foulois became the Army's first certified pilots when they flew Dirigible Number 1 without a civilian instructor on 26 May 1909.[67] Additionally, the Signal Corps had established its telegraph school at Fort Omaha where the balloon aviators were taught radio communications and telegraphy – skills that Foulois would employ later in his career to great effect.[68]

The Signal Corps continued training Army personnel using Dirigible Number 1 for approximately three years after its arrival in Omaha. By 1912, the airship was in such disrepair the Army decided to suspend all airship experimentation. In addition, by this time, the Army's focus had shifted from the balloon to the airplane. The dirigible school at Fort Omaha was merged with the captive balloon school at Fort Leavenworth in 1913 and it would not be until the United States was preparing to enter World War I that the Army would renew its interest in the airship.

Having examined the development of the dirigible airship through the dawn of the first world war, the focus now shifts to the second path inventors took to solve the navigation and power issues that plagued early airborne ISR efforts – the heavier-than-air airplane. Aspiring aviators had long dreamed about heavier-than-air flight. Inventors from Leonardo da Vinci to Octave Chanute hypothesized about aircraft, created elaborate schematics, and even built workable models.[69] Some of these designs effectively solved the heavier-than-air conundrum of aerodynamic lift; with perfect winds and wing design, they were

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[65] Lieutenant Frank P. Lahm, "The Air – Our True Highway," *Putnam's Magazine* 6 (April-September 1909): 270-279.
[66] Major George O. Squier, "Present Status of Military Aeronautics 1908," *Journal of the American Society of Mechanical Engineers*, 2 December 1908, 1589-1590.
[67] Hennessy, *The United States Army Air Arm*, 16.
[68] James J. Cooke, *The U.S. Air Service in the Great War, 1917-1919* (Westport, CT: Praeger Publishers, 1996), 6.
[69] Robert M. Kane, *Air Transportation* (Dubuque, IA: Kendall/Hunt Publishing, 2003), 55.

air-worthy. Much like airships, however, the absence of a light and powerful engine constrained these early trials to nothing more than experiments with glorified kites and gliders.

Beginning in approximately 1896, manned heavier-than-air flight started becoming a reality when Samuel Langley built and successfully tested a 26-pound monoplane powered by a two-horsepower engine.[70] On 6 May of that year, Langley catapulted his unpiloted airplane from a boat in the Potomac River. The flight, which showed the success of Langley's aerodynamic advancements, attained a speed of 25 miles per hour and flew 3,200 feet before landing safely.[71] Langley, recognizing the significance of his accomplishment presciently stated, "I have brought to a close the portion of the work which seemed to be specially mine – the demonstration of the practicability of mechanical flight – and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The world, indeed, will be supine if it do [*sic*] not realize that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened."[72]

Langley's achievement – the first time in history that a heavier-than-air craft sustained itself in flight for more than a few seconds – and the Army and Navy's subsequent failure to provide any sustained airborne ISR during the Spanish-American War convinced the United States to further pursue aircraft development. As the century turned, the United States Army Board of Ordnance and Fortification examined Langley's aircraft and concluded that it had potential for aerial reconnaissance.[73] The Board gave Langley $50,000 to build a full-size, piloted airplane on which he immediately began work.[74] By 1901, he had built

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[70] Charles D. Walcott, "Biographical Memoir of Samuel Pierpont Langley," in *Biographical Memoirs*, vol. VIII (Washington, DC: National Academy of Sciences, 1912), 254.
[71] John David Anderson, *The Airplane, a History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002), 76.
[72] Walcott, "Biographical Memoir of Samuel Pierpont Langley," 254.
[73] Charles Rodriguez, "Developments Before the Wright Brothers," in *The American Aviation Experience: A History*, ed. Tim Brady (Carbondale, IL: Southern Illinois University Press, 2001), 36.
[74] Gordon Swanborough and Peter M. Bowers, *United States Military Aircraft Since 1909* (Washington, DC: Smithsonian Institution Press, 1963), 1.

and successfully tested a one quarter-scale model, but the engineering of his first full-size airplane took much longer to complete than anticipated. Langley, like so many subsequent aviation designers, underestimated both the cost and duration of his project.[75] Plagued by delays, it was not until 7 October 1903 that he attempted another flight test. Unfortunately, this time his aircraft did not fly as it had in 1896. The airplane left the catapult and immediately splashed directly into the Potomac River.[76] A subsequent attempt on 8 December – this time with Army and Navy officials in attendance – had similar results. As Langley launched the aircraft off the ramp, the tail section broke and the aircraft again flopped into the river.[77] Langley's efforts marked a dubious beginning for heavier-than-air flight in the United States. The first airplane purchased with public funds was a complete disaster. This failure brought severe rebuke from both the public and the United States Congress and was likely a primary factor in the Army's delay in recognizing the Wright brothers' nearly simultaneous success.[78]

In 1899, Ohio bicycle makers Orville and Wilbur Wright became interested in aviation. The brothers followed Langley's exploits and in 1900, working on advice provided by Octave Chanute of the Smithsonian Institute, the brothers built their first full-size glider.[79] Supposing they were most likely to discover a successful design for a powered aircraft by learning to control gliders, they began a two-year process of building and testing various glider designs before introducing an engine.[80] As with many of their predecessors, however, they quickly learned that all existing engines were too heavy to install in their aircraft. Undeterred, the brothers worked closely with their mechanic, Charles Taylor, and designed and built their own engine that they subsequently installed on an

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[75] Roger G. Miller, "Kept Alive by the Postman: The Wright Brothers and 1st Lt. Benjamin D. Foulois at Fort Sam Houston in 1910," *Air Power History* (Winter 2002): 32-45.
[76] Robert Bluffield, *Over Empires and Oceans: Pioneers, Aviators, and Adventurers – Forging the International Air Routes* (Ticehurst, UK: Tattered Flag Press, 2014), 11.
[77] Ibid.
[78] Peter P. Wegener, *What Makes Airplanes Fly?: History, Science, and Applications of Aerodynamics* (New York, NY: Springer-Verlag, 1991), 23-25.
[79] Gibbs-Smith, *The Aeroplane*, 37.
[80] Collier, *A History of Air Power*, 39.

aircraft they simply named *Flyer*.[81]

On 17 December 1903, at Kitty Hawk, North Carolina, after several failed test flights, the brothers finally achieved success. At 10:35 in the morning, with Orville at the controls, *Flyer* left the ground and flew for approximately 12 seconds, covering 120 feet.[82] The Wrights conducted three additional flights that day, one lasting nearly a minute and covering over 850 feet.[83] These subsequent flights proved that the first success was not a fluke; man had finally achieved sustainable, powered heavier-than-air flight. The possibilities for military aviation were endless. Unfortunately, the spectacular failures of Langley's demonstrations had jaded the United States Army's opinion toward aviation. Despite the Wrights' repeated attempts to sell their design to the Army, more than four years passed before the Army would again become interested in the airplane.[84]

The news of the Wright brothers' success spread across the United States and interest in aviation slowly regained momentum. In early 1907, influential members of the Aero Club of America sent a letter to President Theodore Roosevelt heralding the Wrights' achievement and lobbying the government to consider the airplane for military service.[85] Roosevelt's interest was piqued and he directed the Secretary of War, William Taft, to investigate. In May 1907, the Board of Ordnance and Fortifications contacted the Wrights informing them of the War Department's interest in their airplane.[86] In response, the Wrights offered an airplane and one instructor pilot for $100,000.[87] The Army did not have the funding to accept the Wright offer and instead the two parties entered

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[81] Fred Howard, *Wilbur and Orville: A Biography of the Wright Brothers* (New York, NY: Ballantine Books, Inc., 1908), 106.
[82] Russell Freedman, *The Wright Brothers: How They Invented the Airplane* (New York, NY: Holiday House, 1994), 76.
[83] Gibbs-Smith, *The Aeroplane*, 41.
[84] Wilbur and Orville Wright, to Secretary of War, letter, 9 October 1905, quoted in Robert Futtrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force, 1907-1960*, vol. 1 (Maxwell AFB, AL: Air University Press, 1989), 15.
[85] Warren A. Trest, *Air Force Roles and Missions: A History* (Washington, D.C.: Air Force History and Museums Program, 1998), 1.
[86] Gill Robb Wilson, "The Memories of a Pioneer," *Flying* 61, no. 2 (August 1957): 41-51.
[87] Hennessy, *The United States Army Air Arm*, 26.

into negotiations that continued into the fall of 1907. Finally, after meeting with Brigadier Generals William Crozier of the Ordnance Department and James Allen of the Signal Corps, requirements were agreed upon and the War Department issued Specification Number 486 for a "Heavier-than-air Flying Machine."[88] Forty-one proposals were received, but only three complied with the outlined requirements and only the Wrights were ultimately able to deliver.[89]

While many in the Army did not initially appreciate the utility of the new flying machine, several did. First among them was Frank Lahm, who in 1906 wrote a prescient essay highlighting the airplane's advantages over the balloon. After a brief review of balloon progress, Lahm stated, "… it is neither the spherical nor the dirigible that is to solve the question of the 'conquest of the air;' it must be solved by a machine which is heavier than the air."[90] Lahm's essay was persuasive in nature as its purpose was to convince Americans that the "conquest of the air" was the next great challenge for science and for man. Lahm finished his essay by discussing the need to keep pace with European armies who he felt were far ahead of the United States in all aviation related matters.[91]

Future air power advocate Billy Mitchell also wrote about air power during these early days of aviation. Although he was not at the time directly involved with aeronautical development, his instructor position at the Army's Signal Corps School at Fort Leavenworth exposed him to those who were. In a pair of lectures, one at the Infantry and Cavalry School and the other at the Signal School, Mitchell presented his analysis of military aviation and discussed his views on the future uses of air power.[92] In the first lecture, presented in May 1905, Mitchell summarized balloon development and discussed the near term

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[88] Fred C. Kelly, *The Wright Brothers: A Biography* (New York, NY: Harcourt, Brace and Co., 1943), 213; Chandler and Lahm, *How Our Army Grew Wings*, 295.
[89] Hennessy, *The United States Army Air Arm*, 27-28.
[90] Lieutenant Frank P. Lahm, "Ballooning," *Journal of the Military Service Institution of the United States* 18 (May-June 1906): 513.
[91] Ibid., 514.
[92] The Infantry and Cavalry School was the predecessor to the Command and General Staff School (CGSC).

future.[93] At the time, Mitchell unequivocally believed the balloon's primary purpose was reconnaissance and he described the manner in which airborne photography could satisfy ground commander requirements.[94] Mitchell finished this lecture by briefly discussing dirigible balloons and their potential advantages over captive balloons. Ever the perceptive thinker, Mitchell's final conclusion was that the lack of mobile air-to-ground communications would hinder the dirigible balloon's full integration.[95] In his second lecture – delivered almost a year after the first – Mitchell's developing thoughts on air power are evidenced. In addition to repeating many of the points he made the previous year, he added sections about the possible offensive uses of the balloon, its potential as a submarine scout, and briefly discussed the Wright's success with heavier-than-air flight.[96] He concluded by prophesying that future conflicts would undoubtedly "be carried out in the…air."[97]

Almost simultaneously, Benjamin Foulois was writing about the Army's need to incorporate aeronautics. As a student at the same school at which Mitchell was instructing, Foulois chose aeronautics as his graduation thesis topic and he made many bold airpower predictions. While historians traditionally recognize Mitchell as the first American air power advocate, Foulois' words are equally as prophetic:

> In all future warfare, we can expect to see engagements in the air between hostile aerial fleets. The struggle for supremacy in the air will undoubtedly take place while the opposing armies are maneuvering for position, and possibly days before the opposing cavalry forces have even gained contact. The results of these preliminary engagements between the hostile aerial fleets will have an important effect on the strategical movements of the hostile ground forces before they have actually gained contact.

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[93] Captain William Mitchell, "2nd Lecture on Field Signal Communications" (lecture, United States Army Infantry and Cavalry School, Department of Military Art, Fort Leavenworth, KS, May 1905), 15, http://cgsc.contentdm.oclc.org/cdm/ref/collection/p4013coll4/id/472 (accessed 15 September 2015).
[94] Ibid., 18-19.
[95] Ibid., 20.
[96] Captain William Mitchell, "The Signal Corps with Divisional Cavalry and Notes on Wireless Telegraphy, Searchlights and Military Ballooning," *U.S. Cavalry Journal*, vol. 16 (April 1906): 669-696.
[97] Ibid.

> The successful aerial fleet, or what remains of it, will have no difficulty in watching every movement and disposition of the opposing troops, and unless the opposing troops are vastly superior in numbers, equipment, and morale, the aerial victory should be an important factor in bringing campaigns to a short and decisive end.[98]

Foulois' foresight was impressive. At the time, no one had predicted air-to-air combat nor discussed the potential multipurpose role of the aircraft. Foulois' vision of a fighter-cum-ISR asset even predated the famed Douhetian multirole "battleplane."[99] In addition to the above prognostications, Foulois predicted the obsolescence of horse cavalry reconnaissance, stating that a "modern military aeroplane" could more thoroughly reconnoiter the territory in front of an army and "could photograph all of its main features..."[100] Perhaps his most important contribution to the future of airborne ISR, however, were his thoughts regarding the future of wireless airborne communication. As discussed earlier, quickly communicating intelligence information to the costumer is a continual challenge for airborne ISR forces. Foulois recognized the problem at the earliest stages and strongly advocated for the continued development of the wireless telegraph.[101] Foulois believed that aircraft could not fully realize their potential unless air-to-ground communication was greatly improved. Additionally, Foulois envisioned the first near real-time imagery downlink capability. In his discussion on the development of wireless communications, he referenced the need to wirelessly transmit aerial photographs, stating, "If this instrument can be relied upon…the aerial fleet of an army will not only be invaluable in securing data of the country over which it passes, but will be able to transmit at once by wireless photographs

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[98] Benjamin D. Foulois, "The Tactical and Strategical Value of Dirigible Balloons and Dynamical Flying Machines" (thesis, United States Army Signal Corps School, 1 December 1907), 3, 168.68-14, AFHRA.
[99] Giulio Douhet, *The Command of the Air*, ed. Joseph Patrick Harahan and Richard H. Kohn (Tuscaloosa, AL: The University of Alabama Press, 2009), 117.
[100] Foulois, thesis, 5.
[101] Benjamin D. Foulois and C.V. Glines, *From the Wright Brothers to the Astronauts: The Memoirs of Major General Benjamin D. Foulois* (New York, NY: McGraw-Hill Book Company, 1960), 45. (hereafter known as Foulois and Glines, *Memoirs*)

of the area passed over."[102] Foulois' paper was widely circulated at the War Department. The old adage, "a good deed never goes unpunished" was apparently just as true then as it is today. Upon reading Foulois' paper, the Chief Signal Officer of the United States Army assigned Foulois to the Aeronautical Board that was conducting the flight trials of the bids the Army had received in response to Specification Number 486.[103]

In June 1909, shortly after becoming the Army's first certified airship pilot, Foulois arrived in Washington, D.C. to assume his new position on the Aeronautical Board.[104] Already convinced that airplanes had much greater potential than airships as reconnaissance platforms, Foulois immediately got to work ensuring the Army would get the best airplane.[105] Reviewing the requirements outlined by the Army, Foulois plotted a demanding air course between Fort Meyer and Alexandria that would strenuously test the competing aircraft.[106] Not content with only being a ground observer, Foulois insisted upon and was granted approval to fly as navigator-observer on the Wrights' final trial flight.[107] On 30 July 1909, with Orville Wright at the controls and Foulois as passenger, the Wrights completed the Aeronautical Board's requirements and three days later, the Army accepted Signal Corps Airplane Number 1 as the United States military's first airplane.

Following the trials, Foulois continued working to improve aircraft communication capabilities. On 18 January 1910, he and amateur radio enthusiast Frank L. Perry rigged a wireless telegraph to a Wright Model A to prove Foulois' earlier conception of wireless communications.[108] Foulois, from

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[102] Ibid.
[103] Benjamin D. Foulois, "Early Flying Experiences: Why Write a Book? – Part 1," *Air Power Historian* 2 (April 1955): 19-20.
[104] Though Foulois had qualified as an airship pilot, he was never very impressed with its capabilities. The potential high speed and maneuverability of the airplane had attracted him from the time he first heard of Langley's trials. For further information, see Foulois, "Early Flying Experiences," 17-18.
[105] Foulois, "Early Flying Experiences," 23.
[106] John F. Shiner, *Foulois and the U.S. Army Air Corps: 1931-1935* (Washington, D.C.: Office of Air Force History, 1983), 2.
[107] Hennessy, *The United States Army Air Arm*, 34.
[108] Foulois and Glines, *Memoirs*, 71.

the aircraft, and Perry, from the ground, exchanged Morse code messages. With this proof of concept, pilots and observers could now communicate in near real-time with the ground. Though this story is not well known, this experiment forever changed the future of airborne ISR. As pilots and observers were then able to quickly communicate to the ground what they were seeing, the aircraft's value to the Army ground commander increased exponentially. The capability still needed much refinement, but the reality of air-to-ground communication had been proven.

Foulois first opportunity to demonstrate the aircraft and its new ability to communicate with the ground came in 1911. Shortly after accepting the first airplane, the Army had moved Foulois and Signal Corps Number 1 to Fort Sam Houston, Texas. While in Texas, Foulois honed his flying skills and also showed the airplane's practical application to military operations by conducting aerial mapping, aerial photography, and airborne reconnaissance of troops who were conducting maneuver drills in the area.[109] When the Mexican Revolution flared up along the Texas-Mexico border, the Army mobilized troops – including Foulois' flying outfit – and moved them from Fort Sam Houston to Fort McIntosh in Laredo, Texas, to conduct a show of force.[110] Foulois took full advantage of this opportunity to demonstrate the viability of using the airplane to work with ground forces. Acting on the orders of the local ground commander, Major General William Carter, on 3 March 1911, Foulois conducted the first official United States military reconnaissance flight in an airplane.[111] With Foulois as pilot and civilian Phillip Parmalee as his navigator-observer, Foulois successfully dropped messages to troops on the ground and was able to receive communications wirelessly from the Signal Corps units deployed in the area.[112] On a subsequent flight, Foulois demonstrated the potential of the aircraft as a

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[109] Shiner, *Foulois and the U.S. Army Air Corps*, 3.
[110] Message, Chief of Signal Corps Brigadier General James Allen, to, Lieutenant Benjamin D. Foulois, 27 February 1911, Record Group 111, file 23631, Records of the Office of the Chief Signal Officer, National Archives and Records Administration (NARA).
[111] Foulois and Glines, *Memoirs*, 83.
[112] Hennessy, *The United States Army Air Arm*, 40.

message courier when he completed a 26-mile round-trip flight from Carter's headquarters to forward deployed units. Carter, a veteran cavalryman who was accustomed to long delays in sending and receiving messages, was greatly impressed.[113] While Foulois was not specifically tasked to locate Mexican forces during these sorties, his exploits demonstrated the airplane's great potential as a force multiplier.

Foulois' successes in Texas prompted Lahm to attempt to codify Army aviation doctrine. Fully convinced that airborne ISR should be the fundamental military application of aircraft, in April 1911, Lahm authored an article titled, "The Relative Merits of the Dirigible Balloon and the Aeroplane in Warfare." In the essay, Lahm outlined three basic missions for which aircraft – both the balloon and the airplane – were suited for military use: strategical and tactical reconnaissance; communication; and combat.[114] Fully aware of ongoing experimentation with the airplane as a bomber, Lahm dismissed the aircraft's effectiveness in this role by highlighting the inefficiency of bombs and targeting. Lahm believed the difficulty with bombing was primarily the inability to concentrate bombs in a tight enough pattern to actually have anything other than a morale effect on targeted ground forces and the civilian population.[115] Instead, Lahm highlighted the aircraft's unique ability to act as an airborne communications relay and, more importantly, its vast potential as an airborne ISR platform. With vision far ahead of his time, Lahm precisely described the difference between strategic and tactical intelligence. His definition of strategic intelligence mirrors what today we call Phase Zero intelligence preparation of the environment (IPOE) and his definition of tactical intelligence accurately describes the essential elements of information (EEIs) still required by ground commanders.[116]

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[113] Benjamin D. Foulois, "Early Flying Experiences: Why Write a Book? – Part 2," *Air Power Historian* 2 (July 1955): 57-58.
[114] Lieutenant Frank P. Lahm, "The Relative Merits of the Dirigible Balloon and Aeroplane in Warfare," *Journal of the Military Service Institution of the United States* 48 (Mar-Apr 1911): 200.
[115] Ibid., 201.
[116] Ibid., 202.

Lahm went on to compare and contrast the dirigible and the airplane as airborne ISR platforms. In his analysis, he cited the balloons' – captive and dirigible – poor maneuverability, slow speed, and vulnerability to ground fire as its major drawbacks. When comparing the airplane, he highlighted speed, maniability (flexibility), and invulnerability as its major advantages. Having concluded that airplanes were the future of United States Army air power, Lahm also suggested a 'group' of airplanes be assigned to each army headquarters in the field. This group was to be tasked at the discretion of the commanding general and would support both strategic and tactical intelligence requirements as necessary.[117] While unaware at the time, Lahm was accurately describing the future United States Air Force concept of "centralized control, decentralized execution." As Glassford had, Lahm concluded his essay by reminding his readers of the United States' poor aviation situation as compared with the other world powers. He implored the Army to adequately fund aviation development and concluded with words that would be used by many of his successor air power zealots, "…advantage…will go to the side which has the largest number [of aircraft] and the speediest, and which makes the boldest and most skillful use of them."[118]

The year following the Texas-Mexico border expedition, the young aviation pioneers had another opportunity to show the greater Army how they intended to integrate the aircraft. In August 1912, the Army conducted the Connecticut Maneuver Campaign exercises in which aviation was included in a support role. The 18,000-troop maneuver exercise was the largest the Army had attempted since the Spanish-American War and was designed to test the Army's ability to confront a large invading force in the United States homeland.[119] In the first phase of the exercise, the Aviation Section – headed by Foulois – was directly assigned to the Maneuver Commander and was given specific tasks to

[117] Ibid., 209.
[118] Ibid., 210.
[119] Report of Brigadier General Tasker H. Bliss, U.S. Army, Commander of Maneuvers and Chief Umpire, "Connecticut Maneuver Campaign," 10-12 August 1912, 42.

demonstrate the airplane's ability to provide early warning of enemy troop movements. On 12 August, Foulois flew an hour-long sortie over his assigned area and accurately reported the location, composition, and strength of the ground forces in the area.[120] The Commanding General, Tasker H. Bliss, wrote in his final report that the information provided by Foulois would have been of "…great value to a Commander in actual war operations."[121] Foulois and fellow pilot Lieutenant Thomas Milling flew sorties throughout the exercise alternating their support to the Red and Blue commanders. Flying at approximately 2,500 feet, the men were able to easily discern troop formations the size of a company or larger.[122] Foulois also took advantage of these sorties to further his work with radio transmission. While not completely successful, at times he was able to send messages from distances of up to 12 miles.[123] In the end, Bliss concluded, "The development of the military aeroplane…indicates the main value…will be the observation of the enemy…and that the commander who has this science developed to the greatest extent…will have a material advantage over his adversary."[124] While not everything went exactly to plan, airborne ISR had won yet another ally.

Foulois' inconsistency in effectively communicating from the airplane during the Connecticut maneuvers had highlighted two major shortfalls. First, as airplane technology advanced, the pilot's focus simply had to remain on flying. Both aircraft used in the maneuvers had been single-seat versions and this had limited the pilots' ability to simultaneously fly the airplane, make observations, annotate those observations on maps, and, more importantly, to report the information in near real-time to ground commanders. Following the maneuvers, Foulois and Milling recommended that trained observers should be required to conduct the observation portion of the sorties while the pilot focused on flying.[125]

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[120] Hennessy, *The United States Army Air Arm*, 71.
[121] Bliss Report, 193.
[122] Annual Report of the Chief Signal Officer, Brigadier General George Scriven, United States Army, to the Secretary of War, 1913, 54.
[123] Ibid., 53.
[124] Bliss Report, 193.
[125] Chandler and Lahm, *How Our Army Grew Wings*, 229.

Acting on these findings, in his 1913 annual report on the status of the Signal Corps, Brigadier General George Scriven recommended that every future airplane be crewed by two pilots who would alternate duties as pilot and observer.[126]

The second major shortfall underscored in the Connecticut maneuvers was the need to continue to advance airborne wireless communication. During the exercises, Foulois and the other pilots frequently had to land their aircraft in order to communicate the intelligence they had collected.[127] After Connecticut, the Aeronautical Division acknowledged the issue and dedicated considerable time and resources toward solving it. In October 1912, a group of pilots that included Milling and future air power legend Henry "Hap" Arnold took two aircraft to Fort Riley, Kansas to conduct experiments in air-to-ground communication and artillery spotting.[128] During the course of two months, the group conducted multiple tests focusing on the radio's antenna length and weight which were the areas they had determined to be the most likely problem.[129] On 2 November, following multiple experiments, the men at least partially solved the issue by affixing a one-pound weight to the antenna. In these tests, radio operators on the ground where able to consistently receive messages from the aircraft at six-mile distances.[130]

In addition to troubleshooting the antenna problem, the airmen also established the early TTPs for directing artillery fire from an airplane. From 5 to 13 November, during the first sorties of these type in the United States, the planes were used to locate targets, pass ranges and directions to artillery batteries on the ground, spot hits, and relay necessary corrections.[131] Not completely convinced they had conclusively solved the radio problem, the men

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[126] Scriven Report, 79.
[127] Foulois Memoirs, 101.
[128] Hennessy, *The United States Army Air Arm*, 72.
[129] Major Follett Bradley, to Major General Charles Menoher, Chief of the Air Service, letter, 14 Dec 1919, 168.7149, AFHRA. Of note, Bradley wrote this letter seven years after the Fort Riley experiments. It appears he was advising the then Air Service Chief, General Menoher, about pre-war experimentation with radio communication and artillery direction.
[130] Ibid.
[131] Ernest L. Jones, "Chronology of Aviation," 168.6501, AFHRA.

developed additional methods to pass information from the airplane to the firing battery on the ground: first and foremost was radio telegraphy; second was a card dropping system which required the airplane to remain in a tight orbit directly over the battery; and third, was a smoke signal system that relied on black smoke emanating from a lamp the pilots carried onboard. While many do not directly make the connection between artillery spotting and airborne ISR, these tests proved the value of the airborne observer, particularly in his ability to locate targets that would normally be hidden to cavalry scout units.[132]

Despite the great advances, funding for the Aeronautical Division remained limited. Prior to 1910, no money had been specifically budgeted and it was not until the Army Appropriation Act of 1911 that aviation received its own line item – the paltry sum of $125,000 for the "purchase, maintenance, operation, and repair of airplanes and other aerial machines."[133] The age-old rift between the older generation Army leadership and its young innovators also continued to hamstring aviation development with the intra-service rivalry even catching the attention of the House of Representatives. In a 1913 hearing discussing the possibility of creating a separate Aviation Corps, an article from the June edition of *Flying* magazine was entered into the official House record. The article, titled, "Perspective Developments in United States Army Aeronautics," discussed the status of Army aviation and lamented the fact that Army leaders had elected to first reorganize the ground armies before addressing aviation.[134] The author criticized the Army for focusing on building up the ground forces while it neglected aviation and called an Army without aviation "absolutely inefficient."[135]

The "ground forces first" mentality also affected the number of personnel

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[132] Hennessy, *The United States Army Air Arm*, 72.
[133] Quoted in Chase C. Mooney and Martha E. Layman, *Organization of Military Aeronautics: 1907–1935*, Army Air Forces Historical Study 25 (Washington, D.C.: Army Air Forces Historical Division, 1944), 5.
[134] House, *H.R. 5304: An Act to Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes: Hearings Before the Committee on Military Affairs*, 63rd Cong., 1st sess., August 1913, 259-260.
[135] Ibid., 260.

the Army was willing to dedicate to aviation. Beginning with the creation of the Aeronautical Division, Chief Signal Officers had lobbied the Army – and Congress – for additional manpower. In the years 1908-1910, bills calling for increases in Signal Corps personnel were introduced.[136] None of this legislation was enacted and the Aeronautical Division remained very modestly sized. In his 1910 annual statement, Brigadier General Allen reported that only one officer and nine enlisted men were assigned to Army aviation.[137] In March 1912, after multiple requests for increases in aviation manpower and the aforementioned comments regarding the United States falling behind other nations, Congress finally directed the Secretary of War to provide a full report on the status of Army aviation.[138]

The War Department's response was a pivotal point in military aviation history. In his report, Secretary of War Henry Stimson stated the Army only had ten officers on aviation duty and the number could not be increased without legislation authorizing additional Signal Corps manpower.[139] He suggested the reintroduction of a proposed bill from earlier in 1912 which had called for the addition of 55 officers, raised aviation pay by 20 percent, and included a provision that would provide six months' pay to beneficiaries of aviators or enlisted men killed while performing aviation-related duties.[140] With Congress' prodding, the Signal Corps was finally receiving the high level attention it needed to grow an effective aviation capability. While the Secretary's request did not immediately result in the changes he requested, it prompted a flurry of aviation-related activity in Congress.

Over the next year, in addition to several debates on the topic, Congressmen introduced several bills that were aimed at increasing the nation's

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[136] Mooney and Layman, *Organization of Military Aeronautics*, 7.
[137] Annual Report of the Chief Signal Officer, Brigadier General James Allen, United States Army, to the Secretary of War, 1910, 26. Though not specifically stated in the report, these ten Airmen were likely Foulois and his team who were at Fort Sam Houston during the timeframe covered by the annual report.
[138] Hennessy, *The United States Army Air Arm*, 107.
[139] House Document 718, 62nd Cong., 2nd sess., 20 April 1912. Original found in RG 233, File 66A-F27.4, NARA.
[140] Ibid.

aviation capability. The first, House Resolution (H.R.) 17256, which would have added 30 officers to the aviation service and doubled aviator pay, passed the House on 5 August 1912, but did not make it through the Senate due primarily to Secretary of War objections.[141] The second aviation-related bill was H.R. 28728. Introduced on 11 February 1913 by Congressman James Hay, this bill would have far-reaching implications as it was the first to suggest the creation of a separate Aviation Corps.[142] Also opposed by the War Department, this bill was debated heavily with several veteran aviators being asked for written opinions on the matter. Chief among those providing input was Foulois who believed the legislation was premature.[143] Citing the lack of sufficient aviation development, Foulois was concerned that creating a separate Aviation Corps would take away from the most important matter of the time, learning to fly. Foulois' opinion reflected that of the other senior aviators and the full Senate never voted on the bill.

While legislation had not been passed directly addressing aviation, the debate regarding the War Department appropriations bill for fiscal year 1914 was happening concurrently. Chief Signal Officer Scriven continued lobbying for increased funding and when the funding bill passed on 2 March 1913, it was very favorable to aviation. In addition to providing the Signal Corps $125,000 for aviation purposes, the bill granted flight pay to Army aviators for the first time.[144] It also increased the number of authorized pilots to 30 – still only half of the Chief Signal Officer's earlier recommendation.

The next H.R. concerning aviation was 5304. Introduced by Hay on 16 May 1913, the bill was very similar to H.R. 28728 with its primary focus being whether aviation should be independent of the Signal Corps.[145] The debate on

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[141] House, *To Fix the Status of Officers of the Army, Navy, and Marine Corps Detailed for Aviation Duty, and to Increase the Efficiency of the Aviation Service*, 62nd Cong., 2nd sess., 1912, HR 17256, 4-9.
[142] House, *To Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes*, 62nd Cong., 3rd sess., 1913, HR 28728, 1.
[143] Foulois Memoirs, 103.
[144] Mooney and Layman, *Organization of Military Aeronautics*, 13.
[145] House, *To Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes*, 63rd Cong., 1st sess., 16 May 1913, HR 5304, 1.

the resolution was different this time. Instead of seeking written opinions from the Army's aviators, Congress called several of them for personal testimony. The list of officers who provided statements reads like a veritable 'who's who' of aviation legends with Foulois, Arnold, Milling, and even Mitchell – who was still not an aviator at the time – providing their thoughts regarding the matter. In testimony, all of the aviators supported aviation remaining in the Signal Corps except one; Captain Paul Beck. While the other aviators remarked that reconnaissance remained the primary purpose of aviation and thus should remain in the Army, Beck had other thoughts.[146] In comments eerily similar to those that would be heard a decade later from Mitchell, Beck blasted the Army for placing non-flyers in charge of aviation stating they could not possibly employ aviation effectively.[147] Beck's thinking was also ahead of his peers regarding future employment of aviation. Having conducted extensive experiments with Riley Scott's bombsight, Beck was convinced that the "aggressive" use of the airplane would become one of its primary roles.[148] Despite Beck's support, the House committee voted to radically redesign the bill before putting it before the larger body.[149]

The rewritten bill abandoned the idea of completely separating aviation from the Signal Corps and instead created an official Aviation Section comprised of 60 officers and 260 enlisted men.[150] The bill also codified aviation training, created aeronautical ratings, increased flight pay, and outlined the benefits to be received by the beneficiaries of aviators killed in the line of duty.[151] Attempting to satisfy the isolationists in Congress, the bill included unequivocal statements

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[146] Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power* (Bloomington, IN: Indiana University Press, 1964), 17.
[147] House, *H.R. 5304: An Act to Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes: Hearings Before the Committee on Military Affairs*, 63rd Cong., 1st sess., August 1913, 39.
[148] "Bomb-Dropping Device for Aeroplanes," *Popular Mechanics Magazine*, December 1911, 930; House, *Hearings*, August 1913, 38.
[149] Hennessy, *The United States Army Air Arm*, 109.
[150] Mooney and Layman, *Organization of Military Aeronautics*, 17.
[151] House, *To Increase the Efficiency of the Aviation Service of the Army, and for Other Purposes*, 63rd Cong., 2nd sess., 12 December 1913, HR 5304, 5-12.

that the United States would not attempt to achieve the same level of aviation development as the European powers and that the bill was designed simply to enable the Army to keep "abreast with the experiments being made in aviation."[152] With the changes, the bill met little opposition. It subsequently passed both houses of Congress and on 18 July 1914 became law.[153]

The creation of the Aviation Section could not have been more timely. Within two weeks after the passage of H.R. 5304, war broke out in Europe. While the United States would not get directly involved for nearly three years, the events of the early part of the war provided the impetus for additional American aviation growth. When Europe went to war, the Army had just begun discussing the fiscal year 1916 Army Appropriations Act. Recognizing the potential for United States involvement, for the first time in history the Army requested over $1,000,000 for aviation.[154] In hearings on the Act in December 1914, Scriven defended the Army's request and highlighted that the latest aviation budgets for all the major European powers put them far ahead of the United States. According to Scriven, Germany had appropriated $45,000,000; Russia, $22,500,000; Great Britain, $1,080,000; and Italy, $800,000.[155] Scriven's argument was apparently not persuasive as when the bill passed on 4 March 1915, the Aviation Section was only given $300,000.[156]

While funding debates raged in Washington, Army pilots were in the field advancing aviation. Mexico's revolution continued and new violence in February of 1913 had prompted President Woodrow Wilson to order a partial mobilization along the border near Galveston.[157] On 25 February, Scriven ordered Chandler

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[152] Mooney and Layman, *Organization of Military Aeronautics*, 17-18.
[153] Maurer Maurer, ed. and comp., *The U.S. Air Service in World War I*, vol. 2, *Early Concepts of Military Aviation* (Washington, D.C.: The Office of the Air Force History, 1978), 1.
[154] Hennessy, *The United States Army Air Arm*, 128.
[155] House, *Army Appropriation Bill, 1916: Hearings before the Committee on Military Affairs*, 63rd Cong., 3rd sess., 4 December 1914, 653-654.
[156] This amount, while far less than the Army had initially requested, was still almost three times the amount of previous years' budgets.
[157] Nicholas Villanueva Jr., "Decade of Disorder," in *The Mexican Revolution: Conflict and Consolidation, 1910-1940*, eds. Douglas W. Richmond and Sam Haynes (Arlington, TX: University of Texas at Arlington Press, 2013), 29.

and his group of aviation students from the Augusta Air School in Georgia to join the mobilization in Texas.[158] Arriving in Texas City on 2 March, upon the orders of Scriven, the group stood up the 1st Aero Squadron (Provisional), which was the first organized flying squadron in the Army.[159] The unit, which consisted of nine airplanes, nine officers, and 51 enlisted soldiers, quickly set up field operations and began searching for ways to provide airborne-derived intelligence to the ground force commander. During this three-month assignment, the unit was never directly tasked to search for Mexican revolutionaries. Instead, it passed its time honing the skills that would be fundamental for success in the upcoming war. In an exercise given to them by the Second Division Commander, Major General Carter, the squadron was tasked to fly deep behind "enemy" lines to locate deployed forces and construct maps that ground forces could use for planning.[160] The squadron executed this task by flying two-ship sorties that enabled them to cover a wide search area. The aviators located their targets and built comprehensive maps of enemy locations and defensive fortifications. Carter was pleased with the results and commended the aviators in an official memo to the Chief of the Signal Corps.[161]

When tensions eased and it became apparent that there would be no direct military intervention in Mexico, the 1st Aero Squadron – now no longer a provisional unit – was transferred to San Diego, California. Shortly after its arrival, the Army separated pilot training from the squadron when it created the Signal Corps Aviation School also in San Diego.[162] The main squadron, now commanded by Foulois, was free to focus on furthering its ability to satisfy ground commander intelligence requirements while the schoolhouse provided it a steady stream of newly qualified aviators. During this time, Foulois and his

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[158] Roger G. Miller, "A Preliminary to War: The 1st Aero Squadron and the Mexican Punitive Expedition of 1916," (Washington, D.C.: Air Force History and Museums Program, 2003), 5; Hennessy, *The United States Army Air Arm*, 74.
[159] Field Order No. 1, Headquarters First Aero Squadron, 5 March 1913, in History, 1st Reconnaissance Squadron: 5 March 1913 to 31 August 2012, 9.
[160] Hennessy, *The United States Army Air Arm*, 78.
[161] Major General Carter, Commanding General, 2nd Division, to Brigadier General Scriven, Chief of Signal Corps, letter, 1 May 1913, RG 111, File 32487, NARA.
[162] Foulois Memoirs, 116.

men experimented with the abovementioned Riley bombsight, began to develop the TTPs for attacking ground targets with specially configured guns, continued developing air-to-ground communications systems, and experimented with airborne photography.[163]

The 1st Aero Squadron's next chance to demonstrate the advance of aviation and airborne ISR would occur again along the Mexican border. In response to a 9 March 1916 raid into United States territory by the Mexican revolutionary Pancho Villa, President Woodrow Wilson ordered the formation of an expeditionary force to pursue and capture Villa.[164] On 10 March, the Army directed Brigadier General John Pershing to organize a force – known as the Punitive Expedition – capable of finding Villa and protecting the United States border. The Army subsequently ordered the 1st Aero Squadron to provide Pershing with airborne reconnaissance and to act as a communications relay between deployed ground forces and Pershing's headquarters.[165] On 15 March, Foulois and his men arrived in the New Mexico border town of Columbus and immediately began preparing for operations. The next day, with Foulois as the airborne observer and Captain Townsend F. Dodd as the pilot, the squadron conducted the first ISR flight by a United States military aircraft over foreign territory.[166] Penetrating approximately 20 miles into Mexico, the airmen found no Mexican rebels.[167] Airborne ISR had enabled decision advantage yet again, however. The information gave Pershing the time he needed to establish operations and distribute his forces as he knew that there were no enemy forces within at least a day's march from his headquarters in Columbus.[168]

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[163] Ibid., 117.
[164] Don Wolfensberger, "Congress and Woodrow Wilson's Military Forays into Mexico," (paper presented at the Congress Project Seminar on Congress and U.S. Interventions Abroad, Woodrow Wilson International Center for Scholars, 17 May 2004), 11.
[165] Major Benjamin Foulois, "Report of Operations of 1 Aero Squadron, Signal Corps, with Punitive Expedition U.S.A., 15 Mar – 15 Aug 1916," (hereafter known as Foulois Report) 1, 168.65011-7A, AFHRA.
[166] Foulois Memoirs, 127.
[167] "Log of the First Aero Squadron for Week Ending March 18, 1916," RG 94, Box 3131, file 2387753, NARA.
[168] Foulois Memoirs, 127.

The first few weeks of the squadron's support to the Punitive Expedition were comprised of message relay missions, mail delivery, and very little effective airborne ISR. The weather, high altitude, and general poor flying conditions of the high Mexican desert hampered Foulois' ability to provide the reconnaissance that Pershing needed. The squadron's aircraft were simply inadequate for the conditions. This prompted Foulois to request better airplanes and additional spare parts. In a letter to Pershing he asked for 10 of the "highest powered, highest climbing, and best weight-carrying" airplanes that could be purchased at the time.[169] On 31 March, partially in response to Foulois' request and partially in reaction to the ongoing war in Europe, Congress allocated a special appropriation of $500,000 to the Aviation Section to purchase additional aircraft, motor trucks, maintenance equipment, automatic photographic cameras, machine guns, rifles, and bombs for the 1st Aero Squadron.[170] The new airplanes arrived on 1 May 1916, but poorly designed propellers prevented their use with Pershing's forces. By the time Foulois' men had worked through the new problems, the Punitive Expedition had come to an end. The last involvement for the squadron was to conduct the United States Army's first "flyover" in Pershing's final review of troops on 22 August 1916.[171]

Despite the seemingly lackluster performance of the 1st Aero Squadron, airmen took many positives away from the experience. They had conducted reconnaissance in areas that were inaccessible to Carter's cavalry and had provided detailed maps to assist in the planning of division-level movements. In addition, the squadron had shown the great value of the airplane as a communications relay as it was able to deliver Carter's commands to his deployed forces in a fraction of the time it normally would have taken.[172] Also, the squadron had significantly advanced the extremely important art of aerial

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[169] Foulois Report, 2.
[170] Annual Report of the Chief Signal Officer, Brigadier General Squier, United States Army, to the Secretary of War in *War Department Annual Reports, 1916*, vol. 1. (Washington, D.C.: Government Printing Office, 1916), 882-885.
[171] Foulois Memoirs, 135.
[172] "History of the 1st Aero Squadron," RG 165, box 231, entry 310, NARA.

photography. Using a developmental camera, they had taken, developed, and created mosaics that showed miles of Mexican territory and revealed many details that would be of benefit to targeting efforts as well as ground maneuvers.[173] Finally, the squadron had established the first aerial mail route and had delivered thousands of letters and messages to Carter's troops.[174] Foulois' final conclusion was that the 1st Aero Squadron "had proven beyond dispute…that aviation was no longer experimental or freakish."[175] He was convinced the successes of the squadron – limited as they might have been – resulted in the overwhelming support the Air Service would receive in the upcoming years from both Pershing and then Secretary of War Newton Baker.

The time between the Punitive Expedition and the United States' entry in the European war reflected America's growing recognition of the importance of air power. The aviation buildup was slow, but the Army had ordered 80 of the then-most advanced aircraft available – the Curtiss JN-4 "Jenny" – and Congress had approved the incredible sum of $13,281,666 on 29 August 1916 for aviation.[176] In addition to greatly increased funding, other changes reflected the renewed interest in air power as the Aviation Section was authorized an increase to 148 flying officers and was directed to establish eight flying squadrons.[177] Unfortunately, the "Jenny" was an underpowered, unarmed aircraft that was good for little more than pilot training. If the Aviation Section was to enter combat in Europe, the United States would have to do much better. The Army had run out of time though. When the United States declared war on 6 April 1917, it was woefully underprepared to contribute via the air. On that date there were only 56 qualified pilots in the entire Army with another 51 in training. The number of airplanes had grown to 300, but the Chief Signal Officer characterized them as "training planes, all of inferior types."[178] To have any wartime impact, a crash

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[173] Foulois Report, 8.
[174] Foulois Memoirs, 136.
[175] Ibid.
[176] Ibid.
[177] Hennessy, *The United States Army Air Arm*, 188.
[178] Annual Report of the Chief Signal Officer, Brigadier General Squier, United States Army, to the Secretary of War, 1918, 3-4.

program in aircraft manufacturing and pilot training would have to be implemented.

The United States was not the only nation learning how to incorporate the new air weapon into its military. In July of 1909 a consortium of French champagne producers hosted the *Grande Semaine de l'Aviation* (The Great Aviation Week) in Reims, France.[179] In what was the world's first international flying competition and air show, the audience, which included several military attachés from Europe's major powers, were treated to a demonstration of the latest in aviation technology and flying skill.[180] The reactions from the various attachés was remarkable. The Communication Troops Inspectorate of the Prussian Army reported with amazement that 36 aircraft took part.[181] The German military attaché in Paris, Major von Winterfeldt, spent several days at the air show and commented that the French had made "enormous progress" in aviation.[182] The number of aircraft involved and the demonstrated skill of the pilots astonished Winterfeldt. In his report to the German High Command, he wrote, "…it was not just a question of timid, short experiments…but instead really serious performances were achieved with respect to stability, speed, maneuverability, endurance and altitude…one may clearly maintain that aviation technology has overcome the stage of playing around or of fruitless experiments. Without a doubt the French will continue to work energetically in this area."[183] The Communication Troops Inspectorate added that "…the much doubted development capacity of the flying machine overall was shown itself plainly to the world at Reims, and makes even a military utility of aeroplanes in the foreseeable future appear entirely possible."[184]

These military men – none of them aviators – were clearly impressed.

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[179] Hallion, *Taking Flight*, 258.
[180] T.A. Heppenheimer, *First Flight: The Wright Brothers and the Invention of the Airplane* (Hoboken, NJ: John Wiley & Sons, Inc., 2003), 304.
[181] David G. Herrmann, *The Arming of Europe and the Making of the First World War* (Princeton, NJ: Princeton University Press, 1996), 139.
[182] Quoted in Herrmann, *The Arming of Europe and the Making of the First World War*, 139.
[183] Ibid.
[184] Ibid., 139-140.

Following the Reims Air Show, many of these nations worked diligently to acquire aircraft and to incorporate the new capability into their respective militaries. The aircraft's ability to provide the ever difficult early warning necessary to head-off any aggressive movements by rival nations provided the impetus needed to integrate aviation assets into standing armies. As the Americans had discovered, developing the aircraft and the requisite TTP was difficult. The European nations had similar goals, but each nation's path to airborne ISR prior to the war was different; their clock was also ticking much faster.

Long anticipating war, the French focused considerable attention on aviation development during the early 1910s. Ever weary of being caught off-guard by a German surprise attack, France led the Allies in pre-war aviation investment. They recognized the changing character of conflict and were convinced the next war would be mobile; the ability to conduct tactical reconnaissance against a rapidly advancing target became paramount in French war doctrine.[185] Following the Reims Air Show, they immediately purchased seven planes, ordered dozens more, and began paying for flying lessons for select officers.[186]

Their crash-course in aviation was impressive. In July 1910, French army aviation assets demonstrated their value to the head of Military Aeronautics, General Pierre Roques. In siege exercises held near Verdun, French aircraft showed the ability to locate targets invisible to the ground forces and, more importantly for the conflict to come, worked effectively with the artillery forces.[187] Following the maneuvers, Roques commented that "aeroplanes are now as vital to armies as guns and rifles."[188] French experimentation continued and by the end of 1911 they had demonstrated advanced capability to reconnoiter with

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[185] "Aeronautics," June 1921, Part XXXVII, sec. 3, in American Mission with the Commanding General, Allied Forces of Occupation, Mainz, Germany, "A Study of the Organization of the French Army Showing its Development as a Result of the Lessons of the World War and Comprising Notes on Equipment and Tactical Doctrine Developed in the French Army, 1914-1921," NARA, RG 120, Box 819.
[186] Herrmann, *The Arming of Europe*, 142.
[187] Ian Sumner, *Kings of the Air: French Aces and Airmen of the Great War* (Barnsley, UK: Pen and Sword Aviation, 2015), 8.
[188] Quoted in Sumner, *Kings of the Air*, 8.

airplanes, and more significantly, had developed a rudimentary air-to-ground wireless communications system that allowed the airborne observer to quickly transmit information to the ground.[189] The French also led the way in aerial camera development. Having initiated a secret plan to perfect airborne imagery, by the beginning of the conflict, they had three types of camera that were all effective on airborne platforms.[190]

Fully appreciating these advancements, on 19 March 1912, the Grand Quartier Général (GQG) recognized aviation as a vital part of the French Army and on 4 April 1914, Aviation Militaire was removed from Army control making it the world's second independent Air Force.[191] In the time leading up to the war, the French organized their squadrons and developed air doctrine for observation and reconnaissance missions.[192] By the start of the war, the Aviation Militaire comprised eight balloon companies and ten aircraft sections.[193] The French also recognized the importance of rapidly moving the information gained from ISR flights up the chain-of-command. Aviation familiarization courses were taught at French staff colleges and officers were expected to fly as passengers on ISR flights to better familiarize themselves with the process. The French believed this acquaintance with aviation would help eliminate misunderstanding of ISR information and allow it to reach decision-makers more quickly. As war approached, the French were clearly the world aviation leaders.

As would be expected, Germany watched France's growing aviation dominance with great apprehension. As previously examined, Germany had invested heavily in the airship in the early years of the twentieth century. Primarily thought of as a long-range reconnaissance asset, by the mid-1900s, German thinking regarding the airship had already begun to change. Upon his

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[189] James J. Davilla and Arthur M. Soltan, *French Aircraft of the First World War* (Stratford, CT: Flying Machines Press, 1997), 55.
[190] Sir Walter A. Raleigh and H. A. Jones, *The War in the Air, Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 1 (Oxford, UK: Oxford University Press, 1922), 75.
[191] "Report on Aeronuatical Matters in Foreign Countries for 1913," 16, The National Archives of the UK (TNA), AIR 1/7/6/98/20; Davilla and Soltan, *French Aircraft*, 2.
[192] Lee Kennett, *The First Air War, 1914-1918* (New York, NY: Simon & Schuster, 1991), 22.
[193] "Report on Aeronuatical Matters in Foreign Countries for 1913," 12, TNA, AIR 1/7/6/98/20.

assumption of command in January 1906, General Helmuth von Moltke, the new Chief of the General Staff, called for a review of the airship's roles and missions.[194] Additionally, the airship's vulnerabilities were continually highlighted by its failure. Though Zeppelin's fame and the German public's love for the airship veiled the airship's flaws for several years, its weaknesses were highlighted for all to see in the German Army maneuvers of 1909 and 1910 when weather and simple ineffectiveness made it a non-factor.[195] While further trials in 1910 showed the airship's vulnerability to artillery and anti-aircraft fire, the Reims Air Show of 1909 had already fundamentally changed the strategic direction of the Army General Staff concerning aviation. In early 1911, Moltke asked the War Ministry to freeze airship construction and delivery for the Army at the nine they already possessed.[196] The German military's concerns over safety, cost, and the overwhelming – and accurate – belief that they were falling behind the French ultimately led them to select the airplane as their ISR platform of choice.

Further solidifying Moltke's choice of the airplane was their great success in the 1911 and 1912 army maneuvers. Army generals used airplanes much like they would the cavalry and in every instance airborne observers detected the location and movements of all enemy corps.[197] Following Moltke's decision, the aviation arms race with the French truly began. This drive to ensure superiority, or at least parity, resulted in a massive increase in German airplane spending between 1909 and 1914. During this time, the airplane budget grew from 36,000 reichsmarks in 1909 to 25,920,000 in 1914.[198]

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[194] James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence, Kansas: The University Press of Kansas, 1997), 15.
[195] Hallion, *Taking Flight*, 278.
[196] General Helmuth von Moltke, Chief of the General Staff, to War Ministry, letter, 2 March 1911, reproduced in General Erich Ludendorff, *The General Staff and Its Problems: The History of the Relations between the High Command and the German Imperial Government as Revealed by Official Documents*, vol. 1 (New York, NY: E.P. Dutton and Company, 1920), 32-33.
[197] Eric Dorn Brose, *The Kaiser's Army: The Politics of Military Technology in Germany during the Machine Age, 1870-1918* (New York, NY: Oxford University Press, 2001), 163.
[198] John Morrow, *Building German Airpower, 1901-1914* (Knoxville, TN: University of Tennessee Press, 1976), 15.

Along with the increased spending came emphasis on pilot training and doctrine development. In 1910, Germany established a flight school in Döberitz and by 1911 it had created an organizational framework for its air forces.[199] After intense study, in 1912, Moltke reaffirmed his decision regarding the airplane. In a report to the War Ministry he suggested the creation of an independent aviation section and requested another reorganization of the aviation organization.[200] During this time, he had also become convinced that airborne observers would be critical to artillery success.[201] With that belief, he directed the newly independent *Fliegertruppe* to begin intense observation and artillery spotting training.[202]

With the increased financing and Moltke's full backing, the integration of the airplane was rapid in Germany. Unlike the other powers who basically learned from trial-and-error, the Germans seemed to have a fairly good idea of how they intended to incorporate the airplane into ground operations prior to integration. By the time the *Fliegertruppe* gained independence in October 1913, the Germans had already developed air power doctrine and had built an aviation organizational framework.[203] Published in March 1913, the "Guidelines for Training the Troops about Aircraft and Means of Resisting Aircraft" defined the missions of aircraft as "strategic and tactical reconnaissance; artillery observation; transmission of orders and information; transport of people and objects; dropping bombs; and fighting aircraft."[204] As the Germans believed airborne ISR to be the main purpose of the aircraft at this point, this doctrine

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[199] Corum, *The Luftwaffe*, 18; Morrow, *Building German Airpower*, 16.
[200] Corum, *The Luftwaffe*, 20.
[201] General Helmuth von Moltke, Chief of the General Staff, to unknown recipient, letter, 12 December 1912, reproduced in General Erich Ludendorff, *The General Staff and Its Problems*, 47-48.
[202] Peter Kilduff, *Germany's First Air Force 1914-1918* (Osceola, FL: Motorbooks International, 1991), 10.
[203] General Helmuth von Moltke, Chief of the General Staff, to the War Ministry, letter, 26 August 1912, reproduced in General Erich Ludendorff, *The General Staff and Its Problems*, 37-43.
[204] James S. Corum and Richard R. Muller, *The Luftwaffe's Way of War: German Air Force Doctrine, 1911-1945* (Baltimore, MD: The Nautical & Aviation Publishing Company of America, 1998), 37.

document focused heavily on the conduct of reconnaissance from the air and also gave guidance to ground troops on how to use camouflage to defeat adversary ISR.

Throughout the rest of 1913 and the first half of 1914, the *Fliegertruppe* continued growing and refining its doctrine. In the 1913 army maneuvers, airplanes were used for ISR, tactical bombing, troop transport, and to counter other aircraft.[205] Additionally, Moltke reversed his earlier decision regarding the airship and announced the Army would need at least 20 for future conflict.[206] As experiments with weaponizing the airship progressed, Moltke had become convinced of the airship's ability to cause a morale effect on both enemy troops and the civilian populace. In August 1914, Germany went to war with ten airships and approximately 250 two-seat reconnaissance aircraft.[207] Moltke's vision and foresight had allowed Germany to keep pace with France and ensured it would not be at a great aviation disadvantage. He had also embraced the vast potential of the new weapon and guaranteed the Germany military aviation organization would be flexible enough to evolve along with the aircraft. As war dawned, Germany was as prepared as any nation for airborne ISR and beyond.

On the morning of 25 July 1909, the Frenchman Louis Blériot flew his namesake Blériot XI monoplane across the English Channel from Baraques, France, to just west of Dover, England.[208] It was not the first time a man had flown over the Channel but the short duration of the flight alarmed many Britons. In just a little over 30 minutes, Blériot showed the world how air power would change the established geographical paradigm. The press immediately began writing about France's newfound ability to ameliorate the British Navy's long-held naval supremacy in the waters surrounding Great Britain. Fantastical

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[205] David T. Zabecki, ed., *Germany at War: 400 Years of Military History* (Santa Barbara, CA: ABC-CLIO, LLC, 2014), 335.
[206] Guillaume de Syon, *Zeppelin!: Germany and the Airship, 1900-1939* (Baltimore, MD: The John Hopkins University Press, 2002), 80.
[207] John H. Morrow Jr., "Defeat of the German and Austro-Hungarian Air Forces in the Great War, 1909-1918," in *Why Air Forces Fail: The Anatomy of Defeat*, ed. Robin Higham and Stephen J. Harris (Lexington, KY: The University Press of Kentucky, 2006), 106.
[208] Scott W. Palmer, *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia* (New York, NY: Cambridge University Press, 2006), 11.

stories of thousands of French air invaders penetrating British air space became commonplace. Whether far-fetched or not, Blériot's accomplishment prompted a rapid reaction from the British. Until that point, British aviation development had basically mirrored the situation in the United States; civilian aviators dominated early development with the British armed forces only showing minor interest in the subject. As in the United States, the British Army fought aviation integration and in early 1909 had convinced then Prime Minister Herbert Asquith of the irrelevancy of aircraft.[209] Blériot's flight changed that.

