

THE UNITED STATES AIR SERVICE AT ST. MIHIEL AND MEUSE-ARGONNE:
REASSESSING THE BIRTH OF AMERICAN AIRPOWER

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Art of War Scholars

by

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ABSTRACT

THE UNITED STATES AIR SERVICE AT ST. MIHIEL AND MEUSE-ARGONNE: REASSESSING THE BIRTH OF AMERICAN AIRPOWER, by Vincent T. Noel, 122 pages.

This thesis seeks to examine the combat performance of the US Air Service during the offensives at St. Mihiel and Meuse-Argonne in the autumn of 1918. The research focuses on doctrinal development and operational experience prior to American entry into the war, which informed Air Service conduct during the battles under examination, as well as the campaigns themselves. Emphasis is placed on the planning and combat employment of observation, pursuit, and bombardment aviation during the campaigns, as well as materiel, training, and operational factors that affected Air Service performance.

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ACRONYMS

AEF American Expeditionary Force

USAS United States Air Service

CHAPTER 1

INTRODUCTION

The aerial armada that went into battle at St. Mihiel on 12 September 1918 has been characterized as a watershed moment in airpower history. The 1,481 American, French, British, and Italian aircraft employed in the battle was the largest aerial force ever fielded during the First World War, and much has been made of their accomplishments and those of the 1st Army's Air Service commander, Colonel (later Brigadier General) William "Billy" Mitchell. Elements of Mitchell's leadership were truly visionary; he recognized airpower's offensive potential and sought to employ his forces against targets across the battlefield and in the enemy's rear. Most historical research has focused heavily on the high-water mark of St. Mihiel and separated it from the Meuse-Argonne battle, which began a mere 10 days after operations in the St. Mihiel salient wound down. From an airpower perspective, the two battles should rightly be viewed as one continuous air campaign, as the qualified success at St. Mihiel concealed problems in training, employment, and materiel that only became apparent once the campaign in the Meuse-Argonne launched.

The Meuse-Argonne offensive was the largest campaign in American history, involving over a million men and 22 divisions. It was also the costliest, with nearly 100,000 wounded and over 26,000 killed. Airpower figured prominently at Meuse-Argonne, but Mitchell did not possess the same force levels he enjoyed at St. Mihiel and a host of operational problems came to light. Inadequate logistical support drastically reduced aircraft availability, as did heavy combat losses. Shortages of highly-trained aircrews, especially observers, increased risks to Air Service missions and the force as

units were compelled to hurl hastily-trained men into the battle. Poor training and cooperation between the Air Service and its supported infantry and artillery units hindered air-to-ground coordination and negated many of the advantages conferred by employing airpower. Materially, the Air Service struggled with faulty hardware and inferior aircraft. Excessively aggressive tactical doctrine saw pursuit aircraft employed in a myriad of battlefield tasks aside from gaining control of the air, which allowed the *Luftstreitkräfte*—the German air force—to routinely penetrate American lines and attack the doughboys. Bombardment aircraft attacked targets of questionable value, often unescorted and at heavy cost, while observation squadrons were forced to generate their own protection organically. On top of these challenges, terrible weather remained the Air Service’s constant companion throughout the campaign.

While the allies were ultimately successful in the Meuse-Argonne and the war, the Air Service struggled due to a doctrinal predisposition towards offensive operations, inadequately developed training programs, and materiel shortcomings. These factors coalesced to prevent the Air Service from providing the degree of support that was expected of it, given the available forces, and were further exacerbated by poor weather. The unique circumstances of the St. Mihiel campaign masked fundamental issues that were not fully revealed until Meuse-Argonne was well underway, and the Air Service’s overall performance suffered as a result.

Despite Meuse-Argonne’s place among the largest campaigns in American history, it has been relatively ill-served in the historical literature. Edward G. Lengel’s 2008 history *To Conquer Hell* is arguably the best recent work to cover the campaign, with Robert M. Ferrell’s *America’s Deadliest Battle* and Douglas Mastriano’s *Thunder in*

the Argonne following behind. All of these secondary works have limited coverage of the Air Service, with airpower anecdotes woven throughout the historical narrative. Moreover, much of the airmen's perspective is told from only a handful of sources, with Mitchell figuring prominently.