At the time of Blériot's flight, the British Army had one airplane – a Wright biplane that the businessman and amateur aviator Henry Rolls had donated – and three qualified pilots.[210] These pilots had been experimenting with the airplane and attempting to convince Army leadership of the potential benefit of airborne ISR. As with the Americans, they experienced considerable resistance from their ground-focused leadership with doubts of the veracity of their information, fear that the loud aircraft noises would spook the cavalry's horses, and general skepticism resulting from the cancellation of flights during bad weather all being cited as reasons to disregard aviation.[211]

Following Blériot's flight, the British government ordered various changes to the organization of military aviation. In May 1910, they established the Advisory Committee for Aeronautics to counsel the Admiralty and War Office on aviation matters.[212] Additionally, they appointed a civilian, Mervyn O'Gorman, as the superintendent of the aforementioned Balloon Factory at Farnborough.[213] This move was made to remove the Balloon Factory from direct military control and to ensure a competent engineer was making decisions at the British's most

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[209] Percy B. Walker, *Early Aviation at Farnborough*, vol. 2, *The First Aeroplanes* (London, UK: Macdonald & Co. Ltd., 1974), 329.
[210] Peter Mead, *The Eye in the Air* (London, UK: Her Majesty's Stationery Office, 1983), 37.
[211] C.F. Snowden Gamble, *The Air Weapon* (Oxford, UK: Oxford University Press, 1931), 114.
[212] The Advisory Committee for Aeronautics, *Report of the Advisory Committee for Aeronautics for the Year 1909-1910* (London, UK: His Majesty's Stationery Office, 1910), 4.
[213] Shortly after, the Balloon Factory became the Royal Aircraft Factory which was responsible for balloon and airplane production.

important aviation manufacturing facility.[214] Finally, the government decided to organize British military aviation into a special unit, the Air Battalion of the Royal Engineers, which was comprised of the Airship Company (responsible for balloons and kites) and the Aeroplane Company (responsible for heavier-than-air craft).[215]

The establishment of these organizations provided much needed stability and strategic direction for British aviation. Aircraft procurement became formalized and civilian aircraft manufacturers were encouraged to compete for government contracts. Content with the acquisition side of aviation, in November 1911 the British government turned its attention to the doctrinal organization of military aviation. The Air Battalion concept had proven to be less than satisfactory as the entire organization was led by non-aviators with one of them – Major Alexander Bannerman – openly lecturing about the infeasibility of the aircraft.[216] That month Prime Minister Asquith requested the Committee of Imperial Defence (CID) consider the future of aviation development and to recommend the best course of action.[217] After a quick study, in April 1912, the Committee submitted its recommendations for immediate action. The principal recommendation was that the government create a consolidated British Aeronautical Service to be designated 'The Flying Corps,' comprised of a Naval Wing, a Military Wing, and a Central Flying School for the training of Army and Navy pilots.[218]

Following the report, a technical subcommittee was appointed to provide advice on the implementation of the committee's recommendation. This subcommittee, headed by pilot and early airborne ISR advocate Brigadier General David Henderson, detailed a number of functions to be accomplished by

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[214] Alfred M. Gollin, *The Impact of Air Power on the British People and Their Government, 1909-1914* (Stanford, CA: Stanford University Press, 1989), 108.
[215] Mead, *The Eye in the Air*, 38.
[216] "Notes of General Brooke-Popham," 22, TNA, AIR 1/4/1. At the time, Brooke-Popham was the commanding officer of the Aeroplane Company of the Air Battalion.
[217] Sir Walter Raleigh, *The History of the War in the Air, 1914-1918: The Illustrated Edition* (Barnsley, UK: Pen and Sword Aviation, 2014), 167.
[218] Mark Andrews, *Fledgling Eagle: The Politics of Air Power* (Peterborough, UK: Stamford House Publishing, 2008), 5.

aircraft in support of military operations.[219] These were listed as: reconnaissance, prevention of enemy reconnaissance, intercommunication, observation of artillery fire, and infliction of damage on the enemy.[220] The main committee immediately adopted the subcommittee recommendations and on 13 April 1912, King George V officially created the Royal Flying Corps (RFC) by royal decree.[221]

Creating the organization on paper was a much easier task than actually obtaining aircraft and training pilots. Following the King's decree, Henderson stated, "At the present time in this country we have, as far as I know, of actual flying men in the Army about eleven, and of actual flying men in the Navy about eight, and France has about 263, so we are what you may call behind."[222] Exacerbating the difficulty in creating the organization was the Royal Navy's outright refusal to unite the various air arms. Despite the subcommittee's recommendation that the RFC should encompass all military flying organizations, the Royal Navy did not participate fully. It never sent its pilots to the Central Flying School and rather chose to use its own Naval Flying School at Eastchurch on the Isle of Sheppey in Kent, England.[223] Additionally, after a short time, the Royal Navy no longer used the name 'Royal Flying Corps, Naval Wing,' and instead opted to be called the 'Royal Naval Air Service (RNAS).'[224] The Navy also eschewed the Royal Aircraft Factory at Farnborough and elected to contract private firms to conduct naval aircraft experimental and developmental work.[225]

With the Royal Navy out of the RFC for all intents and purposes, the first

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[219] In 1907, Henderson authored *The Art of Reconnaissance*. In chapter IX, titled *Aerial Reconnaissance*, he presciently describes the future of airborne ISR and lobbies for the British Army's support in its integration. For further information, see David Henderson, *The Art of Reconnaissance*, 3rd ed. (London, UK: John Murray, 1916), 168-189.
[220] Andrews, *Fledgling Eagle*, 6.
[221] Alistair Smith, *Royal Flying Corps* (Barnsley, UK: Pen & Sword Aviation, 2012), 6.
[222] Quoted in Robert F. Grattan, *The Origins of Air War: Development of Military Air Strategy in World War I* (London, UK: Tauris Academic Studies, 2009), 5.
[223] Raleigh, *History of the War in the Air*, 174.
[224] "Memorandum on the Organisation of the Air Services," by Lieutenant-General Sir David Henderson, July 1917, reprinted in H.A. Jones, *The War in the Air*, Appendices (Oxford, UK: Clarendon Press, 1937), 1-8.
[225] Andrews, *Fledgling Eagle*, 7.

commander of the RFC, Major Frederick Sykes, began molding the organization.[226] Sykes' initial plan called for seven squadrons of 13 aircraft each, with four pilots for each aircraft. He also intended to create an airship and kite squadron along with an aircraft park for supply and maintenance. With these projected numbers, he needed 364 trained pilots; as mentioned earlier, when the RFC formed there were a total of 19 combined in the Royal Army and Navy.[227] To get anywhere close to the required number, a massive recruiting effort would be necessary. As can be expected, progress was slow. By the end of 1912, two squadrons had been formed, numbered 2 and 3, and the balloon factory at Farnborough was designated as number 1. In October 1913, all balloon and airship development was passed to the RNAS and number 1 squadron transitioned to airplanes. By May 1914, the RFC had activated all seven of the programmed squadrons but were still woefully short of pilots.[228]

While the organization was beginning to come together, convincing ground commanders of the value of airborne ISR remained a challenge. Initial attempts at integration met with the expected recalcitrant attitude of the Army's commanders, but little by little, the RFC airmen began winning them over. In the Army's largest exercise of 1912, the RFC performed magnificently. Supporting the Blue, or defending, force of Lieutenant-General Sir James Grierson, the RFC provided invaluable reconnaissance. During the first day of the maneuvers, the RFC airship *Gamma* orbited over the front lines and relayed the movements of Lieutenant-General Sir Douglas Haig's Red force in near real-time via wireless radio.[229] Haig's forces attempted to use hedgerows and camouflage for cover, but the airship's observers never lost sight of the Red forces and reported their movements to Grierson's command post. The airplane also contributed to Grierson's situational awareness of Haig's every move. On the second day of the

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[226] Eric A. Ash, "Sir Frederick H. Sykes and the Air Revolution: 1912-1918" (PhD diss., University of Calgary, 1995), 153.
[227] Ian Philpott, *The Birth of the Royal Air Force* (Barnsley, UK: Pen and Sword Aviation, 2013), 39.
[228] Grattan, *The Origins of Air War*, 6.
[229] Nicholas Rankin, *A Genius for Deception: How Cunning Helped the British Win Two World Wars* (New York, NY: Oxford University Press, 2009), 19.

maneuvers, Grierson's air fleet – all four airplanes – was able to supply the Commanding General with a complete layout of the Red force.[230] The information provided by airborne ISR gave Grierson a resounding decision advantage which resulted in Blue's decisive victory over Red. Following the exercise, Grierson stated, "…their [aircraft's] use has revolutionized the art of war. So long as hostile aircraft are hovering over one's troops all movements are liable to be seen and reported, and therefore the first step in war will be to get rid of the hostile aircraft."[231]

The next two years saw slow, yet steady advances for the RFC and RNAS. As mentioned, all airships were transferred to the RNAS in October 1913. At the time, the RNAS was focused on providing threat warning for the fleet and was less interested in obtaining strategic intelligence information or conducting offensive combat operations. As such, the RNAS airship fleet fixated its pre-war training on maritime surveillance and anti-submarine work.[232] The RNAS also experimented with directing gunfire against coastal targets from its airships, but this met with little enthusiasm from RNAS leadership and was quickly abandoned.[233]

While the RNAS worried about the fleet, the RFC continued to experiment with the tools of airborne ISR. In the summer of 1912, the RFC had realized the importance of airborne photography and had been working to improve the skill and further adapt it to airplanes. That summer the RFC hired its first professional airborne photographer, Frederick Charles Victor (F.C.V.) Laws.[234] Laws was a passionate photographer and immediately began working to solve the problems associated with airborne photography – equipment and TTPs. By mid-1913 he had convinced RFC leadership that vertical, or directly overhead,

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[230] Raleigh, *History of the War in the Air*, 204.
[231] Quoted in Adrian Gilbert, *Challenge of Battle: The Real Story of the British Army in 1914* (Oxford, UK: Osprey Publishing, 2014), 33.
[232] Philpott, *The Birth of the Royal Air Force*, 43.
[233] John Christopher, *Balloons at War: Gasbags, Flying Bombs, & Cold War Secrets* (Stroud, UK: Tempus Publishing Ltd., 2004), 132.
[234] Roy Conyers Nesbit, *Eyes of the RAF: A History of Photo-Reconnaissance* (Stroud, UK: Alan Sutton Publishing Limited, 1996), 10.

photographs would provide the best intelligence value and he had worked closely with industry to develop the Watson Air Camera which was the first camera specifically produced for air photography in the RFC.[235] In July 1914, Laws demonstrated just how far he had advanced airborne photography during an RFC parade at Salisbury Plain. Flying over the parade grounds at approximately 3000 feet altitude, Laws photographed the scene. When he developed the images following the sortie, he was amazed at the details. In one image, he could see a sergeant-major chasing a dog off the parade grounds. In the image, the track of the dog and the sergeant-major could be seen in the bent grass of the parade grounds. From this, Laws realized that similar movement of both troops and vehicles could likewise be discerned; the art of photographic interpretation in the RFC was born.[236] Though not completely prepared for war, RFC airborne ISR had advanced considerably in its short existence. The hard work and diligence would set them up for early success as the war began.

Russia was another major power that was a relative latecomer to aviation. Though it had made rather extensive use of balloons and, to a lesser degree, kites, in the Russo-Japanese War, logistical problems and lack of doctrine hampered effectiveness.[237] Following that conflict, Russia's internal problems prevented its army from further advancing aviation. As the first decade of the twentieth century progressed, little was done. In the case of the Russians, it was Blériot's Channel Flight that prompted change. Grand Duke Alexander Mikhailovich – the second cousin and the Czar's brother-in-law – was in Paris on vacation when Blériot touched down in England. Mikhailovich immediately recognized the military significance of the airplane and upon his return to Russia created the 'Committee for Strengthening the Air Fleet' to promote military aviation.[238] With the Grand Duke's backing, the fledgling Russian air force began

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[235] F.C.V. Laws, "Looking Back," *The Photogrammetric Record* 3, no. 13 (April 1959): 24-41.
[236] Nesbit, *Eyes of the RAF*, 13.
[237] Alexei Ivanov and Philip Jowett, *The Russo-Japanese War 1904-05* (Oxford, UK: Osprey Publishing, 2004), 12.
[238] Von Hardesty, "Early Flight in Russia," in *Russian Aviation and Air Power in the Twentieth Century*, ed. Robin Higham, John T. Greenwood, and Von Hardesty (Oxon, UK: Routledge, 2014), 30.

to grow. His committee helped purchase French aircraft and sent officers to France for pilot training.[239] Not content to purchase foreign aircraft, in 1910 the Russians established their own aircraft factory at Saint Petersburg and began to produce indigenous airships and airplanes.[240] At first the Russians saw equal value in both platforms, but when engineer Igor Sikorsky produced his long-range *Il'ia Muromets* (IM) aircraft in 1913, focus shifted away from the airship.[241]

Russian air power doctrine understandably lagged behind its aircraft development. As with many countries, the Russians had fantastical ideas of what their aircraft could do, but the reality was that they had no practical experience with the airplane and had to develop doctrine on the fly. Sikorsky's IM aircraft gave them a platform from which they could conduct ISR, artillery spotting, and communications. Some saw further possibilities, however, and suggested the IM could serve as a gun platform to destroy enemy airships or as a full-fledged bomber.[242]

When the war began, Russia's front line air force was fairly robust. The Grand Duke's enthusiasm and political connections had given the Russians a competent capability. Likewise, several Russian engineers had emerged as brilliant aircraft designers. In an attempt to keep Russian ingenuity in Russia, the government invested as heavily as possible in these indigenous engineers' designs.[243] Despite the country's ongoing economic woes, the Russians were able to build approximately 250 airplanes and 14 airships by the beginning of the war.[244] While doctrine would have to be developed in the crucible of battle, as the war began, the fledgling Russian air force was in a position to contribute to

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[239] David R. Jones, "The Emperor and the Despot: Statesmen, Patronage, and the Strategic Bomber in Imperial and Soviet Russia, 1909-1959," in *The Influence of Airpower Upon History: Statesmenship, Diplomacy, and Foreign Policy since 1903*, ed. Robin Higham and Mark Parillo (Lexington, KY: The University Press of Kentucky, 2013), 118.
[240] Hallion, *Taking Flight*, 284.
[241] Jones, "The Emperor and the Despot," 119.
[242] Ibid.
[243] David R. Jones, "From Disaster to Recovery: Russia's Air Forces in the Two World Wars," in *Why Air Forces Fail: The Anatomy of Defeat*, ed. Robin Higham and Stephen J. Harris (Lexington, KY: The University Press of Kentucky, 2006), 262.
[244] Walter J. Boyne, *The Influence of Air Power Upon History* (Gretna, LA: Pelican Publishing Company, Inc., 2003), 48.

its ground forces' success.

Italy's aviation effort prior to the early twentieth century was modest at best. The nation was early to fly balloons, doing so in 1784, but did little during the nineteenth century. The Italian Aeronautic Military Corps had flown a dirigible airship in 1908, but had not pursued aircraft on a grand scale.[245] That began to change in 1909 when the Italian government invited Wilbur Wright to Rome to help instruct its pilots and to provide advice on airplane development. By 1910, Italy had its first two certified pilots and had acquired French and Austrian aircraft while it developed its indigenous aircraft production capability.[246] Within a year of qualifying its first two pilots, Italy became the first nation to use the airplane in combat during its war with the Ottoman Empire.[247] On 23 October 1911, the Italian aviator Captain Carlo Piazza conducted the world's first manned ISR flight from an airplane in combat when he reconnoitered the Libyan coast in his Blériot XI monoplane.[248] Approximately a week later, Second Lieutenant Giulio Gavotti became the first airman to drop bombs from an airplane.[249] Flying in an Etrich Taube airplane, Gavotti dropped four grapefruit-sized bombs on Turkish positions at Ain Zara and the Oasis of Jagiura.[250] During the nearly yearlong war, the Italians further demonstrated the airplane's potential by conducting additional tactical reconnaissance, photo mapping, artillery observation, day and night bombardment, and propaganda leaflet distribution missions.[251]

Despite Italy's trailblazing accomplishments, aviation development was sluggish following the war with the Ottomans. Still subordinate to the Italian

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[245] Ciro Paoletti, *A Military History of Italy* (Westport, CT: Praeger Security International, 2008), 132.
[246] Thomas Hippler, *Bombing the People: Giulio Douhet and the Foundations of Air-Power Strategy, 1884-1939* (Cambridge, UK: Cambridge University Press, 2013), 51-52.
[247] Basil Collier, *A History of Air Power* (Oxford, England: Macmillan Publishing Co., 1974), 41.
[248] Gregory Alegi, "The Italian Experience: Pivotal and Underestimated," in *Precision and Purpose: Airpower in the Libyan Civil War*, ed. Karl P. Mueller (Santa Monica, CA: RAND Corporation, 2015), 205.
[249] Christopher Chant, *A Century of Triumph: The History of Aviation* (New York, NY: The Free Press, 2002), 55.
[250] Boyne, *The Influence of Air Power Upon History*, 38.
[251] Morrow, *The Great War in the Air*, 25.

Royal Army, the Aeronautic Corps had difficulty getting the funding it needed to build an air force. As with several other nations, private donations helped considerably and by 1913 the Italians had built an aircraft factory for indigenous aircraft production.[252] With backing from strategic bombing advocate Giulio Douhet and aircraft designer Gianni Caproni, Italian aviation development prior to the war focused on bombers. Convinced of the potential effects of strategic bombing, Caproni's Ca. 1 airplane would become the world's first long-range bomber.[253] Despite Douhet's advocacy, in 1914 Italian air power remained a small and still developing capability when compared to the other great European powers; when the war began, Italy had only 26 aircraft and 39 pilots available.

As this chapter has demonstrated, the ability to control flight was the main motivator for aircraft innovation during this period. The balloon had proved the value of airborne ISR but its limitations severely restricted armies' ability to integrate fully its capabilities. The captive balloon provided valuable tactical intelligence but its static nature limited its compatibility with an increasingly mobile ground force. The free balloon was able to penetrate behind enemy lines and collect strategic intelligence, but without perfect wind conditions it was effectively useless. These shortfalls drove innovation with dozens of inventors trying hundreds of designs; most meeting with abject failure. In the early period, those who struck upon design success were usually stymied by power or navigation problems. Finally, with Count Zeppelin's rigid dirigible and the Wright brothers' *Flyer* airplane, inventors were able to marry their design breakthroughs to engines with significant power to allow control. These successes prompted the next phase in manned airborne ISR's evolution. With two navigable platforms, nations experimented with each to determine which best suited their needs. In every instance, the airplane won out over the balloon – both captive and dirigible. Although balloons would remain in most nations' inventory, the airplane's speed,

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[252] John Buckley, *Air Power in the Age of Total War* (Bloomington, IN: University of Indiana Press, 1999), 38.
[253] Steve Call, *Selling Air Power: Military Aviation and American Popular Culture after World War II* (College Station, TX: Texas A&M University Press, 2009), 19.

maneuverability, and multi-role aspects best suited it as the platform of choice to service ground commander requirements for intelligence, communications, and artillery spotting.

As the early twentieth century progressed, nations recognized the importance of the new air weapon, but budgets, manpower constraints, and hesitancy from Luddite-minded ground commanders delayed the aircraft's integration. Despite this, aviators continued advancing both aviation and airborne ISR. In schools far away from governmental bureaucracy, they learned to fly and developed early reconnaissance TTPs. When called upon, they responded quickly. Whether it was in response to revolution in Mexico, in support of ground forces in maneuver exercises, or in combat over Libya, the young airmen continued to win over support for their new craft. Their progress did not match the rapidity of the world's declining situation, however. War was about to erupt in Europe and none of the great powers had sufficient men, aircraft, or doctrine to conduct airborne ISR in combat. As will be seen in the next chapter, war came nonetheless and airmen would learn on-the-job in battle.

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Chapter 4: The Aircraft Comes of Age – World War I

Their skill, energy, and perseverance have been beyond praise. They have furnished me with the most complete and accurate information which has been of incalculable value in the conduct of operations.
Sir John French, Commander British Expeditionary Force

The aircraft matured rapidly during the early years of the twentieth century. Engineers and aviators continually improved designs and by October 1911, nations were using airplanes in combat. As World War I began, nearly every participating nation had some form of air power. Even though rudimentary air-to-air and air-to-ground attack capabilities existed, ground commanders continued to view aerial reconnaissance and artillery observation as the aircraft's main contribution to land warfare. As the war progressed, however, so did the airplane's capability. Development was staggeringly rapid as new aircraft reached the front only to become quickly outclassed by the next advance. During the course of the war airspeeds doubled, maximum altitudes and climb rates tripled, engine horsepower increased fivefold, and advanced armament was added to aircraft.[1] With these capability increases came additional tasks. By the end of the war, the list of missions that aircraft were performing was lengthy: strategic and tactical bombing; air interdiction; offensive and defensive counter air; artillery spotting; infantry contact patrols; aircraft carrier-based attack; and, tactical and strategic ISR.

While the growth of mission for the aircraft was unprecedented, the evolution and employment of ISR capabilities during the war was equally impressive. As the conflict began, armies were uncertain of the value of the new capability. While some prewar maneuvers and exercises had been successful, skeptical ground commanders still questioned the veracity of the intelligence

[1] Eric Lawson and Jane Lawson, *The First Air Campaign* (Conshohocken, PA: Combined Books, Inc., 1996), 11.

gained by observation.[2] Prewar training had been sporadic and the lack of experience was highlighted as the airborne observers often misidentified troop nationalities, sizes, and activities.[3] Despite the initial growing pains, as stalemate ensued on the ground, airborne ISR became the primary means to gain intelligence about enemy movements.

ISR doctrine also matured considerably during this first great modern war. Beginning as a nascent capability for which all combatant nations lacked solid tactics, techniques, and procedures (TTPs) for its incorporation, by the end of the war, airborne reconnaissance had become absolutely crucial to ground force success. By evaluating the major combatants' use of airborne ISR through several important phases of the war, this chapter will continue to follow the evolution of manned airborne ISR. The rapid development of airborne ISR during the war is one of history's best examples of how technological advancement can alter the conduct of war. As will be seen, the changing character of war required intelligence that needed to be more precise than ever. In World War I, the aircraft proved to be the platform that could best provide what the ground commander needed.

As examined in the previous chapter, aircraft development in the early twentieth century was so rapid that by 1911 several nations were ready to employ the airplane in combat. Italy was the first when on 23 October 1911, Captain Carlo Piazza conducted the world's first manned ISR combat flight when he reconnoitered the Libyan coast searching for Turkish positions.[4] During the nearly yearlong war, Italy's air power monopoly allowed them to further explore the airplane's potential by conducting additional tactical reconnaissance, mapping, artillery observation, day and night bombardment, and propaganda leaflet distribution missions.[5] They also experimented with airships and kite-balloons, but quickly learned that both platforms were best used as artillery

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[2] John H. Morrow, Jr., *The Great War in the Air: Military Aviation from 1909 to 1921* (Washington, DC: Smithsonian Institute Press, 1993), 60.
[3] Lee Kennett, *The First Air War: 1914-1918* (New York, NY: The Free Press, 1991), 30.
[4] Basil Collier, *A History of Air Power* (Oxford, England: Macmillan Publishing Co., 1974), 41.
[5] Morrow, *The Great War in the Air,* 25.

spotters.[6]

The second major conflict that saw aircraft involvement was the First Balkan War of 1912-1913. Coming immediately on the heels of the Italo-Turkish War, this war marked the first encounter in history in which all combatants deployed aircraft operationally.[7] Utilizing a mix of airplanes and balloons, Bulgaria, Greece, Serbia, and Turkey all conducted airborne reconnaissance missions.[8] In this war, the Bulgarians held the preponderance of aviation assets and were able to experiment widely with airborne ISR, bombing, and leaflet dropping. While not a significant air power conflict, two major lessons regarding the use of airborne ISR came out of the war. The first was the reiteration that captive balloons were extremely vulnerable to modern anti-aircraft fire at altitudes less than 4,000 feet.[9] The Bulgarians lost several balloons and observers due to ground fire and, following the war, developed their airborne ISR force to operate at altitudes above 4,000 feet. The second major takeaway was that aerial observation was a professional skill that required dedicated training and practice to perfect. The Bulgarians used "any available soldier or officer" as observers and quickly learned that effective observation techniques had to be taught.[10] Major Robert Brooke-Popham of the Royal Flying Corps (RFC) emphasized this lesson in a lecture to the Royal Army Staff College when he stated, "…an untrained observer is a useless encumbrance," and that "it will probably take as long to train an observer as it does a pilot."[11] Heeding Brooke-Popham's advice, the British established a course for observers in 1914, but the first training class was interrupted by the outbreak of war.[12]

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[6] Peter Mead, *The Eye in the Air: History of Air Observation and Reconnaissance for the Army 1785-1945* (London, UK: Her Majesty's Stationery Office, 1983), 45.
[7] Walter J. Boyne, *Air Warfare: An International Encyclopedia* (Santa Barbara, CA: ABC-CLIO, 2002), 66.
[8] Ibid.
[9] Mead, *The Eye in the Air*, 45.
[10] Ibid.
[11] H.R.M. Brooke-Popham, "Military Aviation," *Army Review*, January 1912, 96, The Liddell Hart Military Archives, BrookePopham 1/4, King's College, London, United Kingdom.
[12] C.G. Jefford, *Observers and Navigators: And Other Non-Pilot Aircrew in the RFC, RNAS and RAF* (Shrewsbury, UK: Airlife Publishing Ltd., 2001), 5.

The lessons learned from air operations in the Italo-Turkish and Balkan Wars helped to further solidify the requirement for aviation. As tensions in Europe increased through the early 1910s, many governments believed war inevitable. Several of those understood the imperative to incorporate air power into their militaries and set about investing in and building nascent air arms. While still uncertain how to adjust war-fighting doctrine to include the aircraft, early European visionaries at least understood the potential of air power. The table below shows the major combatant nations' investment in the years preceding the war:

Table 1: Aviation Spending 1909-1914

Nation	Aviation Spending
Germany	$28,000,000
France	22,000,000
Russia	12,000,000
Italy	8,000,000
Great Britain	3,000,000
United States	435,000

Source: Arthur Sweetser, The American Air Service; a Record of Its Problems, Its Difficulties, Its Failures, and Its Final Achievements (New York, NY: D. Appleton and Co., 1919), 16.

Notwithstanding its demonstrated combat use in Libya and the Balkans, the true utility of airborne ISR – and the aircraft in general – remained unproven as the war began. Most nations had not dedicated sufficient training time to demonstrate, or explore, how the aircraft could help the army on the ground nor had they acquired enough modern aircraft to support their ground forces. Lessons learned from the Italo-Turkish and Balkan Wars, while understood and accepted, had not necessarily been implemented across the various nations. Despite this, the war's first major campaigns would prove the value of prewar investment in aircraft.

The first occasion in which aircraft were instrumental to success occurred

barely a month into the conflict. The Germans, using General Helmuth von Moltke's modified version of the famous Schlieffen Plan, had swept through Belgium in August 1914 with minimal resistance. German offensive aggressiveness had paid off considerably. They had achieved multiple victories in France and Belgium and by the end of August, the overwhelming majority of Allied forces were in retreat toward Paris. Baron Antoine Jomini's dictum that offensive operations are always superior to defensive postures seemed to be bearing out.[13] The Germans had swept aside the paltry Allied defenses and were pursuing the Allies in their retreat. As the German First and Second armies advanced on Paris, the First Army commander, General Alexander von Kluck, swung part of his forces eastward in an attempt to cut Paris off from the main retreating French forces.[14] Though unknown at the time, Kluck's move exposed the flanks of both German armies making them vulnerable to Allied attack.

Having only recently arrived in France, the British Expeditionary Force (BEF) was assigned to hold the left flank of General Joseph Joffre's French forces near the Belgian city of Mons.[15] This task left BEF Commander-in-Chief, General Sir John French, in a precarious situation as his position left a gap of some 80 miles between his left flank and the French coast.[16] To give him the flexibility to move his forces to stifle any German attempts to outflank his position, General French ordered the RFC to conduct airborne reconnaissance sorties in the areas surrounding his forces. On 31 August 1914, British Captain E.W. Furse, one of only three trained observers in the RFC, spotted Kluck's pivot and the exposed flanks of the German armies.[17]

Using this intelligence, Allied commanders immediately began planning a counterattack.[18] Specifically citing the lessons he had learned in the

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[13] Antoine-Henri, Baron de Jomini, *The Art of War* (Mineola, NY: Dover Publications, Inc., 2007), 167.
[14] Lawson and Lawson, *The First Air Campaign*, 40.
[15] Lord Ernest William Hamilton, *The First Seven Divisions: Being a Detailed Account of the Fighting from Mons to Ypres* (London, UK: Hurst Publishing, 1920), 14.
[16] Collier, *A History of Air Power*, 49.
[17] Sir Walter Raleigh, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 1 (Oxford, UK: Clarendon Press, 1922), 316.
[18] Collier, *A History of Air Power*, 50.

aforementioned British Army Maneuvers of 1912, BEF First Army Corps Commander General Sir Douglas Haig requested additional airborne ISR.[19] These further sorties revealed the weak positions in Kluck's formations. As opposed to Haig, Kluck had no indigenous airborne ISR. This was really not of great significance, however, as the aviation units of General Max von Hausen's Third Army had reported extensively on the movements and locations of the BEF and French armies.[20] In contrast to the Allies, German commanders doubted the veracity of their airborne ISR and instead relied on their predetermined beliefs on the outcome of the maneuvers.[21] Ignorant of the locations of the French and British armies, Kluck again pivoted his army in an attempt to mass his forces against the French Fifth Army.[22]

Following Kluck's move, General French again relied on airborne ISR to give him the decision advantage he needed. On 3 and 4 September, British and French airmen reconnoitered the German forces and conveyed detailed information on Kluck's moves.[23] Their reports showed that the German First Army was vulnerable to attacks from not only the French Fifth Army near Paris but also by the BEF and French Sixth Army south of the Marne River.[24] These reports also allowed the French Fifth Army Commander, General Charles Louis Marie Anrezac, and the Sixth Army Commander, General de Maunoury, to prepare their forces for any additional German maneuvers.

British planners were ecstatic with the results of the intelligence they received.[25] BEF Director of Military Intelligence George McDonough stated, "A magnificent air report was received disclosing the movement of all the corps of

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[19] Richard P. Hallion, *Taking Flight: Inventing the Aerial Age from Antiquity Through the First World War* (New York, NY: Oxford University Press, 2003), 345.
[20] Eric Dorn Brose, *The Kaiser's Army: The Politics of Military Technology in Germany During the Machine Age, 1870-1918* (New York, NY: Oxford University Press, 2001), 191.
[21] Sam Hager Frank, "American Air Service Observation in World War I," PhD diss., University of Florida, 1961, 37-40.
[22] Jeffrey T. Richelson, *A Century of Spies: Intelligence in the Twentieth Century* (Oxford, UK: Oxford University Press, 1995), 33.
[23] Lyn Macdonald, *1914: The Days of Hope* (New York, NY: Atheneum, 1987), 245.
[24] Collier, *A History of Air Power*, 50.
[25] Michael Occleshaw, *Armour Against Fate: British Military Intelligence in the First World War* (London, UK: Columbus, 1989), 56.

the First German Army diagonally southeast across the map towards the Marne."[26] General Joffre was equally happy with his airborne ISR forces. French observers provided detailed information regarding German strength on Joffre's western flank.[27] The combination of RFC and French airborne ISR gave Joffre the confidence he needed to declare, "Gentlemen, we will fight on the Marne!"[28]

Joffre's counteroffensive began on 6 September and was over by 12 September. After the Germans made some progress on 8 September, Kluck made yet another tactical error that permitted the BEF and French Fifth Army to fill a gap in Kluck's lines. The next day, having discovered that British infantry and French cavalry were approaching his forces, German Second Army Commander, General Karl von Bülow, ordered a withdrawal of his forces with Kluck's First Army soon following.[29] The subsequent battle halted the Germans and essentially unraveled the Schlieffen/Moltke Plan. The ability of Allied airborne ISR to provide timely, accurate information on German movements and intent resulted in a decisive Allied victory followed by a 40-mile German retreat to the Aisne River where they began fortifying their positions for what would become the infamous trench war stalemate. The first Battle of the Marne changed the course of the war. Airborne ISR provided the intelligence needed to allow Allied commanders to act decisively and save what had appeared to be a likely French defeat and loss of Paris.[30] The German retreat ended all hopes for a quick victory and the Schlieffen Plan was in ruins. In the first battle on the western front, British and French airborne ISR was decisive; on the eastern front, it would be German ISR that would help win a major victory.

Germany's Schlieffen Plan was predicated on the need to secure a rapid victory over England and France in the west, followed by a consolidation of forces

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[26] Quoted in Occleshaw, *Armour Against Fate*, 57.
[27] Field Marshal John French, *1914* (London, UK: Constable and Company, Ltd., 1919), 91.
[28] Holger H. Herwig, *The Marne, 1914: The Opening of World War I and the Battle That Changed the World* (New York, NY: Random House, 2009), 230.
[29] Mead, *Eye in the Air*, 56.
[30] After the battle, Joffre gave credit to the RFC stating that without the British aviators he would not have been as confident in his decision-making. S.F. Wise, *The Official History of the Royal Canadian Air Force*, vol. I, *Canadian Airmen and the First World War* (Toronto, CA: University of Toronto Press, 1980), 340.

in the east to face the vast potential of the Russian army.[31] Despite Germany's wishes, multi-front combat began early. The Russians had their own plan that called for the Russian First Army, under General Pavel Rennenkampf, to move toward the East Prussian heartland while the Second Army, led by General Aleksandr Samsonov, would move north to a point northwest of Tannenberg, Germany. Russia had mobilized much quicker than Germany anticipated, and less than a month into the war, the Germans were already facing Russian armies in Prussia.[32] Recognizing this as a critical moment in the war, the Germans desperately wanted to stop the Russian advance and planned to destroy the Russian forces by shifting all available units to the area.[33]

On paper, both countries possessed similar air orders of battle. Germany had 232 airplanes and 11 rigid airships while the Russians possessed 244 airplanes and 14 semi-rigid blimps.[34] Unfortunately for the Russians, their logistical network and maintenance capability lagged far behind the Germans. Russian soldiers could expect nowhere near the level of airborne support that their German counterparts could. German prewar preparation had given them a system of ISR dissemination that enabled the rapid communication of airborne-derived intelligence. Recognizing his advantage, the German Eighth Army commander, General Hermann von François, ordered his air units to conduct reconnaissance of all surrounding areas. Beginning on 2 August, German ISR aircraft flew dozens of sorties over Russian-held territory. Despite the fact that the Germans had not perfected air-to-ground communications methods, the work they had done before the war paid off and German ISR aircraft began making contributions almost immediately.[35] Between 20 and 30 August, German air reconnaissance obtained detailed information regarding the disposition of the

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[31] The Schlieffen Plan had been heavily modified by Helmuth von Moltke, but the fundamental premise remained the same. For further information see, S.L.A. Marshall, *World War I* (New York, NY: American Heritage Press, 1971), 56.
[32] Hallion, *Taking Flight*, 338.
[33] Lawson and Lawson, *The First Air Campaign*, 39.
[34] Hallion, *Taking Flight*, 339.
[35] John R. Cuneo, *The Air Weapon 1914-1916*, vol. 2 of *Winged Mars* (Harrisburg, PA: Military Service Publishing Co., 1947), 111.

Russian armies.[36] On 30 August, a German ISR flight located the Russian Second Army marching toward Tannenberg with exposed flanks.[37] These reports – combined with German ground-based signals intelligence (SIGINT) collection and visual reconnaissance gained from Zeppelin flights – contributed to François' decision to encircle and cut off the main Russian forces.[38] As opposed to their counterparts on the western front, German leaders in the east paid close attention to the indications and warning their aviation assets were providing. German ISR gave ground commanders unprecedented situational awareness and enhanced the effectiveness of German artillery.[39] By 31 August, Samsonov's Second Army was defeated with approximately 30,000 troops killed and another 90,000 taken prisoner.[40] The victory was one of the most important of the war for the Germans as it allowed them the time they needed to solidify their positions on both fronts. Following the battle, German Field Marshal Paul von Hindenburg lauded the German airborne ISR effort stating, "Without the airplane, there is no Tannenberg."[41] This victory for airborne ISR in the east was in direct contrast to what had occurred in France. From Tannenberg forward, the Germans – like the Allies – placed considerable value on the information provided by airborne ISR.

With these early contributions, the British, French, and Germans had demonstrated tangible airborne ISR success. The intelligence they collected gave their respective ground commanders the decision advantage they needed at the right time. In the case of the British and French, airborne ISR helped stymie the German march on Paris; an effort which undoubtedly changed the early course

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[36] Dennis E. Showalter, *Tannenberg: Clash of Empires, 1914* (Washington, DC: Potomac Books, 2004), 278.
[37] Lawson and Lawson, *The First Air Campaign*, 39.
[38] Wilhelm Flicke, *War Secrets in the Ether, Parts I and II*, trans. Ray W. Pettengill (Washington, DC: National Security Agency, 1953), 29; Douglas H. Robinson, *Giants in the Sky: A History of the Rigid Airship* (Seattle, WA: University of Washington Press, 1973), 85.
[39] Erich Ludendorff, *My War Memories 1914-1918: Volumes 1-2* (Uckfield, UK: Naval & Military Press, 2005), 204-205.
[40] Robert Asprey, *The German High Command at War: Hindenburg and Ludendorff Conduct World War I* (New York, NY: W. Morrow, 1991), 80.
[41] Quoted in James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence, KS: The University Press of Kansas, 1997), 23.

of the war. For the Germans, airborne ISR had helped ensure the near destruction of an entire Russian Army. Both achievements earned much needed confidence from leadership and set ISR airmen up for continued success as the war progressed.

Following the First Battle of the Marne and the Battle of Tannenberg, the war was characterized by the stalemate known as trench warfare. While this type of war would severely restrict ground force mobility, trench warfare gave airborne ISR the chance it needed to solidify further its value as a force enhancer. As will be seen, intelligence obtained from aircraft – the balloon and the airplane – along with the ability to direct artillery fire from the air would become two of the most important aspects of the immobile war.

When trench warfare began, tactical reconnaissance was the primary, and most important, mission of airborne ISR forces; understanding how and where the enemy was building its defensive positions along the front lines was imperative. After the initial phase, strategic reconnaissance also became a major mission of airborne ISR; observation of rail and roadway traffic deep behind enemy lines was vital as the need to accurately ascertain the enemy's strength, movement, and intent was paramount. Once the trenches were established, artillery spotting became a third mission for which airborne ISR forces became responsible. Long foreseen by many airmen, including Benjamin Foulois, the ability to direct artillery fire from an airborne platform was proven in combat during the first Battle of the Marne.[42] On 8 September, during the German retreat, a French observation aircraft identified a concentration of German artillery.[43] By dropping weighted notes to their own artillery, these French airmen directed a barrage that destroyed half the artillery pieces of the German XVI Corps.[44] General Joffre was so impressed by the success of the attack that he ordered changes to the mission allocation of his airborne ISR forces. In his

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[42] Benjamin D. Foulois and C.V. Glines, *From the Wright Brothers to the Astronauts*, (New York, NY: McGraw-Hill Book Company, 1960), 45; this source will hereafter be cited as *Foulois Memoirs*.
[43] Kennett, *The First Air War*, 33.
[44] Lawson and Lawson, *The First Air Campaign*, 41-42.

mandate, he greatly reduced the number of reconnaissance flights and dedicated the majority of his sorties to artillery spotting.[45]

The new requirement to conduct simultaneous tactical, strategic, and artillery spotting missions stressed the nascent ISR forces of the major combatants. Lacking well-developed doctrine, they struggled to divide their meager forces appropriately. Fortunately, it quickly became apparent that the airplane's speed and maneuverability made it the best choice for strategic reconnaissance while the trench warfare stalemate prompted a balloon rebirth. The new and improved captive balloon, which had evolved to become much more stable than the spherical balloons of the previous century, became the platform of choice for the tactical reconnaissance and artillery spotting missions.[46] Each balloon provided approximately a ten-mile radius of coverage and soon the frontlines were dotted with *Caquots* on the French side and *Drachenballones* on the German side.[47] For protection, the balloons were placed just far enough behind friendly lines to be out of range of enemy artillery but still close enough to be able to observe the entire battlefield. Additionally, placing the balloons over friendly territory allowed them to be connected via telephone line directly to ground headquarters which helped solve the continual air-to-ground communication challenge.[48]

Simply dividing the effort between the three main airborne ISR missions was not sufficient, however. While the balloon's location directly over friendly lines partially mitigated the air-to-ground communications problem, the challenges highlighted by Foulois in his Signal Corps School essay still plagued

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[45] Kennett, *The First Air War*, 33.
[46] The Germans and French had evolved the captive balloon to a much more stable kite-balloon; the Germans had the *drachenballone* while the French had the *Caquot*. Both designs were elongated (they looked similar to today's blimps) and provided the stability that had long eluded captive balloon designers. For more information, see Eileen F. Lebow, *A Grandstand Seat: The American Balloon Service in World War I* (Westport, CT: Praeger Publishers, 1998), 12, and James J. Cooke, *The U.S. Air Service in the Great War, 1917-1919* (Westport, CT: Praeger Publishers, 1996), 7.
[47] Edgar F. Raines, *Eyes of Artillery: The Origins of Modern U.S. Army Aviation in World War II* (Washington, DC: The United States Army Center for Military History, 2000), 10.
[48] Ibid.

air-to-ground cooperation between airplanes and the ground forces they were supporting. During the early stages of the war, the primary method for communicating intelligence obtained from ISR sorties was for the pilot to land his aircraft near the artillery battery and simply tell the gunners what he had found.[49] This was rarely effective, however, and after several failed attempts, the British developed a grid system while the German and French focused their efforts on the development of aerial photography.[50] When possible, observers would annotate locations of hostile artillery batteries on maps to aid in their descriptions, but this method was contingent on the observers' ability to recognize the terrain and match it to a map.[51] To correct fire, airmen would either drop weighted messages from their aircraft or they would release flares, smoke grenades, or empty boxes of white talcum powder into the air.[52]

None of the aforementioned communications methods was effective and by at least mid-1915, the British and French had equipped their ISR aircraft with wireless telegraphs that allowed them to send instructions via Morse code to the artillery batteries.[53] While able to broadcast instructions to the ground, the communication was strictly one way. The excessive noise of the engine and the open cockpit prevented the observer from hearing any Morse transmissions from the ground.[54] Additionally, the radio remained prohibitively bulky; to install one of the large wireless devices meant a large sacrifice in fuel and payload.

Unfamiliarity with the terrain also continued to plague the new observers in France. The information they were collecting was of little value as they were often unable to recognize the topographical features they observed from the air and plot them on a map. To help solve this problem, airmen turned again to aerial photography. The concept, proven by the American J.W. Black in 1860,

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[49] Raleigh, *The War in the Air*, 302.
[50] "Organization of German Air Service," 166-167, Gus Hannibal Collection, Small Manuscript Series 763, McDermott Library, United States Air Force Academy (USAFA).
[51] Mead, *The Eye in the Air*, 66.
[52] Kennett, *The First Air War*, 33.
[53] Jim Beach, *Haig's Intelligence: GHQ and the German Army, 1916-1918* (Cambridge, UK: Cambridge University Press, 2013), 159.
[54] Kennett, *The First Air War*, 34.

had three main advantages over visual observation. First, quite simply, the ability to take a photograph was a monumental leap forward. In standard observation sorties, airmen often drew pictures of what they were seeing or attempted to recreate scenes from memory following their sorties. With aerial photography, observers no longer had to take their eyes off the target to document their findings or rely on their battle-shaken memories after their sorties. Additionally, automatic cameras that would take pictures at preset intervals as the aircraft flew along – much like today's preprogrammed imagery target decks on the U-2 and RQ-4 – were developed and used by both the French and Italians.[55] These advances in aerial photography allowed the observer to focus much more attention on collecting intelligence vice interpreting it.

The second advantage was that photographs provided objective data that was untainted by the observer's exaggerations or simple ignorance of the target and terrain.[56] The observer took the pictures in the air and separate photographic interpreters analyzed the photographs to determine their intelligence value. Not only did this provide an objective viewpoint, it allowed the photographic interpreters to develop expertise on certain geographic areas. Having viewed the same territory repeatedly, the interpreters were quickly able to detect any changes to the enemy's positions or fortifications.[57]

Third, the quality of the photographs was far greater than any notes or drawings done by the observers. As mentioned, flying was a loud, dangerous business. During flight, the observer was expected to locate ground targets, take notes, draw maps, look for enemy anti-aircraft guns and aircraft, help the pilot navigate, and after the installation of guns, fight off enemy aircraft. All of these tasks took away from his ability to draw good images or take comprehensive notes. Aerial photographs eliminated this problem. Starting with a very basic aerial camera, by the end of the war, photography had advanced so significantly

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[55] Interestingly, the great air theorist, Giulio Douhet, developed the automatic camera used by the French and Italians. Kennett, *The First Air War*, 37.
[56] Collier, *A History of Air Power*, 52.
[57] Harold E. Porter, *Aerial Observation: The Airplane Observer, the Balloon Observer, and the Army Corps Pilot* (New York, NY: Harper & Brothers Publishers, 1921), 158.

that an image taken from 15,000 feet could be blown up to reveal details as small as footprints in the sand.[58]

The ubiquity of the airborne observation platforms combined with the enhanced airborne technologies made it nearly impossible to make any undetected movements on either side of the front lines. After the war, an American balloon observer stated, "Hardly a train could move within five miles of the trenches, or a group of men come up for relief, or digging begun on a new series of emplacements or batteries, but a pair of eyes would take notice of it."[59] Each side sought to deliver a surprise attack, but under constant aerial surveillance this was next to impossible. To deter the enemy's ISR aircraft, each side began enhancing their anti-aircraft artillery (AAA).[60] While initially successful, the improved capability was quickly countered by both tactics and technology. To avoid the anti-aircraft guns, ISR aircraft began to fly at much higher altitudes. This eliminated the threat from the guns, but created an unforeseen dilemma for the observers. At increased altitudes – sometimes as high as 10,000 feet – the observers' ability to discern details was limited. In addition, as altitude increased, the observers' field of view would likewise increase; they would see much more than they could possibly document.

In addition to better AAA, the airplane itself was improved to counter enemy ISR and to enable friendly ISR, or in doctrinal terms, to gain air superiority or air supremacy. As the airplanes that first arrived on the fields of battle were unarmed, pilots, observers, and even ground maintenance crews improvised the best they could to find ways to attack the enemy and defend their own assets. In the early days of the war they tried just about anything including: shotguns, pistols, rifles, grenades, darts, and, at least in one case, a grapnel hook which was extended below the aircraft to rip the canvas of either balloons

[58] Kennett, *The First Air War*, 37.
[59] Craig S. Herbert, *Eyes of the Army* (private publication, 1968), 115.
[60] Edward B. Westermann, *Flak: German Anti-Aircraft Defenses, 1914-1945* (Lawrence, KS: University Press of Kansas Press, 2001), 15.

or enemy aircraft.[61] As technology continued to evolve, it became clear that forward firing guns mounted on the airplane itself would be the optimum way to counter enemy airplanes. The French first attempted this by attaching a machine gun on a Morane-Saulnier L parasol airplane's fuselage and by reinforcing the propeller with metal plates to keep it from being damaged by the bullets.[62] On the first sortie using this new technology, French pilot Roland Garros shot down a German Luftstreitkräfte C-type Albatros airborne reconnaissance airplane.[63] On subsequent missions, Garros brought down another Albatros along with an Aviatik B.II reconnaissance plane before having to land in German-held territory and being captured by German ground forces.[64]

Because engine trouble had forced Garros to land, the Germans recovered his airplane intact. They immediately recognized the deflectors on the airplane's propeller and attempted to replicate what the French had done. To do this, they summoned Dutch engineer Anthony Fokker to examine the aircraft. Fokker was reportedly unimpressed by what he saw and put his engineering genius to the problem. Within days, Fokker had designed a system whereby the engine's cam device fired the machine gun automatically in-time with the propeller's rotation.[65] This ensured no bullets would ever hit the propeller and eliminated the need for the heavy metal plating of the French design. The machine guns were then in-line with the aircraft fuselage and the world's first true fighter aircraft was born.

All of the aforementioned technological enhancements whittled away at the viability of the captive balloons and dirigibles. Despite their brief rebirth, by the end of 1916 the belligerents had determined both to be of limited value. As the airplane's capability proliferated, it became a grave threat to balloons as did

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[61] Russian pilot Captain Kazakov successfully conducted this grapnel hook attack on 18 March 1915. For further information on this story, see Norman Franks, *Aircraft v. Aircraft* (New York, NY: Macmillan Publishing Co., 1986), 11.
[62] Spencer Tucker, *The Great War, 1914-1918* (London, UK: UCL Press Limited, 1998), 93-94.
[63] Jon Guttman, *Nieuport 11/16 Bébé vs. Fokker Eindecker: Western Front 1916* (Oxford, UK: Osprey Publishing, 2014), 16.
[64] Ibid.
[65] Philip M. Flammer, *The Vivid Air: The Lafayette Escadrille* (Athen, GA: The University of Georgia Press, 2008), 48.

improved ground-based AAA guns.[66] Some airplane pilots even specialized in attacking balloons and the Germans discussed balloon attacks in their prewar air doctrine, "Instructions on the Mission and Utilization of Flying Units Within an Army."[67] The vulnerabilities of the balloon had led the French to practically abandon their captive balloon program and none of the other early Allies seemed interested in expanding their programs after the airplane proved to be so successful.[68] Upon their entry into the war in 1917, the Americans brought a significant captive balloon contingent – numbering some 446 officers and 6,365 men – but they were used primarily in quiet sectors and did not face the same dangers that the early balloonists did.[69]

The Germans, who had invested so heavily in the airship prior to the war, quickly discovered that its vulnerabilities rendered it ineffective for many of the missions they had envisioned. The prewar belief that the airship would serve the German Army in tactical and strategic reconnaissance roles and as a daytime strategic bomber was quickly quashed. During the initial phases of the war, the airship's susceptibility to ground fire caused by its slow speed, inadequate lift, and low ceiling confirmed the German War Ministry's worst fears.[70] When hostilities commenced, the Army had seven airships – four deployed in the West and three in the East.[71] After some early, though limited, success in Belgium, German attempts to bomb the French were met with disaster when three of the four western-based airships were shot down during daylight bombing raids.[72] With direct battlefield support, long-range strategic reconnaissance, and

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[66] Douglas H. Robinson, *The Zeppelin in Combat* (Atglen, PA: Schiffer Publishing Ltd., 1994), 374.
[67] For more information on the pilots who specialized in balloon hunting, see Jon Guttman, *Balloon-Busting Aces of World War 1* (Oxford, UK: Osprey Publishing, 2005). For more on pre-war German doctrine, see Corum and Muller, *The Luftwaffe's Way of War*, 63.
[68] Lennart Ege, *Balloons and Airships* (New York, NY: Macmillan Publishing Co. Inc., 1974), 112-113.
[69] Lebow, *A Grandstand Seat*, 170.
[70] Robinson, *Giants in the Sky*, 84.
[71] Charles Stephenson, *Zeppelins: German Airships, 1900-40* (Botley, UK: Osprey Publishing, 2004), 11.
[72] Michael Belafi Belafi, *The Zeppelin*, trans. Cordula Werschkun (Barnsley, UK: Pen & Sword Aviation, 2015), 131.

daylight bombing fundamentally eliminated as missions for airships, the Germans used them in the two safest roles they could: as naval reconnaissance assets and as nighttime strategic bombers.

While the German Army's only practical use of the dirigible was for night strategic bombardment, the Kaiserliche Marine quickly embraced the platform as its primary scouting cruiser. As it did not face the same threats as its ground support equivalents, the airship, flying over open water, was an ideal naval ISR platform and the Germans used it extensively for defensive reconnaissance over the North Sea.[73] Airships detected the movements of enemy surface vessels and submarines which provided the German high command a fairly accurate picture of the British naval presence in the North Sea. The addition of onboard photographic development capability was also a significant advantage as it allowed the intelligence professionals on the aircraft to quickly analyze and report what they were seeing.

The airship's significant range, endurance, and mobility, along with its powerful radio equipment, allowed it to prove its value in the Battle of Jutland. While limited by the poor weather leading up to the battle, when used, the airship kept Chief of the High Seas Fleet, Vice-Admiral Reinhard Scheer informed of the location of British vessels.[74] This early warning allowed Scheer to best orient his naval forces for the battle. This success cemented the airship's position as the leading naval ISR asset in the Kaiserliche Marine and likely saved the airship from total abandonment. Following the battle, Scheer stated, "This tactic [use of airships] provides the utmost possible security against surprise…therefore airship scouting is fundamental for more extended operations."[75]

German use of the airship continued throughout the war and debate still rages over the ultimate value of its contribution. Zeppelin historian Douglas Robinson concludes that the airship was a failure as an ISR asset primarily due

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[73] Norman Friedman, *Fighting the Great War at Sea: Strategy, Tactic and Technology* (Barnsley, UK: Seaforth Publishing, 2014), 98.
[74] Geoffrey Bennett, *The Battle of Jutland* (Barnsley, UK: Pen & Sword Maritime, 2006), 137.
[75] Robinson, *The Zeppelin in Combat*, 169.

to its unreliability and the German lack of doctrine and planning for its use.[76] For the purposes of this study, however, the German airship is valued for the precedents it set. First, the Germans demonstrated the ability to conduct long-range airborne naval reconnaissance accurately – when the weather permitted – by identifying enemy vessels and submarines. Second, and most importantly, airships were able to communicate this information to their chains-of-command in near-real time. The inclusion of two-way radios and onboard photographic darkrooms truly set them apart as World War I's most technologically advanced ISR assets. The airship's ability to collect, process, exploit, and disseminate intelligence all while airborne is something that airborne ISR platforms today continue to strive to attain.

With the role of the airship and the balloon minimized for the time being, leaders needed another platform to obtain the intelligence they so desperately required. As both sides settled in to trench warfare, practically all ground movement came to a standstill. Despite multiple attempts, all offensives failed to break the deadlock. Modern machine-guns, barbed wire, mines, artillery, and chemical weapons prevented nearly all attempts to take land. Precise intelligence became ever more important but was harder to acquire by traditional means. Neither cavalry scouts nor infantry patrols could move on the battlefields as the barrier of barbed wire and trenches prevented freedom of movement. The airplane helped fill the intelligence need with airborne tactical reconnaissance of the trenches along with strategic-level reconnaissance of the roads and railways behind giving intelligence officers the information they needed to estimate enemy strengths and predict movements or attacks. Additionally, 'offensive observation,' or infantry contact patrols, allowed friendly commanders to know the exact location of their own troops in those rare times when offensive assaults were conducted.

Entente and Central Powers' use of airborne ISR assets continued as described above for the balance of the war with the stalemate continuing to limit

[76] Ibid., 375.

attempts to move the war forward. The United States' declaration of war against Germany on 6 April 1917 brought considerable excitement to the Allies. As previously examined, however, American ISR airmen were in no position to immediately contribute. The Army had established Foulois' 1st Aero Squadron in May 1913, but little progress had been made in acquiring aircraft, establishing doctrine, or training the airmen to conduct ISR missions. The Army's Chief Signal Officer – the man under whom aviation still remained – Brigadier General George Scriven continued to advocate for further spending, but most of his general officer peers were still not convinced of the necessity of the airplane. Despite this, Scriven remained adamant regarding the aircraft's future ISR role. In testimony before the House Military Affairs Committee in December 1914 he concluded, "…as an implement for reconnaissance and as the far-seeing eye of a commander the aeroplane [*sic*] is superb."[77] Notwithstanding Scriven's continued advocacy, other than the primarily abortive attempt to support General John J. Pershing's force in the hunt for the Mexican outlaw Pancho Villa, the 1st Aero Squadron had almost no practical experience.[78]

Despite this hesitancy, the reality of the situation in Europe prompted Congress to accelerate aviation investment. In 1912, the Army had sent Signal Corps officer Lieutenant Colonel George Squier to England as the military attaché.[79] Squier was still in the position when Great Britain entered the war and seems to be the United States Army's best source of information regarding the early conduct of the war.[80] The British gave Squier unfettered access and even allowed him to make a secret trip to the Western Front to observe firsthand British airborne ISR units in action.[81] His detailed reports from the front lines regarding the use of aviation in combat helped convince both the United States

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[77] US House of Representatives, *Making Appropriations for the Support of the Army for the Fiscal Year 1916: Hearings before the Committee on Military Affairs*, 63rd Cong., 3rd sess., 1914, 651.
[78] Foulois and Glines, *Foulois Memoirs*, 122-137.
[79] Paul W. Clark and Laurence A. Lyons, *George Owen Squier: U.S. Army Major General, Inventor, Aviation Pioneer, Founder of Muzak* (Jefferson, NC: McFarland & Company, Inc., Publishers, 2014), 5.
[80] Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power* (Bloomington, IN: Indiana University Press, 1964), 144.
[81] Clark and Lyons, *George Owen Squier*, 5.

Army and Congress to hasten aircraft investment and doctrine development. In a February 1915 report on the RFC, Squier reported, "For strategical and tactical reconnaissances, the aeroplane [*sic*] is at present simply indispensable. In the present form of trench warfare the aeroplane is used to watch, sketch and plot the development of the enemy's trenches day by day, and in most cases it is the only method of keeping informed of the progress of their preparations."[82] With these reports, Squier had already alerted the War Department to the real-world importance of aviation in combat long before the United States was involved in the war.

Squier's influence also convinced the United States Army to diversify its aviation investment. In his 1915 report to Congress, Scriven wrote that there was a need for three different types of military aircraft: "a reconnaissance and artillery fire-control type, a combat type, and a pursuit type."[83] While he still believed observation to be the most important role of the aircraft, his thinking had clearly evolved in the year since his testimony to the Military Affairs Committee. To include the new missions, he intended to create squadrons of 12 aircraft, in which eight aircraft were to be observation type, two were to be "rapid flying machines for chase or transport," and two were to be for offensive purposes.[84]

Early 1916 brought controversy to the Aviation Service in the form of a Congressional investigation into inefficiency in American aviation development and whether there had been an effort to mislead the War Department concerning aviation progress.[85] Testimony as a result of Senate Joint Resolution 65 brought evidence that Lieutenant Colonel Samuel Reber, then chief of the Aviation Section, ordered subordinates to falsify reports concerning the state of aviation

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[82] Report by Major George O. Squier to the War Department, London, 26 February 1915, The General George O. Squier Papers, Archive Collection, United States Army Military History Institute Archives, Bay 5, Row 169, Face P, Shelf 6, Box 1, Carlisle Barracks, PA.
[83] "Report of Chief Signal Officer," in *Annual Reports of the War Department*, vol. 1 (Washington, DC: Government Printing Office, 1915), 742.
[84] Ibid., 747.
[85] Herbert A. Johnson, *Wingless Eagle: U.S. Army Aviation through World War I* (Chapel Hill, NC: University of North Carolina Press, 2001), 173.

training and that he had ignored reports from the training schools about the terrible condition of the training aircraft.[86] As a result of these findings, the Army removed Reber from his position and replaced him with Squier who they recalled from his duty as military attaché in Great Britain.

In May 1916, Squier reported to Washington, D.C., to assume his new post as Chief of the Aviation Section. Reber had already departed and Major Billy Mitchell was acting as temporary chief.[87] Squier and Mitchell had previously worked together at the Army's Signal Corps School and Squier kept Mitchell as his deputy until March 1917 when Mitchell went to France as an aviation observer.[88] Convinced of America's need to accelerate its aircraft production program and its pilot training, Squier tackled his new position with enthusiasm and urgency. His scientific background, his experience in the European war, and his early involvement in aviation gave him the pedigree required to affect change.[89] In one of his first acts, he convinced Congress to appropriate the unheard of sum of $13,281,666 for aeronautical development.[90] With this money, he established ties with private industry and put in motion an acquisition program that was designed to bring United States Army aviation at least to par with the other major European nations.

Even though Squier had acquired the necessary funding to procure aircraft and pilot training, the Army still lacked any coherent doctrine that would guide which aircraft to acquire. Scriven had included fighters and bombers in his latest assessment to the War Department, but no one had written doctrine that explained how to employ these new assets or precisely how to divide the missions. Scriven discussed a potential air arm composition in his 1915 annual

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[86] Senate Joint Resolution 65, 64th Cong., 1st sess., 1916.
[87] Hurley, *Billy Mitchell*, 145.
[88] Mitchell was an obvious choice to be the eyes and ears of the Aviation Section. He knew Europe, spoke French fluently, had high-ranking connections, and, most importantly, Squier trusted him. James J. Cooke, *Billy Mitchell* (Boulder, CO: Lynne Rienner Publishers, 2002), 51.
[89] Squier held a PhD in Physics which gave him access to a range of academics and engineers. These contacts helped Squier truly propel aviation development and acquisition in his early days as Chief of the Aviation Section.
[90] C.V. Allen, "History and Development of Observation Aviation" (lecture notes, Air Corps Tactical School, Maxwell AFB, AL, 14 May 1938), 248.262-34, AFHRA.

report, but the Army had not conducted further analysis to determine the feasibility of his ideas.[91]

Further exacerbating the problem was the fact that even though the War Department had designated the Chief Signal Officer as responsible for aviation development, two separate agencies were also involved in aviation research; the National Advisory Committee for Aeronautics and the National Research Council.[92] Recognizing the problem, the Secretary of the Navy and the Secretary of War established the Joint Army-Navy Technical Board (JANTB). Ostensibly created to standardize the designs and general specification of the aircraft to be procured by the armed services, this board was also charged with making technical decisions and received no guidance from the War Department on doctrinal issues.[93] Lacking direction on the proportion of aircraft to procure, the Board sought input from British, French, and Italian aviators.[94] On 24 May 1917, as the combat-tested European airmen were arriving in Washington to help the Americans determine a course for the future of Army aviation, a telegram arrived from the French Prime Minister, Alexandre Ribot.

Ribot's cable arrived quite unexpectedly and was a startling reminder of the inadequacy of United States aviation. Ribot asked that a flying corps of 4,500 planes, 5,000 pilots, and 50,000 mechanics be sent to France during 1918 to "enable the Allies to win the supremacy of the air."[95] Ribot further suggested that "2,000 airplanes should be constructed each month as well as 4,000 engines," adding that "during the first six months of 1918, 16,500 planes (of the latest type) and 30,000 engines will have to be built."[96] Reflecting upon the

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[91] I.B. Holley, Jr., *Ideas and Weapons* (New York, NY: Yale University Press, 1953), 39.
[92] Alex Roland, *Model Research: The National Advisory Committee for Aeronautics, 1915-1958* (Washington, DC: National Aeronautics and Space Administration, 1985), 45-46.
[93] Theodore M. Hamady, "Fighting Machines for the Air Service, AEF," *Air Power History* 51, no. 3 (Fall 2004): 24-37.
[94] "Testimony of Major B.D. Foulois," in *House Hearings on War Expenditures*, 66th Cong., 1st sess., Serial 2, Part 6, 6 August 1919, 360; "Testimony of Colonel Edgar Gorrell," in *House Hearings on War Expenditures*, 66th Cong., 1st sess., Serial 2, Part 3, 6 August 1919, 2918.
[95] Quoted in Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force, 1907-1960*, vol. I (Maxwell Air Force Base, AL: Air University Press, 1989), 19.
[96] Quoted in Edward M. Coffman, *The War to End All Wars: The American Military Experience in World War I* (Madison, WI: University of Wisconsin Press, 1968), 190.

overwhelming numbers in the Ribot cable, General Pershing, the Commander-in-Chief of the American Expeditionary Forces (AEF), noted in his memoirs, "…in its appeal for such a large number of aviation personnel and airplanes was really a most convincing confession of the plight of the allied armies. But more than that, it strikingly brought home to us a full realization of our pitiful deficiencies, not only in aviation but in all equipment."[97] Using Ribot's request as its guide, the JANTB prepared a report outlining production requirements across the three types of aircraft.[98] To meet Ribot's numbers, the JANTB estimated that American industry would have to build 4,000 observation and artillery control aircraft, 6,667 fighters, and 1,333 bombers, for a total of 12,000; all by July 1918![99]

While the JANTB and the War Department were deciding what type of aircraft to provide the war effort, Pershing was already in Europe making arrangements for the integration of the United States' fighting forces. The AEF Commander, who along with 53 officers and 146 enlisted men had arrived in France on June 13, was eager to learn how his organization could best assist the beleaguered Allies.[100] Waiting for Pershing upon his arrival was Major William Mitchell. Mitchell, who had spent the previous two months observing the British and French aviation sections, was the only American airman in France with combat knowledge. Dispatched by Squier to learn as much as possible about combat aviation, Mitchell had taken advantage of his time in France. Shortly after his arrival, he spent 10 days on the front lines visiting French aviation units and observing the futility of trench warfare.[101] On 24 April, to gain a greater appreciation for the challenges, and advantages, of airborne observation,

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[97] General John J. Pershing, *My Experiences in the World War*, vol. 1 (New York, NY: Frederic Stokes Co., 1931), 28.
[98] David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917-1945* (Ithaca, NY: Cornell University Press, 1998), 43.
[99] Report of Joint Army-Navy Technical Board to the Secretary of War, 29 May 1917, in Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. II (Washington, DC: The Office of Air Force History, 1978), 105.
[100] George B. Clark, *The American Expeditionary Force in World War I: A Statistical History, 1917-1919* (Jefferson, NC: McFarland & Company, Inc., Publishers, 2013), 12.
[101] Mark A. Clodfelter, "Molding Airpower Convictions: Development and Legacy of William Mitchell's Strategic Thought," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Phillip S. Meilinger (Maxwell AFB, AL: Air University Press, 1997), 83.

Mitchell had even flown over the lines in the back seat of a French ISR aircraft.[102] Additionally, Mitchell had spent three days with Major General Hugh Trenchard, field commander of the RFC. During this time, Mitchell and Trenchard discussed several topics including massing aviation, air interdiction, and strategic bombing.[103] These experiences molded Mitchell's thinking about air power employment and upon Pershing's arrival, Mitchell was ready to advise the AEF staff on how to best use aviation.

Shortly after the AEF's arrival, Mitchell met with the AEF Chief of Staff, Brigadier General James G. Harbord, to discuss his plan.[104] In this first meeting, Mitchell proposed the division of aviation in the AEF into tactical and strategic units. In Mitchell's plan, tactical aviation would consist of squadrons that serviced division, corps, and army ground intelligence requirements while strategic aviation would focus on targets "at a distance" behind enemy lines.[105] Foreshadowing his still developing thoughts on air power, Mitchell went on to state the strategic air mission could have "a greater influence on the ultimate decision of the war than any other arm."[106] Six days after receiving Mitchell's plan, Pershing appointed a board of officers – including Mitchell – to determine the structure of AEF aviation. The results of this board's work would form one of the bases for air power doctrine to this day. In their final report, the board stated that "a decision in the air must be sought and obtained before a decision on the ground can be reached."[107] To ensure this, the board recommended 59 squadrons of tactical aircraft for service with the armies with no mention of Mitchell's strategic aviation plan. Pershing accepted the board's

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[102] Diary Entry, 24 April 1917, Diary of William Mitchell, in Mitchell's Diaries, William Mitchell Papers, Carton 4, Library of Congress (LOC).
[103] William Mitchell, *Memoirs of World War I: From Start to Finish of Our Greatest War* (New York, NY: Random House Publishing, 1960), 107.
[104] Clodfelter, "Molding Airpower Convictions," 85.
[105] Cooke, *Billy Mitchell*, 55.
[106] Major William Mitchell, Aviation Section, Signal Corps, to, Brigadier General James Harbord, Chief of Staff, U.S. Expeditionary Forces, memorandum, 13 June 1917, in Maurer, *The U.S. Air Service in World War I*, vol. II, 108.
[107] Quoted in Holley, *Ideas and Weapons*, 47. While the board did not use the specific words, it was describing the need for air superiority – a concept still accepted today as one of the primary goals of air power.

recommendations and on 11 July, their proposal became part of the overall AEF organizational plan.[108]

Other AEF aviators were also thinking about strategic aviation. Major Townsend Dodd, the AEF Aviation officer and one of the Army's first pilots, had spent several days in Britain before his arrival in France and had become convinced that offensive aviation would be the best use of the air weapon in the upcoming war.[109] On 18 June 1917, Dodd wrote a memorandum to Harbord outlining what he considered the most important uses for aviation. According to Dodd, gaining and maintaining air supremacy and developing an offensive capability were the two areas in which the AEF should focus. Foreshadowing the intense debate that would follow in the 1920s, Dodd made a veiled reference to the supposed morale effect of strategic bombing stating, "…this force should also be sufficient to act as a reprisal agent of such destructiveness that the Germans would be forced to stop their raids upon Allied cities."[110]

While Mitchell and Dodd were certainly forward thinking, their ideas were not official Army doctrine. The first instance of the acceptance of the 'tactical' and 'strategical' difference appeared in a report prepared by Major Frank Parker, a non-aviator who had been assigned to Pershing's aforementioned board to study Mitchell's recommendations.[111] Parker's report titled "The Role and Tactical and Strategical Employment of Aeronautics in an Army" was read into the official record on 2 July 1917 at the fifth meeting of Pershing's board.[112] In the report, Parker provided a comprehensive description of the differences between tactical and strategic aviation. According to Parker, the tactical mission

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[108] Clodfelter, "Molding Airpower Convictions," 85.
[109] At the time, Dodd was one of the Army's most experienced aviators. He had qualified as a pilot in the first round of pilot training and had been with Foulois for both Mexican expeditions. Foulois and Glines, *Foulois Memoirs*, 120.
[110] Major Townsend Dodd, Aviation Officer, AEF, to the Chief of Staff, AEF, Brigadier General Harbord, memorandum, 18 June 1917, in Colonel Edgar S. Gorrell, "History of the U.S. Army Air Service," Series A, vol. 23, 43, Record Group (RG) 120, National Archives and Records Administration (NARA), College Park, MD. For future references, this source will be cited as Gorrell's Air Service History along with the title, series, volume, and, where available, page number.
[111] Johnson, *Fast Tanks and Heavy Bombers*, 48.
[112] Maurer, *The U.S. Air Service in World War I*, vol. II, 119.

included observation, pursuit, tactical bombardment, artillery spotting, and liaison work while the strategic mission was the bombing of the enemy air service depots, factories, lines of communication, and personnel. Parker additionally referenced long-range reconnaissance as a strategic mission. To help ensure the delineation was understood, he defined tactical aviation as anything occurring with 25,000 yards of the front lines while strategic aviation was anything more than 25,000 yards from friendly troops.[113]

Meanwhile, back in the United States, the War Department and the recently appointed Chief Signal Officer, Brigadier General Squier, were still struggling with the number and types of aircraft to build.[114] The United States had invited engineers from the Allied nations to provide technical information on tactical aircraft, but their assistance proved to be less useful than anticipated. In an effort to ensure resources were spent on the proper aircraft, on 15 May 1917, Squier approved a plan to send an aeronautical commission led by Major Raynal Bolling to Europe.[115] Departing the United States in mid-June, the Bolling Mission spent six weeks conducting interviews and gathering information in England, France, and Italy.[116] The group, which consisted of 105 military and civilian aviation experts, met with some of the most influential air power thinkers of the time.[117] In Britain, they spent time with General David Henderson, who had become one of the biggest bomber advocates in the RFC.[118] Henderson implored the Bolling group to abandon the idea of having balance between observation aircraft, bombers, and fighters and instead advised Bolling to acquire as many bombers as feasible.[119] In Italy, the Bolling Mission met with

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[113] "The Role and Tactical and Strategical Employment of Aeronautics in an Army," Gorrell's Air Service History, Series A, vol. 23, 65.
[114] Juliette A. Hennessey, *The United States Army Air Arm: April 1861 to April 1917* (Washington, DC: Office of Air Force History, 1985), 191.
[115] Tim Brady, "The Bolling Mission," in *The American Aviation Experience: A History*, ed. Tim Brady (Carbondale, IL: Southern Illinois University Press, 2000), 106.
[116] Rebecca Robbins Raines, *Getting the Message Through: A Branch History of the U.S. Army Signal Corps* (Washington, D.C.: The United States Army Center of Military History, 1999), 194.
[117] Mark Clodfelter, *Beneficial Bombing: The Progressive Foundation of American Air Power, 1917-1945* (Lincoln, NE: University of Nebraska Press, 2010), 11.
[118] Futrell, *Ideas, Concepts, Doctrine*, 20.
[119] Holley, *Ideas and Weapons*, 58.

Gianni Caproni, the aviation manufacturer who was famous for creating and building Italy's bomber aircraft during the war.[120] Caproni, a close friend and confidant of Giulio Douhet, had a marked impact on many members of Bolling's team.[121] He and Bolling Mission member and future strategic bombing advocate Major Edgar S. Gorrell maintained correspondence after the Mission's return to Washington.[122] Finally, the Bolling team spent a considerable amount of time in France with Major William Mitchell.

All three of these encounters undoubtedly shaped the outcome of the overall trip as the first draft of the Mission's recommendations was heavily tilted toward the acquisition of bombers.[123] Ultimately, Bolling's final report endorsed the Mitchell/Parker plan for dividing aviation into tactical and strategic functions and further recommended establishing independent bombing units to conduct day and night strategic bombing.[124] Additionally, Bolling set priorities for the production of aircraft in the United States: the first priority was training aircraft; the second was aircraft to be sent to conduct tactical missions in France; and third was aircraft to conduct strategic aviation operations.[125]

With the initial feedback from the Bolling Mission, Ribot's cable, the JANTB recommendation, and the doctrinal thinking of Mitchell and Parker, the War Department had what it needed to formulate a plan to get American-produced aircraft into France. The monumental task of coalescing the recommendations into an actionable plan was given to Major Benjamin Foulois who, in March 1917, had moved back into the Aviation Section under the Chief Signal Officer.[126] No Army officer had more practical aviation experience than

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[120] Johnson, *Wingless Eagle*, 187.
[121] J.L. Boone Atkinson, "Italian Influence on the Origins of the American Concept of Strategic Bombardment," *Air Power Historian* 4 (July 1957): 141-149.
[122] Futrell, *Ideas, Concepts, Doctrine*, 24.
[123] Patrick Coffey, *American Arsenal: A Century of Waging War* (Oxford, UK: Oxford University Press, 2014), 48.
[124] Major R.C. Bolling, to Chief Signal Officer of the Army, "Report of Aeronautical Commission," 15 August 1917, Gorrell's Air Service History, Series A, vol. 24, 11.
[125] Ibid.
[126] John F. Shiner, *Foulois and the U.S. Army Air Corps, 1931-1935* (Washington, DC: Office of Air Force History, 1983), 8.

Foulois and he leaned heavily upon everything he had learned. Working day and night, he crafted a plan that called for aircraft production on an unprecedented scale. By Foulois' calculations, the United States would need to produce approximately 12,000 combat planes and 24,000 engines by June 30 of 1918. This number included 6,667 fighters, 4,000 observation aircraft, and 1,333 bombers.[127] Having formulated the plan, Foulois' next task was to convince the War Department and Congress of its validity. Throughout the month of June, Foulois and Squier met with Army officials, Secretary of War Newton Baker, and several Congressmen. In early July, they appeared before the House Military Affairs Committee to pitch their plan. Their arguments must have been persuasive. The Committee unanimously voted to support their request and recommended the staggering amount of $640 million for the program.[128] The House and Senate both quickly agreed, and on 24 July 1917, President Woodrow Wilson signed the bill into law.[129]

Despite the funding and blossoming air power doctrine, the fact remained that the United States was utterly unprepared for air operations when the AEF arrived in France. By mid-1917, primarily as a result of Luftstreitkräfte commander-in-Chief General der Kavallerie Ernst Hoeppner's Amerikaprogramm, the German Air Force was on a growth path to 1000 airplanes across 155 squadrons and seven heavy bomber groups.[130] In contrast, the AEF arrived with less than 100 aircraft with none suitable for combat.[131] Understanding it would take time for the American aviation industry to begin producing aircraft, Pershing had to look elsewhere for his immediate needs. On 30 August 1917, the AEF and France signed a contract in which the French agreed to provide the AEF with 1,500 Breguet 14 bombers and ISR airplanes,

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[127] Foulois and Glines, *Foulois Memoirs*, 145.
[128] Major General Benjamin Foulois, Oral History Interview, 12 September 1965, K239.0512-766, AFHRA.
[129] Clodfelter, *Beneficial Bombing*, 11.
[130] Robin Higham, *100 Years of Air Power & Aviation* (College Station, TX: Texas A&M University Press, 2003), 43.
[131] Determining actual number of aircraft at the front is incredibly difficult with wild variance across the various sources. The numbers cited here are from Foulois and Glines, *Foulois Memoirs*, 148.

2,000 SPAD XIII fighters, and 1,500 Nieuport 28 pursuit aircraft.[132] The contract specified delivery to begin in January 1918 and also provided for the substitution of updated types of aircraft if new designs outclassed those specified in the agreement. To ensure all of these aircraft were organized operationally, Pershing approved a plan to establish 202 squadrons, of which 101 would be observation squadrons, 60 fighter squadrons, and 41 bomber squadrons. Pershing believed this structure would allow the Air Service to best service the tactical armies in the field.[133]

Aircraft and organizational structure were not the only items lacking. By September 1917, the American buildup had finally gained momentum but airmen were still arriving with almost no knowledge of airborne radio operations, photography, bombing equipment, night navigation, flight clothing, compasses, and other aviation instruments.[134] To remedy this, Pershing decided to immediately begin conducting pilot and observer training in-country. To help with this, the French agreed to give a large training area near Issoudun to the Americans for pilot finishing training and also arranged to train airplane observers at the French school in Tours.[135] Balloon observers and balloon maneuvering officers were to be trained at a balloon observation school in Cupperly-sur-Marne.[136] Additionally, the training of aerial artillery observers began in the fall of 1917 following the arrival of the first American artillery brigades. Artillery officers were designated as aerial observers and trained with French instructors and equipment at Le Valdahon.[137] These three actions, more than anything, allowed the American air service to begin properly training for combat operations – something they were unable to do in the United States.

When he was finally comfortable with their readiness, Pershing selected

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[132] Hamady, "Fighting Machines for the Air Service, AEF," 24-37.
[133] James S. Corum, "World War I Aviation," in *World War I Companion*, ed. Matthias Strohn (Oxford, UK: Osprey Publishing, 2013), 74.
[134] Chase C. Mooney and Martha E. Layman, Assistant Chief of Air Staff, Intelligence Historical Division, Army Air Forces Historical Studies: No. 25, "Organization of Military Aeronautics, 1907-1935," December 1944, 26-27.
[135] Porter, *Aerial Observation*, 323.
[136] Diary of Frank P. Lahm, 19 December 1917, K239.046-29, AFHRA.
[137] Frank, "American Air Service Observation in World War I," 186.

the relatively quiet Toul Sector for American entry into the air war. In Toul, the opposing armies had remained mostly inactive since the heavier fighting of 1914; the trenches were well-established and little movement occurred. This, in Pershing and Mitchell's minds, gave the Americans the perfect place to get their feet wet and use the training they had received from the French.[138] In February 1918, the 94th and 95th Aero Squadrons (Pursuit) arrived in Toul to provide counter air support for the observation squadrons.[139] The AEF selected the village of Ourches, about 18 miles behind the front lines, and began constructing hangars and airfields.[140] Shortly after, the 1st and 12th Aero Squadrons arrived and, along with a French observation unit, established the 1st Corps Observation Group.[141] In April, when the 88th Aero Squadron arrived, the Group was complete.[142] American manned airborne ISR forces were now in position to enter the fray.

Colonel Billy Mitchell, having been recently given the position of AEF Air Service Chief, gave command of the Army's first airborne ISR group to Major Lewis H. Brereton.[143] Brereton, who had trained under Foulois at the San Diego flying school, had come to France as part of newly promoted Brigadier General Foulois' staff in November 1917. After a short stint as Foulois' Chief of Supply, Brereton moved to Issoudun where he became involved in the training of the 12th Aero Squadron.[144] Mitchell was impressed with Brereton's leadership style and organization ability and when the time came to appoint a commander for the 1st Corps Observation Group, Mitchell selected Brereton.

In addition to the observation squadrons, Pershing sent his balloon

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[138] Sam Hager Frank, "Air Service Combat Operations, Part 5, The Toul Sector Operations," *Cross and Cockade Journal* 7, no. 2 (Summer 1966): 163-165.
[139] History of 94 Aero Squadron, 1 August 1917-1 November 1918, 168.7239-5, AFHRA; and, History of 95 Aero Squadron, 20 August 1917-30 September 1943, SQ-BOMB-95-HI, AFHRA.
[140] Maurer, *The U.S. Air Service in World War I*, vol. I, 171.
[141] History of 1 Aero Squadron, 1 January 1914-1 November 1918, 168.7239-15, AFHRA; History of 12 Aero Squadron, 22 June 1917-31 December 1943, SQ-RCN-12-HI, AFHRA.
[142] Maurer, *The U.S. Air Service in World War I*, vol. I, 29.
[143] Cooke, *The U.S. Air Service in the Great War*, 51.
[144] Roger G. Miller, "A "Pretty Damn Able Commander" – Lewis Hyde Brereton: Part 1," *Air Power History* 47, no. 4 (Winter 2000): 4-27.

squadrons to the Toul sector. The captive balloon, with its ability to connect directly to the ground via telephone wires, was still the Army's top choice for the artillery spotting mission. As previously examined, the Army had paid scant attention to balloon development in the years prior to the war and much work needed to be done to bring any units up to combat readiness. Major Charles deForest Chandler, the Army's first Aeronautical Division Chief, was one of only a few active duty airmen with balloon experience. In spring 1917, Squier had instructed Chandler to reopen the balloon school at Fort Omaha and to establish a Balloon Section in the Chief of the Signal Corps' office.[145] Chandler had reinvigorated balloon instruction in the States, and in October 1917, he and fellow balloon specialist Frank Lahm were ordered to France.[146] Upon arrival, the men reported to Cupperly-sur-Marne and began training balloon operators and observers. By February 1918, they were ready to field their first unit and later that month the 2nd Balloon Company arrived in the Toul sector and joined the units of the 1st Corps Observation Group.[147]

Though now forward deployed, the United States' first airborne ISR group was by no means ready for heavy combat action as they were outfitted with obsolescent, hand-me-down aircraft – the Dorand A.R., the Sopwith 1-1/2 Strutter, the SPAD XI, and the Nieuport 27 – that had already been removed from frontline French units.[148] Pershing and Foulois were keenly aware of the deficiency and worked with the French to accelerate the timelines for aircraft delivery. While AEF leadership fought to obtain better aircraft, the Toul sector actually provided an ideal area for American airmen to apply the skills they had learned from their French instructors in Issoudun and Cupperly. The sector was relatively quiet with the United States Army 26th Division covering an area of

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[145] Lieutenant General Howard A. Craig, "Col Charles DeForest Chandler, Air Service, US Army," *Journal of the American Aviation Historical Society* 18, no. 3 (Fall 1973): 196-199.
[146] Chandler and Lahm were the Army's most experienced balloonists and staff officers. When they departed the United States, the production of balloon pilots and observers fell tremendously at Fort Omaha. Ultimately, Foulois ordered Lahm to return to the United States to investigate the problems. Diary of Frank P. Lahm, 12 January 1918, 36, K239.046-29, AFHRA.
[147] Maurer, *The U.S. Air Service in World War I*, vol. II, 173.
[148] Hamady, "Fighting Machines for the Air Service, AEF," 24-37.

about 11 miles spanning from Apremont to Beaumont.[149] Across from the 26th Division was a potpourri of battle-weary German soldiers who had been sent to the 'peaceful' Toul sector to rest and recuperate before returning to the heavier fighting.[150] The conditions were set for America's first foray into aerial combat.

Pershing's direction to Brereton was simple: "…keep the friendly command informed of the general situation within the enemy lines by means of visual and photographic reconnaissances…the adjustment of artillery fire…to be in readiness to accomplish contact patrols with our troops in case of attack."[151] Additionally, the Group was tasked to train the ground forces on how to use the aircraft to enhance operations. During the month of March, Brereton organized the Group to best meet the tasks he had been given. The 1st Aero Squadron was equipped with the SPAD XI, the 12th Aero Squadron with the A.R. II, and the 88th Aero Squadron had the Sopwith 1-½ Strutters.[152] All were antiquated, but the Group endeavored to prove its worth to the ground forces. Throughout March they spent time working closely with soldiers of the 26th Division to ensure they could provide airborne-derived intelligence when called upon. On 11 April, they got their first chance when several pilot-observer teams flew combat ISR sorties over German lines.[153] The following day the Group's initial contact with the enemy occurred when First Lieutenant Arthur J. Coyle of the 1st Aero Squadron was attacked by three German airplanes.[154] While the records show nothing remarkable resulting from these first sorties, the simple fact that United States Army airborne ISR units were now in the fight was significant. After nearly 11 years of existence, the Army's Aviation Section was finally contributing.

While in Toul, all three squadrons of the 1st Corps Observation Group honed their skills with each specializing in particular subsets of the overall ISR

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[149] Michael E. Shay, *The Yankee Division in the First World War: In the Highest Tradition* (College Station, TX: Texas A&M University Press, 2008), 70.
[150] Mark Ethan Grotelueschen, *The AEF Way of War: The American Army and Combat in World War I* (Cambridge, UK: Cambridge University Press, 2007), 155.
[151] Maurer, *The U.S. Air Service in World War I*, vol. I, 172.
[152] Lawson and Lawson, *The First Air Campaign*, 162-163.
[153] History of 1 Aero Squadron, 5 March 1913-1 January 1954, K-SQ-BOMB-1-HI, AFHRA.
[154] "History of the 1st Aero Squadron," Gorrell's Air Service History, Series E, vol. 1, 17.

mission. The 1st Aero Squadron focused on airborne photography, the 88th Aero Squadron on close- and long-range reconnaissance, and the 12th Aero Squadron on artillery spotting.[155] The quiet nature of the sector was apparent with very few of the Group's sorties encountering enemy aircraft. The same could not be said for AAA, however, with nearly every sortie being threatened by substantial and precise fire.[156] All in all, the time spent in Toul was invaluable for the Group and the ground units it was supporting. Recognizing the still ongoing problem with air-to-ground communications, the Group's airmen used the time to focus on the development of signaling mechanisms with the artillery that would allow for the quick exchange of information in the upcoming conflicts to follow.[157] For the Airmen, the routine nature of the flying operations in Toul would pay dividends in the more difficult conditions of future battles as Toul allowed them to gain confidence and to hone their very green skills.

In addition to the units of the 1st Corps Observation Group, the 91st Aero Squadron saw action in the Toul Sector. The 91st, a long-range reconnaissance unit, was based at an airfield near Gondreville-sur-Moselle and on 7 June 1918, began conducting visual and photographic ISR missions behind enemy lines.[158] The missions they were given provided systematic coverage of the Toul Sector. Their routes covered five visual and nine photographic areas that were flown as frequently as possible in order to allow the photographic interpreters the ability to immediately detect any changes in the German posture. To ensure the most efficient use of the sorties, the Air Service had assigned intelligence officers to each of the flying units. These ground intelligence officers developed comprehensive mosaics of the areas and quizzed their pilots and observers on the various landmarks. According to the unit's history, this method resulted in an improved amount and quality of images.[159]

As with the 1st Corps Observation Group, the 91st Aero Squadron

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[155] "Air Service Bulletins 101-150," Gorrell's Air Service History, Series L, vol. 6, 1.
[156] History of 1 Aero Squadron, 1 January 1914-1 November 1918, 168.7239-15, AFHRA.
[157] History of 88 Aero Squadron, 9 January 1918-1 November 1918, 168.7239-3, AFHRA.
[158] History of 91 Aero Squadron, 1 January 1917-1 January 1919, 168.7103-4, AFHRA.
[159] Ibid.

encountered very few enemy aircraft on its sorties. Like the 1st, it also received significant AAA which forced the squadron to operate at higher altitudes. First seen as a disadvantage, after several sorties at 15,000 feet, the unit learned the higher altitude was actually better for operations as they received less accurate AAA fire and had a wider field of view for the photographic missions.[160] The Squadron also discovered that flying visual reconnaissance sorties at any time other than the first hours of daylight was useless. The Germans conducted nearly all of their troop movements at night and flying in the early morning hours often allowed the observers to catch the enemy's final movements before they settled into the trenches for the day. As the location of the enemy remained the ground commander's most important EEI, catching the final movement of the enemy was sufficient. As with the 1st, the long-range reconnaissance mission of the 91st greatly benefited from the time spent in the Toul Sector. The airmen learned valuable lessons and adjusted their TTP accordingly.

The United States Army's balloonists also honed their skills in the Toul Sector. Following a disagreement between Lahm and Mitchell concerning who was in overall command of the balloon units, the 1st, 2nd, and 4th Balloon companies arrived in Toul and established the 1st Corps Balloon Group.[161] As with the airplane units, the balloonists came woefully unprepared for combat operations.[162] To remedy this, Mitchell asked for and received French balloon instructors to help prepare the American balloon forces. Tasked with correcting artillery fire, locating new targets for artillery fire, and reporting any and all enemy movement along the lines by day and night, the balloon units trained quickly for these missions.[163] As discussed earlier, the captive balloons were perfectly suited to conduct artillery spotting primarily due to their connectivity to a vast network of telephone lines that ran from the balloon directly to various

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[160] "Personal Report of 1st Lieutenant K. Roper," 91 Aero Squadron, 1 June 1918-31 August 1918, 167.4115-8, AFHRA.
[161] John H. Tegler, "The Humble Balloon: Brief History – Balloon Service, AEF," *Cross and Cockade Journal* 6, no. 1 (Spring 1965): 11-25.
[162] Mitchell, *Memoirs of World War I*, 182.
[163] "Tactical History of the Balloon Section," Gorrell's Air Service History, Series F, vol. 2, 351.

headquarters offices and the artillery units themselves.[164] The balloonists learned their tradecraft and worked diligently instructing the artillery regarding the uses, capabilities, and limitations of balloons.[165] After several months in Toul, the balloonists also established meetings with the 1st Corps Observation Group pilots and observers to share information and TTPs.[166] This cooperation, enabled due to the strong connections of Major Chandler with the rest of the aviation community, gave the balloon a rebirth of sorts and helped solidify it as a viable part of the greater airborne ISR network as the war progressed.

While the American airmen learned the basics of airborne ISR, the Germans planned an operation designed to finally break the trench deadlock. Fully understanding the impact the United States' entry would have on the war, the Germans felt 1918 was their last chance to win before the full strength of the AEF reached the battlefront. Backed by the aforementioned Amerikaprogramm of accelerated aircraft production, Germany prepared for a major spring offensive called the Kaiserschlacht (Emperor's Battle). Planned by Chief of Staff General Erich Ludendorff, the offensive was designed to force the Allies to sue for peace before complete American entry. While German industry was never able to produce the numbers called for in the Amerikaprogramm, German air power still presented a sizable force of 3,668 aircraft, from which Ludendorff's staff selected 730 frontline aircraft to field 35 fighter squadrons, 22 ground attack squadrons, 49 observation detachments, and four bomber wings to provide support to the three armies that were to lead the attacks.[167]

On 21 March 1918, Ludendorff's first offensive, codenamed Operation MICHAEL, began along a 50-mile front to the north and south of St. Quentin,

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[164] Major Lewis Brereton, Chief of Air Service, 1st Army Corps, to Director of Air Service, French 6th Army, letter, 9 July 1918, in *United States Army in the World War, 1917-1919, Training and Use of American Units with the British and French,* vol. 3 (Washington, DC: United States Army Center of Military History, 1989), 397-398.
[165] "Review of Balloon Activities, 1917-1918," Gorrell's Air Service History, Series F, vol. 6, 43.
[166] Major Charles Chandler, "Report of the Balloon Section, Air Service, AEF," 31 December 1918, Gorrell's Air Service History, Series F, vol. 1, 8-9.
[167] Lawson and Lawson, *The First Air* Campaign, 177; Corum, *The Luftwaffe*, 37.

between Arras and La Fère.[168] Starting with a five-hour artillery barrage that included the use of chemical weapons, the offensive focused on a lightly defended front that had recently changed from French to British responsibility.[169] The Germans had used their observation aircraft to thoroughly reconnoiter the lines and their attack was purposefully designed to drive a wedge at the exact location where the British and French flanks met.[170] German airborne ISR had photographed the entire 50-mile expanse and German planners leaned heavily on this intelligence to plan the operation.[171] Despite the fact that British airborne ISR had detected the attack preparations days before it began, the initial phase of Operation MICHAEL was a complete success.[172] The Germans had switched tactics and the British Third and Fifth Armies simply could not adapt quickly enough.[173] Utilizing new "Hutier tactics," German 'stormtrooper' ground forces focused on rapid mobility characterized by artillery attacks followed by massive infiltration and continued forward movement, all under the cover of local air superiority.[174] The Kaiserschlacht drove a six-mile deep salient into the British positions while costing the British approximately 20,000 dead and 35,000 wounded before the German forward movement was finally stopped by the Allies on 5 April.[175] In all, the Germans had gained about 1000 square miles of French territory in the two week assault and had reestablished themselves along the Marne River.[176] Following MICHAEL, several other German offensives resulted in

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[168] Marshall Cavendish, *History of World War I*, vol. 2, *Victory and Defeat, 1917-1918* (Tarrytown, NY: Marshall Cavendish Corporation, 2002), 411.
[169] John Buchan, *A History of the Great War*, vol. 4 (Cambridge, MA: The Riverside Press, 1922), 190.
[170] James J. Cooke, *The Rainbow Division in the Great War, 1917-1919* (Westport, CT: Praeger Publishers, 1994), 69.
[171] Kennett, *The First Air War*, 208.
[172] While British airborne ISR had detected German movements along the frontlines, it lacked strategic reconnaissance aircraft that were able to fly deep behind the German lines. Had they possessed strategic ISR aircraft, they may have been able to detect the massive reserve forces the Germans were staging.
[173] Buchan, *A History of the Great War*, 190.
[174] Bruce I. Gudmundsson, *Stormtroop Tactics: Innovation in the German Army, 1914-1918* (Westport, CT: Praeger Publishers, 1989), xiii.
[175] Randal Gray, *Kaiserschlacht 1918: The Final German Offensive* (Oxford, UK: Osprey Publishing, 1991), 91.
[176] David T. Zabecki, *The German 1918 Offensives: A Case Study in the Operational Level of War* (New York, NY: Routledge Publishing, 2006), 198-204.

additional, though not as sensational, successes. At the end of the assaults, the Germans held a huge V-shaped salient that stretched between Soissons and Reims, with the point of the V located on the Marne near Château Thierry. While not the culminating blow that Ludendorff sought, Kaiserschlacht did break the trench stalemate and changed the character of the final months of battle.

It was into this new paradigm along the Marne that many of the American airborne ISR units that had been previously stationed in the Toul Sector were transferred in late June 1918. The 1st Corps Observation and Balloon Groups, both now under the command of the 1st Corps Chief of Air Service, Major Brereton, were given the mission to "apprise the 1st Corps staff of the situation within the enemy lines to a depth of five miles opposite the Allied front; to adjust artillery fire; and to hold itself in readiness to perform infantry contact patrols."[177] These tasks were not unlike those they had been carrying out in the Toul Sector, but in Château Thierry, they faced capable German air forces who were equipped with modern Fokker D. VII planes and who were intent on denying the airmen the ability to complete their missions.[178]

On 1 July, with Brereton's airborne ISR forces in support, the American 2nd Division conducted an attack on the German-held village of Vaux.[179] The 1st and 12th Aero Squadrons performed infantry contact patrols while the other squadrons of the Observation Group flew tactical surveillance primarily to gain combat experience and to orientate them with the units of the 2nd Division.[180] By the end of 2 July, the battle was over. The Germans had provided scant resistance and Vaux was an easy victory for the Americans. While the part played by airborne ISR is uncertain, the capture of the city was an important event for

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[177] Infantry contact patrols required the airborne observers to watch the progress of friendly infantry attacks and to report to the ground commanders any tactical information on the enemy that they could obtain from the air; "History of the I Corps Observation Group," Gorrell's Air Service History, Series C, vol. 12, 35-36.
[178] "Tactical History of the Air Service, AEF," Gorrell's Air Service History, Series D, vol. 1, 7.
[179] John W. Thomason, Jr., *The United States Army Second Division Northwest of Château Thierry in World War I*, ed. George B. Clark (Jefferson, NC: McFarland & Company, Inc., 2006), 192.
[180] Burdette S. Wright, "Notes on Observation Work at Château Thierry Campaign, July 2-August 12, 1918," 17 December 1918, in Gorrell's Air Service History, Series C, vol. 2, 23.

the AEF.[181] It undoubtedly gave them much needed experience and created a favorable impression in the eyes of the other Allies.

Following Vaux, the American airmen settled in for day-to-day ISR operations as no major assaults were planned. During this time, they conducted visual reconnaissance sorties at dawn and dusk to provide locational information for artillery fire and for general situational awareness. Additionally, the 1st and 12th Aero Squadrons conducted photomapping of the frontlines.[182] These missions formed the backbone of the development of a systematic air intelligence capability. Intelligence officers and imagery analysts conferred nightly on the results of the day's sorties and, in conjunction with Corps leadership, developed target lists for the next day. At these meetings, G-2 (Intelligence) Section personnel assigned the enemy positions to be photographed and the particular EEIs required from the images to each airborne squadron.[183] As before, the Air Service embedded non-flying intelligence officers with the flying squadrons to help interpret the intelligence and to train the aircrews.

These first few weeks in the Château Thierry area also allowed the Air Service and the ground units to develop better communications. As discussed, the hurried nature of the AEF's arrival in France had precluded significant training between the airmen and soldiers. To help remedy this, the Air Service assigned experienced observers at the ground divisions to act as air liaison officers.[184] These liaisons were placed in the headquarters to be part of the planning staffs and to advise on the best application of air power in upcoming operations. Additionally, the airborne ISR squadrons each sent officers to the various headquarters locations and other command posts to obtain information on upcoming operations, plans, and requests for ISR. This new system of liaison

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[181] The 1st Corps Observation Group official history simply reflects the missions the Group performed in the battle; there is no assessment of their effectiveness. "Tactical History of Corps Observation," Gorrell's Air Service History, Series D, vol. 1, 20.
[182] History of 12 Aero Squadron, 22 June 1917-31 December 1943, SQ-RCN-12-HI, AFHRA.
[183] "History of the I Corps Observation Group," Gorrell's Air Service History, Series C, vol. 12, 46.
[184] This system is still in use today. Air liaison officers (ALOs) are often assigned to tactical and higher-level Army organizations to ensure the most efficient use of air power.

between the units helped overcome some of the lack of training, but problems still arose in the heat of combat.[185]

On 14 July, Allied headquarters ordered the 1st Corps Observation Group to conduct a strategic photographic mission deep behind German lines. French airborne reconnaissance had indicated a long awaited German offensive to expand the Château Thierry salient was imminent and Allied commanders wanted additional airborne intelligence to help confirm the reporting.[186] Following a harrowing sortie through enemy AAA and aircraft, a pilot and observer from the 12th Aero Squadron returned with excellent photographic images of the German rear areas. The information they collected indicated the Germans were indeed preparing for an offensive based on troop movements and occupation of new battery positions.[187] Airborne ISR was correct; on 15 July the Germans launched what would be their last major offensive of the war.

Designed by Ludendorff to hit the French lines and once again threaten Paris, Operation MARNESCHUTZ-REIMS saw 47 German divisions attack a 150-kilometer sector stretching from Château Thierry to Tahure. Unfortunately for the Germans, this offensive was a failure. French and American airborne ISR had provided the warning necessary for the Allies to prepare a defensive strategy. In addition to the prior day's imagery mission, the Air Service provided near-real time tactical intelligence on the German moves. During the early morning hours of the first day, none other than Colonel Billy Mitchell himself piloted a reconnaissance flight that allowed him to identify the exact location of the main German thrust.[188] Mitchell's low-level reconnaissance sortie revealed five pontoon bridges which the Germans had placed across the Marne. Upon his return, Mitchell ordered aerial attacks to destroy the bridge. These attacks crippled the Germans' ability to move troops across the river and effectively

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[185] "History of the I Corps Observation Group," Gorrell's Air Service History, Series C, vol. 12, 47-48.
[186] Elizabeth Greenhalgh, *Foch in Command: The Forging of a First World War General* (Cambridge, UK: Cambridge University Press, 2011), 389.
[187] Captain Phillip Roosevelt, "History of the Air Service Operations at Chateau-Thierry," in Gorrell's Air Service History, Series C, vol. 1, 4.
[188] Mitchell, *Memoirs of World War I*, 220-222.

stopped the advance.[189] With German forces bottlenecked, airborne ISR crews worked with the artillery batteries to bring heavy firepower onto the stranded German forces. Airborne strategic- and tactical-level ISR sorties had given Allied leadership the decision advantage they needed to counter this final German offensive. Additional airborne ISR in the following days helped identify the weak points in the German flanks and allowed the Allies to focus their counterattack.

Over the next several days, airborne ISR planners – working closely with their ground equivalents – developed a plan in which they divided the counterattack area into zones that would be covered by artillery and dedicated airborne assets.[190] Additionally, they furthered the TTPs for the relatively new infantry contact mission. Despite the fact that European air arms had been conducting the infantry contact mission for several years, the Americans had not trained for this mission and it remained problematic. Airborne observers lacked the requisite skills to confidently identify friendly ground forces and the ground forces lacked the equipment necessary to mark their locations for the airborne observers. This training inadequacy required the aircraft to fly at dangerously low altitudes – sometimes as low as 150 feet – which greatly increased airborne casualty rates.[191] Despite the high threat, airmen endured. Pilots and observers of the 1st and 88th Aero Squadron suffered high losses, but the near-real time intelligence they provided to the ground commanders was critical to Allied success.[192]

The lack of reliable air-to-ground communications also continued to plague artillery direction missions. As Allied gun batteries began moving forward during the counterattack, airborne ISR forces struggled to communicate the targeting data they were collecting. With German forces in retreat, airmen found it incredibly difficult to provide timely locational data to the artillery command

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[189] Harold Evans Hartley, *Up and at 'Em* (New York, NY: Ayer Co. Pub., 1980), 180.
[190] "Tactical History of Corps Observation," Gorrell's Air Service History, Series D, vol. 1, 26.
[191] Ibid.
[192] "Compilation of Confirmed Victories and Losses of the AEF Service as of May 26, 1919," Gorrell's Air Service History, Series M, vol. 38, 71; History of 88 Aero Squadron, 9 January 1918-1 November 1918, 168.7239-3, AFHRA.

posts. To remedy this, each airborne squadron assigned a trained observer to corps-level artillery command posts to act as an Air Service liaison. This helped some, but insufficient radio equipment and bad telephone connections continued to hamper effective operations.[193]

Airborne photography also struggled during the early rapid mobility phase with the limited number of airborne assets being severely challenged to cover the vast area of the Allied counterattack. The advance was so quick that it became impossible for the Air Service to satisfy all of the ground force commanders' requirements. Additionally, the Allies lacked a centralized mechanism to determine the prioritization of imagery exploitation.[194] To mitigate this problem, the G-2 worked closely with the division commanders to identify the areas of highest priority for airborne imaging. With the prioritization method in-place and an increase in low altitude, oblique views, airborne photography was able to contribute considerably to future operation planning.[195] As with the artillery observers, the airborne imagery component had faced challenges and adopted innovative solutions to ensure they were providing the intelligence ground commanders needed. By the end of the counterattack, the new TTPs became standard in Air Service and ground force coordination.

While the pilots and observers in the airplane were learning how to employ the latest aircraft technology and provide relevant, timely ISR to ground commanders, the airmen of the balloon companies were also making their mark. Three Air Service balloon companies saw action in the Aisne-Marne sector during the Château Thierry campaign with all three contributing to the overall Allied success.[196] Like their airplane counterparts, the balloon observers directed artillery fire and conducted infantry contact missions. The rapid Allied movement also created similar challenges for the balloon companies with most of the crews

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[193] "Tactical History of Corps Observation," Gorrell's Air Service History, Series D, vol. 1, 20-23.
[194] Roy M. Stanley, *World War II Photographic Intelligence* (New York, NY: Charles Scribner's Sons, 1981), 32.
[195] "Tactical History of Corps Observation," Gorrell's Air Service History, Series D, vol. 1, 20-23.
[196] "World War I Diary of Col Frank P. Lahm, Air Service," 9 August 1917-10 August 1919, 203, AFHRA.

finding it necessary to relocate their positions almost daily. During the course of the offensive, the 2nd Balloon Company moved a total of 40 miles with the others undoubtedly not far behind.[197] Balloon service was also sometimes a deadly duty. During the five weeks of the campaign, the three balloon companies lost a total of eight balloons to enemy aircraft and had one balloon damaged by artillery fire.[198] In all, no balloon observers were killed, but 12 were forced to make parachute jumps.[199]

By 6 August, the German retreat was complete. They had lost all gains made in Ludendorff's offensives and had retired to the high ground north of the Vesle River.[200] Ludendorff's failure was the last German attempt to win the war. The Allied defeat of this offensive eliminated the threat to Paris, destroyed Ludendorff's future plans for the defeat of the British in Flanders, gave the Allies unprecedented access to rail lines of communications (LOC), and, perhaps most importantly, demonstrated the combat readiness of the AEF – both its ground and air components. Despite the relative lack of training, and in only their second combat action, the airmen of American airborne ISR had proven their value. The Air Service delivered timely intelligence that helped blunt the German offensive and guide the Allied counterattack. Their interaction with artillery, infantry, and Allied headquarters, along with the refinement of combat TTPs, provided experience that would serve them well in the final stages of the war.

Before the German withdrawal was even finished, Pershing had lobbied the overall Allied commander, French Marshal Ferdinand Foch, and the combined land commander, Philippe Pétain, for an American-led area of

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[197] Tegler, "The Humble Balloon," *Cross and Cockade Journal* 6, no. 1 (Spring 1965): 13-15.
[198] Major General Mason M. Patrick, "Final Report of Chief of Air Service, American Expeditionary Forces," in *United States Army in the World War, 1917-1919: Reports of Commander-in-Chief, AEF, Staff Sections, and Services*, vol. 15 (Washington, DC: United States Army Center of Military History, 1991), 230.
[199] These parachute jumps included the first ever by American airmen when Lieutenants Leo Murphy and Malcolm Sedgwick were forced to abandon their balloon on 7 July 1918 following a German attack; Lebow, *A Grandstand Seat*, 94. For a personal account of the incident, see Lieutenant Malcolm Sedgwick, "Letters from the Front to the Folks at Home," *The Literary Digest* 58, no. 8 (24 August 1918): 39-40.
[200] Frank H. Simonds, *History of the World War*, vol. 5 (Garden City, NY: Doubleday, Page, & Company, 1920), 176.

operations.[201] In July, Foch had stated that the "Allied cause…will be better served by having an American army under the orders of its one leader, than by an American army scattered all about."[202] Pershing believed the AEF's performance in the Château Thierry campaign had proven his force's readiness to operate independently and he wanted to hold Foch to his word. On 24 July, following several discussions with both French generals, Pershing got what he wanted and the American First Army was established.[203] While still ostensibly under Pétain's overall command of the Allied armies, the American First was given its own area of responsibility – the St. Mihiel salient – and the mission to eliminate the German presence there. St. Mihiel, a location that had long been a thorn in the side of the Allies, was a 200-square mile fin-shaped area that bulged into Allied lines. The expanse, controlled by the Germans since 1914, held strategic importance for both sides. For the Allies, its possession would provide an area from which they could launch attacks deep into enemy territory. For the Germans, the salient protected the critically important Briey Iron Basin – a key area for German war production – and sheltered their internal railroad network along with the Saar coal fields. The loss of the salient would conceivably give the Allies an open path to finally destroy the last of the German fighting forces.[204]

Eliminating the German presence in St. Mihiel was no trivial matter. As mentioned, the Germans had occupied the area since 1914 and had built a considerable defensive network. To ensure success, Pershing planned to bring the full force of the AEF along with heavy augmentation from the British and French. After consolidating all available ground forces, Pershing had about 250 tanks, 3,000 artillery pieces, and 660,000 soldiers available for the attack.[205]

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[201] Ibid., 218.
[202] Quoted in *United States Army in the World War, 1917-1919: Policy-forming Documents of the American Expeditionary Forces*, vol. 2 (Washington, DC: United States Army Center of Military History, 1989), 520-521.
[203] *United States Army in the World War, 1917-1919: General Orders, GHQ, AEF*, vol. 16 (Washington, DC: United States Army Center of Military History, 1992), 393.
[204] James H. Hallas, *Squandered Victory: The American First Army at St. Mihiel* (Westport, CT: Praeger Publishers, 1995), 2.
[205] Girard Lindsley McEntee, *Military History of the World War: A Complete Account of the Campaigns on All Fronts* (Madison, WI: C. Scribner and Sons, 1943), 525.

Supporting this force was the First Army Air Service, commanded by Colonel Billy Mitchell.[206] Established with the First Army in July, by the end of August, Mitchell's had built his staff and stood-up operations at Ligny-en-Barrois near the St. Mihiel salient.[207] By 1 September, the Air Service had brought all available air assets into its attack plans and was comprised of one army-level observation squadron, seven corps-level observation squadrons, one day bombardment squadron, and 14 pursuit squadrons.[208] Additionally, the British and French made significant contributions to Mitchell's force. At Pershing's request, the French gave an entire air division along with an added pursuit group and one army artillery flying group to help adjust long-range artillery fire.[209] For their part, the British Royal Air Force dedicated eight night bombardment squadrons.[210] This combination of air power resulted in the single largest aggregation of air forces to ever engage in a single operation. At his disposal, Mitchell had 701 pursuit, 366 observation, 323 day bombardment, and 91 night bombardment aircraft for a total of 1,481.[211]

As Pershing had established 12 September as the date of attack, the Air Service had little time to prepare.[212] Despite this, Mitchell's observation units conducted visual and photographic reconnaissance of the enemy's lines and rear areas, adjusted artillery fire, participated in training exercises with the artillery and infantry, and protected the friendly lines from German airborne ISR.[213] Most

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[206] *United States Army in the World War, 1917-1919: General Orders, GHQ, AEF*, vol. 16 (Washington, DC: United States Army Center of Military History, 1992), 393.
[207] "Operations of First Army Air Service, August 10-November 11, 1918," Gorrell's Air Service History, Series C, vol. 3, 7.
[208] "Diagram of First Army Flying Squadrons at the Front, September 12, 1918," Gorrell's Air Service History, Series C, vol. 3, 449.
[209] John J. Pershing, Commander, AEF, to Marshal Foch, Commander, Allied Forces, letter, 15 August 1918, in *United States Army in the World War, 1917-1919: Military Operations of the American Expeditionary Forces*, vol. 8 (Washington, DC: United States Army Center of Military History, 1990), 10-12.
[210] Hugh Trenchard, Commander, RAF, to John J. Pershing, Commander, AEF, letter, 9 September 1918, in *United States Army in the World War, 1917-1919: Military Operations of the American Expeditionary Forces*, vol. 8 (Washington, DC: United States Army Center of Military History, 1990), 58.
[211] Mitchell, *Memoirs of World War I*, 238-239.
[212] Michael S. Neiberg, *Fighting the Great War: A Global History* (Cambridge, MA: Harvard University Press, 2005), 347.
[213] Cooke, *Billy Mitchell*, 87.

important of these missions was probably the aerial photography of the German positions. As airborne visual reconnaissance and photography had been such important factors in the success in Château Thierry, nearly every divisional G-2 (Intelligence) and G-3 (Operations) wanted airborne imagery to assist with their planning.[214] As the Germans were dug into their positions and were not moving, oblique aerial images of their positions provided Allied planners with a fairly complete order of battle.[215] As the attack date approached, Pershing and his staff were confident that their airborne ISR had identified and located the vast majority of the German forces.