For works specifically concerned with the Air Service, James J. Cooke's *The U.S. Air Service in the Great War* is the seminal history of the conflict. Cooke's work is well-researched, and significant attention is devoted to both St. Mihiel and Meuse-Argonne. Similarly, Irving Holley's *Ideas and Weapons* traces the intellectual and materiel genesis of American airpower, which provides a sound foundation for examining the Air Service's combat performance. A very good overview of the Air Service's role in the campaign by Thomas Withington appears in *A Companion to the Meuse-Argonne Campaign*, edited by Lengel. There are also a host of other secondary works concerning airpower, of varying degrees of utility. Most prominent among these is John Morrow's *The Great War in the Air*.

None of these works specifically focus on the operational factors that impacted the Air Service's combat performance, from the perspective of a professional military aviator. This research seeks to identify the Air Service's doctrinal, materiel, and training origins, connecting these early concepts of airpower with the eventual combat employment at St. Mihiel and Meuse-Argonne. This research is written with the professional practitioner of airpower in mind, and the Air Service's experience is replete with lessons concerning, immature technology, training capacity, logistical support, and operational employment that are still relevant in the 21st century.

CHAPTER 2

BEGINNINGS

In the earliest days of military aviation following mankind's first flight in 1903, the heavier-than-air aircraft was viewed solely as a means of reconnaissance.¹ While numerous officers, scientists, futurists, and politicians saw the potential of manned flight for martial purposes, technological limitations meant that reconnaissance was the only role prewar aircraft were capable of conducting in any meaningful way. These fragile aircraft had top speeds under 70 knots, endurance of roughly an hour or less, and very limited lifting capacity. Despite these limitations, the first use of an aircraft in combat occurred during the Italo-Turkish War of 1911-1912.² During that conflict, Italian airmen employed small, hand-held bombs from their aircraft against Ottoman troops in Libya.

While the Italians were busy making airpower history, congressional funding for aviation in the United States was parsimonious. Indeed, during 1913, Mexico appropriated more than triple the amount for aeronautics than the United States did: \$400,000 compared to a mere \$125,000.³ During the same year, Congressman James Hay proposed a bill to remove aviation from the Signal Corps, which was met with widespread opposition from both the War Department and aviation officers.⁴ This first

¹ Richard P. Hallion, *Strike from the Sky: The History of Battlefield Air Attack, 1911-1945* (Washington, DC: Smithsonian Institution Press, 1989), 10.

² *Ibid.*, 11.

³ Irving B. Holley, *Ideas and Weapons* (New Haven, CT: Yale University Press, 1953), 29.

⁴ Hearings before the Committee on Military Affairs, House of Representatives, 63d Cong., 1st sess., 1913, quoted in Maurer Maurer, ed., *The U.S. Air Service in World*

bill failed to gain traction, but Hay persisted and submitted a second bill later in 1913. During hearings on the second bill several aviation officers, including Captain William “Billy” Mitchell and 1st Lieutenant Henry “Hap” Arnold, were asked to testify on the relative merits of placing the Aviation Section directly under the Chief of Staff, as well as their views on the current state of aviation development and its future potential.⁵ With the outbreak of war in Europe, congress took legislative action to close the technological and fiscal gaps between the American and European air services. Principally, this consisted of permanently establishing the Aviation Section of the Signal Corps with a complement of 60 officers and 260 enlisted.⁶ From a practical standpoint, establishing the Aviation Section as a permanent organization assuaged fears that it might be dissolved entirely and convinced American aircraft manufacturers that there was a future in producing dedicated military aircraft as opposed to general purpose designs.⁷

The first technological requirement specification laid out by the Signal Corps in 1914 was for a two-seat reconnaissance airplane with a performance of 70 mph and a lifting capacity of 450 lbs.⁸ Generally, this performance specification was aligned with the emerging European designs of the period. As bids began to emerge from the aviation industry, it became readily apparent that the current aero engines available were

War I, vol. 2, *Early Concepts of Military Aviation* (Washington, DC: Office of Air Force History, 1978), 3.

⁵ Ibid.

⁶ Holley, *Ideas and Weapons*, 30.

⁷ Ibid.

⁸ Ibid., 34.

incapable of meeting the required performance parameters. Furthermore, without promising engine designs on the horizon, further aircraft development would be stymied. This drove the Signal Corps to mount a separate engine competition in 1915 to rectify this technological shortcoming.