When the operation began on 12 September, Allied airmen were greeted with unfavorable weather conditions. A heavy mist, thick clouds, and sporadic rain all combined to make airborne ISR difficult to execute. The weather forced pilots to fly lower which brought them into closer contact with German AAA and aircraft resulting in a much higher loss rate than anticipated.[216] Despite the conditions, airborne ISR performed well during the first two days of the battle. Infantry contact patrols kept the high command informed of the attack's progress and artillery support missions helped guide attacks by redirecting fire onto fleeting targets.[217] Additionally, the 91st Aero Squadron successfully conducted a strategic reconnaissance flight and was able to observe the enemy's rear areas at a depth of 35 to 50 miles.[218] This information revealed that the Germans had elected to evacuate the salient rather than defend it and contributed greatly to Pershing's in-battle adjustments. Finally, the airmen of the balloon corps also performed well during St. Mihiel. Assigned to the various Army corps organized into 15 companies, the balloon observers watched the German positions prior to each Allied movement and quickly reported anything they observed via their

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[214] Diary of Corporal Walter S. Williams, 7-10 September 1918, 168.7037-16, AFHRA.
[215] "Graphs of the Photographic and Visual Reconnaissance Made by the I Corps Observation Group, August 31 to September 16, 1918," Gorrell's Air Service History, Series A, vol. 29, 12.
[216] Cooke, *The U.S. Air Service in the Great War*, 157.
[217] "Tactical History of the Air Service, AEF," Gorrell's Air Service History, Series D, vol. 1, 16-20.
[218] History, 91 Aero Squadron, 1 August 1917-1 November 1918, 168.7239-4, AFHRA.

wired communication system.[219] Also affected by the weather, the balloon companies found their success primarily at the beginning of each day. Already airborne at daybreak, they reported both Allied and German starting locations giving Allied leadership greatly enhanced situational awareness.[220]

By the end of 16 September, the First Army had cleared the salient and recovered 200 square miles of French territory.[221] While a total success for the AEF, analyzing the true impact of airborne ISR's contributions is difficult. The weather, which dominated three days of the four-day offensive, greatly limited the overall effectiveness. When they were able, the observation units had provided timely, accurate information regarding friendly and German troop movements. This information provided Pershing with near-real time situational awareness of the battle. Also, strategic ISR had revealed German intent and had allowed Pershing to adjust on-the-fly. Unfortunately, repeat problems continued to plague the coordination between artillery units and the Air Service. Pilots and observers reported target data to the corps command post rather than directly to the artillery units and the artillery battalions often did not respond to radio calls from the airborne observers.[222] These mistakes on both sides caused long delays and often resulted in the targets not being attacked.[223] As in previous battles, most of the shortfalls can be attributed to a lack of experience and incomplete prior coordination between the Air Service and the ground units to which they were assigned.[224] Despite the problems, Air Service operations in St. Mihiel were largely successful. The overwhelming air power marshalled by Mitchell had given the Army freedom of movement and had allowed them to push the Germans out of the salient in only four days. As Allied leaders had hoped,

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[219] H.A. Toumlin, Jr., *Air Service: American Expeditionary Force, 1918* (New York, NY: D. Van Nostrand Company, 1927), 275.
[220] "Balloon Activity and Operations of Air Service During Recent Activity, St. Mihiel," Gorrell's Air Service History, Series C, vol. 3, 435-439.
[221] Neiberg, *Fighting the Great War*, 347.
[222] Elmer Haslett, *Luck on the Wing: Thirteen Stories of a Sky Spy* (New York, NY: E.P. Dutton & Company, 1920), 113-114.
[223] Johnson, *Wingless Eagle*, 199.
[224] "History of the I Corps Observation Group," Gorrell's Air Service History, Series C, vol. 12, 76.

eliminating the St. Mihiel salient had given them the jumping off area they needed to bring a termination to the war; airborne ISR had played a considerable part in achieving the objective.

Shortly after the end of the St. Mihiel offensive, Foch called for an all-out attack designed to pressure the Germans on every remaining front.[225] The Supreme Allied Commander believed he could win the war by the end of the year and planned to force a German surrender by gaining control of rail lines that connected the various German armies. If successful, Foch's attack would divide the German defenses and block any thought of retreat.[226] Planned to begin on the morning of 26 September, airborne ISR would provide heavy support to the offensive. Foch sent the First Army to the Meuse-Argonne sector and Brigadier General Mitchell's Air Service supported it much as it had done in St. Mihiel.

The Germans occupied strong defensive positions, but were unaware of the impending offensive and remained primarily static. Foch's desire for this attack to be the last demanded complete secrecy. To avoid tipping their hand, the American airborne ISR forces that were brought into the sector were not allowed to conduct any operations until the day prior to the attack.[227] Only the French ISR units that had already been in the area were allowed to continue with their routine reconnaissance, photography, and artillery adjustment sorties. While not allowed to fly their own aircraft, American airmen were permitted to fly with their French counterparts to gain familiarity with the area.

The relative quiet before the attack allowed the ISR airmen time to pre-coordinate with the ground forces they would be supporting. The Air Service endeavored to correct the previous problems they had encountered in providing support to the ground. To do this, they carefully planned the exact communications methods to be used in cooperating with the artillery units during the impending attack. They also provided comprehensive training to the

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[225] Neiberg, *Fighting the Great War*, 347.
[226] Ed Cray, *General of the Army: George C. Marshall, Soldier and Statesman* (New York, NY: Cooper Square Press, 2000), 75.
[227] "History of the I Corps Observation Group," Gorrell's Air Service History, Series C, vol. 12, 78.

infantry units on the proper use of the panel system of marking the ground during infantry contact patrols. Finally, they made personal visits to many of the radio stations to improve the communication between the Air Service and the ground command posts. All of these efforts were initiatives that should have put them in a much better position to provide the support the ground commanders needed.

The final assault began on 26 September and lasted until the Armistice was signed on 11 November. Air Service contributions were similar to those during the Château Thierry and St. Mihiel offensives. Poor weather plagued airborne ISR, but when able to fly, visual reconnaissance provided significant intelligence that helped Allied commanders make decisions. In spite of the weather and determined German defensive counter air effort, American airmen were able to photograph and reconnoiter the entire front opposite the American ground forces.[228] Their photography of the German strongholds of Montmédy, Longwy, Spincourt, Dommary-Baroncourt, and Conflans-en-Jarnisy was integral in the attack planning in the latter stages of the campaign.[229] Additionally, balloon-based ISR again contributed with 13 American and two French companies adding considerably to the overall ISR effort.[230] The balloons moved with the troops and were critical in providing near-real time updates on the locations of German forces. When the end finally came on 11 November 1918, airborne ISR was right there with the ground forces and had undoubtedly contributed to the overall success of the final push.

The conclusions one can draw from airborne ISR's performance in the war are many. A nascent capability in 1914, airborne ISR airmen endeavored to develop doctrine and establish themselves as force multipliers throughout the conflict. While forward-thinking airmen like Hugh Trenchard, David Henderson,

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[228] *United States Army in the World War, 1917-1919: Military Operations of the American Expeditionary Forces*, vol. 9 (Washington, DC: United States Army Center of Military History, 1990), 351-352.
[229] "Tactical History of the Air Service, AEF," Gorrell's Air Service History, Series D, vol. 1, 81-82.
[230] Charles Chandler, "Report of the Balloon Section, Air Service, AEF," 31 December 1918, Gorrell's Air Service History, Series F, vol. 1, 8-9.

Billy Mitchell, and Giulio Douhet dreamed of using the aircraft as a quick war-winning instrument, ISR airmen remained focused on fine-tuning their capabilities to support the army. Lack of prewar training and experience combined with the unreliability of communications hindered airborne ISR's overall effectiveness throughout the war. Despite this, much was done to establish airborne ISR as an essential component of future air forces.

First, ground commanders became increasingly reliant on the imagery supplied by airborne ISR. During 1918 alone, it is estimated that over ten million prints were delivered to the armies on the Western Front.[231] As the quality of aerial photography continued to improve, the remarkable details it provided became irreplaceable. Ranging from the front lines to deep inside enemy territory, ground assault planners could see every detail of the terrain. Trenches, routes of approach, gun emplacements, and even barbed wire were all visible from the airmen's photographs. Additionally, artillery attack preparation was greatly enhanced by the details the photographs provided. Commanders began planning their artillery assaults based almost exclusively on the imagery the airborne ISR assets provided and were hesitant to move forward without it. Finally, strategic bombardment was enabled by the ability to collect imagery from deep behind enemy lines. The long range reconnaissance of the 91st Aero Squadron, along with that of the RAF's No. 25 Squadron, had provided countless images of German rear areas that enabled air planners to attack targets of the greatest strategic importance.[232]

This reliance on imagery created an insatiable demand that drove the rapid modernization of aerial photographic technology and photographic interpretation TTPs. As enhanced fighter aircraft forced the ISR aircraft ever higher, camera companies improved their cameras and film to ensure the resolution of the

[231] Roy Conyers Nesbit, *Eyes of the RAF: A History of Photo-Reconnaissance* (Stroud, UK: Alan Sutton Publishing Limited, 1996), 44.
[232] H.A. Jones, *The War in the Air: Being the Story of the Part Played in the Great War by the Royal Air Force*, vol. 6 (Oxford, UK: Clarendon Press, 1937), 518.

imagery remained usable.[233] The high altitudes also forced aircraft engineers to develop elaborate ways to pump heated air into the aircraft to ensure the cameras did not freeze.[234] Both engineering triumphs would pay big dividends as aircraft technology continued to advance during the years following the war.

The dependence on imagery and the improved technology also resulted in a major increase in camera- and radio-equipped aircraft. In a September 1918 memo to his assistant chief supply officer, Brigadier General Foulois reminded his subordinate that as many observation aircraft as possible should be outfitted with cameras and radios.[235] While the Air Service was never able to outfit its entire fleet, the emphasis on imagery highlighted ground commanders' growing trust of the new technology and the fledging Air Intelligence Section's desire to prove its worth. Additionally, intelligence officers implemented just-in-time photographic interpretation training and ensured imagery intelligence was fused into all reporting. By the later phases of the war, planners were using multiple-source intelligence reports in all stages of the planning process.

The second major advance in solidifying airborne ISR as a key component of the army's inventory was the provision of intelligence professionals to the operations squadrons and planning staffs. As the importance of airborne ISR increased, it became obvious that intelligence officers and photographic interpreters needed to be at the squadron level to ensure the most effective use of the imagery. Following the British model, the G-2 established the requirement for each unit at battalion level and below to have its own intelligence section.[236] At the same time, the G-2 also created an air intelligence organization that placed intelligence officers at bomb and observation squadrons.[237] These officers were

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[233] Robert S. Ehlers, Jr., *Targeting the Third Reich: Air Intelligence and the Allied Bombing Campaigns* (Lawrence, KS: The University Press of Kansas, 2009), 22.
[234] Ibid.
[235] Brig Gen Foulois, Chief of Air Service, American Expeditionary Force, to Assistant Chief of Supply, memorandum, 13 September 1918, 167.403-183, AFHRA.
[236] "Report of the Assistant Chief of Staff, G-2, American Expeditionary Force, 15 June 1919," in *United States Army in the World War, 1917-1919: Reports of the Commander-in-Chief, AEF, Staff Sections and Services,* vol. 15 (Washington, DC: United States Army Center of Military History, 1991), 2.
[237] Ehlers, *Targeting the Third Reich*, 26.

tasked with overseeing the interpretation of aerial photography and with rapidly disseminating the intelligence to planners, aircrews, and other intelligence officers up and down the echelon. By the end of the war, these procedures helped to solidify not only a role for airborne intelligence, but one for the intelligence officer and photographic interpreter.

The third area in which airborne ISR made a significant contribution to the war was in artillery coordination and damage assessment. As examined, artillery attack precision and the target selection process had been greatly improved by aerial observation and photomapping. Aerial photography of the battlefield provided highly detailed maps of enemy positions and was the basis for artillery attack planning. Real-time airborne spotting had made artillery much more precise and much less a guessing game. As the Air Service began conducting strategic bombing attacks far behind enemy lines, commanders wanted the same precision. By November 1917, the British had begun placing cameras on one bomber per squadron and in Foulois' previously mentioned memo, he required his Assistant Chief of Supply to equip at least five percent of all bombers with cameras.[238] These plans were simply not sufficient, however, and ISR aircraft were increasingly included in the bomber formations to conduct battle damage assessment (BDA). Upon their return, these photographs were developed and used by planners to either re-attack targets or to eliminate them from target lists.

Airborne ISR advanced considerably during the war. Evolving from a truly rudimentary, mostly untested capability in 1914 to a battle-tested, dependable contributor by the end of the war, ISR airmen had shown their potential. Though the contributions were many, the true value of airborne ISR during the war remains difficult to measure. Airborne observation prevented freedom of movement during the trench stalemate, but preventing enemy action is not

[238] "Results of Air Raids on Germany Carried Out by the 8th Brigade and the Independent Force, RAF, January 1-November 11, 1918," 16, TNA, AIR 1/2104/207/36; Brig Gen Foulois, Chief of Air Service, American Expeditionary Force, to Assistant Chief of Supply, memorandum, 13 September 1918, 167.403-183, AFHRA.

decisive in and of itself. Airmen conducted tactical and strategic bombing which was enabled by airborne IMINT, but neither contributed significantly to the final outcome. The one decisive area in which airborne ISR contributed was in its support to the artillery forces. If nothing else, World War I was the war of artillery and the aircraft – both the balloon and the airplane – were at least partially responsible for the precision with which both sides used their big guns.[239] Whether through near-real time correction of ongoing artillery attacks or by the use of aerial photographs for planning, the contribution of airborne-derived intelligence to the most important decisive factor of the war is certain.

Having established its worth, the value of airborne ISR would not be in question during the years following the war. The challenge for interwar ISR airmen would be to ensure the aircraft's collection capabilities kept up with technological advances. As will be seen, this would be a daunting challenge. Post-war euphoria and a vow to never again fight a war of such magnitude prompted retrenchment in many nations and a subsequent draw down in forces. In this environment, sheer survival took priority with airmen determined to create a unique niche that would give them the independence so many of them wanted. As strategic bombing dominated air power thought during the years preceding World War II, the role of airborne ISR – despite its proven value – caught the attention of very few. When the Second World War began, however, it was immediately thrust into the limelight and, as always, enterprising airmen turned a very modest capability into a world-class intelligence producer that undoubtedly contributed to Allied success.

[239] Eric J. Leed, *No Man's Land: Combat and Identity in World War 1* (Cambridge, UK: Cambridge University Press, 1979), 206.

Chapter 5: Airborne ISR Completes the Circle

The most powerful air striking force in history would be utterly blind without intelligence.
Brigadier General George McDonald, A2, USSTAF

An unproven, untested, and uncertain capability in 1914, air power emerged from the crucible of World War I as a worthy addition to traditional ground-based capabilities. The aircraft, which was used almost exclusively for airborne ISR at the beginning of the war, proved to be a true force multiplier as it – and its mission sets – evolved throughout the course of the conflict. Despite the aircraft's many roles, by the end of the war ground commanders had become so reliant on the airborne ISR mission that they often delayed attack planning and execution if they did not have it. Aerial observation and photomapping of assault locations became paramount for both sides. By September 1917, the Germans were producing approximately 4,000 photographs daily, and by the end of the war, the Americans had taken over 18,000 photographs and had produced 585,000 prints.[1] The imagery coverage of the frontlines was so thorough that when the St. Mihiel offensive started in September 1918, airborne ISR had located every German artillery piece in the salient.[2] When peace finally came in November 1918, the aircraft had undoubtedly proven its value.

But lessons learned in war are often quickly forgotten in postwar euphoria. Despite the National Defense Act of 1920 and its recognition of the Air Service as an independent branch of the Army, airborne ISR's contribution to victory was not enough to ensure its future.[3] Postwar air power doctrine development

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[1] Major General Mason M. Patrick, "Final Report of Chief of Air Service, American Expeditionary Forces," in *United States Army in the World War, 1917-1919: Reports of Commander-in-Chief, AEF, Staff Sections, and Services*, vol. 15 (Washington, DC: United States Army Center of Military History, 1991), 225.
[2] Frank E. Vandiver, *Black Jack: The Life and Times of John J. Pershing* (College Station, TX: Texas A&M University Press, 1977), 945.
[3] Jeffrey J. Smith, *Tomorrow's Air Force: Tracing the Past, Shaping the Future* (Bloomington, IN: Indiana University Press, 2014), 25.

was virtually nonexistent and memories of airborne ISR's hard earned successes faded as United States Army leadership made drastic cuts to aviation in an attempt to modernize the ground forces.[4] This shift in focus left the fledging United States Army Air Corps (USAAC) with little money to acquire new aircraft and with few forward-thinkers to advance airborne ISR into the next era. Exacerbating airborne ISR's fall from grace was the USAAC and Royal Air Force (RAF) drive toward strategic bombing. With 1930s air power doctrine development dominated by talk of the bomber panacea, little room – or money – was left for airborne ISR.

In Europe, war-weary nations focused primarily on recuperation, reconstruction, and defensive preparations with scant attention paid to airborne ISR. For France, postwar emphasis was placed on preventing another invasion with a preponderance of the defense budget being spent to build the heavily fortified Maginot Line.[5] In Germany, the terms of the Versailles Treaty forced the dismantling of the *Luftstreitkräfte* and greatly limited the civilian aviation industry.[6] For the British, immediate relief at the end of the war quickly turned to introspection regarding the future of air power. Much like the Americans, British air power thought centered around strategic bombing. In Russia, the chaos of the Bolshevik Revolution required a focus on domestic issues that left little room for the development of airborne ISR doctrine.

As a result, most of the world's air arms found themselves woefully underprepared to conduct ISR as new wars brewed in Europe and the Pacific. The USAAC and RAF's interwar focus on strategic bombing had left airborne ISR doctrine virtually unchanged since the end of World War I. In addition to stagnant doctrine, ISR aircraft capabilities had not kept up with the rapidly

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[4] Robert F. Futrell, *Command of Observation Aviation: A Study in Control of Tactical Airpower*, USAF Historical Study 24 (Maxwell AFB, AL: USAF Historical Division, Air University, 1956), 2.
[5] France's war losses were truly atrocious. Out of a prewar population of approximately 40 million, over 1.3 million soldiers died with another 2.8 million wounded. Thomas R. Christofferson and Michael S. Christofferson, *France During World War II: From Defeat to Liberation* (New York, NY: Fordham University Press, 2006), 2.
[6] John Morrow Jr., *The Great War in the Air: Military Aviation from 1909-1921* (Washington, DC: Smithsonian Institution Press, 1993), 354-355.

modernizing militaries or the advance of technology. Though airmen had vigorously advocated for additional reconnaissance aircraft, when America entered the war in 1941 the Air Corps had received few modern airframes.[7] The British were in a better position than the Americans, but only marginally. As will be seen, this would force the United States to rely heavily on Great Britain for air intelligence support during the early stages of the war. Despite this innovation-stifling environment, airborne ISR was on the precipice of a major evolution. As the war progressed, enhanced aircraft capabilities, along with dogged determination and innovation, allowed airborne ISR forces to make significant contributions to their respective nations' success. In addition to the imagery intelligence (IMINT) mission they had validated during World War I, airborne ISR forces in World War II would create first-rate signals intelligence (SIGINT) collection capabilities.[8] The rapid development and refinement of these airborne intelligence collection techniques helped win the war and established the tactics, techniques, and procedures (TTPs) that subsequent airborne ISR forces would follow for years to come.

Following the end of the First World War, militaries around the world conducted rapid force drawdowns. In the first month of demobilization, the United States Army released approximately 650,000 soldiers and within nine months it had discharged nearly 3.25 million.[9] The Air Service, which had grown from fewer than 1,200 personnel in April 1917 to more than 190,000 in November 1918, was not immune from the cuts as it dropped to fewer than 27,000 by the end of June 1919.[10] The UK had approximately 3.8 million men

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[7] I.B. Holley, Jr., *Evolution of the Liaison-Type Airplane, 1917-1944*, Army Air Forces Historical Study 44 (Washington, DC: Army Air Forces Historical Office, 1946), 113-114.

[8] For this paper's discussion, SIGINT is comprised of communications intelligence (COMINT) – which can be simply defined as communications among people – and electronic intelligence (ELINT) – which is defined as communications between machines or equipment. When speaking specifically of either, I will use COMINT or ELINT. When speaking generally, I will use SIGINT to encompass both capabilities.

[9] W. Stewart, ed., *American Military History*, vol. 2, *The United States Army in a Global Era, 1917-2003* (Washington, DC: Center of Military History, 2005), 54.

[10] Maurer Maurer, *Aviation in the U.S. Army, 1919-1939* (Washington, D.C.: Office of Air Force History, 1987), 3-5.

in its armed forces in November 1918; within a year, the total was less than 900,000 and by 1922, it was just over 230,000.[11] In France, from a size of 1,670,000 at the end of the war, by the end of 1919, approximately 306,000 were left on active duty.[12] For Germany, losing the war meant an almost complete dismantling of its armed forces; part V of the Treaty of Versailles limited Germany to no more than 100,000 military members and directed that they could only be defensive in nature.[13]

As time progressed, the American military got even smaller. Desiring a return to the United States' enduring principle of a small standing army, politicians lobbied for further downsizing. On 1 February 1920, Idaho senator William E. Borah stated, "universal military training and conscription in time of peace are the taproots of militarism."[14] Borah's statement reflected the thoughts of many around the world. After the terrible losses during the war, most were eager for a return peace. While the American public and some politicians desired the Army to quickly return to its pre-war size, Congress was not convinced and actually increased the Army's size. In addition to creating the Air Service, the National Defense Act of 1920 authorized the Army a total of 17,726 career officers – more than three times the prewar authorization – and 280,000 enlisted men.[15] Congress' love affair with the military did not last long. By mid-1921, mounting public pressure forced Congress to reverse its earlier decision and reduce the Army's end strength to 137,000.[16] Cuts continued and by the end of 1924, the

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[11] "Minutes and memos of the Cabinet Committee on Demobilisation, 1918," The National Archives of the United Kingdom (TNA), CAB 27/41-42; "Subject: Ministry of Reconstruction: 1st and 2nd reports on the demobilisation of the army," no date given, TNA, CAB 33/11.
[12] Leonard V. Smith, Stéphane Audoin-Rouzeau, and Annette Becker, *France and the Great War, 1914-1918* (Cambridge, UK: Cambridge University Press, 2003), 152-153.
[13] The Treaty of Versailles, 28 June 1919, Part V, Articles 159-213, http://avalon.law.yale.edu/imt/partv.asp (accessed on 24 January 2016).
[14] Robert K. Griffith Jr., *Men Wanted for the U.S. Army: America's Experience with an All-Volunteer Army Between the World Wars* (Westport, CT: Greenwood Press, 1982), 20.
[15] Matthew S. Muehlbauer and David J. Ulbrich, *Ways of War: American Military History from the Colonial Era to the Twenty-First Century* (New York, NY: Routledge Publishing, 2014), 318.
[16] Stewart, *American Military History*, 59.

Army was only authorized 111,000 – a mere 11,000 more than the Treaty of Versailles allowed a defeated Germany.[17]

In addition to the severe personnel cuts, the Army's budget was also meager. Fiscal austerity forced leaders to make difficult decisions. With severely limited funds, they chose to focus on maintaining personnel strength rather than on acquiring new technology.[18] As the 1920s rolled into the 1930s, ground units were still training with the same equipment they had used during the First World War. In his annual report to Congress in 1934, Chief of Staff of the Army General Douglas MacArthur said of the Army's equipment, "We have on hand some hundreds…of tanks, totally unsuited to the conditions of modern war and of little value against an organized enemy in the field."[19]

Despite the personnel cuts, airborne ISR fared remarkably well in the immediate postwar years. In the rush to capture lessons learned and thus create air power doctrine, airmen relayed their experiences, which, with few exceptions, were related to airborne ISR and the direct role it played in helping the ground army secure victory. Despite Billy Mitchell's very vocal opinions regarding strategic bombing, the fact remained that on the day of the Armistice the Air Service had 18 observation squadrons and only one strategic bombing squadron.[20] Additionally, there were 20 pursuit squadrons in service in November 1918, but their missions were primarily to support the observation aircraft and balloons.[21] Airborne ISR remained the primary purpose of air power.

The heavy ISR nature of the Air Service's involvement meant that postwar doctrine formulation was also profoundly slanted toward ISR. One after the

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[17] Donald Smythe, *Pershing, General of the Armies* (Indianapolis, IN: Indiana University Press, 1986), 279.
[18] Stewart, *American Military History*, 59.
[19] Edward T. Imparato, *General MacArthur: Speeches and Reports, 1908-1964* (Paducah, KY: Turner Publishing, 2000), 84.
[20] Edgar S. Gorrell, "The Measure of America's World War Aeronautical Effort," (lecture, Norwich University, Northfield, Vermont, 26 November 1940), manuscript of lecture available in the Edgar S. Gorrell Collection, Box 1, Folder 6, National Air and Space Archives, National Air and Space Museum, Smithsonian Institution, Washington, D.C.
[21] Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. I (Washington, DC: The Office of Air Force History, 1978), 18.

other, the service's senior officers extolled ISR and insisted the best use of air power was in its service to the ground forces. In his official lessons learned summary, Colonel Thomas Milling, who had led the air arm in the First Army, stated, "The Air Service is of value to the military establishment only insofar as it is correlated to the other arms."[22] The commander of the air units in the Second Army, Colonel Frank Lahm, echoed Milling's sentiment. In a letter to Colonel Edgar Gorrell, Lahm stated, "…the main function of aviation is observation and all hinges on that program."[23] Lahm's extensive balloon experience undoubtedly shaped his opinions, but he was unequivocal in his belief that air power was little more than an auxiliary to the ground forces. The American Expeditionary Forces (AEF) Chief of the Air Service Major General Mason Patrick's final report on the Air Service's contribution also lauded airborne ISR's contribution to the ground forces. In assessing the comparative contribution of observation and pursuit aviation, Patrick stated, "the year 1918 has clearly demonstrated the fact that the work of the observer and observation-pilot is the most important and far-reaching which an air service operating with an army is called upon to perform."[24]

With the Air Service's most seasoned leaders backing airborne ISR, it is no surprise that air power doctrine formulation in the years immediately following the war was slanted considerably toward observation and reconnaissance. In 1919, Colonel Gorrell wrote and circulated a study that attempted to clarify and define operating principles for the Air Service. His "Notes of the Characteristics, Limitations, and Employment of the Air Service," described the primary functions of the Air Service as: providing aid to the infantry, conducting fire

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[22] Colonel T.D. Milling, to Chief, Air Service, memorandum, 9 January 1919, "Lessons Learned," in Colonel Edgar S. Gorrell's Air Service History, Series A, vol. 15. Record Group (RG) 120, Microfilm 990, National Archives and Records Administration (NARA), College Park, Maryland. For future references, this source will be cited as Gorrell's Air Service History along with the title, series, volume, and, where available, page number.
[23] Colonel Frank Lahm, letter, to Colonel Edgar Gorrell, 7 May 1919, RG 120, Box 572, NARA.
[24] Major General Mason M. Patrick, "Final Report of Chief of Air Service, American Expeditionary Forces," in *United States Army in the World War, 1917-1919: Reports of Commander-in-Chief, AEF, Staff Sections, and Services*, vol. 15 (Washington, DC: United States Army Center of Military History, 1991), 262.

adjustment for the artillery, conducting reconnaissance for the staff, ensuring the destruction of the enemy's air arm, providing assistance in deciding actions on the ground, and preventing the enemy's air service from rendering similar assistance to the hostile forces.[25] After describing each function, Gorrell concluded by reiterating that above all, airborne ISR was the Air Service's most important function.[26] On the heels of Gorrell's report, came another ISR-friendly study titled, "Tentative Manual for the Employment of Air Service." This study, written by Lieutenant Colonel William Sherman, was another attempt to capture lessons learned from the war and to advance air power doctrine. Like Gorrell before him, Sherman was unequivocal in his conclusion that the Air Service's main purpose was to support the infantry with airborne ISR.[27]

While Airmen were conducting internal studies, organizations outside the Air Service were also examining the lessons of wartime aviation. The Secretary of War, Newton Baker, wrote extensively about air power in his Annual Report of 1919. After downplaying the role of strategic bombing, Baker highlighted the important role of airborne reconnaissance, photomapping, and artillery fire-control.[28] Baker concluded his report by commenting on the need for the Air Service to remain an auxiliary of the Army and underlined the importance of ground forces.[29] The Army's own Dickman Board was the next to reiterate the role of the Air Service. Commissioned by General Pershing to capture the lessons of the war, the Dickman Board concluded that though reconnaissance and observation had become integral to Army success, the ground forces would

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[25] Colonel Edgar Gorrell, "Notes of the Characteristics, Limitations, and Employment of the Air Service," in Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. II (Washington, DC: The Office of Air Force History, 1978), 303.
[26] Ibid.
[27] Lieutenant Colonel William Sherman, "Tentative Manual for the Employment of Air Service," 12 June 1920, 101-147 V.2 C.1, Air Force Historical Research Agency (AFHRA), Maxwell AFB, Alabama.
[28] *Annual Report of the Secretary of War, 1919* (Washington, DC: Government Printing Office, 1919), 70.
[29] Ibid., 75.

remain primary and aviation should continue as an auxiliary.[30] Finally, Assistant Secretary of War Benedict Crowell led a group that travelled to Europe to study the lessons learned of the Allied Powers. Crowell's study, while primarily focused on the overall advance of munitions, contained a section on aviation. In his discussion on aircraft production, Crowell reminded his readers, "the primary purpose of war flying is observation."[31]

The experiences of the war had undoubtedly cast a shadow on the lessons learned. With the preponderance of Air Service involvement being airborne ISR and its support of the ground forces, one can understand why the postwar studies focused almost exclusively on that aspect. As mentioned above, there was only one American strategic bombing squadron in service at the end of the war and it had only been active for a few weeks before the Armistice. A strong body of evidence from which a comprehensive postwar evaluation could be conducted was simply nonexistent. Despite the ISR-slanted analyses, little was done to progress ISR doctrine in the years immediately following the war. The golden opportunity for ISR Airmen passed as in 1921, fundamental Air Service thinking began to change.

In Chief of the Air Service Major General Charles Menoher's annual report of 1921, almost buried amongst the mundane information regarding the status of the Air Service, is a section titled, "Air Service Troops."[32] Only comprising three paragraphs, this segment is perhaps the first time in official Air Service documents where one begins to see a doctrinal departure from the airborne ISR and ground forces support mentality. In this brief section, Menoher outlined the differences between the "air service" and what he called the "air force." In his description, the "air service" was to be comprised of the various functions that

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[30] Chase C. Mooney and Martha E. Layman, Assistant Chief of Air Staff, Intelligence Historical Division, Army Air Forces Historical Studies: No. 25, "Organization of Military Aeronautics, 1907-1935," December 1944, 37-38.
[31] Benedict Crowell, *America's Munitions, 1917-1918* (Washington, DC: Government Printing Office, 1919), 254.
[32] Major General Charles Menoher, "Excerpts from the Annual Report of the Chief of Air Service," *Annual Reports, War Department, Fiscal Year Ended June 30, 1921: Report of the Secretary of War to the President, 1921* (Washington, DC: Government Printing Office, 1921), 185.

directly support the ground commander: observation (both visual and photographic), artillery fire adjustment, and infantry contact patrols.[33] The departure from previous Air Service doctrine came in his description of the "air force." This new arm was to contain all the pursuit, bombardment, and attack aviation and would be offensive in nature and independent of the ground commander.[34] Menoher further stated that a properly balanced Air Service would be 20 percent "air service" and 80 percent "air force." This distinction would ultimately put airborne ISR at a disadvantage as the required division of effort would place a much larger emphasis on the development of "offensive" aircraft. This first-of-its-kind delineation would also become the foundational argument for an independent Air Force and was the spark that lit the impending Air Service (and Air Corps) battles for freedom from the Army.

Menoher's monumental declaration stoked a smoldering fire regarding the future of American air power. Already being fueled by independent-minded airmen like Billy Mitchell, Henry "Hap" Arnold, Ira Eaker, and William Sherman, Menoher's statements put the issue of Air Service independence squarely in the spotlight. While aviation had solidified its place in ground armies through its performance in the war, dispute continued over how it should be used in future conflict.[35] In his 1922 annual report, new Chief of the Air Service, Major General Patrick expounded upon Menoher's description of "air force" and "air service" and pleaded the case for an increase in "air force" aircraft and personnel.[36] In a follow-up letter to the Army's Adjutant General, Patrick further detailed his vision of the future by describing a new organizational construct for the Air Service. In his model, observation would be moved up from the division level to the corps level and all other aviation – pursuit, bombardment, and attack – would be commanded by an airman at the General Headquarters (GHQ) level.[37]

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[33] Ibid.
[34] Ibid.
[35] Richard J. Overy, *The Air War, 1939-1945* (Washington, DC: Potomac Books, Inc., 1980), 9.
[36] Major General Mason Patrick, "Annual Report of the Chief of Air Service for Fiscal Year Ending June 30, 1922," 9 September 1922, 8-9.
[37] Major General Mason Patrick, Chief of Air Service, to Major General Robert Davis, Adjutant General, letter, 19 January 1923, in Appendix I of "Report of a Committee of Officers Appointed

Though not enacted at the time, Patrick's plan prompted a flurry of aviation-related debate and, ultimately, legislation. On 2 July 1926, following several years of investigative boards and debate, President Calvin Coolidge signed a bill put forward by the House Committee on Military Affairs.[38] The aptly titled "Air Corps Act of 1926" put into law several of the initiatives for which the Air Service had been fighting. The main provisions of the legislation recognized the Air Corps' coequal status with the other combat branches of the Army, mandated a five-year expansion program in personnel and equipment, directed that only airmen would command air units, and added an Assistant Secretary of War for Air.[39]

Empowered by its newfound autonomy, the Air Corps sought to further put itself on equal ground with the Army's other branches. To do this it needed funding for the Air Corps Act-mandated expansion program which required it to have 1,800 serviceable aircraft, 1,500 officers, and 16,000 enlisted men by the end of 1932.[40] Air Corps leaders – including the new civilian head, F. Trubee Davison, the Assistant Secretary of War for Air – set about lobbying Congress and Army leadership for the funding they needed to equip the units the Air Service had established in the early 1920s.[41] The expansion program was going to be very expensive and, in a zero-sum budgeting world, any increase in Air Corps budgeting could only happen at the expense of the other arms.[42] When asked about the expansion, Major General Fox Conner, the Army Deputy Chief

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by the Secretary of War to Consider in All Details a Plan of War Organization for the Air Service," 27 March 1923, microfilm 2867, 145.93-65, AFHRA.

[38] "An act to provide more effectively for the national defense by increasing the efficiency of the Air Corps of the Army of the United States, and for other purposes," *Statutes at Large*, vol. 44, *The 69th Congress, 1925-1927* (Washington, DC: Library of Congress, 1927), 780-790, The Law Library of Congress, Library of Congress (LOC), Washington, District of Columbia. For future references, I will simply use "The Air Corps Act of 1926."

[39] Martha E. Layman, *Legislation Relating to the Air Corps Personnel and Training Programs, 1907-1939*, Army Air Forces Historical Studies No. 39 (Washington, DC: Army Air Forces Historical Division, 1945), 28-31.

[40] "The Air Corps Act of 1926," 788.

[41] James P. Tate, *The Army and Its Air Corps: Army Policy toward Aviation, 1919-1941* (Maxwell AFB, AL: Air University Press, 1998), 59.

[42] Peter R. Faber, "Interwar US Army Aviation and the Air Corps Tactical School: Incubators of American Airpower," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Phillip S. Meilinger (Maxwell AFB, AL: Air University Press, 1997), 205.

of Staff, remarked that funding the Air Corps would ruin the regular Army "beyond the hope of recovery."[43]

Despite the grumbling of Army officers, the Air Corps received additional funding and began outfitting the organization it believed it required. With airborne ISR still dominating Air Corps doctrine, purchasing the aircraft it needed became the top priority. This proved to be more difficult than anticipated as even though the War Department tasked the Chief of the Air Corps with the procurement of ISR aircraft, the other arms had to approve the specifications of those aircraft.[44] This unwieldly process always delayed the Air Corps' ability to acquire aircraft. As an example, in 1928 the Air Corps identified the need for a twin-engine observation airplane with extended range and increased speed, but it took until 1930 to get the requirement through the cumbersome bureaucratic process.[45]

Further complicating the aircraft acquisition problem was the Air Corps' growing focus on strategic bombing and the intelligence dilemma it created. To conduct strategic bombing effectively, air planners required airborne photography of prospective targets. With airborne ISR still doctrinally tied to the ground forces and inherently short-range in nature, the Air Corps was left with no method by which it could obtain the deep-penetrating photography that it needed for targeting. To rectify the situation, the Air Corps set in motion a series of shrewd doctrinal changes that would ensure it would have an organic capability to acquire the airborne imagery it required.

First, in October 1935, the Air Corps revised the basic observation training regulation to bifurcate observation into long-range and short-range. The updated regulation described short-range observation as three-hour missions with long-

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[43] Quoted in Tate, *The Army and Its Air Corps*, 31.
[44] Futrell, *Command of Observation Aviation*, 4. The other arms received the intelligence information provided by the Air Corps and thus, were allowed to coordinate on the requirements for ISR aircraft. It made good business sense, but considerably delayed the acquisition process.
[45] "Report on General Requirements for a Twin Engined Observation Airplane," in Air Corps Tactical School files, 248.262-8, AFHRA; "Observation Aviation," Air Corps Tactical School textbook, 1 March 1930, 18-33, 248.101-12, AFHRA.

range observation as eight- or ten-hour missions.[46] This doctrinal shift established, for the first time, a clear departure from the established norms. With these changes, Menoher's vision of a separate "air service" and "air force" was put into motion. Short-range observation was to remain the purview of the ground forces and their main source of battlefield airborne ISR, but long-range observation was to belong solely to the Air Corps for the express purpose of conducting deep airborne photographic missions in support of targeting efforts for strategic bombing.[47] To further solidify the demarcation, shortly thereafter, Chief of the Air Corps Major General Benjamin Foulois sent a memorandum to the Army Adjutant General describing the characteristics of the aircraft that would be required for the "air force's" long-range observation mission. The memorandum defines the aircraft's mission as the long-distance reconnaissance reporting on the disposition and activities of hostile ground, air, and naval forces.[48] The requirement for airborne photography of strategic targets had been set, the next step was to acquire the necessary platform.

The requested aircraft was, for the first time, categorized as a "reconnaissance" platform, a move that clearly showed the Air Corps' intent to separate *its* observation from the ground army's.[49] From then on, in official Air Corps communications, "observation" was only used to describe support to ground forces with "reconnaissance" being used to describe ISR for the Air Corps itself.[50] In a final effort to secure long-range reconnaissance, the Air Corps made the decision that the reconnaissance aircraft "could be the same type airplanes

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[46] "Draft of changes for TR 440-15," 15 October 1935, memorandum, in "Military Characteristics for Aircraft: Type Specifications, Experimental, Service Test and Standard, Fiscal Year 1935/1936," 248.211-36, AFHRA.
[47] Lee Kennett, "The US Army Air Forces and Tactical Air War in the Second World War," in *Conduct of the Air War in the Second World War*, ed. Horst Boog (Oxford, UK: Berg Publishers Limited, 1992), 459-460.
[48] Assistant C/AC to TAG, letter, 8 May 1935, RG 342, Container 6883, NARA.
[49] Futrell, *Command of Observation Aviation*, 4.
[50] Future general officer Otto Weyland was particularly enthusiastic about the new delineation in mission. A study he authored at the Air Corps Tactical School (ACTS) lauded the freedom the "reconnaissance" mission would give the Air Corps. Otto P. Weyland, "Training Program for Observation Aviation" (study prepared for the Air Corps Tactical School, Maxwell AFB, AL), 14 May 1938, 248.262-29, AFHRA.

with which bombardment units were equipped…"[51] The quest for a long-range bomber with ever increasing range would also apply to airborne photoreconnaissance.[52] This strategy tied airborne ISR to the strategic bomber's future and was an "all-in" gamble. If the Air Corps did not get the bomber it so desired, its plan for long-range strategic reconnaissance would also fail. It was an incredibly shrewd decision that ultimately paid off. When Boeing delivered the XB-17 in August 1935, it provided exactly what the Air Corps needed to execute its new strategic bombing strategy.[53]

In Europe, war weary, cash-strapped nations experienced many of the same postwar challenges. In Britain, the RAF faced severe economic cuts and a major disagreement with the Royal Navy as it fought to keep its independence.[54] Additionally, Britons, much like their American counterparts, longed for peace and were hesitant to back any significant military growth. As in the United States, demobilization was rapid and hit the RAF particularly hard. Between the Armistice and March 1920, more than 23,000 officers and 227,000 enlisted men were released with only 3,280 officers and 25,000 enlisted men remaining on active duty.[55] Burdened with an expanded empire, Britain desperately sought cost-saving measures while trying to hold on to its vast territories. In a considerable stroke of luck for the RAF, the British chose to rely on the dissuasive effect of air power combined with the nation's vast potential for industrial mobilization.[56] Learning quickly that a combination of aircraft and armored cars was much more cost effective than large numbers of British ground

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[51] Futrell, *Command of Observation Aviation*, 4.
[52] General Frank Andrews, Commander General Headquarters Air Force, to the Army Adjutant General, letter, 22 July 1935, RG 165, War Plans Division file 3748, NARA.
[53] Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941*, USAF Historical Division Study No. 89 (Washington, DC: Office of Air Force History, 1985), 47.
[54] Anthony Cumming, *The Battle for Britain: Interservice Rivalry Between the Royal Air Force and Royal Navy,1909-1940* (Annapolis, MD: Naval Institute Press, 2015), 41-43.
[55] The Royal Air Force, "The Inter-War Years," in *A Short History of the Royal Air Force*, 55, http://www.raf.mod.uk/rafcms/mediafiles/F21C6257_ABD1_7132_E8716B8C2DA98948.pdf (accessed 5 February 2016).
[56] Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Ithaca, NY: Cornell University Press, 1984), 141.

forces, the RAF became instrumental in British colonial operations.[57] From Iraq to South Africa, RAF air power helped the King hold on, at least temporarily, to the vast British Empire.

As had their American counterparts, the RAF was quick to analyze the lessons of the war to determine ways it could help justify its expansion. In January 1919 – less than two months after the Armistice – the Air Ministry published two short summaries of the British air effort during the war.[58] These documents emphasized the contributions of air power towards the overall success and, interestingly, summarized the impact of German strategic bombing on London. The first two analyses were followed by a succession of three additional studies that all outlined the Air Staff's views on the future of the RAF. While each was subtly different, the overall message from the five studies was how air power could, and should, be used to exert strategic influence in future wars.[59]

Despite the strong evidence presented by the RAF's studies, British airmen – like their American counterparts – still found themselves in a fight for their very existence with the Royal Army and Navy. Unlike their competitors, however, the RAF benefited from the recent memories of the German bombing of London during the war. The nightly raids were fresh on Britons' minds and the RAF used those memories to its advantage. The ability to bomb Berlin in retaliation for any future attacks on Britain became one of the RAF's *raison d'etres* and helped ensure its continued existence. To solidify the strategic bombing doctrine, in December 1919, Chief of the Air Staff Air Marshal Hugh Trenchard presented

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[57] For an excellent description of British use of dissuasive air power in Iraq, see Lieutenant-General Sir Aylmer L. Haldane, *The Insurrection in Mesopotamia, 1920* (London, UK: The Imperial War Musuem, reprinted 2005), 300-301.
[58] "Lessons of the 1914-1918 War," TNA, WO 32/3115; "Synopsis of British Air Effort During the War (1919)," TNA, AIR 8/13.
[59] Air Marshal Sir Hugh Trenchard, Chief of Air Staff, to, the Honorable Winston Churchill, Air Minister, memorandum, "Air Power requirements. Post war air force. Air defence. Comparative cost of British and French services. Air Force extension. Separate Air Force," 11 December 1919, TNA, AIR 8/6; Air Marshal Sir Hugh Trenchard, "Aspects of Service Aviation," *The Army Quarterly* 2, no. 3 (April 1921): 10-21; "RAF Operations Manual CD 22," July 1922, TNA, AIR 5/299.

then Air Minister Winston Churchill with his vision for the future of British air power. Trenchard's plan, officially titled the "Permanent Organization of the RAF – Note by the Secretary of State for Air on a Scheme Outlined by the Chief of Staff," but known more commonly as the Trenchard Memorandum, provided the doctrinal basis for Britain's independent air force.[60] In another proclamation similar to that of Menoher, Trenchard outlined four principles for the future conduct of air war: offensive initiative, air superiority, concentration of force, and centralized command and control.[61]

Unlike USAAC airmen in the United States, the RAF was not beholden to the Army, and Trenchard's doctrine reflected that status. Little was said about airborne ISR's support to the ground and, just like their American counterparts, virtually no attention was paid to the simple fact that only airborne photoreconnaissance could provide the targeting information that the RAF strategic bombing force would need. Throughout the 1920s and early 1930s airborne ISR received few airframes and equipment. Airborne photography had reached such a poor state by 1933 that World War I imagery pioneer, V.F.C. Laws declared it "at a dead end."[62] Things began to change that very year, however. Adolf Hitler's appointment as Chancellor of Germany in January of 1933 sent shockwaves through the British government and by the end of the year it had initiated a rapid increase in RAF strength. Orders were placed for advanced airframes for airborne ISR along with requests for improved photographic equipment and training for photo interpreters.

So desperate was the airborne imagery situation for Great Britain that in September 1938 it hired the freelance entrepreneur Sidney Cotton to conduct clandestine airborne photoreconnaissance. Cotton, who had served in the Royal Naval Air Service (RNAS) during World War I, had taken a great interest in

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[60] "The Interwar Years," 52.
[61] Air Marshal Sir Hugh Trenchard, "Air Strategy," Lecture VII, date unknown, transcript in the Lord Trenchard Papers, Royal Air Force Museum London, MFC 76/1/357.
[62] Quoted in Roy Conyers Nesbit, *Eyes of the RAF: A History of Photo-Reconnaissance* (Stroud, UK: Alan Sutton Publishing Limited, 1996), 63.

airborne photography and was one of the world's foremost experts.[63] Through an American contact, Cotton and Squadron Leader Fred Winterbotham of the Air Section of the British Secret Intelligence Service (SIS) obtained a Lockheed 12A civilian airplane which they modified with extra fuel tanks and a high definition camera.[64] Flying under the guise of a bogus company, the Aeronautical Research and Sales Corporation, between March and August 1939, Cotton and his team obtained imagery of many of the German and Italian military outposts in Germany, Tunisia, Libya, and Italy.[65] When the Germans invaded Poland on 1 September 1939, Cotton's Lockheed was over Wilhelmshaven obtaining the most up-to-date information on the disposition of the German fleet.

While relatively short in duration, Cotton's missions had given the RAF great insight into the challenges of conducting airborne ISR in the modern age. As a result, Squadron Leader Maurice 'Shorty' Longbottom authored a summary of Cotton's exploits and provided recommendations to the Air Ministry on the future of photoreconnaissance in the RAF. The report, titled "Photographic Reconnaissance of Enemy Territory in War" but better known simply as the Longbottom Memorandum, proposed that airborne imagery missions should be conducted by single small aircraft which relied on speed, rate of climb, and high ceilings to avoid enemy fighters and antiaircraft defenses.[66] Additionally, Longbottom recommended the new Supermarine Spitfire fighter as the ideal aircraft for the mission. The Air Ministry agreed and after some debate with Air Vice Marshal Hugh Dowding of Fighter Command, Cotton's organization was loaned two Spitfires in October 1939.[67]

Despite the increased emphasis on rearmament, Great Britain, like the rest of the world, had not recovered from the Great Depression, and even the

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[63] "Frederick Sidney Cotton," war record, TNA, ADM 273/7/216.
[64] F.H. Hinsley et al., *British Intelligence in the Second World War*, vol. 1, *Its Influence on Strategy and Operations* (London, UK: Her Majesty's Stationery Office, 1979), 496-499.
[65] Nesbit, *Eyes of the RAF*, 72-76.
[66] Squadron Leader Maurice Longbottom, "Photographic Reconnaissance of Enemy Territory in War," memorandum, 1 August 1939, in *Photographic Reconnaissance, 1914-April 1941,* Vol. I, TNA, AIR 41/6.
[67] Constance Babington-Smith, *Air Spy: The Story of Photo Intelligence in World War II* (New York, NY: Harper & Brothers, 1957), 19-22.

urgency prompted by the impending war could not make the British industrial machine churn any faster. Thus, in the early stages of the war, the British conducted its airborne imagery operations using modified Bristol Blenheim and Westland Lysander observation airplanes.[68] When the Germans attacked in May 1940, the British Expeditionary Force (BEF) in France had five squadrons of Lysanders for tactical reconnaissance and four Blenheim squadrons for strategic reconnaissance.[69] As Longbottom had warned, the British quickly learned that modern fighter planes and antiaircraft artillery (AAA) would decimate these slow, lumbering aircraft. With this realization, the British wholeheartedly backed the recommendations of the Longbottom memorandum and began to pursue high-altitude, high-speed IMINT aircraft and by 1941 they were using Spitfires to conduct the preponderance of their airborne IMINT missions.[70]

For the Germans, the restrictions imposed by the Treaty of Versailles handcuffed military aircraft development during the 1920s. Forbidden from maintaining an air force, the Germans instead developed a state-of-the-art civilian aviation industry which they deftly used to mask military manufacturing efforts.[71] This allowed them to overtly build aircraft within the mandate of the Versailles Treaty and positioned them well for the rearmament period following Hitler's 1935 establishment of the Luftwaffe.[72] These efforts – along with secret aircraft training and testing in Russia – simplified the process of creating a war-ready air organization under the Nazis.[73] At its birth, despite the Versailles

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[68] Alfred Price, *The Spitfire Story* (London, UK: Arms and Armour Press, 1995), 93.
[69] Hilary Aidan St. George Saunders and Denis Richards, *Royal Air Force, 1939-1945: The Fight at Odds*, vol. I (London, UK: Her Majesty's Stationery Office, 1953), 108.
[70] Ibid.; Martin Bowman, *Mosquito Photo-Reconnaissance Units of World War Two* (Oxford, UK: Osprey Publishing, 1999), 7.
[71] Edward M. Homze, *Arming the Luftwaffe: The Reich Air Ministry and the German Aircraft Industry 1919-1939* (Lincoln, NE: University of Nebraska Press, 1976), 65-68.
[72] Lieutenant Colonel Leslie H. Arps and Lieutenant Colonel Frank V. Quigley, "The Origin, Development, and Organization of the German Air Ministry and the Luftwaffe," memorandum, 1 October 1945, 570.04-1, AFHRA.
[73] For details on German aircraft training in Russia, see James S. Corum, *The Luftwaffe: Creating the Operational Air War, 1918-1940* (Lawrence, KS: University Press of Kansas, 1997), 115-118.

Treaty restrictions, the Luftwaffe had approximately 1,000 aircraft and 20,000 airmen.[74]

In addition to aircraft production, the Germans advanced their air power doctrine. Almost immediately following the war, Army Chief of Staff Colonel General Hans von Seeckt led a thorough study of the war and implemented adjustments to German warfighting doctrine.[75] A significant air-minded thinker, von Seeckt tracked the developing air theories of Billy Mitchell, Hugh Trenchard, and J.F.C. Fuller and ensured the ideas were circulated amongst the other air power thinkers in the German military.[76] In 1926, the Reichswehr Air Staff, led by Major General Helmuth Wilberg, published a new, comprehensive air doctrine titled "Directives for the Conduct of the Operational Air War."[77] In another doctrinal demarcation strikingly similar to Menoher's proclamation of 1921, the "Directives" divided the air force into two forces – one that would provide direct support to the army and a second that would conduct strategic bombing and long-range reconnaissance.[78]

During the next decade, German airmen refined their doctrine and in 1935 published Luftwaffe Regulation 16 (Conduct of the Air War). The new doctrine called for the use of the air weapon in concert with German political grand strategy and reflected the thinking of then Luftwaffe Chief of Staff Walther Wever.[79] This doctrinal shift was substantial for airborne ISR as it reiterated the importance of aircraft support to the ground commander. Whereas the "Directives" seemed to be leading the Luftwaffe clearly down a strategic bombing path, Wever's doctrinal proclamation more accurately reflected German

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[74] Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II,* vol. 1, *Plans and Early Operations, January 1939 to August 1942* (1948; new imprint, Washington, DC: Office of Air Force History, 1983), 87.
[75] Bruce Condell and David T. Zabecki, eds., *On the German Art of War: Truppenführung* (Boulder, CO: Lynne Rienner Publishers, 2001), 3.
[76] James Corum, *The Roots of Blitzkrieg* (Lawrence, KS: University Press of Kansas, 1992), 157-159.
[77] Corum, *The Luftwaffe*, 81.
[78] Ibid.
[79] Williamson Murray, *Strategy for Defeat: The Luftwaffe, 1933-1945* (Maxwell AFB, AL: Air University Press, 1983), 8.

capabilities at the time. While Wever was a strategic bombing advocate, he also knew the German aircraft industry was then incapable of producing heavy bombers with the range necessary to conduct lengthy strategic bombing campaigns.[80] For airborne ISR, this decision placed greater emphasis on tactical photoreconnaissance and air-to-ground communications.

From the outset of rearmament, airborne IMINT had been an important priority for the Germans. Before the Luftwaffe became an official organization, Theodor Rowehl, a civilian employee of the Abwehr, was already conducting covert airborne photoreconnaissance flights of Polish fortifications along the Germany-Poland border.[81] Throughout the early 1930s, Rowehl flew imagery sorties against Germany's neighbors using a heavily modified Junkers 34 transport aircraft. In missions over Poland, the Soviet Union, Czechoslovakia, and France, Rowehl was able to photograph naval bases, industrial areas, fortifications, and even French engineer work on the Maginot Line.[82] In 1936, Commander-in-Chief of the Luftwaffe Hermann Göring gave Rowehl command of the Squadron for Special Purposes and outfitted the unit with high-quality personnel, aircraft, and equipment.[83] Equipped with the state-of-the-art Heinkel (He) 111, Rowehl's unit added Great Britain to its list of targets. Disguised as a commercial passenger aircraft, the Squadron for Special Purposes' He 111 provided detailed images of potential bomber targets across Great Britain including armament factories, harbors, fortifications, and lines of communication.[84] The squadron's products comprised the preponderance of the Luftwaffe's targeting data and were instrumental to its early successes in the war.

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[80] John Hiden, *Republican and Fascist Germany: Themes and Variations in the History of Weimar and the Third Reich, 1918-1945* (London, UK: Longman Publishing, 1996), 234.
[81] Jeffrey T. Richelson, *A Century of Spies: Intelligence in the Twentieth Century* (New York, NY: Oxford University Press, 1997), 96.
[82] David Kahn, *Hitler's Spies: German Military Intelligence in World War II* (New York, NY: Collier Books, 1985), 116.
[83] Richelson, *A Century of Spies*, 96.
[84] Kahn, *Hitler's Spies*, 118.

In 1938, the Commander-in-Chief of the German Army, Generaloberst Wernher Freiherr von Fritsch famously stated, "The military organization that has the best photographic intelligence will win the next war."[85] German aviation production during the late 1930s supported Fritsch's statement as the Henschel (Hs) 126, the He 45, the He 46, and the Dornier (Do) 17 were custom built for photoreconnaissance.[86] As had the Americans, the Germans divided airborne ISR into long-range squadrons (Fernaufklärungsgruppe (FAG)) for strategic photoreconnaissance and short-range (Nahaufklärungsstaffeln) to support the ground forces.[87] The He 45, He 46, and Hs 126 were ultimately designated for short-range while the Do 17 handled the long-range missions.[88]

As the rearmament period turned to war in 1939, German ISR aircraft production continued. Searching for a more survivable platform, in 1940, Germany began development of the Junkers (Ju) 86P.[89] The Ju 86P was a modified Ju 86 with an expanded wing span and, by 1941 had demonstrated an operating altitude of over 47,000 feet – far higher than any Allied interceptor aircraft could reach.[90] As with other leading-edge German aircraft design, however, the Ju 86P fell victim to the Nazis' mismanagement of the entire aircraft production process.[91] Ultimately, the Germans settled on the Focke-Wulf (Fw) 189 for short-range reconnaissance and the Ju 88 and later Ju 188 for long-range operations.[92]

In France after World War I, the gutting of the *Armée de l'Air* was rapid. In the decade following the end of the war, the number of fighter squadrons fell

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[85] Quoted in Geoffrey J. Thomas and Barry Ketley, *Luftwaffe KG 200: The German Air Force's Most Secret Unit of World War II* (Mechanicsburg, PA: Stackpole Books, 2015), 1.
[86] Corum, *The Luftwaffe*, 162.
[87] Chris McNab, *Hitler's Eagles: The Luftwaffe, 1933-1945* (Oxford, UK: Osprey Publishing, 2012), 61.
[88] Thomas and Ketley, *Luftwaffe KG 200*, 4-5.
[89] Antony L. Kay, *Junkers Aircraft and Engines, 1913-1945* (Annapolis, MD: US Naval Institute Press, 2004), 142.
[90] Ibid., 143.
[91] Murray, *Strategy for Defeat: The Luftwaffe*, 13 and 101.
[92] James S. Corum and Richard R. Muller, *The Luftwaffe's Way of War: German Air Force Doctrine, 1911-1945* (Baltimore, MD: The Nautical & Aviation Publishing Company of America, 1998), 220.

from 83 to 32 with ISR squadrons dropping from 145 to 60.[93] As with most other nations, the elation of peace fostered pacifism in the French people and government. A spirit of fatalism also prevailed as many believed – correctly – that the Germans had not truly been defeated and another war was inevitable. Arguably the world's premier air force at the end of the war, the French paid scant attention to furthering air power doctrine in the years that followed. Despite the French Air Force gaining independence from the Army in July 1934, French military doctrine continued to view airborne ISR as primarily a supporting force for the infantry.[94] Just like their American and British counterparts, French airmen used the strategic bombing principles of Giulio Douhet as justification to distance themselves from the Army while devoting scant time to developing the airborne ISR that would enable effective targeting.[95] In 1936, then Air Minister Pierre Cot furthered the derogation of French airborne ISR when he initialized his "Plan II" for air force rearmament.[96] Aligning with the Douhetian line of thinking, "Plan II" gave the highest priority to bomber production while minimizing fighter and ISR aircraft production.[97]

Despite the minimization of airborne ISR, France recognized the imminent threat to its east. After losing most of its spy network in the early days of the Nazi regime, France was desperate for intelligence. With human intelligence (HUMINT) denied, it turned to airborne ISR. In 1936, in coordination with the British SIS, it initiated an airborne photoreconnaissance program that provided

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[93] Faris R. Kirkland, "The French Air Force in 1940: Was It Defeated by the Luftwaffe or by Politics?" in *Air University Review* (September-October 1985), http://www.airpower.maxwell.af.mil/airchronicles/aureview/1985/sep-oct/kirkland.html (accessed 9 February 2016).
[94] Craven and Cate, *The Army Air Forces in World War II,* vol. 1, *Plans and Early Operations*, 91.
[95] Charles Christienne and Pierre Lissarague, *A History of French Military Aviation* (Washington, DC: Smithsonian Institute Press, 1986), 259.
[96] Robert A. Doughty, "The French Armed Forces, 1918-40," in *Military Effectiveness*, vol. 2, *The Interwar Period*, eds. Allan R. Millet and Williamson Murray (New York, NY: Cambridge University Press, 2010), 51.
[97] Julian Jackson, *The Fall of France: The Nazi Invasion of 1940* (Oxford, UK: Oxford University Press, 2003), 17. For more on French interwar air doctrine, see Anthony Christopher Cain, *The Forgotten Air Force: French Air Doctrine in the 1930s* (Washington, DC: Smithsonian Institution Scholarly Press, 2002).

imagery of the German fortifications along the French-German border.[98] Both nations used the imagery to help assess the German threat with the British – who were much better equipped for the mission – taking the lead as the 1930s waned. Subsequent British airborne photomapping missions, led by Sidney Cotton, provided accurate intelligence regarding German movements and preparations all across western Germany in early spring 1939.[99] As with the French flights, the British shared their images thus providing the French with some insight into German intent.

Unfortunately, it was too little, too late. Cot's program was slow to develop and when war came to France in May 1940, the French Air Force was deficient in every aspect. They had not developed doctrine for the few new aircraft they had acquired and their neglect of airborne ISR prevented them from fully appreciating the extent of the German invasion. As a result, the Luftwaffe dominated the French Air Force and held air superiority during the entire six-week campaign. Pacifism, an incoherent strategy, fatalism, and a general lack of focus had turned *l'Armee de l'Air* into little more than an inconvenience for the German invaders.

The Soviets faced unique challenges as they developed their air power doctrine during the interwar years. Having left the First World War early due to the Bolshevik Revolution, the new Soviet Union found itself entangled in internal problems and uprisings for the first several years of the 1920s. Soviet use of air power during this time was more a result of necessity than calculated doctrine. A 'Special Purpose Aviation Group' was formed of 15 Sikorsky four-engine Ilya Muromet bombers, but its use was fragmented and had little effect on the overall outcome.[100] Like most of the other nations, airborne ISR still comprised the majority of the fledgling Soviet Air Force's mission and it remained doctrinally tied to the ground forces. This began to change following the Civil War when the brilliant Russian commander and military theorist Mikhail Tukhachevskii

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[98] Hinsley, *British Intelligence in the Second World War*, 28.
[99] Nesbit, *Eyes of the RAF*, 72.
[100] James Sterrett, *Soviet Air Force Theory, 1914-1945* (London, UK: Routledge, 2007), 6-7.

commented on the necessity to separate the air force from the army to ensure maximize efficiency.[101]

During the 1920s, the Soviets faced the same financial problems as the rest of the world. The First World War and the Civil War had left little money in the Soviet treasury and its industry was also nearly non-existent. Despite this, they were painfully aware of the need for a strong defense. To rebuild, they dedicated as much of their budgets as possible to the military and to aviation in particular. The Five-Year Plan of 1928 allocated ten percent of the entire budget to defense and was the impetus for the rebirth of Soviet air power.[102] Following the inject of funding, the Soviet Air Force slowly began to grow. In addition to the already obtained Nikolai Polikarpov-designed R-1 reconnaissance aircraft, the Soviets ordered additional copies of Andrei Tupolev's R-3.[103]

With the existing R-1s and new R-3s, the Soviets had modern aircraft that they could rely on for airborne observation. In August 1929, both were put to operational use in a crisis with China over control of the Chinese Eastern Railway.[104] To prevent Chinese raids into Soviet territory, the USSR created a Special Far Eastern Army and assigned it 65 aircraft to provide airborne ISR and artillery spotting. Throughout the conflict, the R-1s and R-3s provided situational awareness to the commander, Marshall Vasily Blyukher, and directed artillery fire. The success in the Far East provided Soviet ground commanders confidence in airborne ISR and helped form the air-ground cooperation doctrine of the 1930s. As war with Germany loomed, Soviet war doctrine evolved with airborne ISR remaining an integral part of the Red Army's planning. Aircraft also improved and by the mid-1930s the Polikarpov R-5 series had replaced all other

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[101] Ibid.
[102] Lennart Samuelson, *Plans for Stalin's War Machine: Tukhachevskii and Military-Economic Planning, 1925-1941* (London, UK: Macmillan Press Ltd., 2000), 74-77.
[103] ANT-3 was Tupelov's designation for the aircraft; when it came into service in the Soviet Air Force, it was redesignated R-3.
[104] Henry Wei, *China and Soviet Russia* (Princeton, NJ: Von Nostrand Co., 1956), 87.

types as the Soviet Air Force's standard airborne photoreconnaissance and observation aircraft.[105]

On the other side of the Pacific, Japan spent the years following the Russo-Japanese War struggling to develop a coherent air doctrine. They had been impressed with the Russian use of balloons for ISR during the Siege of Port Arthur, but were unable to develop their own capability. Additionally, there was great disagreement between the Imperial Japanese Army and Navy about which service should control aviation with both ultimately retaining their own air arms. This separation splintered aviation development as the two services could not even agree on their most likely enemy; the Army believed it to be the Soviet Union while the Navy focused its training and doctrine on the United States.[106] For airborne ISR, the doctrinal debate paralyzed aircraft acquisition with it being 1935 before the Army submitted its first requirement for a purpose-built ISR aircraft. In May 1937, it began receiving the Ki-15-I or Army Type 97 Command Reconnaissance Plane Model 1 and almost immediately put it into service in the war against China.[107] When the upgraded Ki-15-II was put into production, the Japanese Navy ordered 20 for long-range coastal reconnaissance. These aircraft, along with the Mitsubishi Ki-46 served both services throughout the war.

Because the Japanese never fully developed a strategic bombing doctrine, most of their airborne ISR was used in a tactical role to directly support either ground or navy commanders. The Army's Ki-46 was upgraded with cameras for photoreconnaissance, but this was late in the war and had little operational impact.[108] For the Imperial Japanese Navy (IJN), carrier-based ISR was a fundamental part of naval growth during the interwar years. Search and reconnaissance from the IJN's first carrier, the *Hōshō*, was designed to protect

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[105] Robert Jackson, *Army Wings: A History of Army Air Observation Flying, 1914-1960* (Barnsley, UK: Pen & Sword Aviation, 2006), 70.
[106] Osamu Tagaya, "The Imperial Japanese Air Forces," in *Why Air Forces Fail: The Anatomy of Defeat*, eds. Robin Higham and Stephen J. Harris (Lexington, KY: University Press of Kentucky, 2006), 178.
[107] René J. Francillon, *Japanese Aircraft of the Pacific War* (London, UK: Putnam & Company Ltd., 1979), 149.
[108] Mark H. Lewis, *The Sun Will Rise!: Air War Japan 1946*, vol. 3 (Gordon, Australia: Xlibris Publishing, 2015), 239.

the fleet and locate targets for offensive naval aviation.[109] For this mission, the Japanese developed several carrier-launched observation aircraft. As the war progressed, however, ISR aircraft were increasingly left at shore to save additional space on the carriers for attack aviation. This neglect of airborne ISR development would haunt the IJN as it would struggle late in the war to find targets for its torpedo, bomber, and Kamikaze aircraft.

Thus the stage was set for war. The major powers had struggled to develop air power doctrine and ISR aircraft during the interwar period, but each had ultimately overcome either the interservice disagreements or doctrinal debates sufficiently to allow them to acquire the aforementioned capabilities. Most feared war was coming, and Germany and Japan knew they would launch the first salvos. For France and Great Britain, the threat was palpable and desperately close. This awareness accelerated the buildup in Britain, but did not help matters in France. By the late 1930s, Great Britain's plight was so desperate that it turned to a civilian aviator for its airborne ISR needs. In the United States, the struggles for Air Corps independence led airmen down a path that 'assumed' airborne ISR would be available. The strategic bombing visionaries had won their argument during the late 1930s and aircraft such as the B-17 and B-24 were ordered. All would soon find out if their interwar planning had been sufficient.

When Germany launched its attack on Poland on 1 September 1939 it was clearly the nation that had best evolved its interwar air power doctrine for the war it expected to fight. German air power theory was more comprehensive than that of the other nations as it was not singularly focused on strategic bombing or support to ground forces; the Germans possessed a comprehensive doctrine that enabled significant operational flexibility.[110] They also used airborne ISR to great effect in the early stages of the *blitzkrieg* campaigns in Poland and France. Airborne reconnaissance – both photographic and visual observation – missions provided deep looks into the areas in which the German ground forces were

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[109] Mark R. Peattie, *Sunburst: The Rise of Japanese Naval Air Power, 1909-1941* (Annapolis, MD: Naval Institute Press, 2001), 47.
[110] Corum, *The Luftwaffe*, 284.

attacking.[111] Ranging far in front of the advancing troops, airborne ISR was the new eyes of the infantry. German airborne reconnaissance gave Wehrmacht leadership the confidence it needed to adjust operations to ensure maximize advantage. Additionally, the Germans had advanced air-to-ground communications considerably during the interwar years. Radios for voice and Morse were installed in every aircraft which enabled airborne reconnaissance aircraft to relay what they were seeing in near real-time.[112] The close work of airborne ISR and the German ground forces certainly enabled the quick victories that were to shock the world in the first months of the war.

As opposed to the Germans, the French and British were paralyzed by their lack of interwar air power doctrinal evolution. When blitzkrieg struck France in May 1940, neither the RAF nor the *Armee de L'Air* could do anything to stop the German advance. Fulfilling the interwar prophesies of Douhet, Trenchard, and Mitchell, the Luftwaffe quickly gained air superiority by destroying much of the British and French air forces while they were still on the ground.[113] Allied inability to provide airborne ISR left commanders virtually blind to German moves and contributed to the Wehrmacht's quick domination in Western Europe. The Germans took France in only six weeks and the British humiliation was complete following the BEF evacuation from Dunkirk in June.

Following the 'Miracle of Dunkirk,' the RAF was seen as the United Kingdom's sole capability to take the war to Germany. As such, Churchill used the prewar promise of strategic bombing as his primary rationale to dissuade those who sought an early peace treaty with Germany.[114] With this chosen

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[111] Robert Michael Citino, *The Path to Blitzkrieg: Doctrine and Training in the German Army, 1920-1939* (London, UK: Lynne Rienner Publishers, Inc., 1999), 225.
[112] Air-to-ground communications between airborne ISR aircraft and the ground were greatly enhanced by the creation of the *Schwerer Panzerfunkwagen (Sd Kfz 263)*. The Sd Kfz 263 had direct communications with the aircraft and was present at most German headquarters units. Nigel Askey, *Operation Barbarossa: The Complete Organisational and Statistical Analysis*, vol. IIA (London, UK: self-published by Nigel Askey, 2013), 86-87.
[113] Alistair Horne, *To Lose a Battle: France 1940* (London, UK: Penguin Books, 1969), 247; David Griffin, "The Battle of France 1940," *Aerospace Historian* (Fall 1974): 144-153.
[114] Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: The Evolution of British and American Ideas about Strategic Bombing, 1914-1945* (Princeton, NJ: Princeton University Press, 2002), 186.

course of action, Churchill instituted a massive expansion of Bomber Command.[115] While this move would ultimately result in Bomber Command's acquisition of state-of-the-art aircraft to conduct strategic bombing and intelligence collection, in June 1940, the RAF was still primarily outfitted with outdated Bristol Blenheim bombers for strategic reconnaissance and the lightweight Westland Lysander for tactical reconnaissance.[116] Additionally, the efforts of Cotton notwithstanding, the British had not developed any specialized airborne ISR units or an organization for the systemic interpretation of airborne photographs.[117] This lack of prewar preparation left the RAF with a completely inadequate ability to conduct targeting and battle damage assessment (BDA) – two absolutely critical functions to the accomplishment of effective strategic bombing.

Despite this shortfall, the British simply had to go to war with the capability they possessed and they put the Blenheim and Lysander over hostile territory to search for targets. Unfortunately, their prewar fears regarding the use of slow, lightly armed aircraft as ISR platforms were quickly realized. Of 89 Blenheim IMINT missions conducted over Germany in the first eighteen months of the war, 16 were shot down and half of the others did not produce suitable imagery as a result of faulty equipment and the evasive actions undertaken by the aircraft to avoid enemy fighters and flak.[118] The Lysander fared little better, with 60 aircraft either shot or forced down.[119] These atrocious losses helped convince the British of the need for strong fighter escort, both for airborne ISR

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[115] David Reynolds, "Churchill and the British Decision to Fight On in 1940: Right Policy, Wrong Reasons," in *Diplomacy and Intelligence During the Second World War*, ed. Richard Langhorne (Cambridge, UK: Cambridge University Press, 1985), 156-157.
[116] Taylor Downing, *Spies in the Sky: The Secret Battle for Aerial Intelligence During World War II* (London, UK: Hatchette Digital, 2011), 34.
[117] Sebastian Cox, "Sources and Organisation of RAF Intelligence and its Influence on Operations," in *The Conduct of the Air War in the Second World War*, ed. Hoorst Boog (Providence, RI: Berg Publishing, 1992), 555-559.
[118] Robert S. Ehlers, Jr., *Targeting the Third Reich: Air Intelligence and the Allied Bombing Campaigns* (Lawrence, KS: University Press of Kansas, 2009), 87.
[119] Ibid.

aircraft and for bombers. In the meantime, the RAF would have to rely on Cotton's Spitfires to provide the photomapping it needed.[120]

While the British and French learned the first bitter lessons of modern aerial combat, USAAC intelligence slumbered. A few officers, including Captain Robert Oliver of the Air Corps Tactical School (ACTS), realized the need for enhanced air intelligence to support strategic bombing, but other than Oliver's lectures at ACTS, precious little had been done within the Air Corps to prepare the service for war and it would be well into 1940 before any substantial effort was made.[121] In November of that year, Chief of the Air Corps General Henry "Hap" Arnold established the Intelligence Division under the Office of the Chief of Air Corps.[122] This move allowed Arnold to greatly expand the number of intelligence officers in the Air Corps and also gave him the ability to hire civilian experts. The change, however, prompted little real action. Intelligence leadership debated concepts and created a theoretical architecture that would allow them to provide support to both the ground army and the Air Corps, but without additional funding – which remained scarce at this stage – their plans remained just that.

Until 20 June 1941 and the creation of the United States Army Air Forces (USAAF), the Air Corps Intelligence Division remained subordinate to the Army G-2. With independence, the newly established Assistant Chief of Air Staff, Intelligence (ACAS A-2) sought greater autonomy from the Army. Arnold's first A-2, Brigadier General Martin Scanlon, believed the A-2 should provide the USAAF with all the intelligence necessary to conduct air operations.[123] After having been denied access to intelligence by the War Department General Staff G-2 on several occasions, Scanlon's deputy, Colonel R.C. Candee concluded, "It

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[120] Alfred Price, *Targeting the Reich: Allied Photographic Reconnaissance over Europe, 1939-1945* (London, UK: Greenhill Books, 2003), 9-10.
[121] Robert C. Oliver, "Military Intelligence MI-1-C" (lecture, ACTS, Maxwell AFB, AL, 3 April 1939), 248.5008-1, AFHRA.
[122] Bruce W. Bidwell, *History of the Military Intelligence Division, Department of the Army, General Staff: 1775-1941* (Westport, CT: Praeger Publishing, 1986), 305.
[123] Victor H. Cohen, "History of the Military Intelligence Division, 7 Dec 41-2 Sep 45: A Critical Review," (unfinished and undated manuscript), 45, 170.22, AFHRA; Scanlon's thoughts on the purpose of the USAAF A-2 were validated seven years later in the Key West Agreement of 1948.

is apparent that all restrictions which tend to limit the reliability and efficiency of the Air Intelligence Division should be removed."[124] Arnold agreed and directed Scanlon to determine the best method by which the USAAF could become a viable intelligence producer. Scanlon faced considerable resistance from the Army G-2, but ultimately negotiated several agreements that allowed the USAAF A-2 to conduct its own intelligence operations and begin establishing a mechanism to support both of its customers – air and ground forces.[125]

With freedom from the Army G-2 secured, the USAAF began building its air intelligence structure. Earlier in 1941, after prompting from the team building the Air Corps' first air war plan, the A-2 staff realized that it had precious little data on Germany and no reliable method to obtain updated information. As a result, Arnold sent a series of observers to Great Britain to obtain any intelligence the British were willing to share on the German industrial system and to learn anything they could about airborne IMINT operations. The first of these observers was Major Charles P. Cabell. Spending approximately three months in England from late February to May 1941, Cabell's observations established the basic airborne IMINT fundamentals that the USAAF would follow throughout the war and beyond.[126] In a theme that would recur throughout the war and carries on even today, British cooperation was nearly without reservation. Cabell remarked that the British had "thrown open" all the doors to their program and their secrets.[127] Fortunately for the USAAF, Cabell took full advantage of his unfettered access. In visits to Cotton's Photographic Reconnaissance Unit (PRU) at RAF Benson in Oxfordshire, he learned the concept of using high-speed, high-

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[124] R.C. Candee, Chief, Intelligence Division, to General Arnold, Chief of the Air Corps, "Intelligence Division, OCAC," memorandum, 11 July 1941, 203-6, volume V, part 2, document 253, AFHRA.
[125] Thomas A. Fabyanic and Robert F. Futrell, "Early Intelligence Organization in the Army Air Corps," in *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*, ed. John F. Kries (Washington, DC: Air Force History and Museums Program, 1996), 46.
[126] Charles P. Cabell, "Final Report of Military Air Observer to Great Britain," 7 April 1941, 1, 168.7026-2, AFHRA.
[127] Charles P. Cabell, *A Man of Intelligence: Memoirs of War, Peace, and the CIA*, ed. Charles P. Cabell Jr. (Colorado Springs, CO: Impavide Publications, 1997), 22.

altitude fighter aircraft for reconnaissance purposes.[128] While visiting the Photographic Interpretation Unit (PIU) at RAF Medmenham in Buckinghamshire, Cabell began to appreciate the need for well-trained, professional photo interpreters.[129] As a result, his after-action report included multiple recommendations for the USAAF: to build a separate organization to oversee IMINT functions, to establish a technical training school to train both photo interpreters and IMINT intelligence officers, and to establish intelligence groups to oversee IMINT operations.[130] Speaking to the great trust General Arnold placed in Cabell, the USAAF incorporated all of Cabell's recommendations without reservation.[131]

While Cabell's visit had helped set in motion the creation of a viable USAAF air intelligence structure, it did little to solve the immediate problem of obtaining updated targeting information on Germany. For this mission, Arnold dispatched Major Haywood Hansell. In July 1941, Hansell arrived in Great Britain for the express purpose of bringing home any intelligence that would help the USAAF's strategic bombing planning efforts. As they had for Cabell, the British welcomed Hansell with open arms and granted him near unrestricted access to their files on the Luftwaffe, German aircraft and engine production, and the German transportation system.[132] In return, Hansell provided the British with intelligence on the German power grid and on German petroleum and synthetic products.[133] At the end of his trip, Hansell brought home nearly a ton of

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[128] Charles P. Cabell, "Aerial Photography: Organization and Operation of Photographic Reconnaissance Unit Number One, Benson, England," Report No. 42413, 21 February 1941, 168.7026-2, AFHRA.
[129] Charles P. Cabell, "Interpretation of Aerial Photographs," Report No. 42415, 21 February 1941, 168.7026-2, AFHRA.
[130] Cabell, "Final Report of Military Air Observer to Great Britain," 2.
[131] Ehlers, *Targeting the Third Reich*, 80. As further testament to his quality, Cabell went on to become the Air Force's first four-star intelligence officer and retired after serving nine years as the Deputy CIA Director.
[132] Haywood S. Hansell, Jr., *The Air Plan That Defeated Hitler* (Atlanta, GA: Higgins-McArthur/Longino & Porter, Inc., 1972), 52.
[133] Ibid. The source of the American information on these targets is unclear.

documents to assist the Air War Plans Division (AWPD) with the building of the United States' first strategic bombing war plan.[134]

The third USAAF officer to visit Great Britain was Major D.W. Hutchinson. In October 1941, he traveled to England to expand on the information Cabell had obtained and to work closely with the British on details for an American Air Intelligence School.[135] Hutchinson's trip solidified the importance of airborne IMINT. During his visit, he also visited the PRU and PIU where he learned the seriousness of the British dearth of targeting information on Germany. In his after-action report, he stated, "…the British estimate that over 80 percent of their intelligence comes from aerial photographs."[136] While Cabell's report had caused significant discussion and policy creation in the A-2, Hutchinson's visit impelled action. Almost immediately upon his return, the USAAF created its first Air Intelligence School at College Park, Maryland, to train photo interpreters and officers.[137]

In addition to the Air Intelligence School, Hutchinson's recommendations prompted the USAAF to undertake a major effort to develop an aircraft suitable for airborne IMINT. Having failed at earlier attempts to develop an indigenous platform, in mid-1941, the USAAF began to seriously evaluate the success of the British Mosquito – to the extent that the USAAF eventually used the type in its own squadrons.[138] Cabell's recommendations and Hutchinson's opinions solidified the USAAF decision to pursue its own high-altitude, high-speed fighters as reconnaissance aircraft.[139] The achievements of the twin-engine Mosquito prompted the USAAF to look for a twin-engine aircraft to emulate the Mosquito's speed, maneuverability, and high-altitude capability. Fortuitously, the Lockheed P-38 Lightning was already in wide production and was an airplane

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[134] Haywood S. Hansell, Jr., *The Strategic Air War Against Germany and Japan: A Memoir* (Washington, DC: U.S. Government Printing Office, 1986), 24.
[135] D.W. Hutchinson, "Central Interpretation Unit Training," 27 October 1941, I-2, 168.7026-2, AFHRA.
[136] Ibid.
[137] Ehlers, *Targeting the Third Reich*, 84.
[138] Roy M. Stanley, *World War II Photographic Intelligence* (New York, NY: Charles Scribner's Sons, 1981), 83.
[139] Charles P. Cabell, *A Man of Intelligence*, 22.

that could be easily converted for a reconnaissance role. With the platform identified, the USAAF quickly began an airborne ISR modification program that converted the P-38E into the F-4.[140] The F-4 was successful throughout the war and was the only United States airborne ISR platform with a philosophical tie to future airborne IMINT platforms; it was unarmed and depended on its speed and high altitude to keep it safe.[141] The USAAF finally had a purpose-built airborne ISR platform. Production was rapid and the F-4, along with its follow-on variant the F-5, became the work horse for American airborne IMINT during the war. Other platforms were used, including the P-51, B-17, B-25, and B-29, but none rivaled the F-4's capability. Having secured one leg of the airborne intelligence collection triad, the USAAF now shifted its focus to the other two, ELINT and COMINT.

As militaries modernized and their operating areas extended, the use of radio signals to communicate became ever more widespread. An enduring challenge that had long limited the effectiveness of airborne ISR, two-way radio communications had evolved significantly during the interwar period and had become standard equipment in aircraft by the time the Second World War began. Modern militaries' reliance on radio communications would be a major force enhancer but also created vulnerability for the nation who did not properly secure its communications.[142] As an observer during the Battle of Britain, then Colonel Carl Spaatz learned to appreciate the value of SIGINT from his observations of British practice.[143] Upon his return to the United States, he advocated for the development of a similar USAAF capability. Time was not on the USAAF's side, however, and as its first Airmen began arriving in Great Britain in 1942, they brought with them little general intelligence capability and no SIGINT collection capacity. In a report discussing SIGINT operations in North

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[140] "The Fork-Tailed Devil," *Flying Magazine* 37, no. 2 (August 1945): 26-28 and 124-126.
[141] Charles P. Cabell, *A Man of Intelligence*, 22.
[142] R. A. Ratcliff, *Delusions of Intelligence: Enigma, ULTRA, and the End of Secure Ciphers* (New York, NY: Cambridge University Press, 2006), 215.
[143] David R. Mets, *Master of Airpower: General Carl A. Spaatz* (Novato, CA: Presidio Press, 1988), 110.

Africa, Signal Corps Colonel Harold Hayes stated, "Prior to the arrival of US troops in the British Isles, little was known about the operation of signal intelligence in the field. Signal radio intelligence companies had been activated and trained…but lacking [*sic*] the ability to perform against enemy combat radio nets, no actual experience in, nor even clear conception of the possibilities of signal intelligence…"[144] For the early part of the war, much like IMINT, the United States would rely on the British for SIGINT support and training.

In early February 1942 when Brigadier General Ira Eaker arrived in Britain to establish American operations, he brought a total of two intelligence officers with him, Major Harris Hull and Captain Carl Norcross.[145] For over a month Hull and Norcross were the only members of what would become the Eighth Bomber Command intelligence staff.[146] Despite their lack of resources, the two set out diligently to establish a working relationship with the British. As the two nations had previously agreed to exchange all military intelligence, the British lived up to their part of the agreement and were extremely forthcoming with intelligence information and technical procedures.[147] Hull and Norcross were granted unencumbered access to the majority of the British intelligence enterprise. Years later, Norcross commented, "I often think if the RAF had arrived in Alaska to help us out against the Japanese, it would be most unlikely that we would be as generous with our materials and help as the British were with us."[148] Eaker added, "They [the British] turned over to us all of their experience; they kept no secrets. I don't believe there was ever a more thoroughly cooperative effort in warfare than the RAF…and our tiny but growing US air effort…in the years '42 and '43."[149] The nascent relationship was blossoming, but for the USAAF to truly

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[144] Colonel Harold Hayes, "Lessons Learned from the Operation of Signal Intelligence in the North African Theater of Operations," memorandum, to Assistant Chief of Staff G-2, War Department, Historic Cryptographic Collection, RG 457, Box 949, NARA.
[145] Robert F. Futrell, "US Army Air Force Intelligence," in *Conduct of the Air War in the Second World War*, ed. Horst Boog (Oxford, UK: Berg Publishers Limited, 1992), 459-539.
[146] Col Carl Norcross, interview, 142.052, AFHRA.
[147] Hinsley, *British Intelligence in the Second World War*, 115.
[148] Quoted in James Parton, *Air Force Spoken Here: General Ira Eaker and the Command of the Air* (Bethesda, MD: Adler & Adler, Publishers, Inc., 1986), 142.
[149] Ibid.

become an equal partner, more had to be done.

Eaker had arrived in England with little guidance regarding binational cooperation, but by the time Major General Carl Spaatz arrived in May 1942, the poor state of USAAF's organic intelligence services was apparent to all. As a result, General Arnold had armed Spaatz with a letter of instruction outlining the need to establish a strong working relationship with the various British SIGINT organizations.[150] Within two months of his arrival, Spaatz had secured an agreement for USAAF airmen to train at British SIGINT schools and in August the first five trainees – four officers and one enlisted man – began their training at the basic intelligence school in Cambridge.[151] In September, two additional officers attended Cambridge, two attended the British Air Intelligence course at Newbold Revel, and one was selected to attend the British "Y" School at Beau Manor.[152] With this binational training, the foundation was laid for the Americans to initiate their own air intelligence function. Following graduation, most of these British-trained airmen returned to London to set up and establish the USAAF European Theater of Operations United States Army's (ETOUSA) Signal Intelligence Division (SID) while the rest were sent to the British's Government Code and Cipher School (GC&CS) at Bletchley Park.[153] British training of American intelligence professionals increased as the war progressed. The British graciously welcomed USAAF airmen into nearly all of their intelligence organizations and by the end of the war, the intelligence function was truly binational with British and American collaboration occurring in all theaters of combat.[154] American SIGINT had a foothold; the next step was to translate the capability to airplanes.

Incredible scientific advances before and during the Battle of Britain

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[150] Hansell, *The Air Plan That Defeated Hitler*, 144.
[151] "History of Signal Intelligence Division (SID) European Theater of Operations United States Army (ETOUSA)," vol. II, Technical History, Historic Cryptographic Collection, Section 1, RG 457, Box 968, NARA.
[152] "Y" was the British designator for SIGINT; "History of SID ETOUSA," 1.
[153] "History of SID ETOUSA," 2.
[154] "Instances of Collaboration Between U.S. Army COMINT and Foreign COMINT Units During World War II (in European, Mediterranean, China-Burma, Southwest-Pacific Theaters)," Historic Cryptographic Collection, RG 457, Box 1369, NARA.

impelled the war's first operational use of airborne SIGINT aircraft. Beginning in at least 1936, reports that the British were building 350-foot-high antenna masts along the southern and eastern shores of Great Britain started reaching the German high command.[155] The first-of-its-kind radar system – designed to provide British Fighter Command with advanced warning of any German air attacks – was completed by the spring of 1939.[156] The Germans were desperate to obtain information concerning the British radar and in May 1939, the head of the Luftwaffe Signals Service, Major General Wolfgang Martini, outfitted the *Graf Zeppelin II* airship with an array of radio receivers designed to intercept signals from the British radar.[157] First flying on 7 May 1939 and followed by another flight on 2 August, the Germans conducted airborne SIGINT sampling in an attempt to ascertain the nature of the British air defense system.[158] Due primarily to German radio malfunctions on the first flight and British radar malfunctions on the second, the Germans were unable to collect any valuable information.[159] While the Germans were unsuccessful, the same cannot be said for the British.[160] They monitored the 7 May German flight and were able to use the airship's presence as an operational test of their air defense system.[161] The electronic war had begun.

During the first stages of the Battle of Britain, Fighter Command had considerable success defending the island against German daylight bombing attacks.[162] The advantage shifted, however, when the Germans switched tactics

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[155] Derek Wood and Derek Dempster, *The Narrow Margin: The Battle of Britain and the Rise of Air Power, 1930-1940* (London, UK: Hutchinson Publishers, 1961), 17.
[156] "Use of Air Ministry Chain Home Low radar station for warning of invasion," 3, undated report that summarizes British radar activity through 1941, TNA, ADM 179/151.
[157] Wood and Dempster, *The Narrow Margin*, 17. Contrary to common belief, the airship in this incident was not the older *Graf Zeppelin* brought out of retirement; this was in fact the *Graf Zeppelin II*. I am indebted to Dr. Rich Muller for clarifying this bit of confusing history.
[158] David E. Fisher, *A Race on the Edge of Time: Radar – The Decisive Weapon of World War II* (New York, NY: McGraw-Hill Book Company, 1988), 4-7.
[159] Peter J. Hugill, *Global Communications Since 1844: Geopolitics and Technology* (Baltimore, MD; The Johns Hopkins University Press, 1999), 194.
[160] Sir Winston Churchill, *The Second World War*, vol. I, *The Gathering Storm* (Boston, MA: Houghton Mifflin Company, 1948), 140.
[161] Wood and Dempster, *The Narrow Margin*, 18.
[162] Overy, *The Air War, 1939-1945*, 34.

and began conducting night attacks in September 1940.[163] The darkness – along with typical British cloud and fog – gave the Germans a natural defense from British fighters. More importantly, the Germans had started using a radio guidance beam, which they called *Knickebein*, to direct its bombers to their targets in the United Kingdom.[164] Due to these newfound advantages, German bombers – though less efficient at hitting their targets due to darkness – operated with virtual impunity.[165] Fighter Command had not developed a capable night airborne intercept capability at the time and was shooting down fewer German bombers. In a war of attrition that the British simply had to win, something had to be done.

To stop the German use of the homing beam and tip the balance back in their favor, the British needed to determine the nature of the beam, its source, and develop a mechanism to deny its use to the Germans. To do this, the British formed the world's first airborne ELINT outfit – the Blind Approach Training and Development Unit (BATDU) – and outfitted it with three specially configured Avro Anson aircraft.[166] The mission of the BATDU was to conduct airborne ELINT collection and direction finding (DF) to gather information on the *Knickebein* signal and its origin.[167] The unit flew its first sortie on 19 June 1940 – history's first airborne ELINT flight flown in combat – and during the third sortie, on 21 June, was successful in collecting the signal and locating its origin.[168] Professor R.V. Jones' Scientific Intelligence Directorate analyzed the collected data and

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[163] David Alan Johnson, *The Battle of Britain: And the American Factor, July-October 1940* (Conshohocken, PA: Combined Publishing, 1998), 290-294.
[164] A full description of the radar war is beyond the scope of this analysis, but is best documented in R.V. Jones, *Most Secret War: British Scientific Intelligence, 1939-1945* (London, UK: Hamish Hamilton, 1978).
[165] Stephen Bungay, *The Most Dangerous Enemy* (London, UK: Aurum Press, 2001), 270.
[166] Martin Streetly, ed., *Airborne Electronic Warfare: History, Techniques, and Tactics* (London, UK: Jane's Publishing Company Limited, 1988), 124; Interestingly, the British did not have a radio receiver capable of collecting the German *Knickebein* signal. As a result, they settled on an American receiver, the Hallicrafters S-27 to outfit the Ansons. For further information, see Alfred Price, *The History of US Electronic Warfare* (Westford, MA: The Association of Old Crows, 1984), 12.
[167] "Blind Approach Training and Development Unit (later Wireless Intelligence Development Unit). Formed at Boscombe Down (UK) in September 1939," 27, 1 Oct 1940, TNA, AIR 29/602.
[168] Jones, *Most Secret War*, 97 and 52.

subsequently built a radio jammer that the RAF used to deny the Germans use of the beam.[169] This incident marked the first battle in the airborne electronic war; a war that would continually challenge both sides' engineers, mathematicians, and airmen and one that would become central to the United States' future manned airborne ISR programs.

On the other side of the planet, the chance capture of a functional Japanese early warning (EW) radar by United States Marines on Guadalcanal in August 1942 emphasized the need to develop a Pacific-based ELINT collection capability.[170] Prior to this, the United States had not considered Japanese use of radar as a potential threat. With the British established as the leader in European ELINT collection, the Americans focused their efforts on the Pacific and began building equipment to help defeat Japanese EW radars. At the National Research Lab outside Washington D.C., scientists and engineers began a program known as CAST MIKE.[171] Based on analysis of the captured Japanese EW radar, the CAST MIKE project built receivers capable of collecting the signal and jammers to deny its use to the Japanese. One of these receivers was installed in a B-17E bomber based at Espiritu Santo in the New Hebrides and on 31 October 1942, this aircraft conducted its first sortie.[172] Though no signals were collected during this first foray, the mission is significant as it marks the United States' first operational airborne ELINT mission.

American experimentation with various types of aircraft continued into early 1942 under the cover term Ferret – a word used to describe aircraft specifically designed for airborne ELINT collection.[173] After a photo reconnaissance mission in the Aleutians Islands near Alaska revealed the

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[169] Ibid., 104.
[170] Lieutenant W.G. Lamb, "Target Report – Japanese Land-based Radar," report of the U.S. Naval Technical Mission to Japan, 9, 27 December 1945, call number D820.S2 U524 E-03, Navy History and Heritage Command archives, Washington Navy Yard, Washington, DC.
[171] Captain Don C. East, "A History of U.S. Navy Fleet Air Reconnaissance," online http://www.vpnavy.org/adobe/vq1_vq2_history_01_07feb2015.pdf (accessed 21 February 2016), 45-58; originally published in *The Hook* (Spring 1987).
[172] Alfred Price, *The History of US Electronic Warfare*, 49.
[173] George Raynor Thompson and Dixie R. Harris, *The Signal Corps: The Outcome, Mid-1943 through 1945* (Washington, D.C.: United States Army Center of Military History, 1991), 315.

presence of a Japanese radar set, the Army decided to put its experimental ELINT aircraft to the test.[174] On 6 March 1943, Ferret I – a modified B-24D – conducted the first successful airborne ELINT collection of a Japanese radar when electronic warfare officers (EWOs) on board detected signals emanating from the suspected site.[175] Over the next several days Ferret I conducted a thorough survey of the Japanese radar order of battle on Kiska, Attu, and Agattu Islands.[176] With Lieutenants Bill Praun and Ed Tietz operating the radio gear, Ferret I collected operating parameters and coverage areas of the radars on Kiska Island.[177] With the detailed information in hand, the Eleventh Air Force (AF) commander, Major General William Butler, immediately ordered an air strike on the radars.[178] Airborne ELINT had established its worth in the Pacific. Until Allied forces could get within airborne range of the major Japanese strongholds, however, there was little utility in conducting frequent sorties. As 1943 arrived, the USAAF chose to shift the focus of its airborne ELINT collection to the Mediterranean theater.

The success of the CAST MIKE program and Ferret I demonstrated the value of airborne ELINT operations. As a result, the USAAF outfitted three B-17s – designated Ferret III, IV, and V – and sent them to the Mediterranean to support ongoing operations.[179] Ferret III arrived in Algiers on 7 May 1943 and, as was seen with airborne IMINT and ground SIGINT, its crew immediately began exchanging information and TTPs with their British counterparts from the RAF's 192 Squadron.[180] Based on British advice, the Americans modified the collection equipment on Ferret III to enhance collection. On 17 May, the aircraft conducted

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[174] "A Short History of Electronic Warfare," *The Navigator* 16, vol. 2 (Winter 1968): 1-5.
[175] John T. Farquhar, *A Need to Know: The Role of Air Force Reconnaissance in War Planning, 1945-1953* (Maxwell AFB, AL: Air University Press, 2004), 13.
[176] Price, *The History of US Electronic Warfare*, 53.
[177] Paul Lashmar, *Spy Flights of the Cold War* (Annapolis, MD: Naval Institute Press, 1996), 19.
[178] Lieutenant Colonel John Andrews (former officer of 404the Bombardment Squadron), interview by John H. Cloe (Alaskan Air Command historian), 9 September 1984, K239.0512-1537 C.1, AFHRA.
[179] "The Work of the Ferrets," *Radar*, no. 4 (August 1944): 21-27. Interestingly, the author could find no mention or record of there being a Ferret II aircraft.
[180] "Squadron Number: 192 Record of Events: Y," 1-31 May 1943, 13, TNA, AIR 27/1156/22. 192 Squadron also flew airborne ELINT missions using modified Wellington bombers.

its first Mediterranean flight and over the next 16 months – May 1943 to September 1944 – the Mediterranean Ferrets flew 184 sorties and discovered 450 enemy radar sites in Sardinia, Italy, Corsica, and southern France.[181] From this data, the Allied Operational Research Section built charts and maps showing the best approach routes for aircraft and invading ground forces.[182] Amphibious invasion planners subsequently used this information to assist in the planning for operations HUSKY (Sicily), AVALANCHE (Salerno), SHINGLE (Anzio), and DRAGOON (South France). In the invasion of Corsica alone, allied aircraft conducted over 500 attacks on radar sites that American and British airborne ELINT had located.[183]

After initially proving its value, airborne ELINT continued to proliferate. Hearing of the success in the Aleutians and the Mediterranean, intelligence officers in the Pacific theater petitioned the USAAF for additional Ferrets.[184] In late fall 1943, Ferrets VII and VIII arrived in theater and immediately began flying missions all over the South Pacific. In sorties spanning the vast territory from Australia to Japan, the Ferrets – along with F-13A photoreconnaissance aircraft – located and identified Japanese radars for subsequent bomber operations.[185] In a part of the world that had received almost no prewar intelligence preparation of the environment (IPOE), the information the USAAF Ferrets provided was of critical importance to the understanding of the Japanese order of battle. As the Pacific war progressed, so did the number of Ferret aircraft in theater. By 1945, the USAAF had stationed 15 B-24 Ferrets in the Pacific Theater and had additionally experimented with a B-29 version.[186]

While airborne ELINT's contribution to the Mediterranean and Pacific theaters was unquestionable, it was perhaps most effective in the Allied buildup

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[181] Microfilm 25116 at AFHRA has the flight records of the 16th Reconnaissance Squadron in hundreds of pages of reports. The totals were compiled from those reports.
[182] Aileen Clayton, *The Enemy is Listening* (New York, NY: Ballantine Books, 1980), 262.
[183] Thompson and Harris, *The Signal Corps,* 319.
[184] Ibid., 317.
[185] "Organization of Radar Intelligence in Headquarters, 21 Bomber Command," 22-25, 762.04-1, AFHRA.
[186] "The Search for Jap Radar," *Radar*, no. 10 (30 June 1945): 9-11.

to Operation OVERLORD – the invasion of Europe. Airborne ELINT played a major part in the invasion planning during hundreds of collection sorties all along German-occupied territory. By the early spring of 1944, Dr. R.V. Jones' Scientific Intelligence Department at the Air Ministry in London had a fairly comprehensive picture of the German radar system.[187] However, many of the German radars were mobile and routine updates were required to maintain exact knowledge of their positions; this task fell to the Ferret aircraft of the RAF's 192 and 214 Squadrons.[188] These Ferret sorties ensured the Allies' awareness of German radar use and also contributed to the development of radar jamming devices that were used extensively during the actual invasion.[189] As in the other theaters, airborne ELINT had contributed prominently to the overall success of the invasion.

Airborne ELINT collection continued in both theaters throughout the war. Ever-improving collection capabilities, combined with refined TTPS, produced a remarkably efficient capability by August 1945. Airborne ELINT collection was prolific with the British alone flying over 1,400 operational sorties.[190] These missions resulted in the identification, geo-location, and subsequent destruction of countless enemy radar locations. Postwar estimates vary and gauging a force enhancer's true impact is always difficult, but according to one official survey of electronic warfare: "…it can be said that radar countermeasures undoubtedly saved the US forces in England roughly 450 planes and 4,500 casualties…Roughly, the same considerations apply to our Strategic Air Force in Italy whose size was fully half that of its British-based counterpart."[191] Whether these numbers are completely valid or not is irrelevant. What is certain is that the efforts of these early airborne ELINT pioneers unequivocally contributed to Allied success and saved countless lives.

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[187] Price, *The History of US Electronic Warfare*, 117.
[188] "Squadron Number: 214. Records of Events: Y," January – May 1944, TNA, AIR 27/1323/1-6.
[189] Price, *The History of US Electronic Warfare*, 123.
[190] Streetly, *Airborne Electronic Warfare*, 128.
[191] Quoted in Price, *The History of US Electronic Warfare*, 197.

While the Allies were refining their airborne ELINT and IMINT capabilities, an effort was underway to create an airborne COMINT capability. The idea of placing linguists on aircraft to monitor enemy radio signals traces back to the electronic war in the Mediterranean. In the summer of 1942, during flights to determine the extent of German radar coverage in the Sardinia-Taranto-Tripoli areas, the British began placing linguists on 162 Squadron's Wellington ELINT (Ferret) aircraft.[192] Initially an experiment, the linguists' ability to provide the pilots with advanced warning of German fighter activity became highly valued. After a year of experimentation in the Mediterranean, the British expanded the airborne linguist program. In June 1943, at a meeting between officials from the Air Ministry, RAF station Kingsdown, and 192 Squadron, an agreement was reached to expand the airborne COMINT flights to Western Europe.[193] The group arranged to outfit a 192 Squadron Halifax with two S-27 receivers and the commanding officer of RAF Kingsdown – the lead organization for the collection, processing, exploitation, and dissemination (PED) of terrestrial-based COMINT intercepts – agreed to detach two linguists to conduct operational tests.[194] Four days later, the Air Ministry issued additional instructions for the first flight. In a sign of the true combined nature of United States and United Kingdom operations, the Air Ministry had arranged for its Halifax to accompany an Eighth Air Force bombing mission with the 306th Bombardment Group.[195] The first of these flights took place on 20 June 1943 and was highly successful. Before the aircraft even left English airspace, RAF Flight Officer Ludovici and Sergeant Clark were able to easily collect the communications of Luftwaffe fighters and their ground controllers over Europe.[196] Initially focusing on the Luftwaffe fighter

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[192] "Intelligence section: Signals: 'Y' investigation flights: No 162 Squadron," 1 January-31 October 1943, TNA, AIR 51/298; Clayton, *The Enemy is Listening*, 212.
[193] "Minutes of a meeting held at Air Ministry on Thursday, 17th June, 1943, to consider the question of Airborne Interception of V.H.F. R/T," TNA, AIR 40/2717.
[194] F.H. Hinsley et al., *British Intelligence in the Second World War*, vol. 3, part 2, *Its Influence on Strategy and Operations* (London, UK: Her Majesty's Stationery Office, 1988), 785-786.
[195] Squadron Leader Butler, Air Ministry A.I.4., to Commanding Officer, 192 Squadron, memorandum, "V.H.F. R/T. Interceptions," 21 June 1943, TNA, AIR 40/2717.
[196] Flight Officer Ludovici, "Report on Airborne Search for German V.H.F. R/T – Dutch and Frisian Area," 21 June 1943, TNA, AIR 40/2717.

control bases at Schipol and Leeuwarden in Holland, the airborne linguists quickly learned Luftwaffe attack TTPs and provided real-time warning to the aircrews they accompanied.[197]

As with many other intelligence-related advances, the Americans followed the British lead. By at least August 1943, Lieutenant General Carl Spaatz, Commander of the Northwest African Air Forces (NAAF) had ordered airborne linguists to fly on Mediterranean-based Ferret aircraft.[198] With the initial flights on Ferret aircraft having been successful, Major General James Doolittle, Commander of Twelfth Air Force, also began placing linguists on B-17s during bomb raids into Italy and Germany.[199] After hearing of the great success the linguists were having in the Mediterranean, the Americans began an effort to man bombers in Eighth Air Force with airborne linguists. In a memo dated 13 October 1943, Eighth Air Force commanding general, Ira Eaker, petitioned British Air Vice Marshal Frank Inglis for Air Ministry cooperation in outfitting bombers of the Eighth Air Force for airborne COMINT collection.[200]

The tactical and strategic value-added from airborne COMINT collection was immediate. At a March 1944 meeting at Fifteenth Air Force Headquarters, one of the earliest airborne German-speaking linguists, Sergeant Kurt Hauschildt, described the tactical value of airborne COMINT.[201] Using only paper and pencil – no recording or playback ability was installed on the aircraft at the

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[197] "No. 192 Squadron flight reports," 1 April 1943-31 January 1945, TNA, AIR 14/2928; "Squadron Number: 192. Summary of Events: Y," July 1943, TNA, AIR 27/1156/25-26.

[198] Colonel William W. Dick, Air Adjutant General, Headquarters Northwest African Air Forces, to Air Officer Commanding-in Chief, Mediterranean Air Command, letter, 9 August 1943, in "Intelligence section: Signals: 'Y' service: investigation flights by American aircraft," document 10A, TNA, AIR 51/299.

[199] Alexander S. Cochran, Robert C. Erhart, and John F. Kreis, "The Tools of Air Intelligence: ULTRA, MAGIC, Photographic Assessment, and the Y-Service," in *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*, ed. John F. Kries (Washington, DC: Air Force History and Museums Program, 1996), 97.

[200] Lieutenant General Ira C. Eaker, Commander, Eighth Air Force, to Air Vice Marshal Frank F. Inglis, Assistant Chief of Staff for Intelligence, Air Ministry, "Extension of "Y" Service," 13 October 1943, TNA, AIR 40/2717.

[201] Hauschildt was a native-born German who had immigrated to the United States with his family shortly after his birth. This was typical of the first batch of airborne linguists as there was limited linguistic training available in the United States, and, native speakers were far more fluent than the linguists produced by the War Department language schools. For Hauschildt's enlistment record see RG 64, Box Number 1400, Film Reel Number 6.166, NARA.

time – the airborne linguists were able to keep the bomber formation informed when enemy fighters were airborne and could even determine the approximate range of the reacting German fighters based on the signal strength of the monitored frequency.[202] When combined with the linguists' knowledge of the Luftwaffe reactor bases, this information gave the bombers unprecedented situational awareness.

The linguists' understanding of Luftwaffe tactics saved lives and aircraft. As the Northwest African Strategic Air Forces (NASAF) Operational Research Section had already determined, the Germans preferred to attack bombers which had become detached from the main bomber formation. Airborne linguists could determine when German fighters were trailing the formation waiting for stragglers and would subsequently warn the aircrews to tighten their formations.[203] The NASAF Director of Operations (A3), Brigadier General Charles Born, confirmed the tactical relevance stating that his pilots had been very impressed by the immediate value of airborne COMINT and greatly preferred flying with the "German-speaking fellas" onboard.[204]

In addition to protecting the aircraft and bomber formations, the linguists were able to call-in friendly fighters to attack airborne Luftwaffe aircraft. First Lieutenant Roger Ihle, one of the earliest American airborne electronic warfare officers, stated, "We had these German speaking boys we had monitoring all of the aircraft frequencies of the Germans, so when they heard the Germans starting to scramble, why, they told the [American] fighters what was happening…"[205] The airborne position that we now know as "Direct Support Operator" was born. The enhanced situational awareness that airborne linguists provided had been validated.

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[202] "Airborne R/T Interception by N.A.S.A.F," 1, 21 March 1944, TNA, 40/2717.
[203] 2d Lt Jakob Gotthold, "Report on Airborne Interception of Enemy R/T Traffic Carried Out with the Fifteenth Air Force," report, Air Communications Office, HQ US Army Air Corps, 6, 1 November 1944, McDermott Library, Clark Special Collections Branch, General George C. McDonald Collection, Collection 16, Series 5, Folder 11, United States Air Force Academy (USAFA).
[204] "Airborne R/T Interception by N.A.S.A.F," 1, 21 March 1944, TNA, 40/2717.
[205] Quoted in William E. Burrows, *By Any Means Necessary* (New York, NY: Farrar, Straus, and Giroux, 2001), 85-86.

While the tactical impact of the airborne linguists was important, their contribution to the strategic understanding of the Luftwaffe was perhaps more so. At the same Fifteenth Air Force meeting where Sergeant Hauschildt reviewed the tactical importance of airborne COMINT, there were also discussions about the strategic value. British Flight Lieutenant J.D. Simmonds opined that the NASAF had not historically appreciated the strategic value of airborne COMINT, but that the sharing of information between Fifteenth Air Force and 276 Wing had started to change opinions.[206] As time passed and the credibility of the linguists grew, their post-mission reports were becoming more appreciated for their strategic importance. Not valued initially, after intervention from the more experienced British, NASAF intelligence analysts began to use the post-mission logs to determine German order of battle in Central Europe. This knowledge greatly enhanced the Allies' overall understanding of both German operational and strategic intent and was used extensively in invasion planning during the Italian campaign and for strategic bombing.[207]

During the same meeting, General Born and the NASAF Director of Intelligence (A2), Colonel Young, lobbied for an expansion of the airborne linguist program. After much discussion, the meeting attendees agreed that two linguists would accompany each mission – an increase from the then apparently haphazard methodology of deciding which missions to fly – and that four aircraft from each bomb group would be outfitted with the S-27 Hallicrafter receiver. Also, the need for additional German linguists was discussed. Colonel Young mentioned a previous higher headquarters offer of 100 German speakers, but British Flight Lieutenant Simmonds advised him to be cautious as the success rate of prospective linguists up to that point had been very poor and that an airborne linguist "has to be thoroughly fit physically, quick on the uptake, and at the same time reasonably phlegmatic."[208] Finally, it was agreed that the A2 would from that point take control of the linguist program from the A3.

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[206] "Airborne R/T Interception by M.A.S.A.F," 1, 21 March 1944, TNA, 40/2717.
[207] Ibid.
[208] Ibid.

On 15 March 1944, recognizing the need to extend its COMINT coverage deeper into Germany, Major General Doolittle, then commander of Eighth Air Force, issued instructions to his three bombardment divisions for the implementation of airborne COMINT intercept operations.[209] In a very specific memorandum, Doolittle – or at least a member of his Intelligence staff – outlined the technical aspects of airborne COMINT collection and the operational manner by which Eighth Air Force expected it to be employed. Details as minute as the frequency range to be collected and instructions for the PED of the intercepts were also included. Within three weeks of the memorandum, Doolittle's bomber divisions began flying with linguists on board.[210] This effort had all been enabled with the assistance of the RAF. Anticipating the need, months prior, the Eighth Air Force had instituted a training program to provide a pool of qualified airborne linguists.[211] British Women's Auxiliary Air Force (WAAF) Section Officer M.K. 'Rusty' Goff – one of the first WAAF SIGINT officers – was selected to lead the training.[212] Goff, a German and Italian linguist who had extensive experience in the British 'Y' service, was tough on her trainees. From a pool of over 100 initial applications, she whittled the list down to four whom she felt comfortable certifying. To further prove her dedication to the airborne COMINT mission, after an apparently disappointing training session with a group of potential linguists, Goff elected to fly a combat sortie with Eighth Air Force to show she could do better than the American trainees. If reports are accurate, her intercept logs from

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[209] Major General James Doolittle, Commander, Eighth Air Force, to Commanding Generals, 1st, 2nd, and 3rd Bombardment Divisions, memorandum, "Intercept of Enemy Fighter R/T Traffic," 15 March 1944, TNA, 40/2717.

[210] "S27 Report from mission of April 1, 1944," 4 April 1944, 520.6251, AFHRA. After reading every available log from airborne intercept operations in the Eighth Air Force, this is the earliest one I could find that proves a linguist was flying with the bomber formations. This particular log is from the 95th Bomb Group's 1 April mission over Ludwigshafen, Germany; Technical Sergeant Emil W. Bachman was the linguist. I also cross-referenced the 'Y' log with the Group's official mission reports in GP-95-HI (Bomb) at AFHRA and could not find an earlier mission on which a linguist was listed as a crewmember. That said, identifying the airborne linguists from the crew reports is problematic as it does not appear that a standard crew position was ever created for them; some logs list the linguist as 'Y' while others use 'S27.'