The manifest utility of military aircraft was becoming readily apparent to both military and civilian leaders in the United States. The wartime experiences of the European combatants encouraged a previously parsimonious Congress to further invest in aviation development. The National Defense Act of June 1916 doubled the budget for aviation to \$800,000 and made further allowances for increased training of pilots and observers.⁹ Despite this substantial funding increase, aircrew selection and training were still woefully below requirements, and only a mere 43 officers were trained during all of 1916.¹⁰ However, it should be noted that there existed a reasonable contingent of both civilian and military aviators who had received flying instruction at their own expense, and from a practical standpoint, the differences in training were virtually indistinguishable from official army instruction given the immature state of military aviation.

Somewhat surprisingly given the position of US military aviation, the Signal Corps proved reasonably prescient and quite receptive to events in Europe. However, the European belligerents were incredibly sensitive to releasing detailed military information related to aviation, and most of the technical information gleaned was derived from

⁹ Holley, *Ideas and Weapons*, 35.

¹⁰ *Ibid.*

American manufacturers working on contracts for the combatants.¹¹ The Signal Corps recognized and articulated the necessity for aircraft designed for specific roles, rather than the general-purpose designs that had been proliferated previously. The Signal Corps envisioned three specific categories of aircraft: a “reconnaissance and artillery fire-control type, a combat type, and a pursuit type.”¹² It is important to note that there were no design requirements for specific airframes, but rather broad outlines for general categories of aircraft. The army expected the aircraft to fulfill roles similar to those performed by the cavalry. As such, it was optimized for endurance, stability, and good visibility to enable effective ground observation. A dedicated observer who could also act as an aerial gunner for self-defense or limited offensive action would be carried in this type. The combat type was a bit more nebulous. In this instance, the design emphasized speed and maneuverability, rather than endurance and stability. Additionally, a combat type was expected to have greater lifting or payload capacity in order to conduct limited air-to-ground attacks while also retaining the second aircrew member for aerial gunnery and observation. One very specific technical requirement to enable aerial gunnery was for a “clear field of fire in every direction up to 30° from the line of flight.”¹³ Finally, the pursuit type was optimized for offensive action in air-to-air combat as a single-seat aircraft design emphasizing speed and maneuverability.

¹¹ Holley, *Ideas and Weapons*, 36-7.

¹² *Ibid.*, 35.

¹³ US Army War College Division, “Statement of a Proper Military Policy for the United States,” quoted in Maurer, *Early Concepts of Military Aviation*, 49.

As an aside, the army used many different appellations in official documents to describe the various aircraft types during 1913-1916. Pursuit aircraft were referred to variously as “scouts,” “light scouts,” “speed scouts,” or more entertainingly, “speed machines.”¹⁴ “Battle machines” appears to have been used to describe any military aircraft type the writer fancied, but it was most commonly used in reference to reconnaissance and combat types, as was the more descriptive “bomb-carrying or offensive types.”¹⁵ Further muddying the waters, the combat type was also referred to as a “fighting aeroplane,” which can easily lead to the reader confusing it with the pursuit type thanks to the widely-accepted modern term for pursuit aircraft, “fighter.”¹⁶ For the sake of clarity and simplicity, this research will use “observation,” “combat,” and “pursuit” while discussing American military aircraft categories as described by the Signal Corps requirement.

In March 1915 the army directed the War College to conduct a thorough study of preparedness and requirements in order to develop “a proper military policy for the United States.” The War College submitted to the Chief of Staff in September.¹⁷ This report was supplemented by numerous ancillary studies, including one relating to military aviation. The military aviation supplemental study contained a detailed concept of operations for the employment of military aircraft in combat.

¹⁴ War College Division, “Statement of Proper Military Policy,” 47.

¹⁵ *Ibid.*

¹⁶ *Ibid.*, 49.

¹⁷ *Ibid.*, 41.

The first doctrinal mission articulated was “strategical” reconnaissance, which was synonymous with reconnaissance performed by aircraft as opposed to cavalry or tethered balloons.¹⁸ Reconnaissance performed by the latter two methods was classified as tactical, a doctrinal distinction from strategical reconnaissance. There was no mention of how far from the front line strategical reconnaissance would or should be conducted, nor was there a description of which types of reconnaissance requirements were best or ill-suited for aircraft to perform. The primary doctrinal difference between tactical and strategical reconnaissance was simply the means by which said reconnaissance was conducted. At the time, this doctrinal predilection towards platforms instead of capabilities was commonplace for all of the major combatants.