[211] "The Contribution of the "Y" Service to the Target Germany Campaign of the VIII Air Force," report, Eighth Air Force Director of Intelligence, 4, 18 March 1945, Carl Spaatz Papers, Box 297, LOC.

[212] Clayton, *The Enemy is Listening*, 332.

that day were lauded by the British 'Y' service operators at RAF Kingsdown.[213]

After the initial training build-up and implementation, the Eighth Air Force used up to 12 linguists per mission and truly began to value the contribution the linguists were making.[214] In a time of unsecure communications, however, the information obtained by the airborne linguists was only useful to the bomber formation in which the linguist was flying.[215] As all bomber formations adhered to strict radio silence procedures until after 'bombs away,' much of the intelligence collected was only available to the aircraft in which the linguist was flying.[216] As early as 1 November 1944, Technical Sergeant Jakob Gotthold – one of the USAAF's first airborne linguists – made recommendations for the development of an interplane signaling system, but one was never sufficiently established before the end of the war.[217]

Despite the obvious benefits to the crews, airborne COMINT in the European theater was limited by a lack of airborne recorders and by a shortage of trained personnel. In a January 1945 meeting of Eighth Air Force commanders and A-2s, a lengthy discussion ensued regarding both topics. Colonel James V. Edmundson, commander of the 468th Bomb Group, highlighted the fact that of the 100 Hallicrafters S-27 receivers his group had requested, only four had arrived with the other 96 having been given to the Navy.[218] In the same meeting, Colonel Samuel Barr added that the lack of trained linguists was his biggest problem.[219] Gotthold also highlighted these problems in his summary of airborne COMINT to HQs USAAF in November 1944. In his report, Gotthold recommended

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[213] Peter Jackson and David Haysom, *Covert Radar and Signals Interception: The Secret Career of Eric Ackermann* (Barnsley, UK: Pen & Sword Aviation, 2014), 54-55.
[214] "Status of "Y" Intelligence in Eighth Air Force," report, Eighth Air Force Director of Intelligence, 1, 1 May 1945, Carl Spaatz Papers, Box 297, LOC.
[215] Maj H. Elsas, "Outline History of Operational Employment of "Y" Service," report, A-2, 8th AF HQs, to Maj Leon Benson, A-2, HQ USSTAF, 6 June 1945, 3, Carl Spaatz Papers, Box 297, LOC.
[216] Gotthold, "Report on Airborne Interception of Enemy R/T Traffic," 4.
[217] Ibid.
[218] The Hallicrafters S-27 was the receiver of choice for the airborne mission. For further information see, Gotthold, "Report on Airborne Interception of Enemy R/T Traffic," 2; Minutes, HQ USSTAF/Directorate Intel, "Meeting of A-2s of American Air Forces in Europe, Held 0900-1800 Hours, Jan 23, 1945," Carl Spaatz Papers, Box 121, LOC.
[219] Ibid.

the use of recorders on all airborne linguist sorties and lobbied for the creation of a comprehensive training program to ensure standardization across the linguists.[220] Brigadier General George C. McDonald – Spaatz' Intelligence Officer – was present at the A-2 meeting and promised to address the persisting airborne COMINT problems with Spaatz.[221]

Even with the problems, the innovative linguists ensured airborne COMINT collection had significant tactical impact and strategic utility.[222] The meeting of the A-2s mentioned above reiterated the lingering problems, but the overall conclusion was that airborne COMINT was a major contributor and had to be expanded. An Eighth Air Force report sent by Major Herbert Elsas to General McDonald concluded that the information derived from airborne COMINT collection was "the only basic source material of signals intelligence originated by Eighth Air Force."[223] As the USAAF was still trying to justify its requirement to have an indigenous intelligence capability, airborne COMINT was seen as a unique source that could not be provided by the other services. Additionally, in a report on the effectiveness of airborne COMINT, the Eighth Air Force A-2 stated, "The airborne 'Y' project can be considered to have produced highly successful results…"[224]

In Europe and the Mediterranean, the USAAF would continue flying airborne COMINT missions until V-E Day. While the impact of their contribution can certainly be debated, the mere fact that they had advanced such a great deal in less than three years must be commended. As had been seen over the previous 40 years of flight, the ingenuity and determination of these Airmen had resulted in an exquisite capability that protected aircrews, gave the USAAF unprecedented insight into German tactical operations, and, perhaps more importantly, was a unique capability that could not be replicated by the ground

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[220] Gotthold, "Report on Airborne Interception of Enemy R/T Traffic," 18.
[221] "Meeting of A-2s of American Air Forces in Europe," 8.
[222] "The Contribution of the "Y" Service," 1.
[223] Major Herbert Elsas, A-2 Section, 8 AF, to Director of Intel HQ 8 AF, 5 May 1945, report, Carl Spaatz Papers, Box 297, LOC.
[224] "The Contribution of the "Y" Service," 4.

Army or Navy.

While airmen in the European Theater of Operations (ETO) were honing their airborne COMINT collection capabilities, a similar effort developed in the Pacific Theater. In the early stages of the war, there was little need for an airborne COMINT capability. Ship- and ground-based COMINT interception collected strategic and tactical Japanese communications and was deemed adequate to meet both the Army and Navy's needs. The vast distances of the Pacific theater also hindered the development of airborne COMINT. Bases were limited and none gave the USAAF the proximity it needed to attack the Japanese homeland. To partially remedy this, the Air War Plans Division of the Air Staff implemented Operation MATTERHORN; a plan to use air bases in China built by the forces of Chiang Kai-shek.[225] By spring 1944, many of these airfields in China, and some in India, were available for B-29 operations and on 5 June, Twentieth Air Force flew its first sortie when it attacked the Makasan railway yards in Bangkok, Thailand.[226] Ten days later, the Command conducted its first foray into the Japanese home islands when it bombed the Yawata Iron and Steel Works on Kyushu.[227] Almost immediately, Twentieth Bomber Command's 58th Bomb Wing began using Japanese-American, or Nisei, airmen on the flights to provide the same type of intelligence that the German-American airborne linguists in the ETO had been providing.[228] These Nisei from the 6th Radio Squadron Mobile (RSM) were ground linguists, but a few of them volunteered for flying status – likely due to the extra pay – and were soon contributing.[229] Little is documented about the effectiveness of these early operations, but at least two of the Nisei,

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[225] Hansell, Jr., *The Strategic Air War Against Germany and Japan*, 142.
[226] "From Matterhorn to Missiles: The History of the Twentieth Air Force, 1944-1998," 25-29, 760.01, AFHRA.
[227] Mark Clodfelter, *Beneficial Bombing: The Progressive Foundations of American Air Power, 1917-1945* (Lincoln, NE: University of Nebraska Press, 2010), 199; "Material Provided Radar Operator, Yawata Mission (Japan)," 15 June 1944, 248.5123-10, AFHRA.
[228] James C. McNaughton, *Nisei Linguists: Japanese Americans in the Military Service During World War II* (Washington, DC: Department of the Army, 2006), 371. The unanswered question here is whether Twentieth Bomber Command got the airborne linguist idea from Eighth Air Force or if the idea was generated indigenously.
[229] History, "Unit History, 6th Radio Squadron Mobile," SRH-397, September 1944-December 1945, call number 35019428, National Defense University Library, Washington, DC.

Sergeants Kazuo Kamoto and Masaharu Okinaka, were awarded Air Medals for the support they provided.[230]

As the war in the Pacific progressed, the island hopping campaign provided new air bases for the USAAF. By November 1944, B-29s of the Twenty-First Bomber Command were attacking the Japanese homeland from bases in the Marianas. With the value of airborne COMINT proven, the Twenty-First sought ways to take advantage of the new capability. Primarily due to a shortage of Nisei available to fly, Twenty-First Air Force first installed only recorders on their B-29s and asked ground-based Japanese linguists to transcribe the collection post-mission.[231] This provided some strategic value, but intelligence officers knew they could do more. Seeking the tactical value that having linguists on board provided, the 8th RSM was called upon to provide Twenty-First Air Force the additional manpower it needed.[232] Arriving in Guam on 10 November 1944, the 8th RSM brought 50 Nisei linguists to assist with transcription and to fly on Twenty-First Air Force bombing and Ferret missions.[233]

After going through aircrew training and waiting for the B-29s to be equipped with the S-27 receiver, in the spring of 1945, ten of the 8th RSM's Nisei began flying operational combat missions on B-29 and B-24 Ferret aircraft.[234] Their impact was immediate. In a memorandum from Lieutenant Commander Robert Seaks, officer-in-charge of the Army-Navy Radio Analysis Group-Forward (RAGFOR), to the 8th RSM squadron commander, Major William Mundorff, Seaks stated, "Its [voice intercept] potentialities were just being realized…not too much

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[230] "Win Medals for B-29 Missions," *Pacific Citizen* 20, no. 25, 23 June 1945, online at http://ddr.densho.org/ddr/pc/17/25/ (accessed 27 February 2016).
[231] "21 Bomber Command Mission Statistics," 1 October 1944-1 March 1945, 702.308, AFHRA.
[232] "OP-20-G File, Communication Intelligence Organization, 1942-1946," SRH-279, document that describes the function of USAAF intelligence units on Guam and specifically, the 8th Radio Squadron Mobile, 34-36, Reel 5, Frame 310, Cryptologic Documents Collection, Library of the U.S. Army Military History Institute, Carlisle Barracks, Pennsylvania.
[233] History, "The Story Behind the Flying Eight Ball," 8th Radio Squadron Mobile, 1 November 1942 – 2 September 1945, 25.
[234] While only ten Nisei actually flew, according to the 8th RSM history, all 50 volunteered. For further information see "The Story Behind the Flying Eight Ball," 39; Kenneth P. Werrell, *Blankets of Fire: U.S. Bombers Over Japan During World World II* (Washington, DC: Smithsonian Institution Press, 1996), 191.

has been known about Jap [*sic*] use of voice in Air/Ground traffic…Jap [*sic*] voice…was close to a virgin field, and one which the 8th RSM was almost alone endeavoring to exploit."[235] From that spring to the end of the Pacific War, the airborne Nisei – along with the rest of the 8th RSM – performed exceptionally well. The squadron received kudos from multiple commanders and even received a commendation letter from Admiral Nimitz himself.[236] In the commendation, Nimitz stated, "Joint operation of the 8th Radio Squadron Mobile and the Navy Supplementary Station in Guam…proved to be a very profitable arrangement…The proficiency developed by the officers and men of the 8th Radio Squadron Mobile in their field of signal intelligence, and hence their share in the victory over Japan, can well be a source of pride to them."[237]

In addition to the Nisei of the 8th RSM in Guam, there was a similar effort conducted from Clark Air Base in the Philippines. Between April and July 1945, Nisei airmen of the USAAF's 1st RSM flew on at least five B-24 bombing missions over Formosa and Kyushu.[238] While the exact number of Nisei who flew is uncertain, these airmen – like their brethren in the 6th and 8th RSMs – contributed significantly to the situational awareness of their aircrews. Flying in a modified position in the bomb bay of the aircraft, the airmen listened for any Japanese air or anti-aircraft activity that would help keep the bombers safe. In a reflection of the importance of their contributions, many of the 1st RSM Nisei were awarded Bronze Stars for their contributions.[239]

While the United States and Great Britain continued advancing their airborne ISR capabilities throughout the war, the Germans and Japanese were

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[235] Lt Cdr Robert B. Seaks, Officer in Charge, RAGFOR, to Major William Mundorff, Commander, 8th RSM, "Performance of 8th Radio Squadron Mobile," date not provided, reproduced in "The Story Behind the Flying Eight Ball," 40.
[236] John C. Fredriksen, *Fighting Elites: A History of U.S. Special Forces* (Santa Barbara, CA: ABC-CLIO, LLC., 2012), 120.
[237] Admiral Charles Nimitz, Commander in Chief, U.S. Pacific Fleet and Pacific Ocean Areas, to Commanding General, U.S. Army Strategic Air Forces, "Contributions of the 8th Radio Squadron Mobile to the Joint Army-Navy Radio Analysis Group," date not provided, reproduced in *The Story Behind the Flying Eight Ball*, 40-41.
[238] Larry Tart and Robert Keefe, *The Price of Vigilance: Attacks on American Surveillance Flights* (New York, NY: Ballantine Books, 2001), 174.
[239] Ibid., 175.

effectively unable to develop or field significant improvements. Despite the considerable lead the Germans had at the beginning of the war, the setbacks of 1940-1942 combined with the general mismanagement of aviation production prevented it from truly advancing its ISR capability. Additionally, the predominant air doctrine of direct support to the ground forces had left the Germans without an integrated photoreconnaissance interpretation capability.[240] As a result, individual tactical units were left to PED their own collection with no overarching, higher level plan. Finally, although it developed a world-class ground SIGINT capability, the Germans did little to develop an airborne capability short of the *Fuehlungshalter* system that had Luftwaffe aircraft fly among the British and German bomber crews to intercept their communications.[241] The early *Graf Zeppelin II* mission and *Fuehlungshalter* aside, they did not develop a purpose-built aircraft or significantly modify a fleet for airborne SIGINT collection. This, of course, is likely attributable to the simple fact that by 1943, Germany was primarily fighting a defensive war and had little ability to produce an offensive SIGINT capability. Airborne photoreconnaissance continued throughout the war when conditions permitted, but relatively little advancement was made.

The Japanese found themselves in a similar position; losing massive amounts of territory and a steady retreat toward the home islands gave little time or importance to the development of ISR capabilities. Ground- and ship-based tactical airborne reconnaissance was conducted until the very end, but little progress was made with regards to aircraft or technological capability. As the Japanese had gambled everything on a quick defeat of the United States Navy, they had done nothing to develop a strategic bombing capability or an airborne ISR program to support it. Always fighting a losing air war, attrition rates for Japanese reconnaissance aircraft were atrocious. As the war progressed, the

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[240] George William Goddard, *Overview: A Life-long Adventure in Aerial Photography* (Garden City, NY: Doubleday Publishing, 1969), 340-341; the version used for this reference was found in the George W. Goddard Papers, Box 6, LOC.
[241] Colin D. Heaton and Anne-Marie Lewis, *Night-fighters: Luftwaffe and RAF Air Combat Over Europe, 1939-1945* (Annapolis, MD: Naval Institute Press, 2008), 80.

Japanese industrial machine simply could not produce enough aircraft to replace those lost to Allied air and sea power.[242] When Japan surrendered in August 1945, its Army and Naval air forces were decimated.

The end of the war in the Pacific marked the end of airborne ISR's most dramatic period of evolution. From a nascent capability that was truly one-dimensional with airborne IMINT and visual reconnaissance as its only functions, airborne ISR had developed substantially during the war years. By the end, Great Britain and the United States had developed airborne COMINT, ELINT, and IMINT collection capabilities that would set the foundation for all future manned airborne ISR. British and American Ferret aircraft mapped the electronic signals environment and were absolutely instrumental to the Allies' ability to plan for invasions and bombing missions. The airborne linguists on the Ferrets and bombers protected aircrews in real-time and greatly contributed to the strategic understanding of the German Air Force and the Japanese Imperial Forces. As would be seen shortly after the war, the advance of airborne IMINT and SIGINT would pay huge dividends as the United States and Britain scrambled to develop intelligence on a new enemy.

While the role of airborne SIGINT was certainly important, the part played by photoreconnaissance in the Allied victory cannot be overstated. When Flying Officer Michael Suckling piloting a photoreconnaissance mission in one of Sidney Cotton's modified Spitfires imaged the great German battleship *Bismarck* sheltering in a Norwegian fjord near Bergen, the resulting attack and ultimate sinking of the battleship likely saved thousands of lives.[243] When Squadron Leader Tony Hill imaged the German radar *Würzburg* in a daring mission, the imagery he collected provided the intelligence needed to conduct Operation BITING, a raid on the radar site and acquisition of the German technology.[244]

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[242] Edward S. Miller, *War Plan Orange: The U.S. Strategy to Defeat Japan, 1897-1945* (Annapolis, MD: Naval Institute Press, 1991), 366.
[243] Michael Tamelander and Niklas Zetterling, *Bismarck: The Final Days of Germany's Greatest Battleship* (Drexel Hill, PA: Casemate, 2009), 119.
[244] David Pritchard and R.V. Jones, *The Radar War: Germany's Pioneering Achievement, 1904-45* (Wellingborough, UK: HarperCollins Publishers, 1989), 73; Ken Ford, *The Bruneval Raid – Operation Biting 1942* (Oxford, UK: Osprey Publishing, 2010), 13.

When John Merrifield clicked the camera shutter at the exact moment the Germans were launching a V-1 during a photoreconnaissance flight in a Mosquito on 28 November 1943, he provided all the information the British scientific community needed to deduce the operating procedures for the rocket and ultimately led to the destruction of all 96 launch sites as part of Operation CROSSBOW.[245] The Combined Bomber Offensive against Germany would not have been successful without the dedication of airborne IMINT crews and the all-important photo-analysts on the ground. These and so many other examples led to a trust in airborne IMINT that had previously not existed. Gone was the skepticism on the part of the ground commanders. The trust had grown so significantly that no major operations were planned in the latter half of the war without detailed airborne photoreconnaissance first providing planners with the IPOE they needed. When combined with the intelligence coming in via both airborne and ground-based SIGINT collection, the Allies possessed a distinct decision advantage that undoubtedly contributed to their victory. As war turned to peace, the question of whether airborne ISR would suffer as the militaries demobilized was quickly answered as a wartime ally became a Cold War enemy.

[245] Bowman, *Mosquito Photo-Reconnaissance Units*, 18.

Chapter 6: Cold and Hot Wars…Airborne ISR as a Strategic and Tactical Asset

Those who say it cannot be done should not get in the way of those doing it.
Big Safari Motto

Airborne ISR evolution in World War II was blindingly rapid. In the years before the war, all the major powers had developed airborne photoreconnaissance capabilities. Some had done more than others, but Germany, France, Italy, the Soviet Union, Japan, Great Britain, and the United States had all endeavored through the challenges of the Great Depression to field some capability. In varying degrees, most advanced their technology during the war by incorporating new cameras, techniques, and aircraft. By the war's end, airborne IMINT support to operations was nearly ubiquitous with airborne photoreconnaissance contributing to nearly every major victory in the war – and its absence going a long way towards explaining many a defeat. Additionally, Great Britain and the United States developed viable airborne SIGINT capabilities. The United Kingdom led the way as its radar war with Germany necessitated the first foray into airborne ELINT. This early success led to additional airborne ELINT with the Royal Air Force (RAF) flying electronic probing missions all along the periphery of Nazi held territory in the Mediterranean and Western Europe. The Americans soon followed. Beginning in the Pacific, United States Army Air Forces (USAAF) Ferret airplanes – heavily modified B-24s and B-29s – collected radar information on the Japanese and then the Germans. These missions proved to be pivotal in helping plan bombing and invasion routes as the Allies pushed back the Axis powers. Additionally, the British and Americans developed the first airborne COMINT capability when they placed linguists on the Ferrets and bombers. Flying close to and over enemy-held territory, the linguists greatly expanded the reach of the terrestrial-based SIGINT collection sites and provided internal protection for the aircraft in which they

flew. By the end of the war, manned airborne ISR had undoubtedly proven the value that so many had predicted during the infancy of air power.

While airborne ISR had advanced tremendously, its future was once again uncertain. The war had upset the world geopolitical order causing great changes to the international state system. Prior to the war there were seven important powers – France, Germany, Great Britain, Italy, Japan, the Soviet Union, and the United States. By the war's end, the United States stood alone. While the other victor nations emerged from the war in economic peril, American gross national product (GNP) had nearly doubled during the war. By 1945, it held about half of the world's manufacturing capacity, the majority of its food surpluses, and nearly all the financial reserves.[1] The sleeping giant had awoken. As many of its enemies had feared, the United States had brought a new meaning to the term 'total war.' With its full potential realized, America had truly triumphed and the atomic bombing of Japan epitomized just how far the country had come.

With Japan and Germany militarily defeated and economically shattered, any postwar airborne ISR evolution would fall to the victors. The British, Americans, and Soviets had won the war, but only the United States and Soviet Union emerged in positions that would allow any significant advancement. Unfortunately, as had happened following every other major conflict, postwar demobilization retarded any immediate technological advances.[2] As expected, military reductions came quickly and they cut deeply. Within five months of V-J Day, the United States Army's total strength had been sliced almost in half from approximately 8,020,000 to 4,228,936.[3] By 30 June 1947, the number had fallen even farther to 925,163. Despite air power having cemented itself alongside the other Army branches, the USAAF was not immune to the cuts with aircraft and personnel being drastically reduced. At war's end, the USAAF counted 68,400

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[1] Melvyn P. Leffler and David S. Painter, *Origins of the Cold War: An International History*, 2nd. ed. (New York, NY: Routledge Publishing, 2005), 3.
[2] Chauncey E. Sanders, "Demobilization Planning for the USAF," USAF Historical Study No. 59, 19 September 1955, 1-11.
[3] Ibid., 265.

aircraft and 2.2 million men. By the end of 1947, two-thirds of the aircraft had been scrapped and the personnel strength was down to a paltry 303,000.[4]

Due primarily to these cuts and the simple fact that the United States had an unprecedented, if fleeting, asymmetric advantage with the atomic bomb, nuclear weapons quickly rose to the fore of American military doctrine and policy. As such, a substantial portion of the significantly diminished postwar budget was apportioned to the United States Air Force's nuclear-capable aircraft and the logistics required to fight and win an atomic war.[5] Additionally, by at least October 1945, it had become clear to American leaders that the Soviet Union would be the United States' primary, and most dangerous, adversary. In a letter to General Henry Arnold, General Carl Spaatz advised caution in the demobilization pace of the USAAF as, at least in his mind, "…the USSR is able to project moves on the continent of Europe and Asia which will be just as hard for us to accept and just as much an incentive to war as…those occasioned by German policies…"[6] Convinced of the threat from the USSR, General Spaatz, who would soon become Commanding General of the USAAF, gave highest priority to what he called the "backbone" of the Air Force, the long-range bomber groups and the fighter groups designed to protect them.[7]

With the primary mission set, USAAF planners began building target information for strategic air warfare. Like their predecessors before the war, they quickly recognized the dearth of intelligence on the USSR. If called upon, Air Force bombers needed to know what the critical Soviet targets were; in the late 1940s, American-derived information simply did not exist. To partially remedy this, Airmen in the postwar Air Force established doctrine and policy that would

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[4] Herbert M. Mason, Jr., *The United States Air Force: A Turbulent History* (New York, NY: Mason/Charter Publishing, 1976), 207.
[5] Robert F. Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force, 1907-1960*, vol. I (Maxwell AFB, AL: Air University Press, 1989), 215.
[6] General Carl Spaatz, Commander, U.S. Strategic Forces in the Pacific, to, General Henry Arnold, Commanding General U.S. Army Air Forces, letter, 11 October 1945, Box I:103, Carl Spaatz Papers, Library of Congress (LOC), Washington, D.C.
[7] House, Military Establishment Appropriation Bill for 1948: Hearings before the Subcommittee of the Committee on Appropriations, 80th Cong., 1st sess., 1947, 600; "Spaatz Board Report," 23 October 1945, Carl Spaatz Papers, Box I:22, LOC.

support the need for an independent airborne ISR service. Building on the previously established doctrinal differences between "air service" and "air force," in the early days following the war, Airmen officially entered the terms "strategic aerial reconnaissance" and "tactical aerial reconnaissance" into USAAF doctrine. In the intelligence appendix of the USAAF's report on the contributions of air power to the defeat of Germany, the United States Air Forces in Europe (USAFE) Director of Intelligence (A-2) defined "strategic aerial reconnaissance" as "the program of acquiring aerial intelligence as a basis for carrying on strategic air warfare against the enemy."[8] Further in the report, the USAFE A-2 defined "tactical aerial reconnaissance" as being concerned with "large scale daily cover of the enemy forward areas, damage assessment photographs for fighter bomber attacks, and enemy defenses, airfields, and other special targets up to 150 miles from the front."[9]

This clear delineation served to further the USAAF's needs for an indigenous airborne ISR collection capability. Additionally, one of the conclusions in the United States Strategic Bombing Survey (USSBS) was that "the U.S. should have an intelligence organization capable of knowing the strategic vulnerabilities, capabilities and intentions of any potential enemy."[10] In a shrewd move to ensure Air Force airborne ISR autonomy and, more importantly, to guarantee an increased share of the military budget, the service had established the requirement for long-range intelligence to support its strategic air war doctrine. To provide airborne intelligence beyond 150 miles behind the front required purpose-built aircraft.[11] This calculated move gave the

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[8] "The Contribution of Air Power to the Defeat of Germany," appendix M, Miscellaneous Aspects of Air Power, 1, Assistant Chief of Staff, A-2, Headquarters United States Air Forces in Europe, date not annotated, Carl Spaatz Papers, Box I:274, LOC.
[9] Ibid.
[10] John T. Greenwood, "The Atomic Bomb–Early Air Force Thinking and the Strategic Air Force, August 1945–March 1946," *Aerospace Historian* 34, no. 3 (September 1987): 161.
[11] To meet this requirement, the USAAF ordered the Republic XF-12 Rainbow to be the first purpose-built manned airborne ISR aircraft. Though it was a high-performing 4-engine aircraft that likely would have helped satisfy the early intelligence requirements of the Cold War, it was never put into production as it was outclassed by the arrival of the RB-47. 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, 2010), 11.

service the authority it needed to begin pursuing aircraft that would provide the range and coverage it needed to collect intelligence on the nation's new enemy.

Though the draconian cuts to the armed forces had greatly hamstrung the United States' ability to advance its airborne ISR programs, a miniscule, yet viable, capability remained. As early as autumn 1945, the USAAF began conducting ISR missions near the borders of Soviet-occupied territory. Flying heavily modified C-47s, B-17s, and B-24s, Airmen based in Britain and occupied Germany conducted photomapping of large areas under Soviet control. Under a project titled CASEY JONES, USAFE-based aircraft mapped nearly 2,000,000 square miles of Europe and North Africa.[12] While the IMINT was useful, the inability to obtain strategic-level images along with the increased danger posed by Soviet air defenses, forced planners to search for other solutions. At the time, their options were few. In a project known as WRINGER, refugees, former prisoners of war, German collaborators, and Soviet deserters were all sought out to provide intelligence on the USSR.[13] While somewhat helpful, WRINGER did not provide the level of detail needed. German scientists who had been either captured after the war or had escaped were a bit more useful, but their information was often outdated by the time it reached targeteers and their loyalty was always in question.[14] To fully support its new doctrine, the USAAF simply needed better intelligence.

As the USAAF was internally struggling to provide the intelligence it needed to conduct strategic air warfare, national level decision-makers were also becoming cognizant of the lack of Soviet information. Throughout 1946 and most of 1947, policy makers debated the postwar roles and responsibilities of the

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[12] Robert J. Boyd, "Project Casey Jones, Post-Hostilities Aerial Mapping," Strategic Air Command report, 30 September 1988, 1, K416.04-38, Air Force Historical Research Agency (AFHRA).

[13] James M. Erdmann, "The WRINGER in Postwar Germany: Its Impact on United States-German Relations and Defense Policies," in *Essays in Twentieth Century Diplomatic History Dedicated to Professor Daniel M. Smith*, eds. Clifford L. Egan and Alexander W. Knott (Washington, DC: University Press of America, 1982), 159-191.

[14] David Alan Rosenberg, "U.S. Nuclear War Planning, 1945-1960," in *Strategic Nuclear Targeting*, ed. Desmond Ball and Jeffrey Richelson (Ithaca, NY: Cornell University Press, 1986), 40.

national intelligence community. Government officials recognized the need for the services to maintain organic ISR capabilities for service-specific requirements, but also knew that the information collected by the services would often be of strategic value to national-level decision makers. To ensure oversight and sharing of all the nation's intelligence, in July 1947, President Harry Truman signed the National Security Act of 1947 which formally created the United States Air Force (USAF) and the Central Intelligence Agency (CIA). The Act additionally created the position of Director of Central Intelligence (DCI) who was responsible for "the coordination of…intelligence activities of the departments and agencies of the Government…"[15] Shortly following the National Security Act of 1947, President Truman issued Executive Order 9877. This order, titled "Functions of the Armed Forces," gave the Air Force the mission of providing strategic reconnaissance to national decision-makers.[16] With these two executive actions, USAF airborne ISR garnered national-level attention that it had not previously enjoyed. The fact that airplanes would provide the preponderance of the strategic intelligence necessary to keep awareness of Soviet military developments truly thrust it into the limelight. As the uncertainty surrounding a potential military conflict with the USSR persisted, the need for Air Force airborne ISR to provide intelligence intensified.

The first major USAF airborne ISR operation of the Cold War – Project NANOOK – was conducted over the Arctic Ocean. Understanding the shortest route to the Soviet heartland was over the North Pole, Air Force's Strategic Air Command (SAC) based long-range bombers in Alaska. Before the bombers could use the Arctic routes, however, ISR aircraft had to gather information about this uncharted territory. To obtain this material, in June 1946, SAC formed its first operational unit – the 46th Reconnaissance Squadron (RS) – and deployed it to

[15] United States Congress, "National Security Act of 1947," RG 319, Records of the Army Staff, 1903-2009, Publications Files, 1950-1951, NARA.
[16] Executive Order 9877, Functions of the Armed Services, 26 July 1947, Records Group (RG) 11, Executive Orders, 1862-2011, NARA.

Ladd Field outside of Fairbanks, Alaska.[17] One of the project's participants, Fred Wack, summarized the squadron's mission: "…the most important purpose of NANOOK was the first goal of finding new lands if any existed, and for the United States to lay claims to these. Visual and radar photography of the arctic ice pack…and Soviet Coastal areas and military installations…were all added goals to the mission of the 46th."[18] General Curtis LeMay, Commander of SAC, added, "…the polar ice cap had never been explored by air and there was concern that the Soviet Union might find and operate…military stations that could be a threat to the United States."[19]

To allow for the long-duration sorties required for Project NANOOK, the squadron's nine B-29Fs were stripped of all gun turrets, had extra fuel tanks installed in their bomb bays, and were equipped with multiple types of long-range cameras.[20] On 2 August 1946, the squadron conducted its – and SAC's – first operational mission.[21] Over the next three years, aircrews from the 46th flew these grueling missions in the search for land masses that SAC could potentially use as weather stations, divert bases, or forward operating areas. During subsequent sorties, the 46th RS mapped nearly the entire Arctic Ocean area and identified several locations that SAC would subsequently use as early warning radar bases.[22]

While these sorties gathered navigational information and developed standard operating procedures for Arctic flights, they also had a strategic

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[17] History, 46th Reconnaissance Squadron, 1-12 October 1947, 1-3, Sq-Photo-46-HI, AFHRA; this history details the Squadron's participation in Operation Nanook; Lt Col George H. Peck, Chief, Media and Civil Relations, Office of Public Affairs, Strategic Air Command, to HQ USAFHRC and HQ SAC/HO, letter, "Subject: Manuscript Submission for Historical Record," 20 Oct 88, K-SQ-PHOTO-72-SU-PE, AFHRA; History, 46th Reconnaissance Squadron, 1 June–1 July 1946, 1, Sq-Photo-46-Hi, AFHRA.
[18] Fred J. Wack, The Secret Explorers: Saga of the 46th/72nd Reconnaissance Squadrons (Turlock, CA: Seeger's Printing, 1992), 1.
[19] General Curtis LeMay, "Reflections on SAC," Box B64, General Curtis LeMay Papers, LOC.
[20] The "F" stood for photo. These B-29s were also called F-13s or FB-29s. For additional information on the IMINT variant of the B-29, see Robert A. Mann, *The B-29 Superfortress: A Comprehensive Registry of the Planes and Their Missions* (Jefferson, NC: McFarland Publishing, 2004), 105.
[21] Alwyn T. Lloyd, *A Cold War Legacy: A Tribute to SAC, 1946-1992* (Missoula, MT: Pictorial Histories Publishing Company Inc., 1999), 65.
[22] Ibid., 248-249.

intelligence value. In an operation known simply as Project 20, crews flew surveillance missions from Point Barrow, Alaska, to the end of the Aleutian chain.[23] During Project 20 flights, crews were tasked with photographing any Soviet naval or air vessels in addition to any "unusual object or activity."[24] In a separate program – Project 23 – aircrews combined IMINT and ELINT collection techniques.[25] In each Project 23 mission, two aircraft – one configured for ELINT and the other for IMINT – flew along the Siberian coast with the ELINT aircraft flying at high altitude "directly over the coastline," while the IMINT airplane flew a parallel course several miles out to sea.[26] The Ferret aircraft forced Soviet air defense radars to activate by flying in close proximity to the coast while the IMINT airplane imaged the radar sites based on geo-locational data collected by the ELINT platform.[27] While a theoretically sound technique, the cameras on the IMINT aircraft were simply not capable of producing high-quality imagery at the time. The practice, however, was a completely new innovation. As technology advanced, this technique of multi-platform cross-cueing would become standard practice in the ISR community and is still used today to maximize efficiency.

These early sorties also highlighted the political complications accompanying airborne strategic intelligence collection. Following a 22 December 1947 Project 23 sortie, the Soviets issued a diplomatic protest over airborne ISR operations in the Arctic.[28] The Soviets claimed that an American aircraft violated Soviet airspace "for about seven miles along the coast of the Chukotski Peninsula at a distance two miles from the shore."[29] The subsequent

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[23] Major Carl M. Green, Reconnaissance Branch, Air Intelligence Requirements Division, Directorate of Intelligence, to Chief, Air Intelligence Requirements Division, memorandum, "Subject: Coordination of Photo and Photo Intelligence Activities," 11 December 1947, RG 341, Box 40, Entry 214, NARA.
[24] Ibid.
[25] John T. Farquhar, "Northern Sentry, Polar Scout: Alaska's Role in Air Force Reconnaissance Efforts, 1946-1948," in *Alaska at War, 1941-1945: The Forgotten War Remembered*, ed. Fern Chandonnet (Fairbanks, AL: University of Alaska Press, 2008), 401-402.
[26] Green, "Coordination of Photo and Photo Intelligence Activities."
[27] Ibid.
[28] Lloyd, *A Cold War Legacy*, 67.
[29] Soviet Note Number 261, Embassy of the Union of Soviet Socialist Republics, 5 January 1948, RG 341, Box 40, Entry 214, NARA.

Air Force investigation revealed that the aircraft had likely violated Soviet sovereign airspace but there was no method to determine how close the aircraft had actually gotten to the Russian landmass.[30] Additionally, there was only vague guidance from the State Department regarding a safe standoff distance.[31] In the end, no fault was assigned and the Americans answered the Soviet demarche by simply blaming bad weather for any possible violations.[32] While no disciplinary actions were taken, the incident was the first of countless sovereignty violations and subsequent political complaints that would come to characterize strategic airborne ISR during the Cold War.[33]

Building on the success of the combined IMINT/ELINT missions, in April 1947 SAC began flying dedicated ELINT collection missions along potential Arctic bombing routes to find and inventory the numbers and types of Soviet radars.[34] Searching for unidentified signals across the magnetic spectrum, the airborne electronic warfare officers (EWOs) were tasked to locate the radars and identify their function – early warning, aircraft control, or antiaircraft. In a predecessor to today's RC-135U COMBAT SENT, the work of the EWOs was specifically requested to help in "designing equipment to counter the emission."[35] The program was expanded further in July 1948 when Air Force Director of Intelligence, Major General Charles Cabell, directed Alaskan Air Command (AAC) to increase the frequency of its Ferret sorties. In a memorandum to the AAC Commander, Cabell described the increased need for characterization of the Soviet radars in the Far East and reiterated the overall importance of ELINT

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[30] Air Intelligence Requirements Division, Collection Branch, to, Commander in Chief, Alaska, letter, "Subject: Violations of Soviet Frontier," no date given, RG 341, Box 41, NARA.
[31] "Subject: Photographic Coverage – Chukotski Peninsula," memorandum, no date or author given, RG 341, Box 41, NARA; the State Department had recommended a 12-mile standoff distance, but it was simply that, a recommendation. In a time with no Global Positioning System (GPS), it is certain that the line was crossed continually.
[32] Paul Lashmar, *Spy Flights of the Cold War* (Annapolis, MD: Naval Institute Press, 1996), 41.
[33] While the United States primarily agitated the Soviets with airborne ISR, the USSR returned the favor through the use of its ISR ships.
[34] "USAF ELINT Survey Report," 21 February 1958, 3-5, TS-HOA-78-183, AFHRA.
[35] "Study on Electronic and Other Aerial Reconnaissance," Appendix A, 10 November 1949, RG 341, Entry 214, file 2-3003-99, NARA.

collection to the strategic bombing targeting effort.[36] Additionally, for the first time, Cabell established standard operating procedures (SOP), policies, outlined the specific search areas of greatest interest to the Air Force, and defined the essential elements of information (EEIs) that AAC aircrews should be looking to answer. Finally, Cabell ordered the AAC to put at least one airborne linguist on each Ferret aircraft to search for Soviet voice communications.[37]

Almost simultaneously, in frustration at the continued lack of detailed information on Soviet radar locations and capabilities, the Secretary of the Air Force, Stuart Symington, sent a letter to General Carl Spaatz, the Chief of Staff.[38] Symington was highly concerned about the growing body of evidence pointing to the existence of Soviet bomber bases on the Chukotski Peninsula. A few weeks earlier, Air Force intelligence analysts had produced a report in which they estimated that Soviet bombers based on the peninsula could attack the majority of strategic targets in North America with little-to-no warning.[39] Symington relayed his worry regarding the lack of detailed information on the Soviet bases and urged Spaatz to authorize direct overflight of the USSR. Spaatz agreed and on 5 August 1948, the 46th RS conducted what is often recognized as the first authorized mission that was purposefully tasked to overfly the USSR.[40] Using completely stripped RF-13A aircraft, the aircrews were able to achieve altitudes of 35,000 feet which put them out of the range of Soviet air defenses.[41] During the 19-hour sortie, the aircrew flew deep into Siberia and obtained unprecedented images of Soviet radar sites along with detailed photography of the Russian littoral area.[42]

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[36] Major General Charles P. Cabell, Director of Intelligence, Air Force, to Commanding General, Alaskan Air Command, 26 July 1948, RG 341, Entry 214, file 2-3003, NARA.
[37] Ibid.
[38] Stuart Symington, Secretary of the Air Force, to General Carl Spaatz, letter, 5 April 1948, Box I:252, Apr. 9-Dec. 31, 1948, LOC.
[39] "Limit of Offshore Distance for Reconnaissance Flights in Pacific Areas," HQ USAF Director of Intelligence analysis paper, 27 July 1948, RG 341, Entry 214, file 2-3003-99, NARA.
[40] Curtis Peebles, *Shadow Flights: America's Secret War Against the Soviet Union* (Novato, CA: Presidio Press Inc., 2000), 194.
[41] The RF-13A was another ISR version of the B-29; Wack, *The Secret Explorers*, 82.
[42] Wack, *The Secret Explorers*, 82.

From the beginning of these missions, the Air Force recognized the inherent danger – and potential political embarrassment – of overflight and began looking at other ways to obtain the imagery they needed. In April of 1948, the Air Force Director of Intelligence, Major General George McDonald, instituted a program to improve the cameras on airborne IMINT aircraft to allow for greater standoff distances and reduced risk to the aircrews.[43] Beginning in August 1948 and continuing until at least July 1949, the 46th/72nd RS conducted multiple airborne IMINT missions all around the periphery of the Chukotski Peninsula.[44] For these sorties, the Air Force installed very long focal-length cameras to provide detailed imagery of the Soviet bases at greater distances.[45] Under Project LEOPARD, the oblique imagery the RF-13A's collected revealed that the Soviets were conducting limited activity on the peninsula and that there were "no visible bases…from which any long range bombing attack could be launched."[46] Despite the increased camera size, coverage was still inadequate at distances averaging 10 to 20 miles from shore.[47] Ever cautious, the then-Air Force Director of Intelligence, Major General Charles Cabell, advised that "there well might be elaborate inland bases on which no information is available or no photo coverage exists."[48]

Despite the numerous flights along the Chukotski Peninsula periphery, Airmen in the Arctic still did not have the data they needed to ensure safe

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[43] Major General George C. McDonald, Director of Intelligence, USAF, to, Director of Plans and Operations, Routing and Record Sheet for Memorandum, "Subject: Photographic Coverage – Chukotski Peninsula Airfields," 23 April 1948, RG 341, Entry 214, file 3-3000-99, NARA.
[44] For reasons the author was unable to ascertain, in October 1947, the 46th RS was redesignated as the 46th/72nd RS until June 1949 when it dropped the 46th; "Now It Can Be Told," history of the 46th/72nd Reconnaissance Squadron, July 1946-September 1949, 23-25, unknown author, K-SQ-Photo-72-SU-PE, AFHRA.
[45] Jeffrey Richelson, *American Espionage and the Soviet Target* (New York, NY: William Morrow Inc., 1987), 102-104.
[46] "Memorandum for the record," unknown author, 15 March 1949, RG 341, Entry 214, file 6700-99, NARA.
[47] Deputy Chief of Staff/Operations, Intelligence Directorate, memorandum for record, exact date unknown – circa mid-1948, reproduced in R. Cargill Hall and Clayton D. Laurie, eds., *Early Cold War Overflights, 1950-1956, Symposium Proceedings,* vol. II, *Appendixes* (Washington, DC: Office of the Historian National Reconnaissance Office, 2001), 413.
[48] Major General C.P. Cabell, Director of Intelligence, USAF, to Major General Budway, Alaskan Air Command, 27 December 1948, letter, RG 341, Entry 214, file 2-5400-99, NARA.

passage for SAC bombers. By the end of October 1949, Projects RICKRACK, STONEWORK, and OVERCALLS had been added with over 1,800 photographs produced. These new missions extended the coverage from the Chukotski Peninsula south through the Kurile Islands.[49] Though these additional missions did not reveal the presence of Soviet bombers in the region, they did identify several potential bases from which bombers could operate. Additionally, missions under Project OVERCALLS highlighted the growing Soviet submarine program by showing significant activity at Petropavlovsk and the Tarinski Bay Naval Base.[50]

Soviet activity in the Arctic was not the Air Force's only concern. As the Iron Curtain descended across eastern Europe, knowledge of Soviet radar capabilities became of utmost importance to air war planners at USAFE. On 9 August 1946, a USAAF C-47 Skytrain conducting a routine courier mission was attacked and shot down by Yugoslavian Yak-3 aircraft when it accidentally strayed into Yugoslav airspace during bad weather.[51] While all crewmembers survived and were eventually released, ten days later another C-47 crew was not as lucky.[52] Brought down in almost the exact same area, this time all four crewmembers perished. USAFE leadership wanted answers as to how the Yugoslavians could so effectively intercept and shoot down aircraft in poor weather conditions. Convinced of the presence of advanced radars to control fighters, the command began looking for ways to characterize the threat.

To gain appreciation of the extent of Soviet – and Eastern Bloc – radar coverage in eastern Europe, USAFE formed the 7499th Squadron and equipped

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[49] "Memorandum of Photographic Reconnaissance of USSR," RG 341, Entry 267, file 2-10103, NARA.
[50] Colonel A. Hansen, Chief, Reconnaissance Branch, Air Intelligence Requirements Division, Directorate of Intelligence, HQs USAF, to Aeronautical Chart Service, letter, "Subject: Transmittal of Photo Intelligence Reports," 25 October 1949, RG 341, Entry 214, file 2-9600-99, NARA.
[51] Futrell, *Ideas, Concepts, Doctrine*, 216.
[52] "Tito's Story! Fliers Freed," *Chicago Tribune*, 23 August 1946, online version, http://archives.chicagotribune.com/1946/08/23/page/1/article/titos-story-flyers-freed (accessed 9 March 2013).

it with modified B-17 Ferret ELINT aircraft.[53] Beginning in 1947, the 7499th flew three missions per month along the Germany-Austria border searching for Soviet radar installations. During these sorties, the airborne EWOs detected the presence of multiple Soviet early warning radars and one antiaircraft radar in Yugoslavia.[54] Additionally, USAFE flew covert missions during the Berlin Airlift. C-47s and at least one C-54D – modified for IMINT – along with B-17 Ferrets, joined the steady stream of airplanes coming into and out of Berlin.[55] As Soviet radar could not distinguish these aircraft from other types of authorized aircraft, the move provided USAFE with a deeper look into Soviet-occupied Germany and provided a better understanding of Soviet radar capability.[56] While these sorties did not permit a comprehensive appreciation of Soviet air defenses in eastern Europe, they did provide USAFE with an initial estimate of Soviet defensive capability.

Building on the intelligence cooperation established during World War II, USAFE also worked closely with the RAF to provide additional airborne IMINT coverage in Germany. Under Operation NOSTRIL, camera-equipped Lancaster bombers of 82 Squadron joined their American counterparts in Germany to accomplish photomapping of the British Occupied Zone (BOZ).[57] Underlining the urgency in obtaining information on the Soviets, the United Kingdom assigned NOSTRIL the second highest priority for the RAF at the time. Shortly after the Lancasters arrived, the RAF sent a detachment of Mosquitos from 38 and 540 Squadrons to Germany to help with the task.[58] These aircraft, along with Avro Ansons and Spitfires, helped tremendously in the early days after the war.

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[53] John T. Farquhar, *A Need to Know: The Role of Air Force Reconnaissance in the War Planning, 1945-1953* (Maxwell AFB, AL: Air University Press, 2004), 41.
[54] History, 7499th Air Force Squadron, 1 July–31 December 1947, Sq-Comp-7499-HI, AFHRA.
[55] "Historical Data of Units Assigned to United States Air Forces in Europe (USAFE)," section on 7499th Composite Squadron, 44-46, 570.07, AFHRA.
[56] Lieutenant Colonel (retired) John Bessette, "Covert Air Reconnaissance in Europe: USAFE Operations, 1946-1990" (lecture, Wings & Things Guest Lecture Series, National Museum of the United States Air Force, Wright-Patterson Air Force Base, Ohio, 2011).
[57] "Photographic Survey of British Zone of Germany, Operation NOSTRIL," Aug 1952-Dec 1953, The UK National Archives (TNA), AIR 14/3995; "Air Ministry to Bomber Command: Air Survey Photography – British Zone of Germany," 26 August 1952, TNA, 14/3995.
[58] Ibid.

To further their knowledge of Soviet activity in Europe, USAFE instituted at least two additional covert airborne IMINT programs. The first, codenamed BIRDSEYE, used modified A-26 Invaders. At the time, the Soviets and United States had imposed a restriction on conducting airborne ISR in the flight corridors that crisscrossed Germany. To circumvent the constraint, in April 1946, the 45th RS, based at Fürstenfeldbruck Air Base (AB) in southern Germany, received 15 A-26s that had been outfitted with cameras.[59] The newly designated RB-26s, with K-18 cameras shooting images through a concealed hole in the nose, flew along the border with East Germany imaging areas that USAFE felt may be targets in a future war.[60]

USAFE's second covert airborne IMINT program was instituted as a result of a direct request from the USAFE Commander, General Lauris Norstad, to the Air Force Chief of Staff (CSAF), General Hoyt Vandenberg. On 14 March 1951, Norstad wrote the CSAF asking for an airborne IMINT platform that he could use to collect intelligence on East German and Soviet military equipment in the USAFE area of responsibility (AOR).[61] Having received modified RB-36D aircraft, but unable to use them due to the corridor restrictions, Norstad was seeking another way to gather the intelligence USAFE so desperately needed.[62] Vandenberg directed Air Material Command (AMC) to find a solution. In what would become a legacy of success that continues today under the name Big Safari, project managers at AMC's Wright Air Development Center (WADC) in Dayton, Ohio, teamed up with a group from General Dynamic's Convair Division in Fort Worth, Texas, to install a gargantuan 20-foot focal length camera – the

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[59] Roger K. Rhodarmer, "Recollection of an Overflight "Legman"," in *Early Cold War Overflights, 1950-1956, Symposium Proceedings,* vol. I, *Memoirs*, eds. R. Cargill Hall and Clayton D. Laurie (Washington, DC: Office of the Historian National Reconnaissance Office, 2001), 15-16.
[60] Doug Gordon, *Tactical Reconnaissance in the Cold War: 1945 to Korea, Cuba, Vietnam and the Iron Curtain* (Barnsley, UK: Pen & Sword Aviation, 2006), 10.
[61] General Lauris Norstad, Commander, United States Air Forces Europe, to General Hoyt Vandenberg, Chief of Staff of the Air Force, letter, "Actions Necessary," 14 March 1951, Hoyt Vandenberg Papers, Box 86, LOC.
[62] Bessette, "Covert Air Reconnaissance in Europe."

K-42 Big Bertha – on a Boeing C-97 aircraft.[63]

The project, codenamed PIE FACE, was Big Safari's first and it produced mixed results. The incredible feat of installing a camera that large in an airborne platform notwithstanding, the C-97 was not particularly well-suited for an airborne ISR role.[64] First, it was unpressurized which caused many mechanical problems at the optimum IMINT altitude of 30,000.[65] Additionally, aircraft vibration reduced the quality of the K-42's images. Often the camera's massive 18-by-36 inch images would be smeared so badly that imagery analysts could not interpret them. Despite these flaws, when functioning properly, Big Bertha produced the world's most advanced photographs. In early tests, in an image of New York City taken from approximately 72 miles away, analysts could see people in Central Park.[66] To further prove the value of PIE FACE imagery, the Air Force continued flying these missions until at least summer 1960.[67]

The early airborne ELINT and IMINT flights provided useful information regarding Soviet peripheral defenses. As war plans called for aerial attacks on 30 Soviet cities, however, SAC faced a major intelligence shortfall which complicated its ability to plan. The peripheral radar information and imagery provided no actual intelligence on the Soviet economy or inland industrial infrastructure and greatly limited the potential effectiveness of any strategic air attack. In June 1948, Brigadier General P.T. Cullen, the Commander of the 311th Air Division – the command responsible for all SAC reconnaissance at the time – wrote a letter to the SAC Commander-in-Chief (CINCSAC), General Curtis LeMay, bemoaning

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[63] Colonel Bill Grimes (retired), *The History of Big Safari* (Bloomington, IN: Archway Publishing, 2014), 10-12.
[64] History, Deputy Director for Collection and Dissemination, HQs USAF, 1 July-31 December 1953, K142.01 V.4, AFHRA.
[65] Bessette, "Covert Air Reconnaissance in Europe."
[66] Dino Brugioni, *Eyes in the Sky: Eisenhower, the CIA, and Cold War Aerial Espionage*, ed. Doris G. Taylor (Annapolis, MD: Naval Institute Press, 2010), 75.
[67] "Memorandum of discussion on all forms of aircraft intelligence reconnaissance operations, including U-2s, RB-47s, other aircraft, and types of intelligence derived from these operations," specific date not provided, Summer 1960, Eisenhower Presidential Library, https://www.eisenhower.archives.gov/research/online_documents/aerial_intelligence/Summer_1960.pdf (accessed 9 March 2016).

the state of his reconnaissance force.[68] In his letter, Cullen highlighted the overall lack of airborne ISR doctrine and his ability to provide the type of intelligence necessary for nuclear war. Soon after, LeMay complained to Air Force Chief of Staff Vandenberg.[69] As a result, in December 1950, Vandenberg asked Bernard Brodie – the world-renowned expert on atomic strategy – to review the target list the Joint Staff had developed for attacks on the Soviet Union. Brodie's critique was harsh. Brodie, like LeMay, felt the targets had been selected arbitrarily and that the effects resulting from attacks on them would also be arbitrary. He furthered recommended that SAC conduct a thorough analysis of the Soviet industrial complex before building its target folders. Brodie was convinced that the target list would not produce the predicted Soviet collapse.[70] Armed with Brodie's review, Vandenberg had the catalyst he needed to prompt action from the White House.

In Washington, officials nervous about the 3 September 1949 successful Soviet test of an atomic bomb were already looking for ways the United States could increase intelligence collection to enable strategic targeting of Soviet economic centers and military bases.[71] President Truman's National Security Council (NSC) had been conducting internal meetings to reexamine the United States' objectives vis-à-vis the Soviet Union. The result of the deliberations was NSC 68. The document recognized what it called the "fundamental design" of Communism which was to retain and solidify absolute power through the "complete subversion or forcible destruction of the machinery of government and

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[68] Brigadier General P.T. Cullen, Commander, 311th Air Division, to Commander-in-Chief, Strategic Air Command, letter, 4 June 1948, in History of Strategic Air Command 1948, vol. IV, K416.01 V.1, AFHRA.

[69] "Notes for Discussion with General Vandenberg," 4 November 1948, Diary Folder, Box B64, LeMay Papers, LOC; General Curtis LeMay, Commander, Strategic Air Command, to General Hoyt Vandenberg, CSAF, letter, 12 December 1949, reproduced in Peter J. Roman, "Curtis LeMay and the Origins of NATO Atomic Targeting," *Journal of Strategic Studies* 16 (March 1993): 49 (entire article 46-74).

[70] David Allen Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945-1960, in *Strategy and Nuclear Deterrence*, ed. Steven E. Miller (Princeton, NJ: Princeton University Press, 1984), 128.

[71] Michael S. Goodman, *Spying on the Nuclear Bear: Anglo-American Intelligence and the Soviet Bomb* (Stanford, CA: Stanford University Press, 2007), 46.

structure of society in the countries of the non-Soviet world."[72] While NSC 68 did not explicitly call for increased airborne ISR, the need for greater intelligence is implicit in much of the analysis regarding the Soviet military buildup and its atomic weapons program.

At about this same time, the geopolitical complications of conducting periphery sensitive reconnaissance operations (SRO) and overflight came to the fore. Embarrassed by the American ISR community's ability to range near and even over their territory, the Soviets were looking for a way to deter the peripheral reconnaissance flights.[73] On 8 April 1950, they were finally successful when two Soviet La-11 fighters shot down a United States Navy (USN) PB4Y-2 Privateer off the Latvian coast in the Baltic Sea, killing all ten American service members.[74] This aircraft was the Navy's version of the B-24 Ferret and the incident is the first known Cold War shoot-down of an airborne ISR aircraft. The event forever changed the way the United States conducts peacetime airborne ISR. President Truman immediately implemented a 30-day stand down to reassess ISR operations.[75] The next month, the Joint Chiefs of Staff (JCS) codified the rules governing peacetime airborne reconnaissance and authorized the resumption of periphery reconnaissance.[76] The new rules stipulated that: ISR aircraft had to remain at least 20 miles from the coast of the nations they were collecting against; missions were to deviate from approved flight plans only for safety reasons; and missions flown on routes normally flown by unarmed transport

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[72] Harry S. Truman, NSC 68, *A Report to the National Security Council on United States Objectives and Programs for National Security*, 7 April 1950, 6, http://www.trumanlibrary.org/whistlestop/study_collections/coldwar/documents/index.php?documentdate=1950-04-12&documentid=10-1&studycollectionid=arms&pagenumber=1 (accessed 9 March 2016).
[73] Strobe Talbott, ed. and trans., *Khrushchev Remembers* (Boston, MA: Little, Brown and Company, 1970), 356.
[74] David F. Winkler, *Cold War at Sea: High-Seas Confrontations between the United States and the Soviet Union* (Annapolis, MD: Naval Institute Press, 2000), 12-13.
[75] John T. Farquhar, "Aerial Reconnaissance, the Press, and American Foreign Policy, 1950-1954," *Air Power History* 62, no. 4 (Winter 2015): 41 (whole article 38-51).
[76] General Omar Bradley, Chairman, Joint Chiefs of Staff, to Mr. Louis A. Johnson, Secretary of Defense, "Subject: Special Electronic Airborne Search Operations," 5 May 1950, in Department of State, Foreign Relations of the United States 1950-1955, The Intelligence Community 1950-1055, Document 6, online https://history.state.gov/historicaldocuments/frus1950-55Intel/d6 (accessed 17 March 2016).

aircraft could fly either armed or unarmed.[77]

For imagery, these new procedures were particularly problematic. As reviewed earlier, cameras with the range to look deep into Soviet-controlled territories were few in number and alternate methods to obtain intelligence information for Air Force targeting purposes were limited. In an October 1950 memorandum, the Air Force Intelligence Directorate listed the few ways in which the Air Force could collect the information it needed: daytime airborne IMINT missions over Soviet territory (which the memorandum noted were considered acts of war); the use of cruise missiles as an airborne IMINT platform; or unmanned balloons with cameras affixed.[78] This presented the Truman Administration with a true dilemma; either authorize Air Force and USN airborne ISR aircraft to fly closer to and even over Soviet territory or remain blind to the developments going on inside the Soviet Union. As seen in his 5 May 1950 memorandum that restarted airborne ISR flights after the PB4Y-2 shoot down, General Omar Bradley, the Chairman of the Joint Chief of Staff (CJCS), was in favor of resuming periphery sorties. Backing him was General LeMay who had been calling for increased ISR including direct overflight of the Soviet Union since taking over as CINCSAC.[79]

With two of the military's most powerful general officers backing the program, Truman authorized the complete resumption of all airborne periphery ISR flights under the stipulations of Bradley's memo. The PB4Y-2 shoot down had fundamentally elevated the peacetime airborne reconnaissance program to the executive level. Prior to this event, airborne ISR was managed and operated exclusively by the military services with little coordination at even the Theater level. As such, very little awareness existed at the State Department or White House regarding where, or when, American ISR aircraft were operating. From

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[77] Ibid.
[78] Air Force Intelligence Directorate, to General Vandenberg, Chief of Staff of the Air Force, memorandum for record, 3 October 1950, RG 341, Entry 214, Chronological Series 1950, NARA.
[79] R. Cargill Hall, "The Truth About Overflights," *The Quarterly Journal of Military History* 9, no. 3 (1997): 27. (entire article 25-39)

this decision forward, the Department of Defense was responsible for informing both State and the President of its airborne ISR activities. As would be seen, this awareness would be critically important as violent incidents between American ISR aircraft and Soviet air defenses would continue through at least 1970.

While the debate raged regarding peacetime airborne ISR, armed conflict broke out on the Korean Peninsula. The 25 June 1950 North Korean invasion of South Korea created an opportunity for the Truman Administration and a quandary for the Air Force's airborne ISR force. For Truman, his approval of the resumption of periphery ISR flights following the PB4Y-2 loss had explicitly forbidden direct overflight of the Soviet Union. At the time he did not believe the United States had legal justification to conduct overflights of the USSR, but with the Soviets and Chinese directly involved in Korea, his opinions began to change.[80] Additionally, Truman was concerned that the Soviets were planning attacks in Europe and possibly an aerial attack on the United States homeland.[81] To help provide intelligence related to Soviet intentions, on 22 July, General Bradley ordered the resumption of all peacetime airborne reconnaissance operations (PARPRO) sorties.[82] This authorization did not include overflight, however. In December 1950, the Air Force Vice Chief of Staff, General Nathan Twining, briefed Truman on the limitations caused by the restriction on overflight and again asked for permission for a limited number of sorties.[83] After a detailed briefing, in which the President asked many questions and reviewed the proposed flight paths, Truman authorized two overflights – one over Russia's Arctic northern shore in Siberia and one farther south closer to Japan.[84]

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[80] R. Cargill Hall, "Early Cold War Overflight Programs: An Introduction," in *Early Cold War Overflights,* 1.
[81] R. Cargill Hall, "Postwar Strategic Reconnaissance and the Genesis of Corona," in *Eye in the Sky: The Story of the Corona Spy Satellites*, eds. Dwayne A. Day, John M. Logsdon, and Brian Latell (Washington, DC: Smithsonian Institution Press, 1998), 94.
[82] Hall, "Early Cold War Overflight Programs," 1; Truman had ordered an ISR stand-down following the North Korean invasion of South Korea.
[83] General Nathan Twining, interview by John T. Mason, Jr., Interview #3, 17 August 1967, transcript available at https://www.eisenhower.archives.gov/research/oral_histories/t.html, 126-191, Eisenhower Presidential Library (accessed 12 March 2016).
[84] Ibid.

Reflecting the urgency of the need for overflight, within a week of the Twining briefing to the President, the Air Force Director of Intelligence asked for, and received, permission to have the fourth aircraft of the Air Force's most modern jet bomber, the B-47, pulled from the production line and modified for photoreconnaissance.[85] Identified as Project WIRAC, by July 1951, the aircraft was ready and forward deployed to Eielson Air Force Base (AFB), Alaska, to begin operations.[86] Unfortunately, the airplane was lost in a ground fire before it could conduct its first overflight sortie.[87] The mere fact that the Air Force was willing to pull one of its most advanced bombers from the production lines was a testament to the terrible state of target knowledge on the USSR.

The renewed PARPRO authorization prompted a flurry of activity, particularly in Europe. On 1 November 1950, the Air Force activated the 55th Strategic Reconnaissance Wing and based it at Ramey Air Force Base, Puerto Rico.[88] Within weeks, the 55th sent three of its new RB-50G ELINT aircraft to RAF Mildenhall in the United Kingdom to begin conducting periphery ISR sorties against the Soviet Union.[89] Additionally, SAC started Project ROUNDOUT which was designed to photomap the entire surface area of western Europe to search for potential targets to slow down a Soviet ground advance in the case of an invasion.[90] As part of the effort, RB-29s and the enormous RB-36 photographed locations in Germany, Austria, France, Belgium, the Netherlands, and Italy.[91]

To further increase the amount of airborne ISR coverage in western Russia, President Truman and then British Prime Minister Clement Atlee agreed

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[85] Major General Carl A. Brandt, USAF Director of Requirements, Deputy Chief of Staff for Development, to Directorate of Intelligence, Deputy Chief of Staff for Operations, memorandum, "Intelligence Requirement for B-47s for Special Reconnaissance Missions," 4 January 1951, RG 341, Box 2-17300, Folder 1, NARA.
[86] Peebles, *Shadow Flights*, 15.
[87] R. Cargill Hall, "Postwar Strategic Reconnaissance and the Genesis of Corona," 95.
[88] History, 55th Strategic Reconnaissance Wing, 1-31 November 1950, K-WG-55-HI, AFHRA.
[89] "Strategic Air Command Operations in the United Kingdom, 1948-1956," 27, K416.04-11, AFHRA.
[90] History, 28th Strategic Reconnaissance Wing, November 1950, 45-48, K-WG-28, HI, AFHRA; History, 7th Air Division, 1 July-1 December 1952, 24-26, K-DIV-7-HI V.1, AFHRA.
[91] "Strategic Air Command Operations in the United Kingdom, 1948-1956," 26.

to a combined overflight effort of the USSR.[92] While the United Kingdom certainly had the will to assist, the method was not as clear as the RAF still possessed World War II era Mosquitos, Lancasters, and Lincolns and had not purchased modern aircraft capable of safely penetrating Soviet airspace. To remedy this, under Operation JIU JITSU an agreement was made to stage SAC RB-45C Tornado aircraft at RAF Sculthorpe and for RAF aircrews to be trained to fly them over Soviet territory.[93] In August 1951, three RAF crews reported to the 91st Strategic Reconnaissance Wing (SRW) at Barksdale Air Force Base (AFB) in Louisiana to begin their familiarization with basic B-45 operations and maintenance.[94] After ten days at Barksdale, the RAF members moved to Langley AFB where they received their introduction to the specialized RB-45C.[95] In December, after a brief stint at Lockbourne AFB near Columbus, Ohio, the crews returned to the United Kingdom, and in February 1952, the new Prime Minister, Winston Churchill, authorized the overflights.[96] On 17 April, three RB-45C aircraft took-off almost simultaneously, rendezvoused with a United States Air Force refueling tanker near Denmark and then split along three flight paths over the USSR: one over the Baltic States, one in the Moscow area, and one over central southern USSR.[97]

Though the intelligence gained was landmark, it did not provide the level of detail that planners had hoped as the main Soviet bases and testing facilities were deeper within Russia than the RB-45s could penetrate. In a 16 December

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[92] "Truman-Attlee Discussions, December 1950," Department of State: Chronology File Subseries 1950-1952, Container 1, Box 8, File 26, Harry S. Truman Papers, Korean War File, Truman Presidential Library, Independence, Missouri.
[93] John C. Fredriksen, *The B-45 Tornado: An Operational History of the First American Jet Bomber* (Jefferson, NC: McFarland & Company, Inc., 2009), 173-174.
[94] History, 91st Strategic Reconnaissance Wing, vol. I, September 1951, K-WG-91-HI V.1, AFHRA.
[95] John Crampton, "RB-45C Overflight Operations in the Royal Air Force," in *Early Cold War Overflights, 1950-1956*, *Symposium Proceedings,* vol. I, *Memoirs*, eds. R. Cargill Hall and Clayton D. Laurie (Washington, DC: Office of the Historian National Reconnaissance Office, 2001), 153.
[96] Prime Minister Winston Churchill to Secretary of State for Air, letter, "Approval of Operation Jiujitsu," 24 February 1952, reproduced in R. Cargill Hall and Clayton D. Laurie, *Early Cold War Overflights,* vol. II, 448.
[97] Crampton, "RB-45C Overflight Operations in the Royal Air Force," 157.

1952 letter from RAF Air Chief Marshal Sir Hugh P. Lloyd to Air Force 7th Air Division Commander Major General John P. McConnell, Lloyd lamented that the operation had not satisfied SAC's intelligence requirements.[98] The simple fact that the flights continued for two years – despite the low value of the intelligence – underlines SAC's desperate situation. With only peripheral airborne SIGINT and a still unsatisfactory IMINT capability, Air Force and CIA planners began to explore aircraft that could finally give them the deep look into the USSR that they so urgently needed.

While the Korean War prompted a renewed emphasis on collecting strategic-level intelligence around and in the Soviet Union, for the Airmen of the Far East Air Force (FEAF), Korea created an intelligence problem for which they were unprepared. SAC's focus on obtaining targeting information on the Soviets had left the other major commands with very little airborne ISR. When the war began, the FEAF airborne ISR inventory included: 18 RF-80As in the 8th Tactical Reconnaissance Squadron (TRS); two RB-29s in the 31st Strategic Reconnaissance Squadron (SRS); and two RB-17s along with three RB-45Cs of the 6204th Photomapping Flight (PMF).[99] Additionally, there was only one FEAF photointerpretation and analysis squadron, the 548th Reconnaissance Technical Squadron (RTS).[100] Further exacerbating the ISR shortage was the lack of Air Force intelligence personnel in Far East Command (FECOM) General Douglas MacArthur's inner circle and on the FEAF staff.[101] When the war started, only one Air Force intelligence officer was assigned to the FECOM G-2 and of the 98

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[98] Robert Jackson, *United States Air Force in Britain: Its Aircraft, Bases, and Strategy Since 1948* (Ramsbury, UK: Airlife Publishing Ltd., 2000), 40.

[99] Robert F. Futrell, "A Case Study: USAF Intelligence in the Korean War," in *The Intelligence Revolution: A Historical Perspective, Proceedings of the Thirteenth Military History Symposium*, ed. Lieutenant Colonel Walter T. Hitchcock (Washington, DC: Office of Air Force History, 1991), 279; History, Far East Air Force, 25 June-31 December 1950, 158, K-720.01 V1, AFHRA; "Strategic Air Command (SAC) Intelligence Collection in Korea," 3-4, 25 June 1950-27 July 1953, K416.601-12, AFHRA.

[100] History, 548th Reconnaissance Technical Squadron, 1 June-31 October 1950, 1, K-SQ-RCN-548-HI (TECH), AFHRA.

[101] MacArthur's intelligence staff was dominated by his G-2, Major General Charles Willoughby. Additionally, only one USAF intelligence officer served within the G-2 staff. Charles P. Cabell, *A Man of Intelligence: Memoirs of War, Peace, and the CIA* (Colorado Springs, CO: Impavide Publications, 1997), 260.

Airmen in the FEAF A-2, only 30 had formal intelligence training.[102] Lieutenant General Otto Weyland, the FEAF Commander, famously remarked that "it appears that the lessons [of World War II] either were forgotten or never were documented."[103] He was exactly right.

Immediately upon the outbreak of the conflict, Fifth Air Force began seeking ways to improve its tactical reconnaissance (TACRECCE) capability. By October 1950, the Air Force had increased the strength of the 8th TRS from 17 to 30 RF-80As, the 31st SRS had moved its RB-29s from Travis Air Force Base (AFB), California, to Johnson AB, Japan, and the 6204th PMF had moved its B-17s from Clark AB, Philippines, to Johnson AB.[104] Shifting existing resources was not Fifth Air Force's only initiative. By the end of September, the 162nd TRS, the 45th TRS, and the 363rd RTS had joined the others in Japan.[105] Additionally, on 26 September, the Fifth Air Force activated the 543rd Tactical Support Group (TSG) to oversee all TACRECCE.[106]

Additional organizations and aircraft were critical, but FEAF also needed experienced personnel. In January 1951, Lieutenant General George Stratemeyer, FEAF Commander, petitioned the Air Force for Colonel Karl "Pop" Polifka and four experienced imagery analysts.[107] Polifka had commanded the Mediterranean Allied Photographic Reconnaissance Wing (MAPRW) in World War II and was considered one of the Air Force's foremost experts on tactical airborne IMINT.[108] Within days of his arrival, Polifka began making improvements to the

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[102] Futrell, "USAF Intelligence in the Korean War," 279.
[103] Otto P. Weyland, "The Air Campaign in Korea," *Air University Quarterly* 6, no. 3 (Fall 1953): 40.
[104] Futrell, "USAF Intelligence in the Korean War," 282; Judy G. Endicott, *USAF Organizations in Korea, 1950-1953*, 71, AFHRA, available online at: http://www.afhra.af.mil/shared/media/document/AFD-090611-102.pdf (accessed 12 March 2016).
[105] Robert F. Futrell, *The United States Air Force in Korea* (Washington, DC: Office of Air Force History, 1996), 546.
[106] History, 543rd Tactical Control Group, 26 September-31 October 1950, K-GP-RCN-543-HI, AFHRA.
[107] Futrell, *The United States Air Force in Korea*, 546.
[108] Robert C. Ehrhart, "The European Theater of Operations, 1943-1945," in *Piercing the Fog: Intelligence and Army Air Forces Operations in World War II*, ed. John F. Kries (Washington, DC: Air Force History and Museums Program, 1996), 180.

efficiency of FEAF's TACRECCE operations. His first objective was to establish a method to deconflict target requests from the various FEAF customers. To accomplish this, Polifka instituted a ledger system that tracked all tactical IMINT sorties and the status of the imagery interpretation from each.[109] This allowed his photo interpreters to prioritize their efforts and deliver intelligence much more proficiently. This type of system was extremely forward-thinking for the time and its basic fundamental premise is still employed in today's imagery target decks and processing, exploitation, and dissemination (PED).

Polifka had such success that when FEAF reorganized its TACRECCE units, Stratemeyer selected him as the organization's commander. On 25 February 1951, FEAF activated the 67th Tactical Reconnaissance Wing (TRW) and assigned it all the Korea-based TACRECCE units.[110] Upon establishment, the 67th TRW had the following units: the 67th Group (formerly the 543rd TSG), 12th TRS (formerly the 162nd TRS), the 15th Tactical Reconnaissance Squadron (formerly the 8th TRS), the 45th TRS, and the 363rd RTS.[111] In August, the geographically separated units all relocated to Kimpo Airfield near Seoul giving the 67th TRW enhanced control of its units and greatly contributing to the wing's ability to meet the theater's heavy demands.[112] Prior to the move, raw imagery was flown from the collecting units to the 548th RTS at Yokota or to its detachment in the Philippines before being disseminated to the customer.[113] After the move, all tactical IMINT sorties returned to Kimpo where the imagery was read out as quickly as possible, and was then disseminated.

While the 67th TRW expanded its units and aircraft inventory, it still faced a significant shortfall in photo interpreters and analysts. Complicating the issue was the lack of United States Army (USA) photo interpreters. In an agreement

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[109] History, History of Fifth Air Force, 1 January-30 June 1951, vol. II, *Operations*, 337, K730.01 V2, AFHRA.
[110] History, 67th Tactical Reconnaissance Wing, 25 February-30 June 1951, K-WG-67-HI, AFHRA.
[111] Futrell, *The United States Air Force in Korea*, 546-547.
[112] Ibid., 547.
[113] Glenn B. Infield, *Unarmed and Unafraid* (New York, NY: The Macmillan Company, 1970), 136.

between the Air Force and USA, the Army was obligated to manage the interpretation and reproduction of photography it obtained from the Air Force.[114] Unfortunately, the Army's intelligence capability was also in disarray at the beginning of the conflict. Eighth Army was aware of the obligation to process its own imagery, but it was simply unable to meet the requirement due to a lack of personnel.[115] Thus, until February 1951, the 363rd RTS processed all tactical imagery.[116] This severely hamstrung both services' ability to take full advantage of the growing TACRECCE capability as there were far more images taken each day than the Air Force's imagery analysts could analyze.[117]

Fortunately, the consolidation of the 67th TRW at Kimpo had improved the Wing's ability to satisfy customer requirements. Before his death during an operational sortie in July 1951, Polifka had normalized the entire IMINT process from requirements through dissemination. Requests for imagery from units all over Korea were funneled up through Fifth Air Force, who approved or disapproved the targets, and then sent them to the 67th TRW for execution. Based on their priority, targets were either placed in a queue for immediate prosecution or were added to an established target deck that was systematically serviced by the various units within the 67th TRW. In a time before integrated communication networks, the co-location of the wing's units greatly facilitated its ability to rapidly distribute the imagery tasking. Additionally, the Wing established a mechanism whereby field units could request time-sensitive imagery directly from the 67th TRW itself.[118] Dissemination was challenging as all images were hard-copy only, but the 67th established an adequate courier network to deliver the imagery almost immediately after it was interpreted.

While the above efforts solidified the Air Force's ability to provide tactical

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[114] William T. Y'Blood, *Down in the Weeds: Close Air Support in Korea* (Washington, DC: Air Force Historical Support Division, 2002), 39.
[115] Futrell, *The United States Air Force in Korea*, 548.
[116] History, 363rd Reconnaissance Technical Squadron, 1 January-28 February 1951, K-SQ-RCN-363-HI (TECH), AFHRA.
[117] The inability to process all the collected intelligence remains a problem in today's intelligence community. The expansion of sensors has overwhelmed the analytical capacity.
[118] "Daily Intel Sitrep, 5 AF Daily Summary and Statistical Report," 13, 16-30 September 1951, K720.059-41, AFHRA.

airborne ISR directly to the warfighter, where the 67th TRW significantly distinguished itself was in the establishment of a visual reconnaissance (VISRECCE) system it called "Hammer." In Hammer operations, North American RF-51Ds flown by the 45th TRS patrolled sectors extending 15 to 20 miles forward of each army corps' area of responsibility.[119] As the pilots flew these areas repetitively, they were able to almost immediately detect any new enemy forces present in their observation areas. The pilots communicated the changes directly to the corps fire-support coordination centers and also directed friendly fighter-bomber strikes against the targets they located.[120] The 45th TRS' pilots were the eyes of the ground force much like remotely piloted aircraft (RPA) with their full-motion video (FMV) capability have become today. Today, FMV is streamed directly to the warfighter; in Korea, the 45th's pilots made up for the lack of technology with their target expertise. They were able to identify targets for the Army's artillery batteries along with the coalition's fighter-bombers and close air support (CAS) aircraft. Radio communications allowed airborne ISR aircraft to communicate in real-time directly with attack assets. Technology had finally caught up with Foulois' dream of so long ago.

Throughout the remainder of the war, FEAF's TACRECCE capabilities steadily increased with units receiving additional aircraft and personnel. In July 1952, the Army established the 98th Engineer Aerial Photo Reproduction Company, giving the Army the ability to meet its photo interpretation obligations.[121] From then through the armistice in July 1953, tactical IMINT exceeded all expectations. In barely two years, the 67th TRW shattered all of the standards set by TACRECCE units in World War II. From D-Day to V-E Day, the Ninth Air Force reconnaissance group averaged 604 sorties a month. In the same time period, from April 1952 through March 1953, the 67th TRW averaged 1,792. In the same timeframe, the photo interpreters that supported the Third Army in

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[119] "Tactical Doctrine of the 45th Tactical Reconnaissance Squadron," 1 January 1952, K-SQ-RCN-45-SU-RE, AFHRA.
[120] Futrell, *The United States Air Force in Korea*, 547.
[121] Ibid., 552.

its drive across Europe made 243,175 photo negatives, while the 67th TRW made 736,684.[122] TACRECCE was a major contributor toward the United Nations' ability to secure an armistice and effectively end the conflict. As seen, it provided Army and Air Force commanders with the information they needed for both immediate fire operations and future planning. Additionally, the 45th TRS had established the foundation for future CAS and forward air controller (FAC) missions.

While airborne IMINT collection was immediately improved following the outbreak of the war, airborne SIGINT was much slower to develop. In June 1950, FEAF's only operational SIGINT unit – the 1st Radio Squadron Mobile (RSM) – was undermanned and focused on the USSR. As the war began, the squadron, and indeed the entire United States intelligence community, had no Korean linguists, limited access to North Korean COMINT, and no airborne capability.[123] In an internal report, the United States Air Force Security Service (USAFSS) – the USAF organization responsible for SIGINT – characterized its capabilities at the outbreak of war as "pitifully small and concentrated in the wrong places."[124]

Embarrassed by its initial inability to provide the airborne-based SIGINT that tactical commanders so desperately needed, the USAFSS pursued expansion of its rudimentary airborne capability. As they had in World War II, Airmen first began flying as "tag-a-longs" on non-ISR aircraft. In as early as January 1951, Unit 4 of the 21st Troop Carrier Squadron (TCS) was flying deep-penetrating, low-level sorties into North Korean territory.[125] Their primary mission was the infiltration of friendly spies, but these Douglas C-47 sorties often carried a linguist to provide direct threat warning of enemy action to the mission aircraft and to support Fifth Air Force intelligence requirements.[126] In January

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[122] Ibid., 555.
[123] Thomas L. Burns, "The Origins of the National Security Agency: 1940-1952," in *United States Cryptologic History*, Series V, vol. 1 (Fort Meade, MD: Center for Cryptologic History, 1990), 85.
[124] Headquarters USAFSS, *A Special Study: Securing Air Force Communications, 1948-1958*, vol. I, 1 April 1966, 37.
[125] History, 374th Troop Carrier Wing, 1-31 January 1951, 23, K-WG-374-HI, AFHRA.
[126] Warren A. Trest, *Air Commando One: Heinie Aderholt and America's Secret Air Wars* (Washington, DC: Smithsonian Institute Press, 2000), 34.

1951 alone, the unit is known to have flown as many as 13 sorties where "radio intercept" was listed as the primary mission.[127] These forays deep behind enemy lines gave the FEAF unprecedented understanding of the enemy situation and contributed significantly to the Fifth Air Force's air planning effort.[128]

Not content to merely provide direct support to the 21st TCS, the USAFSS also explored ways by which it could provide COMINT directly to the warfighter. In February 1953, it installed a COMINT collection position on a C-47 airborne Tactical Air Control Center (TACC) operated by the 6147th Tactical Control Group (TCG).[129] First utilized as a communications relay positioned between front line aircraft and the ground-based TACC at Kimpo, the airborne C-47 quickly became a command and control platform in its own right.[130] In the beginning, "Mosquito Mellow," as it became known, passed messages between tactical air control parties (TACP), airborne controllers, fighter-bombers, and the "Mellow" station of the TACC.[131] The COMINT operator on the Mosquito Mellow became a critical supplement to the situational awareness the platform was providing to the pilots of Fifth Air Force. As the linguist was listening to North Korean communications in real-time, he was often able to provide threat warning that resulted in fighters, bombers, and ground forces being diverted from their primary missions to support emerging situations.[132] In another foreshadowing of the future, these early airmen set a precedent that would ultimately become standard operating procedure among the RC-135, E-3A AWACS, and E-8 JSTARS aircraft. The three platforms often share near real-time intelligence information to enhance situational awareness and decision making.

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[127] Michael E. Haas, *Apollo's Warriors: United States Air Force Special Operations During the Cold War* (Maxwell AFB, AL: Air University Press, 1997), 26.
[128] Trest, *Air Commando One*, 42-43.
[129] History, 6147th Tactical Control Group, 1 January-30 June 1953, K-GP-TACT-6147-HI, AFHRA.
[130] James A. Farmer and M.J. Strumwasser, *The Evolution of the Airborne Forward Air Controller: An Analysis of Mosquito Operations in Korea* (Santa Monica, CA: The Rand Corporation, 1967), 37.
[131] Gary Robert Lester, *Mosquitoes to Wolves: The Evolution of the Airborne Forward Air Controller* (Maxwell AFB, AL: Air University Press, 1997), 68.
[132] Farmer and Strumwasser, *The Evolution of the Airborne Forward Air Controller*, 39.

The final effort by the USAFSS to provide additional airborne COMINT directly to the warfighter was in a project known as BLUE SKY. Having helped develop the USAFSS's fledging ground SIGINT capability at the beginning of the war, Major Leslie Bolstridge of the 6920th Security Group proposed the idea of equipping C-47s with COMINT collection equipment.[133] In late 1952, FEAF gave the group three C-47s and assigned them to the 6053rd Radio Flight Mobile at Yokota AB.[134] Operations commenced almost immediately and were a huge success. Operating over mainland Korea and the Sea of Japan, the newly outfitted RC-47 was able to provide unprecedented access to targets deep within North Korea and China. The Group's Korean linguists collected information that was unavailable through other sources and had a major impact on the tactical and strategic understanding of Communist intent.

Analysis of the unit's collection was an interesting endeavor. With limited ability to process the intelligence on the aircraft, Airmen of the 6920th created an innovative system in which the mission aircraft would jettison its tape recordings to waiting members of the USAFSS's Detachment 153 on Cho Do Island. In a procedure that foreshadowed the CORONA imagery satellite's delivery mechanism, the RC-47's crew rigged parachutes on the recorded tapes and then released them over a designated area of beach on the island.[135] The tapes were then quickly taken to Detachment 153 where any pertinent intelligence was passed to the "Mosquito Mellow" platform and other decision-makers. Although not as timely as direct warning of threats eventually became, this method provided valuable intelligence. As proof, when one of the squadron's RC-47s crashed during a takeoff from Yokota, FEAF commander General Otto Weyland offered his own VIP C-47 as a replacement for the damaged aircraft.[136]

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[133] Larry Tart, *Freedom Through Vigilance: History of U.S. Air Force Security Service (USAFSS)*, vol. IV, *Airborne Reconnaissance, Part I* (West Conshohocken, PA: Infinity Publishing, 2010),1787; The 6920th Security Group was the USAFSS organization that oversaw the 1st and 15th RSM's operations in Korea.
[134] History, 6053rd Radio Flight Mobile, 1 January-30 June 1952, K-FLT-RADIO-6053-HI, AFHRA.
[135] Larry Tart and Robert Keefe, *The Price of Vigilance: Attacks on American Surveillance Aircraft* (New York, NY: Ballantine Books, 2001), 198.
[136] Ibid., 197.

When the war began, FEAF had possessed very little tactical airborne ISR capability. Nevertheless, as it had done in World War II, the Air Force built a competent COMINT collection capability and a world-class TACRECCE system. The ability of Airmen to swing their focus rapidly from the USSR to Korea showed not only their flexibility but the power of innovation. When properly outfitted with adequate equipment – whether the RC-47 or the various IMINT platforms they received during the course of the war – the aircrews quickly improvised and found ways to contribute to the fight. These experiences in Korea would set the stage for tactical support in Vietnam. The war in Korea also had lasting impact on the Cold War; direct Soviet and Chinese involvement turned what was largely a two-nation standoff into a global confrontation. The pre-Korean War problem of limited intelligence on targets deep within the Soviet Union remained, but now it was amplified by a need for vigilance elsewhere. As the 1950s progressed, the intelligence community developed new ways by which it could obtain the ISR it so greatly needed.

In 1946, Colonel Richard Leghorn – who had commanded the 30th Photographic Reconnaissance Squadron during World War II and flown IMINT missions over Normandy in preparation for the D-Day invasion – set the stage for the future of strategic airborne ISR in comments he made to a symposium of photographic experts.[137] In his remarks, Leghorn stated:

> …it is unfortunate that whereas peacetime spying is considered a normal function between nation states, military aerial reconnaissance – which is simply another method of spying – is given more weight as an act of military aggression. Unless thinking on this subject is changed, reconnaissance flights will not be able to be performed in peace without permission of the nation state over which the flight is to be made. For these reasons, it is extraordinarily important that a means of long-range aerial reconnaissance be devised which cannot be detected. Until this is done, aerial reconnaissance will not take its rightful place among the agents of military information protecting our national security prior to the

[137] Air Force Space Command official website, "Biography of Colonel Richard Sully Leghorn," http://www.afspc.af.mil/library/biographies/bio.asp?id=9942 (accessed on 17 March 2016).

launching of an atomic attack against us.[138]

Leghorn's words were prophetic. The United States' strategic airborne ISR efforts through 1954 were insufficient. As he had predicted, ISR flights along the target nation's periphery prevented the United States from obtaining the level of intelligence it needed to prepare for strategic air warfare. As Brodie, SAC, and the Air Force had highlighted in their repudiation of the JCS targeting plans, there was a complete dearth of intelligence about Soviet capabilities and industrial infrastructure. Something simply had to change.

In 1951, the Air Force established Project Lincoln – later known as Lincoln Laboratory – at the Massachusetts Institute of Technology (MIT) to conduct research on air defense.[139] Its first project was a SAC-sponsored study codenamed Beacon Hill, under which some of the nation's finest scientific minds came together to search for ways to improve airborne ISR.[140] During the first half of 1952, the group spent every weekend at MIT receiving briefings and brainstorming high-flying aircraft and reconnaissance balloon projects. On June 15, Beacon Hill issued its initial report titled "Problems of Air Force Intelligence and Reconnaissance." While much of the report reflected many of the radical ideas the scientists and engineers had discussed, it fully supported the idea of pursuing high-altitude ISR. In the report's conclusion, the Beacon Hill group wrote:

> We have now reached a period in history when our peacetime knowledge of the capabilities, activities, and dispositions of a potentially hostile nation is such as to demand that we supplement it with the maximum amount of information obtainable through aerial reconnaissance. To avoid political involvements, such aerial reconnaissance must be conducted either from vehicles flying in friendly airspace, or…from vehicles whose performance is such that they can operate in Soviet airspace with greatly reduced chances of

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[138] Richard S. Leghorn, "Objectives for Research and Development in Military Aerial Reconnaissance," 13 December 1946, reproduced in R. Cargill Hall and Clayton D. Laurie, *Early Cold War Overflights,* vol. II, 407-408.
[139] Eva C. Freeman, *MIT Lincoln Laboratory: Technology in the National Interest* (Boston, MA: Lincoln Laboratory, 1995), 8.
[140] Victor K. McElheny, *Insisting on the Impossible: The Life of Edwin Land* (Cambridge, MA: Perseus Books, 1998), 282.

detection or interception.[141]

The report further urged the development of an aircraft that would fly at an altitude of at least 70,000 feet. At that height, the group believed, American aircraft would be safe from any Soviet air defenses. The Beacon Hill scientists further recommended that this new aircraft be designed as a "spy plane" from its very beginning and not be simply another converted fighter or bomber.[142] This last recommendation highlighted the Beacon Hill scientists' belief that there existed a lack of creative thinking in the Air Force.

Fortunately for the Air Force, concurrent to the Beacon Hill study, Colonel Leghorn had assumed a position at the Air Staff working for then-Colonel Bernard Schriever in the Office of Developmental Planning (ODP).[143] Leghorn's assignment put him in charge of planning the Air Force's ISR development where his main function was discovering unique methods to obtain additional intelligence in support of the Air Force's strategic mission.[144] Among his major achievements while at the Air Staff was his recommendation that the Air Force build a specialized, high-altitude, lightweight aircraft capable of conducting covert missions at altitudes of greater than 70,000 feet.[145] While not adopted at the time, Leghorn's work ensured the requirement was on the books.

In late 1952, engineers at the New Developments Office of the Bombardment Aircraft Branch at Wright Field, Ohio, conceptualized what would ultimately become the U-2. Having witnessed the introduction of the jet-powered B-45, Air Force Major John Seaberg and two German aeronautical experts – Woldemar Voight and Richard Vogt – conceived an airframe that combined a

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[141] Quoted in L. Parker Temple, *Shades of Gray: National Security and the Evolution of Space Reconnaissance* (Reston, VA: American Institute of Astronautics and Aeronautics, 2005), 51.
[142] McElheny, *Insisting on the Impossible*, 287.
[143] Herbert F. York and G. Allen Greb, "Strategic Reconnaissance," *Bulletin of the Atomic Scientists* 33, no. 4 (April 1977): 33. (whole article is 33-42)
[144] Herbert Frank York, *Arms and the Physicist* (Woodbury, NY: The American Institute of Physics, 1995), 204.
[145] Peebles, *Shadow Flights*, 65.

turbojet engine with a streamlined airfoil and low wing load.[146] Their imagined aircraft would achieve unprecedented altitudes and be almost invisible to any existing radars. With the urgency for intelligence on the USSR still paramount, Seaberg began creating a set of specifications. In March 1953, Seaberg's requirement was ready and he issued a request for proposals to the American aircraft industry. The requirement called for "an aircraft that had an operational radius of 1,500 nautical miles and was capable of conducting pre- and post-strike reconnaissance missions during daylight."[147] The requirement also stated that the aircraft had to have "an optimum subsonic cruise speed at altitudes of 70,000 feet or higher over the target, carry a payload of 100 to 700 pounds of reconnaissance equipment, and have a crew of one."[148] Finally, Seaberg outlined an additional requirement that would have ramifications on many future Air Force aircraft. Under the category "Detectability," Seaberg requested, "Consideration will be given in the design of the vehicle to minimize the detectability by enemy radar."[149]

In an interesting move, the Air Force sent Seaberg's requirement to only three small aircraft companies – Bell Aircraft Corporation, Fairchild Engine and Airplane Company, and Martin Aircraft Company – completely bypassing the major aircraft contractors of the time.[150] While all three set about building models to meet the Air Force's requirements, a fourth company entered the process. Though the Air Force had not solicited his company, the assistant director of Lockheed Aircraft, John "Jack" Carter, heard about the project from an acquaintance in the acquisition community.[151] As Lockheed was in the process of building the F-104 – the Air Force's first production Mach 2 fighter –

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[146] Chris Pocock, *Dragon Lady: The History of the U-2 Spyplane* (Ramsbury, UK: Airlife Publishing Ltd., 1989), 3; Gregory W. Pedlow and Donald E. Welzenbach, *The CIA and the U-2 Program, 1954-1974* (Langley, VA: CIA Center for the Study of Intelligence, 1998), 8.
[147] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 8.
[148] Ibid.
[149] Curtis Peebles, *Dark Eagles* (New York, NY: ibooks, inc., 1995), 19.
[150] The USAF believed that large aviation corporations would not treat the project with the attention it deserved. They were certain a large production run was unlikely and wanted more of a craftsman-type approach to the project.
[151] Peebles, *Shadow Flights*, 67.

Carter felt his company could produce an aircraft suitable for the Air Force's requirements. He turned development over to the mastermind behind the F-104, an aviation designer named Clarence "Kelly" Johnson who had also designed the P-38 and P-80.[152]

Within a few short months, Johnson developed a new aircraft design by using the F-104 fuselage and adding high-aspect ratio wings. As the F-104 had already achieved altitudes of over 100,000 feet, Johnson was certain that his new model – which he called the CL-282 – would have no problems meeting the Air Force requirements.[153] In March 1954, Johnson submitted his idea to now-Brigadier General Schriever's ODP. Schriever forwarded the proposal to Seaberg who rejected it because "it did not offer any serious advantages over the designs already reviewed."[154] About a week later, the Air Research and Development Command (ARDC) selected the Bell X-16. Schriever remained interested in Johnson's design, however, and invited him to the Pentagon to give a briefing on the CL-282.

In early April, Johnson arrived in Washington and briefed Schriever and his team. The General was immediately impressed and invited members of the Research and Development Directorate to hear follow-on briefings and discussions.[155] Trevor Gardner, the Special Assistant for Research and Development to the Secretary of the Air Force, was also fascinated with Johnson's CL-282 design. Schriever and Gardner recommended further review of the aircraft and tasked members of the ODP to go to Offutt AFB to brief CINCSAC General LeMay.

Shortly after, three members of Schriever's team, but interestingly, no one from Lockheed, traveled to Omaha to pitch the CL-282 to LeMay.[156] The briefing was a complete failure. LeMay was not interested in establishing a separate ISR

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[152] William Green and Gordon Swanborough, *The Great Book of Fighters* (St. Paul, MN: MBI Publishing, 2001), 345.
[153] Jackson, *High Cold War*, 105.
[154] Bruno W. Augenstein and Bruce Murray, *Mert Davis* (Santa Monica, CA: RAND Corporation, 2004), 6.
[155] Brugioni, *Eyes in the Sky*, 96.
[156] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 11.

unit within SAC and was content with obtaining IMINT from his RB-36Ds.[157] According to one attendee, halfway through the briefing, LeMay stormed out remarking that the "whole business was a waste of his time" and that he "was not interested in an airplane without wheels or guns."[158] On June 7, Lockheed received official rejection notification from the Air Staff. In its formal notification, the Air Force stated it had rejected the CL-282 because it was "too unusual," had only one engine, and the Air Force was already committed to the modification of the B-47 for its strategic reconnaissance needs.[159]

Lockheed was undeterred by the Air Force rejection and continued to push the CL-282 program to anyone who would listen. Additionally, Johnson had convinced Gardner of the aircraft's utility. As a member of the research and development community, Gardner had contacts in the Central Intelligence Agency's (CIA) Office of Scientific Intelligence and following the Air Force's rejection, Gardner recommended the design to the CIA.[160] Additionally, in July 1954, President Dwight Eisenhower had established the Technological Capabilities Panel (TCP) to advise the NSC on scientific solutions to the United States' defense challenges.[161] One of the members of the group, Dr. Edwin Land, who had also been a member of the Beacon Hill Group, had received a briefing on the CL-282 prior to the group's formation.[162] Land, and other members of the TCP, believed the CIA, and Dulles in particular, needed to "move from the old OSS-HUMINT approach…to suddenly employing technical collection systems that operated overhead."[163]

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[157] Philip Taubman, *Secret Empire: Eisenhower, the CIA, and the Hidden Story of America's Space Espionage* (New York, NY: Simon & Schuster, 2003), 83.
[158] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 12.
[159] Diary of Kelly Johnson, 7 June 1954, *Log for Project X*, quoted in Pedlow and Welzenbach, *The CIA and the U-2 Program*, 11.
[160] "Report on Special Aircraft for Penetration Photoreconnaissance," 5, Central Intelligence Agency, K193.8633-2, AFHRA.
[161] Valerie L. Adams, *Eisenhower's Fine Group of Fellows: Crafting a National Security Policy to Uphold the Great Equation* (Lanham, MD: Lexington Books, 2006), 109.
[162] Albert D. Wheelon, "CORONA: A Triumph of American Technology," in in *Eye in the Sky*, 29-30.
[163] R. Cargill Hall, *An Interview with William O. Baker* (Washington, DC: NRO History Office, 1996), 13.

After gaining approval from the other panel members, on 5 November 1954, Land wrote a letter to the CIA Director, Allan Dulles, recommending the agency pursue the CL-282 due to the aircraft's ability to provide "collection of large amounts of information at a minimum risk..."[164] Dulles demurred believing the CIA's focus should remain clandestine intelligence collection.[165] Land was undeterred, however, and sought a higher-level audience. During a TCP update to Eisenhower, Land and the TCP Chair James Killian pitched the CL-282 idea. Eisenhower was impressed with the proposal, but wanted to hear from his cabinet. On 24 November 1954, in a meeting attended by the Secretary of State, the Secretary of Defense, Dulles, General Twining, and the Secretary of the Air Force, Eisenhower authorized the acquisition of 30 CL-282s at a total program cost of 35 million dollars.[166] After approving the project, the President added a stipulation that "it should be handled in an unconventional way so that it would not become entangled in the bureaucracy of the Defense Department or troubled by rivalries among the services."[167] Having obtained the President's approval, Lockheed began immediate production and on 4 August 1955, the first two prototypes began test flights.[168]

Despite his approval, Eisenhower was reluctant to conduct direct overflight of the Soviet Union. He was acutely aware of the provocative nature of

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[164] Edwin H. Land, Chairman, Project 3, Technological Capabilities Panel, to Allen W. Dulles, Director, Central Intelligence Agency, letter, 5 November 1954, "A Unique Opportunity for Comprehensive Intelligence – A Summary," National Security Archive Briefing Book No. 75, ed. Jeffrey T. Richelson, copy available at http://nsarchive.gwu.edu/NSAEBB/NSAEBB74/U2-03.pdf (accessed 13 March 2016).

[165] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 32.

[166] Andrew J. Goodpaster, "Memorandum of Conference with the President on November 24, 1954; authorization by the President to Purchase thirty U-2 aircraft," Dwight D. Eisenhower's Papers as President, Ann Whitman Diary Series, Box 3, ACW Diary November 1954, Eisenhower Presidential Library, copy of memorandum also available at https://www.eisenhower.archives.gov/research/online_documents/u2_incident/11_24_54_Memo.pdf (accessed 12 March 2016). It is unknown why Dulles changed his opinion from his earlier meeting. The strong support of the scientific community and the simple fact that Lockheed would have the CL-282 operational before Bell even produced a prototype of the X-16 may have been factors.

[167] James Rhyne Killian, *Sputnik, Scientists, and Eisenhower: A Memoir of the First Special Assistant to the President for Science and Technology* (Cambridge, MA: MIT Press, 1977), 58.

[168] Dennis R. Jenkins, *Lockheed Secret Projects: Inside the Skunk Works* (St. Paul, MN: MBI Publishing Co., 2001), 34.

overflights and feared they would increase the chances of war. The President had to weigh the risk against the results of the recently concluded Solarium Study which had confirmed the necessity of accurately measuring Soviet and Chinese offensive threats.[169] Accordingly, when he approved the CL-282 – subsequently renamed the U-2 – he asked that the CIA run the program instead of the Air Force.[170] The President felt the civilian-run CIA would provide a more easily defended cover story in the event of an accident or shoot down. Additionally, Soviet military experts had told the President that Soviet radar would not be able to detect the U-2 and that if by chance it was shot down or had a malfunction that it would be "impossible" for the pilot or airplane to survive.

Even with these assurances, the President tried one last time to avoid having to overfly the USSR. At the Geneva Summit in July 1955, Eisenhower proposed to Soviet Premier Nikita Khrushchev what he called "Open Skies" – a reciprocal aerial reconnaissance of each other's nations as a peacekeeping tool to help allay suspicions on each side.[171] Eisenhower envisioned this as an exchange of "military blue prints" that showed the location and military disposition of each nation's forces and infrastructure.[172] Sure that Eisenhower's proposal was some type of trick, Khrushchev reacted in his trademark bombastic style by wagging his finger at the President while allegedly shouting, "Nyet, nyet, nyet."[173] With the "Open Skies" proposal soundly rejected, the President decided to make the U-2 operational.

In April 1956 – just eight months after its maiden flights – the U-2 deployed for the first time. In mid-April, two U-2s were loaded onto two C-124 transport

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[169] George F. Kennan, interview by Richard D. Challener, 1967, in *Interviews with George F. Kennan*, ed. T. Christopher Jespersen (Jackson, MS: University Press of Mississippi, 2002), 121-122.
[170] Andrew J. Goodpaster, "Cold War Overflights: A View from the White House," in *Early Cold War Overflights,* vol. I, 42.
[171] W.W. Rostow, *Open Skies: Eisenhower's Proposal of July 21, 1955* (Austin, TX: University of Texas Press, 1982), 6-7.
[172] Goodpaster, "Cold War Overflights: A View from the White House," 41.
[173] Ibid.

aircraft and flown to RAF Lakenheath in England.[174] The first U-2 squadron – known by its cover name as the 1st Weather Reconnaissance Squadron – accepted the aircraft and prepared them for Soviet overflight.[175] To avoid potential embarrassment to the United Kingdom, the CIA only flew test flights from England and later decided to rebase the U-2s at Wiesbaden AB in Germany. On 20 June 1956, the CIA conducted the first operational U-2 flight with a short duration sortie over Poland and East Germany.[176] Upon processing the imagery, U-2 photo interpreters were impressed at the greatly improved quality the U-2 provided.[177] With this first test complete, Eisenhower gave his approval to proceed on 21 June.[178]

On the 4th of July, 1956, following a short delay due to the attendance of the Air Force Chief of Staff, General Twining, at the Moscow Air Show, the U-2 flew its first sortie over Soviet territory.[179] The pilot, Hervey Stockman, flew directly over East Berlin, Poland, and Belarus. Leaving Belarus, Stockman headed north toward Leningrad. As he crossed into Russian territory, the Soviet Air Force began reacting. Contrary to American hopes, the Soviets could indeed see the U-2 and were vigorously trying to shoot it down. Stockman observed MiG fighters below him trying desperately to reach him, but he continued on with little choice but to trust the aircraft's designers.[180] Stockman finished his sortie without incident. Building on the success, four additional sorties were flown over the next several days with one of the sorties flying directly over Moscow. The images the U-2 took during these flights provided unprecedented views of

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[174] Paul F. Crickmore, *Lockheed Blackbird: Beyond the Secret Missions* (Oxford, UK: Osprey Publishing, 1993), 18.
[175] Jeffrey T. Richelson, *A Century of Spies: Intelligence in the Twentieth Century* (New York, NY: Oxford University Press, 1995), 265.
[176] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 100.
[177] Brugioni, *Eyes in the Sky*, 148.
[178] Richard M. Bissell, Project Aquatone Director, CIA, memorandum for record, "Conversation with Colonel Andrew J. Goodpaster, Dr. James Killian and Dr. Edwin Land," 21 June 1956, available at http://nsarchive.gwu.edu/NSAEBB/NSAEBB74/U2-03.pdf (accessed 13 March 2016).
[179] Nathan F. Twining, *Neither Liberty nor Safety* (New York, NY: Holt, Rinehart & Winston, 1966), 259-260.
[180] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 108.

military installations deep in Soviet territory. These first flights revealed much about the USSR's order of battle with flights over Soviet airfields showing the number of M-4 Bison and Tu-95 Bear strategic bombers was significantly lower than Pentagon estimates.[181] The lack of bombers disproved the bomber gap trumpeted by many politicians and gave the Eisenhower administration breathing room to form a more comprehensive defense and ISR strategy.

These U-2 sorties forever changed the Cold War. From 4 July 1956, the United States would no longer guess about Soviet military capabilities and order of battle. Despite vigorous, well-documented protests from the Soviets, airborne ISR flights over Communist-controlled territories continued through the 1 May 1960 shooting down of Francis Gary Powers' aircraft.[182] By that time, the United States had begun to earnestly collect IMINT from space satellites and had started work on the faster, stealthy SR-71.[183] While the use of satellite imagery would expand throughout the Cold War, the U-2 had unequivocally proven the importance of manned airborne IMINT. Though the development of enhanced air defense systems ultimately forced the United States to use manned airborne IMINT assets primarily in permissive environments, the flexibility they provide cannot always be replaced by satellites. The Air Force's recent decision to indefinitely delay the U-2's retirement only highlights this point.[184] As will be seen, the aircraft's ability to support both strategic and tactical intelligence requirements has proven irreplaceable.

Like airborne IMINT, Air Force airborne SIGINT collection capability grew rapidly following the Korean War. As opposed to the previous pattern where capabilities were allowed to atrophy following conflict, after Korea the USAFSS was determined to provide the nation with a world-class, highly flexible airborne SIGINT capability. While the war was still underway, USAFSS had initiated its

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[181] Dick van der Aart, *Aerial Espionage* (New York, NY: Prentice Hall Press, 1984), 30.
[182] Alexander L. George, RAND Report RM-1346, *Soviet Reactions to Border Flights and Overflights in Peacetime* (Santa Monica, CA: RAND Corporation, 1954), viii.
[183] Richelson, *A Century of Spies*, 302-303.
[184] Aaron Mehta, "Sources: U-2 in USAF Budget Request," *Defense News*, 2 February 2015, http://www.defensenews.com/story/defense/policy-budget/budget/2015/01/30/u2-in-usaf-fy16-budget-request/22603521 (accessed 17 March 2016).

first attempt at creating a purpose-designed SIGINT aircraft. In October 1950, after studying the theoretical feasibility of performing dedicated airborne COMINT missions, First Lieutenant Fred Smith wrote the first specifications for an airborne COMINT platform.[185] Smith turned his requirements into a requisition request and asked Headquarters Air Force (HAF) to allocate four B-50 bombers to USAFSS to be custom-designed for SIGINT. His request was denied, but HAF did apportion a retired B-29 for USAFSS to use as a test bed.

In October 1951, USAFSS began modifying the B-29, tail number 44-62290, for its COMINT mission and in June 1952, the aircraft deployed to the 91st SRS at Yakota AB, Japan, to fly operational missions in the Sea of Japan and Korea.[186] Subsequent deployments to Alaska, Europe, and North Africa solidified the value of airborne COMINT operations. The RB-29 – as the modified aircraft was known – had shown that it could gather intelligence from remote areas that were completely unreachable by ground intercept sites.[187] Further highlighting the importance of the collection, USAFSS lobbied HAF for continued use of the aircraft after the initial test period had expired and again asked for B-50s.[188] This time, USAFSS obtained the backing of the newly formed National Security Agency (NSA) who controlled the funding for cryptologic operations. With NSA's support, the Air Force approved ten RB-50s – five for Europe and five for the Far East.[189] In December 1955, the Air Force awarded the conversion contract to the Texas Engineering & Manufacturing Company (TEMCO) in Greenville, Texas, and work immediately began on Project HAYSTACK – the

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[185] Larry Tart and Robert Keefe, *The Price of Vigilance: Attacks on American Surveillance Aircraft* (New York, NY: Ballantine Books, 2001), 179.
[186] Ibid., 180-181. Following installation of COMINT collection equipment and antenna, the B-29 became known as the RB-29.
[187] Grimes, *The History of Big Safari*, 109.
[188] Colonel C.C. Rogers, USAF Directorate of Intelligence, to Major General Roger M. Ramery, Director of Operations, Deputy Chief of Staff, Operations, memorandum, 1 July 1953, reproduced in Hall and Laurie, *Early Cold War Overflights,* vol. II, 481; Capt Lambert, memorandum for record, "To initiate action to make available to USAF Security Service, for airborne intercept, the RB-29 which was used to conduct the airborne intercept tests," 1 July 1953, reproduced in Hall and Laurie, *Early Cold War Overflights,* vol. II, 482.
[189] Tart and Keefe, *The Price of Vigilance*, 185.

conversion of the ten B-50s to RB-50s.[190]

With the RB-50, airborne COMINT collection could truly expand. The Air Force had configured the RB-29 as primarily a Morse code intercept platform and had only placed one voice intercept position on the aircraft.[191] As Soviet communications moved from the high frequency (HF) to the very-high frequency (VHF) and ultra-high frequency (UHF) spectrums, it soon became clear that linguists – not Morse operators – were the key to truly gaining a comprehensive understanding of Soviet tactical systems. Because of this, the RB-50 had four voice intercept positions and only one Morse position.[192] In summer 1956, TEMCO completed the conversion and the new RB-50s were assigned to the 6091st SRS at Johnson AFB, Japan, and the 7406th Support Squadron (SS), at Rhein-Main AB, Germany.[193] While statistics are not available for the impact the RB-50 had in the Far East, it provided an immediate improvement to the level of SIGINT collection in Europe. In the first six months of 1957, the two aircraft assigned to the 7406th SS flew 97 missions and produced 1,535 hours of intercepted communications with most of it being unique.[194] The new aircraft was able to range all around the Iron Curtain periphery and collected COMINT on the Soviets that was not being collected by any other means.

While the RB-50 provided a monumental improvement in airborne COMINT capability, the Air Force had already began planning for its replacement. As USAFSS had outlined in its argument for continued use of the

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[190] Lance Martin, History of Majors Field, "Plane Better: Majors Field Contractor Celebrates More Than 50 Years of Improving Aircraft," date unknown, available online at http://www2.l-3com.com/is/50th/Majors_Field_history.pdf (accessed on 13 March 2012). TEMCO was the predecessor to today's L-3 Communications Integrated Systems company. L-3 is the primary contractor for Big Safari programs and is involved in a multitude of manned and unmanned airborne ISR projects for the USAF including the RC-135 and MC-12.
[191] As the understanding of the value of voice intercept was still not clear, planners undoubtedly followed the World War Two model. The voice intercept operator was still thought of as a "Direct Support Operator;" the strategic importance was yet to be appreciated.
[192] Grimes, *The History of Big Safari*, 110-111.
[193] Tart and Keefe, *The Price of Vigilance*, 192; History, 7499th Support Group, 1 July-31 December 1956, K-GP-SUP-7499-HI, AFHRA.
[194] Bob W. Rush, "A History of the USAFSS Airborne SIGINT Reconnaissance Program (ASRP), 1950-1977," 8, 20 September 1977, Series X.J.4.f., Center for Cryptologic History, National Security Agency (NSA), Fort Meade, Maryland.

RB-29 and the Beacon Hill group had concluded in its discussion for a high-altitude IMINT aircraft, the next COMINT platform needed to be a purpose-built aircraft to maximize collection capability. As such, the RB-50 would be the last SIGINT aircraft built through an ad hoc process of retrofitting intelligence collection gear into existing platforms. In April 1957, the Air Force awarded TEMCO with a contract under the Big Safari program to convert ten new C-130 transport aircraft into dedicated SIGINT collection platforms.[195] As opposed to previous programs in which TEMCO modified old platforms, under Project SUN VALLEY I, TEMCO received new aircraft directly from the Lockheed C-130 plant in Marietta, Georgia.[196] With new airframes, there was no need to "shoe horn" the SIGINT equipment into the available space; engineers were able to more easily design equipment. The result was a major leap forward – both in capability and crew comfort. The newly designated C-130A-IIs contained ten intercept positions (nine for voice intercept and one for Morse code intercept), a crew rest area, a galley, and even an airline-type toilet.[197] Airborne collection had truly evolved from the days of the first linguists flying in cramped conditions in the B-24s and B-17s. The Air Force's newest ISR platform solidified airborne SIGINT collection as a fundamental capability and, from the SUN VALLEY project forward, the Air Force would never be without a purpose-built airborne SIGINT collection aircraft in its inventory.

In July 1958, the 7406th SS began receiving the C-130A-II and by the end of the year, the squadron had completed the conversion from the RB-50 to the new aircraft.[198] With the increase in flights along the periphery of the USSR, the risk of shoot down also increased. Soviet and Communist Bloc fighters were becoming increasingly aggressive with their intercepts of PARPRO aircraft. Such was the concern in the Pentagon that, in late 1958, the Air Force Director of Intelligence (A-2) stopped all PARPRO flights and requested a 'value added'

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[195] Alfred Price, *The History of US Electronic Warfare: The Renaissance Years, 1946-1964*, vol. II (Alexandria, VA: The Association of Old Crows, 1989), 165.
[196] Grimes, *The History of Big Safari*, 115.
[197] Price, *The History of US Electronic Warfare*, 166.
[198] History, 7499th Support Group, 1 July-31 December 1958, K-GP-SUP-7499-HI, AFHRA.

assessment of the intelligence being collected as compared to the risk of shoot down. After a thorough analysis, the study revealed that the information being collected by the PARPRO aircraft was unavailable through other means. Hesitantly, the A-2 allowed the missions to resume.[199]

The A-2's review of the dangerous nature of PARPRO had come as a result of the shoot down of a C-130A-II over Soviet-controlled Armenia on 2 September 1958.[200] During a routine ISR sortie flown from Incirlik AB in Turkey, Mig-15s assigned to the 11th Air Army Fighter Division had shot down the ISR aircraft after it apparently strayed over Armenian territory.[201] Lost as a result were six front-end aircrew from the 7406th and the eleven USAFSS airborne linguists and Morse operators from Detachment 1 of the 6911th Radio Group Mobile. The incident was one of countless interactions between American ISR aircraft and Soviet fighters that occurred during the 1950s and 1960s. While most were harmless, at least 40 of the intercepts resulted in the loss of the American reconnaissance aircraft.[202] Despite the danger, the strategic intelligence that the evolved capability provided was irreplaceable. Ground SIGINT collection sites were capable, but their range was limited, and overhead SIGINT collection was still a few years in the future. The airborne SIGINT platform – much like its IMINT brethren – was able to provide commanders with the flexibility needed to reach anywhere on the globe.

While flights over the USSR and along its periphery were providing extremely valuable strategic intelligence, airborne ISR platforms would be put to even greater tests over Cuba. Many believe the Cuban Missile Crisis jolted an

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[199] Rush, "A History of the USAFSS ASRP," 12.
[200] This incident was the tenth documented case of Soviet aircraft shooting down American reconnaissance aircraft. Michael L. Peterson, "Maybe You Had to Be There: The SIGINT on Thirteen Soviet Shootdowns of U.S. Reconnaissance Aircraft," *Cryptologic Quarterly* (Summer 1993): 24.
[201] Declassified NSA SIGINT report, "Shooting Down of US C-130 Transport Aircraft in the Transcaucasus," 3 September 1958, https://www.nsa.gov/public_info/_files/c130_shootdown/transport-aircraft_transcaucasus.pdf (accessed 13 March 2016).
[202] "Cold War Reconnaissance and the Shootdown of Flight 60528," undated NSA article, https: //www.nsa.gov/public_info/_files/c130_shootdown / cold_war_recon_shootdown_60528.pdf (accessed 13 March 2016).

unaware intelligence community in October 1962. This is simply not the case. On 23 August 1962, President John F. Kennedy's National Security Advisor, McGeorge Bundy, had issued National Security Action Memorandum No. 181 which directed several government agencies to take action specifically in response to the possibility of surface-to-air and surface-to-surface missiles in Cuba.[203] Additionally, the President began to provide public warnings regarding Soviet influence in Cuba in September – a full month before the public disclosure of nuclear weapons.[204] Recent declassified USAFSS and NSA documents also show that airborne ISR assets were gathering intelligence in and around Cuba at least 18 months before the well-known incident drew the nation's attention.

Prior to the failed Bay of Pigs invasion of 17 April 1961, the intelligence community, and USAFSS in particular, indeed paid scant attention to Cuba.[205] Shortly after the event, however, SIGINT collectors began to detect Soviet-type radar emissions from the island and Marine Corps airborne TACRECCE sorties identified Soviet Firecan mobile fire control radars in two locations on the island.[206] When Fidel Castro publically pledged his loyalty to the Soviet Union and announced that Cuba would follow the Communist model, American interest skyrocketed.[207] Realizing its overall collection capability against Cuba was poor, the NSA initiated a series of steps to ensure American policymakers understood the events unfolding on the island. Part of these actions including increased

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[203] McGeorge Bundy, National Security Action Memorandum No. 181, 23 August 1962, The National Security Archive, the George Washington University, online http://nsarchive.gwu.edu/nsa/cuba_mis_cri/620823%2520Memorandum%2520No.%2520181.pdf&sa=U&ved=0ahUKEwjhvtfbmL7LAhWmJZoKHVz0CMsQFggEMAA&client=internal-uds-cse&usg= AFQjCNEBG4W0XXXwR oIqCTEvreXncDveBg (accessed 13 March 2016).

[204] Raymond L. Garthoff, "US Intelligence in the Cuban Missile Crisis," in *Intelligence and the Cuban Missile Crisis*, eds. James G. Blight and David A. Welch (Portland, OR: Frank Cass Publishers, 1998), 18.

[205] When the Cuban Missile Crisis began, the USAFSS had no trained Spanish linguists. To field an airborne capability, native speakers were pulled from the various intelligence schools. Segundo Espinosa, interview by the author, 12 April 2010 and 25 March 2016. Mr. Espinosa was one of the first airborne Spanish linguists. When the crisis erupted, he was at technical training at Goodfellow Air Force Base, Texas.

[206] Donald C. Wigglesworth, "The Cuban Missile Crisis: A SIGINT Perspective," *Cryptologic Quarterly*, Spring 1994, 78.

[207] Theodore Draper, *Castro's Revolution: Myths and Realities* (New York: Frederick A. Praeger, 1962), 115.

airborne and shipborne SIGINT collection capability. Unfortunately, while SAC had flown a few airborne ELINT missions against Cuba in 1960, the general focus remained the USSR. This meant USAFSS – and the rest of the intelligence community – needed to divert resources to focus on the Cuban problem.[208]

The first USAFSS contribution was to conduct airborne hearability, or sampling, tests around Cuba. In a hearability test, the general signal environment is sampled to determine what types of communications are in the collection area and whether or not they can be intercepted adequately through airborne collection. In June 1962, the USAFSS' only C-130B STRAWBRIDGE aircraft performed these tests.[209] Flying without any Spanish linguists as there were none in the USAFSS at the time, this sortie collected several Cuban voice communications and proved to NSA that airborne collection would be beneficial. As a result, USAFSS brought one of its C-130-IIB's back to the United States from Europe to begin flying COMINT collection sorties off the Cuban coast.[210]

The need to provide dedicated airborne COMINT of Cuba created a dilemma for the USAFSS. As mentioned, at the beginning of the crisis, USAFSS did not have a Spanish linguist capability.[211] To provide the airborne intelligence with which it was tasked, an effort was made to acquire Airmen from across the Air Force with the language skills, and more importantly, the analytic competence, to process the collected COMINT. To begin the program, USAFSS scoured its already existing airborne and ground linguists who were familiar with

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[208] Gene Poteat, "Stealth, Countermeasures, and ELINT, 1960-1975: Some Beginnings of Information Warfare," *Studies in Intelligence* 42, no. 1 (Spring 1998): 51-59, declassified CIA document, http://www.foia.cia.gov/sites/default/files/DOC_0006122549.pdf (accessed 18 March 2016).

[209] Wigglesworth, "The Cuban Missile Crisis," 84; According to Big Safari historian Bill Grimes, when TEMCO converted eleven additional C-130s to SIGINT collectors under the SUN VALLEY II program, one aircraft was specially configured to collect special signals, or machine communications. Grimes, *History of Big Safari*, 126.

[210] Gabe Marshall, "The Calm Before the Storm – USAFSS in the Cuban Missile Crisis," 1, 26 October 2012, 25th Air Force History Office, online http://www.25af.af.mil/News/ArticleDisplay/tabid/6217/Article/334127/the-calm-before-the-storm-usafss-in-the-cuban-missile-crisis.aspx (accessed 13 March 2016).

[211] "The Air Force Response to the Cuban Crisis," 55, undated document circa December 1962, USAF Historical Division Liaison Office, online http://www.afhso.af.mil/shared/media/document/AFD-111201-027.pdf (accessed 13 March 2016).

the Spanish language.[212] After determining that its linguist ranks would not provide an adequate number of Spanish speakers, USAFSS expanded its search to include other career fields.[213] The language skills of these Airmen varied from native speakers down to some who had only attended high school Spanish classes.

In July 1962, the 6940th Technical Training Wing at Goodfellow AFB stood-up a 24-hour crash course in PARPRO orientation and aircraft familiarization.[214] After this initial training, the Airmen deployed to MacDill AFB in Tampa and began conducting daily sorties against Cuban targets.[215] Their skills coalesced quickly and on 10 October 1962, the C-130B-II detachment produced a SIGINT report that provided evidence that Cuban air defense personnel were using the Soviet aircraft tracking system and were conducting aircraft tracking in real-time.[216] This report showed that the Cubans now likely had a viable early warning radar system and could detect aircraft operating in and around Cuban air space. With this report, the USAFSS had proven itself yet again and airborne SIGINT flights continued throughout the crisis. While most information remains classified, if the report above is any indication of the performance of the USAFSS crews, it is certain that they made lasting contributions to the overall understanding of Cuban and Soviet capabilities and intentions.

The success of airborne IMINT – by both strategic and tactical assets – in the Cuban Missile Crisis is well-known, but should not be understated. As American satellite reconnaissance was still in its nascent stages and was oriented to provide coverage of the USSR, policy makers leaned heavily on airborne IMINT to provide the imagery the satellites could not. Due to the increased focus on Cuba, the CIA began conducting bi-monthly U-2 overflights

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[212] Most of these first Spanish linguists were qualified in other languages, but were either native Spanish speakers or had Hispanic heritage. Espinosa, interview with the author, 2010.
[213] Ibid.
[214] Marshall, "The Calm Before the Storm," 1.
[215] Tart, *Freedom Through Vigilance*, vol. V, 2377.
[216] Declassified NSA report, serial number redacted, 10 October 1962, online, http://www.nsa.gov/public_info/_files/cuban_missile_crisis/10_october_intercept.pdf (accessed 13 March 2016).

in spring 1962.[217] On 29 August, a U-2 returned photographic proof that Soviet SA-2 missiles were installed on the western side of the island and subsequent sorties revealed additional SA-2 sites and MiG-21 interceptors in the central regions of the island.[218] As the SA-2 was the same missile that downed Powers' U-2 in 1960, intelligence planners feared U-2 overflight of Cuba would soon be halted and they would lose their main source of IMINT. With this in mind, they doubled the number of missions and on 14 October 1962, a U-2 piloted by Richard S. Heyser took the famous photographs of the nuclear missile preparations underway near San Cristobal.[219] Follow-on flights discovered additional missile sites, MiG-21 aircraft, and even Il-28 bombers.

When President Kennedy was shown the imagery, the world spiraled into the well-known crisis that was ultimately resolved through a naval blockade and concessions on both sides. Airborne strategic IMINT collection had saved the Americans. Without the U-2 flights, the SIGINT alone would not likely have been sufficient to unequivocally prove the presence of the nuclear weapons on Cuba.[220] Given an additional few weeks, the Soviets might have been able to operationalize the missiles and present a *fait accompli* to the United States; a move that would have incredibly weakened the American bargaining position and further destabilized the already rocky relationship between the two nations. Throughout the crisis, Kennedy relied on airborne IMINT collection to provide updates regarding the extent and status of the missile installations. Even when Major Rudolph Anderson's U-2 was shot down by an SA-2 on 27 October, Kennedy continued the overflights; the value of the intelligence was simply worth the risk.

Airborne IMINT and SIGINT collection in the Cuban Missile Crisis

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[217] Pedlow and Welzenbach, *The CIA and the U-2 Program*, 200.
[218] Jackson, *High Cold War*, 116.
[219] Robert Kipp, Lynn Peake, and Herman Wolk, "Strategic Air Command Operations in the Cuban Missile Crisis of 1962," 8-11, Strategic Air Command History Office, Historical Study No. 90, vol. 1.
[220] Further attesting to the value of the U-2 imagery is the fact that United States Ambassador to the United Nations, Adlai Stevenson, showed the U-2 images to the world in order to discredit the Soviet claims that they were only installing defensive weapons in Cuba.

unquestionably contributed to the ultimate peaceful resolution and marked an inflection point in relations between the Soviets and Americans. Following the crisis, the Cold War entered a period marked by less direct confrontations and the tactics of strategic airborne ISR reflected this less aggressive stance. Direct overflights of the USSR were not authorized. Satellites provided the necessary imagery for strategic air warfare planning and SIGINT satellites began to come online in May 1962.[221] While direct overflight was not permitted, periphery PARPRO flights continued unabated as did the evolution of communications technology. In order to maintain the edge it had established, the airborne ISR community had to also evolve.

Though the Sun Valley C-130A-II and C-130B-II were major improvements over the RB-50, the C-130 was a slow aircraft with limited range and equipment space. To bring airborne SIGINT collection into the jet age, the Air Force needed a large, long-range aircraft that it could easily modify. The search was a short one. In the mid-1950s, the Air Force had purchased the B-707 from Boeing and had begun producing KC-135 air refuelers and C-135 transport aircraft.[222] Big Safari engineers quickly determined the B-707/KC-135 platform was suitable for modification and begin planning the next evolution in airborne SIGINT collection. The Air Force agreed and purchased three aircraft to specially modify for the airborne SIGINT mission. In October 1961, in a project known as OFFICE BOY, Big Safari began converting the three KC-135s to KC-135A-IIs at the Ling-TEMCO-Vought (LTV) plant in Greenville, Texas.[223]

While previous modification projects had only provided modest upgrades to earlier capabilities, the OFFICE BOY build was a complete leap forward. The collection system on the RC-135D was far more complex than anything before. For OFFICE BOY, the LTV team developed cutting edge technologies that truly advanced airborne SIGINT collection. The ability to collect SIGINT across the

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[221] William E. Burrows, *Deep Black: Space Espionage and National Security* (New York, NY: Random House Inc., 1986), 221.
[222] Swanborough, *United States Military Aircraft*, 147.
[223] "Big Safari Program History," Section 2, 8, Report GP4082.02.01, E-Systems Greenville Division, 1 March 1983. The KC-135A-IIs were redesignated as RC-135Ds in 1965.

radio spectrum and process it on board was landmark for its time. Additionally, the OFFICE BOY provided a VHF/UHF direction finding (DF) capability that allowed the aircraft to pinpoint the emanating location of the signals it was collecting.[224] The engineers at LTV transformed the KC-135 into a state-of-the-art platform with fifteen COMINT collection positions – three times the number on the C-130B-IIs – and two dedicated ELINT positions. To further solidify this new platform as the future of airborne SIGINT collection, OFFICE BOY was the first ISR aircraft that was able to be refueled in the air.

Big Safari finished its modifications in fall 1962 and the first operational RC-135D entered the Air Force in December 1962. Assigned to SAC's 4157th Strategic Wing at Eielson Air Force Base, Alaska, by April 1963 all three aircraft had been delivered.[225] As with previous SIGINT aircraft, the front-end aircrew were assigned to SAC while the linguists, Morse operators, special signals operators, and maintenance technicians, belonged to the USAFSS. At Eielson, the USAFSS established the 6985th RSM and placed then-Captain Doyle Larson in command.[226] Beginning in January 1963, the Airmen of the 6985th flew round-robin PARPRO missions out of Eielson and long endurance sorties from Alaska across the Arctic to the United Kingdom. The RC-135D performed as advertised and enabled the USAFSS to fill some of the most important intelligence gaps during these early days post-Cuban Missile Crisis. Ranging all around the periphery of the Soviet Union and other Communist Bloc nations, the RC-135D – and its successors – gave national decision-makers the decision advantage they needed as they crafted Cold War strategy. As the 1960s progressed, a new challenge waited in the jungles of Southeast Asia, however, that would once again pull the USAFSS focus away from the PARPRO strategic reconnaissance mission. As the new crisis emerged, the evolution of Air Force

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[224] Grimes, *History of Big Safari*, 130.
[225] History, 4157th Strategic Wing, 1 January-31 December 1963, 22-23, K-WG-4157-HI, AFHRA.
[226] Larson would go on to become a legend in the USAF airborne SIGINT world ultimately achieving two-star rank and command of the Electronic Security Command (the USAFSS successor).

airborne ISR, with the U-2, SR-71, C-130B-IIs, the new RC-135Ds, and the myriad of tactical reconnaissance aircraft, had well poised the Air Force to collect valuable information. As will be seen, communicating that information to air and ground warfighters would be the biggest challenge.

As opposed to the build-up required in the Korean War, both airborne IMINT and SIGINT entered the Vietnam conflict much better prepared to support tactical air and ground warfighters. Indeed, airborne ISR assets were conducting operations in and around Vietnam long before the United States acknowledged its presence there. By early 1961, airmen of the 6988th RSM were flying their RC-47 Project ROSE BOWL COMINT aircraft over Laos and Vietnam during the Laotian Crisis of 1961.[227] Additionally, airborne IMINT was one of the main missions of the first American Airmen to see combat in Vietnam. In early 1961, a Tactical Air Command (TAC) SC-47 Skytrain was shot down over Laos while photographing Pathet Lao and North Vietnamese positions in the Plain of Jars.[228] Finally, when the Air Commandos of the 4400th Combat Crew Training Squadron (CCTS) arrived in South Vietnam in December 1961 for Operation FARM GATE, they utilized their T-28B and B-26 aircraft as VISRECCE assets to help determine Viet Cong and North Vietnamese Army (NVA) disposition of forces.[229]

As the 1960s progressed, so did the presence of airborne ISR units over and around the skies of Vietnam. Shortly after taking office, President Lyndon B. Johnson increased clandestine operations against North Vietnam. In July 1964, airmen of the 6988th SS and the 6091st Reconnaissance Squadron (RS)

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[227] Robert J. Hanyok, "Spartans in Darkness: American SIGINT and the Indochina War, 1945-1975," in *The NSA Period: 1952 – Present*, series VI, vol. 7, (Fort Meade, MD: Center for Cryptologic History, 2002), 242.

[228] Craig C. Hannah, *Striving for Air Superiority: The Tactical Air Command in Vietnam* (College Station, TX: Texas A&M University Press, 2002), 8; The SC-47 was specially configured for IMINT and was shot down by North Vietnamese antiaircraft artillery fire on 23 March 1961, Craig C. Hannah, *Striving for Air Superiority: The Tactical Air Command in Vietnam* (College Station, TX: Texas A&M University Press, 2002), 8.

[229] Haas, *Apollo's Warriors*, 228; Brigadier General Benjamin H. King, interview by Lieutenant Colonel U. Castellina and Major Samuel E. Riddlebarger at Maxwell AFB, Alabama, 4 September 1969, K239.0512-219, AFHRA; Robert F. Futrell, *The United States Air Force in Southeast Asia: The Advisory Years to 1965* (Washington, DC: Office of Air Force History, 1981), 80.

deployed their C-130B-IIs to Bangkok, Thailand, to begin flying COMINT missions against the North Vietnamese.[230] Operating under the mission name QUEEN BEE, the C-130B-II would orbit over the Gulf of Tonkin collecting COMINT on the North Vietnam Air Force (NVAF) and Vietnamese air defenses.[231] In a repeat of problems that occurred during the Korean War, at first, the ISR aircraft had no way of passing threat warning to the strike pilots and other aircraft as there was no secure voice communications network. After NVAF Mig-17s shot down two F-105 Thunderchief fighter-bombers over Thanh Hoa on 4 April 1965, Second Air Division – the Air Force organization running the air war at the time – and USAFSS sought a solution to the communication problem.[232] USAFSS had established a system to sanitize the Top Secret intelligence it was collecting, but the information was often useless by the time it actually reached the warfighter. Within a few weeks, USAFSS and NSA had created a new standard operating procedure (SOP) by which information on enemy fighters and surface-to-air missiles (SAMs) was passed directly from the orbiting COMINT platform to friendly fighters over clear UHF radio.[233] Additionally, in April 1965, the Air Force began flying the EC-121D Super Constellation as a command and control, early warning aircraft.[234] Almost immediately upon its arrival in theater, the USAFSS began equipping the platform with a COMINT intercept suite in a

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[230] Earl H. Tilford, Jr., *Setup: What the Air Force Did in Vietnam and Why* (Maxwell AFB, AL: Air University Press, 1991), 81; Futrell, *The Advisory Years*, 228: Tart, *Freedom Through Vigilance*, vol. IV, part I, 2107.

[231] History, 4252nd Strategic Wing, Annex A (Classified Annex), Project Corona Harvest document 0219565, K-WG-4252-HI, AFHRA. Information extracted is unclassified.

[232] Captain Carl W. Reddell, "Special Report: COLLEGE EYE," 1-2, 1 November 1968, Project CHECO Southeast Asia Report #71, HQs PACAF, Tactical Evaluation Directorate, CHECO Division, copy available through the Texas Tech University Virtual Vietnam Archive, http://www.vietnam.ttu.edu/virtualarchive; Thomas C. Hone, "Southeast Asia," in *Case Studies in the Achievement of Air Superiority*, ed. Benjamin Franklin Cooling (Washington, DC: Air Force History and Museums Program, 1994), 526-528.

[233] James Pierson, "History of the Pacific Security Region, 1 July 1964-30 June 1965," 34, 7 February 1966, United States Air Force Security Service, declassified document, 25th Air Force Historian's Office, Lackland AFB, Texas.

[234] Major Paul Burbage et. al., "The Battle for the Skies Over North Vietnam," in *The Tale of Two Bridges and The Battle for the Skies Over North Vietnam*, USAF Southeast Asia Monograph Series, vol. I, Monographs 1 and 2, ed. Major A.J.C. Lavalle (Washington, DC: Office of Air Force History, 1985), 128.

program called COLLEGE EYE.[235] By 1967, the USAF had modified all EC-121Ds with a four-position COMINT collection capability and USAFSS airmen – predominately from the 6988th RSM – onboard were providing near-real-time support to USAF and USN aircraft operating over Vietnam.[236] Additionally, LTV Electrosystems (formerly TEMCO) specially modified one EC-121 to include improved radar DF capability, an Identification Friend or Foe (IFF) interrogator, and four additional COMINT intercept positions.[237] Known as the EC-121K SEA TRAP/RIVET TOP and fielded in August 1967, this new combined command and control (C2) and COMINT collection aircraft had an immediate impact. Fusing real-time COMINT, enemy IFF, and radar DF data, the EC-121K gave controllers unprecedented clarity of North Vietnamese fighter and SAM threats.[238] The capability it provided truly highlighted the evolution of airborne ISR. In scarcely 50 years, the USAF had gone from using smoke signals and dropped messages to having a fully integrated communications capability that enabled the delivery of near real-time SIGINT data directly to air and ground warfighters. SEA TRAP/RIVET TOP epitomized everything the early pioneers had envisioned for the potential of airborne ISR. According to Big Safari historians, "No project ever received as much favorable commentary in such a short combat tour as RIVET TOP."[239]

Airborne IMINT forces also took advantage of their early arrival in Southeast Asia and provided substantial levels of intelligence to tactical warfighters throughout the war. By the time the major United States force build-up began in 1965, ISR airmen had already established mechanisms that would ensure the timely delivery of the imagery that was so vital for targeting and protection. In a system similar to the one established by "Pop" Polifka in the

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[235] "Report, Relative Effectiveness College Eye, Rivet Top, Big Look," vol. II, 25-36, 10 January 1968, K717.0413-44 V.2, AFHRA.
[236] USAF Tactical Fighter Weapons Center, *Project Red Baron II: Air to Air Encounters in Southeast Asia*, vol. II, part 1 (Nellis AFB, NV: USAF Tactical Fighter Weapons Center, 1973), D-1, K160.0311-20 V. 2, PT. 2, AFHRA.
[237] "Project SEA TRAP Test Directive," 4-8, K168.06-152, AFHRA; Grimes, *The History of Big Safari*, 162.
[238] "RIVET TOP Messages," 2-3, K168.06-68, AFHRA.
[239] Quoted in Grimes, *The History of Big Safari*, 166.

Korean War, requests for imagery were validated by United States Pacific Air Forces (PACAF) collection managers before they were tasked to the individual collection platforms. Dissemination also worked in a similar fashion to the Korean War. Seventh Air Force – the successor organization to Second Air Division – established imagery processing units at all its main bases. After the imagery was read out, it was delivered by courier to the requesting unit to aid in the next day's mission planning. The availability of TACRECCE in Vietnam was also unprecedented. According to Air Force reports, during the nine-year war, TACRECCE aircraft flew approximately 650,000 sorties.[240]

In another attempt to get intelligence directly to the warfighter, American forces in Vietnam designed the first automated tactical data links. Building on the COLLEGE EYE program, PACAF planners initiated Operation COMBAT LIGHTNING.[241] In a memorandum to the Secretary of the Air Force, the Seventh Air Force Commander, Lieutenant General William Momyer, described the project as being "designed to interface a number of automated subsystems to give me a near real-time command and control capability…"[242] The idea was to link all tactical systems in theater together via one data link that all could receive.[243] Airborne systems – particularly the COLLEGE EYE EC-121Ds and the newly arrived RC-135D – fed COMINT, fused with radar data, into the COMBAT LIGHTNING system.[244] Though classification problems prevented COMBAT LIGHTNING from achieving complete success, it did provide a real-time exchange of tactical information for the first time and set the precedent for post-war efforts to improve overall situational awareness.

With the initiation of LINEBACKER II operations in 1972, the USAF

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[240] Herman L. Gilster, *The Air War in Southeast Asia: Case Studies of Selected Campaigns* (Maxwell AFB, AL: Air University Press, 1993), 5.
[241] "Combat Lightning (Fusion)," HQ USAF and PACAF Files, 3, K143.5072-4, AFHRA.
[242] Lieutenant General William W. Momyer, Commander, Seventh Air Force, to Harold Brown, Secretary of the Air Force, memorandum, 1 May 1968, K143.5072, AFHRA.
[243] Frank M. Machovec, "Southeast Asia Tactical Data Systems Interface," Chapter 2, Project CHECO Southeast Asia Report #220, 1 January 1975, HQs PACAF, Tactical Evaluation Directorate, CHECO Division, copy available through the Texas Tech University Virtual Vietnam Archive.
[244] "Interface of COMBAT LIGHTNING Program," 8, K243.03-147, AFHRA.

suffered increased aircraft attrition rates. During the nearly three-year hiatus between the end of ROLLING THUNDER and the beginning of LINEBACKER II, the North Vietnamese had greatly improved their air defense network. By 1972, with help from the Soviets and Chinese, the North Vietnamese had constructed what was one of the best air defense systems in the world. It was battle-tested, had excellent radar integration, the world's most advanced SAM (the SA-2), and an outstanding fighter in the Mig-21.[245] These enhancements to the North Vietnamese air defenses gave a rude awakening to American aircrews who returned to the skies over North Vietnam in the early stages of LINEBACKER II. During June 1972 alone, the USAF lost 12 aircraft and the USN nine. Seven of the American losses were to MiGs, while the USAF and USN had only downed two enemy fighters.[246] American pilots were discouraged by the losses and sought improved situational awareness. During ROLLING THUNDER, SEA TRAP/RIVET TOP had provided them with the direct threat warning they needed to avoid losses and defeat the NVAF. Unfortunately, the one EC-121K had left theater and ultimately been sent to the aircraft boneyard.[247] Aircrew wanted the level of support they had received from SEA TRAP/RIVET TOP; they took their request up the chain-of-command.

In response to his pilots' pleas, the Seventh Air Force Commander, General John Vogt, sent a letter to the Chief of Staff of the Air Force, John Ryan. In the letter, Vogt stated his analysis showed that the USAF was losing the air-to-air war.[248] Vogt asked Ryan if he could get the National Security Agency (NSA) to improve their support to him.[249] Ryan took immediate action. He first called the

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[245] M.F. Porter, "Linebacker: Overview of the First 120 Days," 44, Project CHECO Southeast Asia Report #147, 27 September 1973, HQs PACAF, Operations Analysis Directorate, CHECO/CORONA Division, copy available through the Texas Tech University Virtual Vietnam Archive.
[246] John T. Smith, *The Linebacker Raids* (London, UK: Arms & Armour Press, 1998), 88.
[247] Grimes, *The History of Big Safari*, 166.
[248] Major General Doyle E. Larson, "Direct Intelligence Combat Support in Vietnam: Project Teaball," in *American Intelligence Journal* 15, no. 1, (Spring/Summer 1994): 56.
[249] Major General Doyle E. Larson, "Project Teaball," unpublished notes, date unknown (obtained via FOIA request from 25th Air Force Historian Office), 1.

Director of the NSA, Vice Admiral Noel Gayler, and read Vogt's message to him.[250] Gayler replied that he believed they could improve their support and appointed then-Colonel Doyle Larson – the NSA representative to the Pentagon – as the project lead.[251] Larson made immediate contact with General Ryan and was directed to establish an action team in the Air Staff's Quick Reaction Group (QRG). In what would become known as Project TEABALL, Larson's team – which included Korean War COMINT veteran Delmar Lang – quickly set about brainstorming potential ways to get SIGINT directly to the cockpits.

The QRG team agreed that the RC-135D was the most capable platform available, but the aircraft did not have the necessary communications capacity to pass information directly to the fighter and bomber pilots.[252] To solve the RC-135D communications issue, Larson's team set up a path for the RC-135D data to flow to a U-2 that would be on-station at the same time.[253] As the U-2 was already downlinking its collection to a van at Nakhon Phanom (NKP) AB in Thailand, Larson's team decided the best way to pass the RC-135D collection to the tactical warfighters was to set up a command and control van next to the U-2 exploitation van.[254] In the new van, the RC-135D and U-2 collection was combined with radar data from ground collection sites and the EC-121D. All of this data was then fed into the COMBAT LIGHTNING data link system.[255] Similar to the arrangement Lang had established in Korea, this new system would allow the command and control van – using callsign Teaball – to pass direct threat warning information via voice within seconds of reception.[256]

To ensure pilot buy-in and confidence in the intelligence they would be receiving, the in-country project officer, Lieutenant Colonel Bill Kirk – himself a pilot – briefed TEABALL operations to all the Seventh Air Force's fighter and

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[250] Ibid.
[251] Ibid.
[252] Ibid., 2.
[253] Walter J. Boyne, "The Teaball Tactic," *Air Force Magazine* 91, no. 7 (July 2008): 69.
[254] Larson, "Direct Intelligence Combat Support," 57.
[255] Machovec, "Southeast Asia Tactical Data Systems Interface," 23.
[256] Major General Jack Bellamy, Assistant Director of Air Operations MACV/J-3, COMUSSAG/7th Air Force Deputy Chief of Operations, "End of Tour Report," 15 August 1974, K712.131, AFHRA.

bomber pilots. Due to classification limitations, he could not tell the aircrews all the details, but he made sure that they all understood that the data would be accurate and that they were to believe it. During the first week of August 1972, Project TEABALL went into effect.[257] After an initial period of growing pains marked by communications problems, the project met with huge success. As in Korea, American pilots now had the information they needed to avoid enemy air ambushes and to set up their own. Kirk's indoctrination of the pilots had been successful. They trusted the information they were receiving and put it to good use. From a nearly .47:1 ratio in favor of the NVAF before TEABALL, the kill ratio skyrocketed to over 4:1 after its inauguration.[258] Looking back on TEABALL operations, General Vogt stated, "With the advent of TEABALL, we dramatically reversed this [1oss-to-victory ratio]…during Linebacker we were shooting down the enemy at the rate of four to one…same airplane, same environment, same tactics; largely [the] difference [was] TEABALL."[259]

TEABALL had shown that SIGINT-derived information could be shared in near-real-time with unindoctrinated personnel. The establishment of the TEABALL control van ensured the sensitive pieces of the information could be stripped away before the intelligence was passed to the warfighter.[260] When combined with the COLLEGE EYE program, SIGINT support to the tactical fight was robust. In a final analysis of the system, it has been estimated that the TEABALL system saved the lives of at least twenty pilots and over $40 million in aircraft.[261]

As in Korea, airborne ISR had shored up the United States' military

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[257] M.F. Porter, "Linebacker: Overview of the First 120 Days," 46.
[258] Ibid.
[259] Quoted in Marshal L. Michel, *Clashes: Air Combat Over North Vietnam, 1965-1972* (Annapolis, MD: Naval Institute Press, 1997), 283.
[260] SIGINT professionals were most concerned about revealing the source of their intelligence. As the tactical warfighters really only needed to know where the enemy was located, and not HOW the information was obtained, a system was devised whereby SIGINT professionals stripped any data that would identify source and only based the most basic information to the warfighters.
[261] "TEABALL: Some Personal Observations of SIGINT at War," *Cryptologic Quarterly* 9, no. 4 (Winter 1991), 95.

position in the frustrating war. The dynamic, customer-responsive strategic airborne IMINT assets (the U-2 and SR-71) and TACRECCE organization ensured Airmen, Soldiers, and Marines all had the most up-to-date information on the targets and operating areas they were tasked to attack or patrol. It was not a perfect system, but considering the widely dispersed forces and the remote locations in which many of them were based, it functioned remarkably well. Additionally, the Vietnam War was a dynamic, highly mobile conflict. Of the sometimes thousands of images taken each day by the various airborne ISR platforms, many were either completely new or the terrain had been altered by the fighting on the ground or the bombing from the air.[262] This factor alone made photointerpretation incredibly difficult. Despite this, Airmen in the various imagery career fields endeavored to provide the best possible support they could. With few exceptions, they were commended by the warfighters they supported. Airborne SIGINT also shined during the war. From its early entry with Korean War-era RC-47s to the end of the war when it exited with the highly modernized RC-135D, airborne SIGINT was a true difference maker.[263] By the early 1970s, airborne SIGINT was ubiquitous in and over the skies of Vietnam.[264] While flight data does not seem to exist for the RC-47 and C-130B-IIs, the RC-135D alone flew approximately 3,250 sorties and compiled 39,286 hours on station.[265]

With the U-2 and the RC-135, the Air Force capped an exciting period in the evolution of airborne ISR. Growing from a nascent capability at the end of the Second World War, airborne intelligence collection had taken its rightful

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[262] Wayne Thompson, *To Hanoi and Back: The United States Air Force and North Vietnam, 1966-1973* (Washington, DC: Air Force History and Museums Program, 2000), 17.

[263] As a testament to the rapid advance of airborne SIGINT technology during the Vietnam War, consider that the RC-135 remains today the premier airborne SIGINT asset in the world. To go from the extremely outdated RC-47 to the elite RC-135 in only ten years was a truly remarkable feat and a reflection of the amazing ingenuity and innovative spirit of the Airmen of that day.

[264] Though not within the scope of this current study, during the Vietnam War the USAF also experimented with unmanned aerial vehicles (UAVs) configured for airborne ISR. The Lightning Bug was the most prolific flying both strategic and tactical level IMINT missions. For more on the use of UAVs in Vietnam, see Thomas P. Ehrhard, *Air Force UAVs: The Secret History*, Mitchell Institute Study, Air Force Association, 2010, 23-29.

[265] Robert S. Hopkins III, *Boeing KC-135 Stratotanker: More than Just a Tanker* (Leicester, UK: Aerofax Midland Publishing Limited, 1997), 147.

place as a flexible provider of strategic intelligence. Faced with a dearth of information regarding Soviet targets, Air Force planners undertook a crash effort to build capabilities that would provide them the detailed information they needed to conduct strategic air warfare. Modified aircraft – B-17s, B-24s, and C-47s – were the first to get involved. Their photomapping of Europe and North Africa set the precedent for future airborne IMINT missions in Alaska.

SAC's war planners also relied heavily on airborne ELINT collection. Lacking information regarding Soviet air defense systems, SAC configured existing airframes to probe the Soviet periphery looking for any electronic emanations that would help identify Soviet radars. Flying dangerously close to the USSR, these initial sorties provided strategic war planners with information on the extent of Soviet defenses along the Arctic approaches. While the peripheral intelligence was important, it was not sufficient to plan air strikes within the USSR. Direct overflight was needed and in 1948, the Air Force began its long history of penetrating Soviet territory when it flew its first F-13A sortie deep into Siberia. Though Presidential approval would wax and wane, deep penetration of Soviet airspace continued through the U-2 shoot down in May 1960.[266]

Strategic airborne COMINT collection also came of age during this period. Using a modified B-29 airframe, airborne linguists quickly proved their worth flying intercept missions against Soviet communications in the Sea of Japan and over Korea. Often used as a political instrument, the Airmen of these early Cold War sorties endeavored to collect the best intelligence they could on what they all believed to be a tangible threat to the United States. Their success led to the Air Force institutionalization of airborne COMINT as a fundamental necessity and in 1957, the C-130A-II became the first COMINT platform that was exclusively built for airborne ISR. Rapid evolution over the next decade resulted

[266] While acknowledged American overflight ceased in 1960, the danger to ISR flights along the USSR periphery did not stop. In all, the Soviets downed at least 20 American ISR aircraft during the Cold War with some estimates going as high as 40. While the dangerous interactions with Russian aircraft mostly ceased after the end of the Cold War, the recent rise of Russia has brought a return to the old Cold War intercepts. For further information see Burrows, *By Any Means Necessary* and Tart, *Price of Vigilance.*

in the RC-135 – a platform that remains the Department of Defense's premier airborne SIGINT collector.

Unlike the majority of the other conflicts, following Vietnam manned airborne ISR continued to evolve. While the Air Force already possessed the airframes that would take it through the Cold War and beyond, the collection systems were continually improved in spiral upgrades that ensured the platforms always had the latest technologies. Though the U-2's cameras were extremely advanced for their time, they have been upgraded multiple times over the years since the Vietnam War. The U-2's SENIOR YEAR Electro-Optical Reconnaissance System-2C (SYERS-2C), Advanced Synthetic Aperture Radar System IIA (ASARS-IIA), and its Optical Bar Camera (OBC) are all state-of-the-art and have solidified the U-2 as a platform of choice for tactical and strategic airborne imagery.[267]

To this day, the RC-135 remains the crown jewel of the United States' airborne SIGINT collection platforms. Since Vietnam it has received a series of capability upgrades and refinements to ensure it stays 'one step ahead' of technological advances. Each upgrade to the aircraft has increased its ability to collect intelligence and, importantly, its ability to communicate with customers in near real-time. While the details of its complete capabilities are classified, the state-of-the-art SIGINT it provides often makes it the first American aircraft to arrive in areas of conflict and, more often than not, also makes it the last to leave – as a continual presence in the Middle East since 1990 attests.

Following Vietnam, the airborne ISR fleet returned to its prewar mission of keeping tabs on the Soviet Union. The 1970s and 1980s were characterized by a true state of cold war as little direct confrontation between the superpowers took place. Proxy wars and conflagrations in Latin America and the Middle East allowed both to demonstrate their geopolitical dominance, but did not require direct, nuclear-threatening clashes as had Korea and the Cuban Missile Crisis.

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[267] Jeffrey T. Richelson, *The U.S. Intelligence Community*, 7th ed. (Boulder, CO: Westview Press, 2016), 197-198.

As the 1980s closed, the Soviet Union was near collapse. From the dawn of the Cold War to its abrupt end, Air Force airborne ISR was there for the whole thing. A legacy of aircraft had provided the strategic level intelligence that the nation's – and our partner nations' – leaders needed to ensure they held a decision advantage over their adversaries. When the nation called for the strategic assets to adapt to a tactical war to provide intelligence direct to warfighters, the incredibly flexible Airmen of the Air Force were able to do what was asked of them.

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Conclusions, Lessons, and Prognostications

Conclusion

The USAF's ability to deliver near real-time intelligence directly to fighter cockpits and ground warfighters during the Vietnam War capped a hard-fought struggle that spanned over two thousand years. Growing from ground commanders' simple desire to obtain a better view of potential enemies and battlegrounds, manned airborne ISR has become an integral part of all major militaries. In the earliest stages, seeking a higher vantage point drove the invention of the manned kite. First used by the Chinese, little documentation exists to describe their employment. One can only guess at the severity of the danger the first airborne observers faced, but the intelligence demand was such that commanders took the requisite risk to ensure they obtained enhanced warning of enemy intent and tactics. While kites were a major improvement over ground-based reconnaissance, they were severely limited by their frailty. Other solutions for manned flight were sought and in 1783, the French Montgolfier brothers truly ignited the evolution of airborne ISR when they successfully flew a hot air balloon for the first time.

This first sortie was shortly followed by man's first balloon ascension. Not long after man got his first aerial view, thought turned to the military application of the new invention. Visionaries and thinkers from Europe to the United States wrote about the vast possibilities and within ten years of its invention, the French conducted the first military balloon ISR flights. Balloon use by the Union Army in the American Civil War demonstrated the significant force enhancing power of airborne ISR. In the first two years of the war, aeronauts Thaddeus Lowe and John La Mountain conducted dozens of sorties that provided significant intelligence to Union generals. Unfortunately, funding and higher priorities limited widespread balloon-based ISR but the precedent had been set. Army

leadership greatly valued the intelligence provided by the first American ISR airmen and came to rely on it for planning and situational awareness.

Other than a few free-flight test sorties conducted by La Mountain, the vast majority of balloon ISR during the Civil War was done with static balloons. Like kites, static balloons were a significant improvement over ground-based intelligence sources, but their inability to move quickly with the ground forces and their vulnerability to ground fire greatly limited their utility. As a result, following the war designers endeavored to improve on the static balloon. Multiple engineers attempted to provide both navigability and power to various balloon designs, but most failed. Through a combination of designs, in 1900, Count Ferdinand von Zeppelin of Germany solved both challenges when his LZ-1 airship successfully completed its maiden flight. The world had its navigable balloon and several nations began planning for its incorporation into the various armed services. The airship was a significant advance over the static balloon, but its utilization was to be short lived as in 1903 the Wright brothers' airplane success provided the ultimate platform for manned airborne ISR's next evolutionary phase.

Though most militaries would keep the static balloon and airship in their inventories through World War I, most realized the significant advantage of the airplane and it quickly became the focus of prewar airborne ISR improvement efforts and their resulting successes. The level of preparation of the various nations varied, but by 1914 and the beginning of the war, many had developed at least the basic ability to conduct manned airborne reconnaissance and observation. While undoubtedly still a nascent capability, these first ISR airmen contributed greatly to ground commanders' operational planning. Early success solidified its importance and as aerial photography and wireless air-to-ground electronic communications were introduced, the ability to provide actionable intelligence in near real-time was improved. By the end of the war, airborne ISR was ubiquitous, providing an unblinking eye over the trenches. Ground commanders developed significant trust in the intelligence airborne ISR provided and during the latter stages of the war even refused to conduct ground

operations without first 'seeing' the battlefield through the airborne images provided by the various air forces.

Postwar euphoria, isolationism, intra- and interservice rivalries, and the uncertainty of air power's future role limited airborne ISR's development in the 1920s and 1930s. Interwar airmen of the United States and Great Britain focused on developing a strategic bombing capability but neglected to acquire an ISR capability that could provide the bomber forces with targeting information. France did little to advance airborne ISR as it devoted most of its attention to developing defensive capabilities that would slow any future German aggression. In Germany, the embarrassment of the first war's loss prompted careful planning for the next one. This led German interwar strategists to mature air power doctrine – including airborne ISR – to coincide with the type of war the Germans planned to fight. Thus, when the war began, only Germany was in a true position to provide its ground and air forces with the airborne ISR they needed. In its blitzkrieg campaigns, Luftwaffe ISR aircraft ranged in front of the Heer providing real-time updates that considerably assisted German ground commanders' ability to adjust their battle plans to the reality of the situation on the ground.

As the war ground on, the other combatants advanced their own capabilities and airborne ISR began providing intelligence that was unavailable via other means. Throughout the war, the British and Americans experimented with various types of airborne IMINT aircraft. First using modified, but outdated, bombers, both nations realized the danger modern air defenses posed. To mitigate the hazards, first Britain, and then America, pursued high speed, high altitude airplanes to conduct airborne ISR. The resulting aircraft – the British Mosquito and the American F-4 – became the workhorses of the IMINT forces during the later stages of the war and set the high speed, high altitude precedent for their ultimate successors, the U-2 and SR-71. Both nations also learned the necessity of well-trained photo interpreters, all-source analysts, and air intelligence liaisons. By the end of the war, they had developed a world-class imagery system that was providing near real-time images for both strategic bombing targeteers and tactical warfighters.

Concurrent to the IMINT efforts, in 1940, the British conducted the first airborne ELINT collection mission in combat. This sortie – flown to collect and identify the German homing beam that was enabling successful German night bombing of Great Britain – was a smashing success. The British identified the parameters of the German signal and within weeks, had developed a jamming system to deny access to the signal. In the United States, ELINT aircraft were also the first major airborne SIGINT contributors. In 1942, the USAAF modified a B-17 bomber by installing radio receiving equipment in its weapons bays, and flew the first American ELINT combat sortie. The following year, an ELINT-modified B-24 flying off the Aleutian Islands collected the first Japanese radar signal and geolocated its location. In perhaps the first hint at the importance of airborne SIGINT collection, USAAF fighter-bombers immediately attacked and destroyed the Japanese radar. With these successes, the airborne ELINT program progressed rapidly. By 1943, multiple platforms were flying in the Mediterranean and the English Channel. These aircraft collected technical data on the German radar networks that revealed gaps in German air defense coverage. Using this information, invasion planners were able to plot infiltration routes that gave Allied invasions the best chance of success.

As the Germans retreated from Africa and Italy, ground-based COMINT collection suffered. In an attempt to extend the collection range, the British began placing linguists on their airborne ELINT missions. In 1943, the Americans followed suit and by the invasion of Normandy, it was standard practice for German linguists to fly on bombing missions deep within Nazi-held Europe. The practice was also adopted in the Pacific theater with Japanese-speaking Nisei airmen providing the same type of capability as the linguists in Europe. The information the linguists were able to intercept – much like that of their airborne IMINT and ELINT brethren – was unique. Analyzing enemy TTPs, the linguists developed a comprehensive understanding of German and Japanese air tactics and built order of battle information that was unavailable from other sources. More importantly perhaps, the airborne linguists provided

real-time threat warning to the airborne crews. These forewarnings prevented countless deaths and unquestionably contributed to Allied success.

With the conclusion of World War II, manned airborne ISR shifted its focus to the USSR. Though often deadly, IMINT and SIGINT flights around the periphery of Soviet territory became common. While they provided desperately needed intelligence on Soviet air defenses, they were unable to penetrate deep within the country. A short-lived overflight program using modified bombers provided additional information, but until 1956, the United States had little strategic intelligence on Soviet targets. That all changed with the arrival of the U-2 when direct overflight of the USSR became possible. With its first flight, the U-2 began refuting some of the myths of the Cold War; its imagery of Soviet air bases disproved the perceived bomber gap. With the introduction of the U-2, the United States' strategic airborne IMINT capability was guaranteed. The follow-on SR-71 improved the capability, and never again would the USAF be without a dedicated strategic airborne IMINT platform.

Airborne SIGINT also greatly evolved during the Cold War. From a rudimentary capability following World War II where linguists still "piggybacked" on modified bombers, the USAF developed purpose-built SIGINT aircraft. In the early 1950s, with the introduction of the RB-50, USAF airborne SIGINT began its precipitous development. The RB-50 was quickly followed by the USAF's first purpose-built airborne SIGINT platform, the C-130A-II, and within a decade, the RC-135 was in the inventory. Thus, by the early 1960s, the USAF had the backbone of its strategic airborne ISR capability already in place; the U-2 and the RC-135 remain to this day the primary components of that arsenal.

The above highlights the Cold War successes of strategic airborne ISR. There was also tremendous tactical success. During the Korean and Vietnam Wars manned airborne ISR forces that had become accustomed to conducting only strategic collection missions were asked to provide tactical intelligence directly to air and ground warfighters. As this study has shown, airborne ISR Airmen also succeeded mightily in these situations. In Korea, after overcoming a considerable learning curve, tactical IMINT and SIGINT kept ground and air

commanders apprised of enemy intentions. In the case of SIGINT, timely warning information provided directly to pilots undoubtedly contributed to the lopsided F-86 to MiG-15 kill ratio. During the Vietnam War, manned airborne ISR forces repeated their success of the Korean War. They constructed similar dissemination and direct threat systems that allowed the timely, accurate delivery of intelligence directly to ground and air commanders. In Project TEABALL, airborne COMINT was fused with ground- and air-based radar data to provide a comprehensive picture of enemy location and intent. The long sought after dream of so many airborne ISR pioneers was finally realized.

Understanding their effort had not been perfect, following the Vietnam War, ISR Airmen endeavored to improve their tactical support ability. In an attempt to shorten the intelligence delivery chain, they created digital data links that would allow multiple users the ability to "see" intelligence and radar information simultaneously. This eliminated the reliance on relay centers as was done in both Korea and Vietnam. Additionally, ISR Airmen undertook a diligent effort to ensure the ability to communicate via secure voice directly with the warfighters. Too often during the previous wars, airborne ISR forces possessed threat information that may have saved lives, but were unable to communicate it quickly enough. After rigorous coordination with ground and air components, airborne ISR platforms were equipped with a myriad of radio communications that enabled them to communicate directly with the warfighter. No longer would either situational awareness or threat warning have to be relayed by a third-party.

When Operation DESERT STORM began in 1991, manned airborne ISR forces had truly evolved. They possessed the ability to see and hear the adversary and to subsequently communicate that information in near real-time to the people that needed it. Additionally, they had developed the collection platforms and trained the Airmen to be able to conduct the tactical and strategic intelligence collection missions. The incredible flexibility and innovative spirit of ISR Airmen allowed them to be effective in both distinct missions. The long journey that had begun with the first nameless Chinese observer who sat

precariously on a kite while he watched enemy movements had finally been completed. The linguist in the back of the RC-135 or the imagery analyst at a U-2 processing site would not recognize their ancient predecessor or even understand the connection, but they are inextricably linked in the evolutionary path of manned airborne ISR.

Lessons and Prognostications

In essence, the main lesson that results from the analysis of the evolution of manned airborne ISR is that the intelligence it provides has become an absolutely foundational part of the modern decision making calculus. ISR is ingrained to such an extent that the days when intelligence was viewed as simply a force enhancer are long gone; today, manned airborne ISR *is* operations. The study of its evolution reveals the travails undertaken over nearly 2000 years to arrive at today's capability. The principal message is that military leaders cannot affort to let the capability atrophy. During times of peace, militaries severely neglected manned airborne ISR, often looking to it as the first target for cuts following conflict. Despite the monumental achievements it had gained, fiscal austerity, isolationist attitudes, and service rivalries often led to manned airborne ISR's marginalization. As a result, when war struck, whether in 1914 or 1939, many nations found their manned airborne ISR forces woefully unprepared. In both cases, a slow build up resulted in eventual successes, but during each, the United States intelligence community was reliant on other nations for the preponderance of its intelligence. This dissertation's analysis serves to highlight the importance of maintaining manned airborne ISR skills and capabilities despite the ebb and flow of peace and conflict. Following the Korean War, airborne ISR capabilities did not atrophy, and when needed in Vietnam, it was ready. This momentum continued through Operation Desert Storm and endures today. As the USAF enters another postwar period following withdrawal from Iraq and Afghanistan, ISR strategists must remember this lesson.

While the USAF now possesses an extremely large airborne ISR capability, to avoid repeating the mistakes of the past, airborne ISR strategists must continue to promote the necessity of maintaining the force. The future is uncertain. Debate rages whether the last 15 years of irregular warfare herald a change in the character of war or if the counterinsurgency (COIN) fights in Iraq and Afghanistan were mere aberrations. Followers of the latter argument advocate for a return to a strategic intelligence focus while supporters of the former argue for a greater tactical intelligence capability and a larger investment in advanced RPAs. Proponents of both views present impassioned arguments. Whoever is correct, however, is almost irrelevant to future USAF airborne ISR strategy. Long-term thinkers must consider both arguments and posture an airborne ISR force that is able to provide tactical and strategic intelligence. The study of the history of airborne ISR has shown the necessity to maintain both capabilities will always be present. Balancing the force to ensure successful intelligence collection across the range of military operations (ROMO) is the challenge for today's ISR strategist. The analysis presented in this dissertation has shown that both capabilities will undoubtedly be required.

This argument about the character of modern war creates an additional challenge for airborne ISR forces. The strategic airborne ISR force that developed during the Cold War was primarily designed to operate in permissive environments.[1] While the USSR certainly interfered with the PARPRO flights along its periphery, by and large, it permitted the United States to conduct strategic intelligence collection. The USAF's recent RPA expansion was also enabled by the freedom of operating in permissive airspace. Since October 2001 in Afghanistan and March 2003 in Iraq, Coalition air forces have operated with relative impunity. RPAs and the newest manned airborne ISR platform, the MC-12W, matured in this environment. While future USAF support to COIN will typically occur in uncontested airspace, this will certainly not be the case if the

[1] Though the U-2 was initially designed to directly overfly contested airspace, modern air defenses quickly relegated the U-2 to permissive environments.

United States is to face a near peer adversary in a major contingency operation. Today's current airborne ISR aircraft – both manned and unmanned – are limited in non-permissive environments. The challenge for the airborne ISR strategist is to persuasively advocate for future capabilities that provide the ISR enterprise the ability to conduct operations in anti-access/area denial (A2/AD) environments.

The tactical support now provided directly to the warfighter by the RC-135, the U-2, and the MC-12W is unprecedented. As highlighted earlier, these platforms communicate directly with ground forces providing both threat warning and enemy information in near real-time. The provision of intelligence directly to the warfighter is now a fundamental capability and one on which the warfighter greatly depends. As today's ground forces have also matured primarily in the permissive environment, the reliance on persistent manned airborne ISR has become almost second nature. In future contested environments, with the current airborne ISR force, this luxury will simply not exist. ISR strategists – and ground forces – need to plan for this future. Developing an airborne capability, likely unmanned and thus expendable, that is able to operate in non-permissive environments must be a high priority as the USAF moves forward.

This is not to say that the manned airborne ISR force would play no role in an A2/AD conflict. Enhanced sensors on the U-2 and the RC-135 give both aircraft a significant standoff range that would keep them out of the range of major threats but still permit them to provide real-time intelligence to those in the threat. While the U-2 was originally designed to directly overfly denied territory, it has evolved significantly since the 1950s and is now able to conduct its mission at significantly improved ranges. The RC-135 was purpose-built for the PARPRO mission and has always had the type of sensor range to allow it to stay safely out of air defense range. When part of integrated ISR packages that include fighter support, both platforms play a significant role in providing warfighters in A2/AD environments the intelligence they need on existing and emerging threats.

As this study has proven, the flexibility of manned airborne ISR, and more importantly, ISR airmen, is one of its major advantages over other types of platforms. While RPAs provide flexibility, their predominately short loiter periods and limited ranges greatly restrict their applicability – particularly if tasked to provide strategic intelligence collection. Additionally, most RPAs fly very slowly when compared to the jet-powered RC-135 and U-2. If the current airborne ISR force is to service both strategic and tactical intelligence requirements, ISR strategists must consider the need to expand the manned portion of the airborne force. Far-flung adversaries and the unpredictability of the international system demand a manned airborne ISR force that is ready to respond at a moment's notice; only manned airborne ISR provides the flexibility to rapidly deploy to the world's hot spots.

Another major lesson this dissertation has uncovered concerns the general difference between strategic and tactical intelligence collection and the ramifications conducting both types has on the airborne ISR force itself. While the USAF has built a world-class manned airborne ISR aircraft capability, it has often given too little attention to the people who are responsible for the analysis of the collected information. Traditionally-strategic airborne ISR airmen – like those who fly on the RC-135 or prosecute the collection from the U-2 – have increasingly been thrust into tactical intelligence roles. As mentioned above, the strategic intelligence cycle is much slower than the tactical intelligence cycle. Asking our strategically-focused Airmen to bounce back and forth between both types of intelligence is dangerous as it creates a force that is proficient at neither. As the USAF moves into the post-COIN phase, it must give thought to this dilemma and seriously consider increasing the number of both linguists and analysts who prosecute airborne ISR missions. If traditionally-strategic platforms are to continue providing tactical support, they must be provided an adequate number of Airmen to do both missions properly. The exigencies of the conflicts in Iraq and Afghanistan pulled the RC-135 and U-2 away from their foundational missions. Now that those conflicts have wound down, a reassessment of the work force must be accomplished. If the USAF intent is for

these platforms to maintain the capability to do both strategic and tactical intelligence collection in the future, this requirement should also include an increase in personnel.

The final lesson the dissertation has shown is that having a singularly focused airborne ISR force creates problems when that force is asked to do something outside of the norm. As USAF manned airborne ISR forces – particularly airborne COMINT forces – entered the Korean War, Cuban Missile Crisis, and Vietnam War, they were completely unprepared. They possessed no linguists or analysts who focused on Korea, Cuba, or Vietnam. Additionally, their ISR aircraft were configured for strategic collection. Though it evolved, providing intelligence directly to warfighters was impossible as these wars began. In Korea and Vietnam, the strategically-focused forces that began the conflicts looked nothing like the tactically-focused ones that ended them. This lesson must be remembered as the USAF moves forward. While no one can predict every geopolitical problem the United States will face, ISR strategists must advocate for the maintenance of at least minimal competency against a wide variety of likely future enemies. Returning to a singular focus – as during the Cold War – will undermine the USAF's flexibility to provide valuable intelligence in other areas.

All is not gloomy, however. The USAF manned airborne ISR community already possesses the greatest possible advantage – its Airmen. When combined with the exquisite collection platforms in the USAF inventory, they form a highly flexible, dynamic capability that has met every challenge it has been presented. Vast, interconnected networks and the ability to deploy to any location on the globe give USAF ISR an asymmetric advantage over any potential adversary. In the end, the evolution of manned airborne ISR has provided decision makers the ability to better understand the challenges we face and the information needed to stay ahead of potential adversaries. Through an understanding of the history of manned airborne ISR development, future leaders can make informed decisions that will ensure we keep and expand our decision advantage.

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