Regarding training and personnel, the aviation supplement correctly identified the necessity for highly-trained, specialized aircrews to conduct reconnaissance missions. Reconnaissance was to be “carried out by a commissioned officer who requires considerable experience in order to be able to distinguish objects on the earth and assign to them their true military value. [. . .] The observer is always a trained tactical officer, because in reconnaissance of this nature an untrained person can not interpret the military significant of what he sees.”¹⁹ Thus, in a two-place observation aircraft the observer was typically in command of the aircraft instead of the pilot, who was often a noncommissioned officer. Also mentioned were methods of aerial photography, with

¹⁸ War College Division, “Statement of Proper Military Policy,” 48.

¹⁹ *Ibid.*, 49.

discussion on the use of barographs in conjunction with lens focal lengths to determine scale and correct incorporation of photographs onto military maps.²⁰

Cooperation between aircraft and artillery was another primary doctrinal mission outlined in the aviation supplement. The nature of combat on the Western Front drove artillery emplacements to exercise a high degree of camouflage and concealment, and aircraft were correctly recognized as having an ability to overcome this battlefield problem. Accordingly, aircraft were to “first, pick up the targets, report their location to the field artillery, and then observe the fire of the batteries. By means of prearranged signals or radiotelegraphy the aeroplanes are able to indicate to the artillery where their fire is making itself felt.”²¹ The report failed to address precisely how these prearranged visual signals would work. Additionally, testimonies before the Senate Committee on Military Affairs indicate that radio communications were one-way (air-to-ground) as the noise present in open-cockpit aircraft and the technological limitations of audio devices rendered correct reception of morse code messages impossible for aircrews conducting artillery cooperation and observation missions. Finally, the aviation supplement concedes that “if artillery is insufficiently provided with airplanes, it is well established that an enemy so provided has an overwhelming advantage.”²²

The next doctrinal mission specified was “control of the air,” meaning offensive action against other aircraft to enable reconnaissance and observation aircraft to conduct

²⁰ War College Division, “Statement of Proper Military Policy,” 49.

²¹ *Ibid.*

²² *Ibid.*

their missions without interference from the enemy.²³ Army planners assessed antiaircraft weapons to be ineffective against aircraft, due to difficulties in fire control for artillery pieces and the low effective maximum altitudes of small arms. While antiaircraft weapons and tactics were certainly immature at this point, the army's assessment would prove incorrect as the technology improved rapidly later in the war. The aviation supplement argued, "the way in which enemy aeroplanes can be dealt with is by aeroplanes;" a remarkably accurate doctrinal assertion given that the so-called "Fokker Scourge," which laid bare the superiority of purpose-built pursuit aircraft with forward-firing armament, began only a few weeks prior to the document's publication. Thus, it is reasonable to conclude that American airmen likely arrived at this doctrinal position by correctly anticipating the character and direction in which aerial warfare was moving.

The final doctrinal mission articulated in the aviation supplement was "bomb dropping."²⁴ The supplement treated this mission area with guarded optimism, given the primitive nature of aiming devices and bomb carriage, suspension, and release technologies. Weapons were categorized by size only, ranging from 15 to 50 lbs, with the most common being 15-35 lbs.²⁵ The study did not mention different desired weapons effects for the bombs, such as incendiary, demolition, penetration, or cratering. The supplement went to great lengths to expound upon the difficulties in aiming, and recommends the tactical employment of 30-60 aircraft in order to overcome poor

²³ War College Division, "Statement of Proper Military Policy," 49.

²⁴ *Ibid.*, 50.

²⁵ *Ibid.*, 50-51.

accuracy.²⁶ This was a highly aspirational figure given that the entire Signal Corps possessed a total of 23 aircraft at the time.²⁷ Organizing, maintaining, and coordinating a formation of this size would have been quite beyond the ken of the 1915 Signal Corps, but this doctrinal stance at least demonstrated forward-thinking, even if lacking in the details necessary for execution. The supplement closes with the dubious assertion that aerial attacks have been successful against “railways, roads, bridges, and hostile parks of various kinds,” based upon glowing headlines coming out of Europe.²⁸ Precisely how the supplement defined success is not discussed, and of the target sets cataloged, it only viewed railway marshaling yards or a “hostile park” as suitable candidates for the aerial bombardment. Roads, railways, and bridges are linear targets that are remarkably difficult to hit with any degree of precision using unguided weapons. Indeed, to this day a standard bomber tactic for attacking a linear target with unguided bombs is to drop a line of weapons across the target at a gentle crossing angle to ensure that a modicum of weapons effects are achieved. Attempting to drop the bombs precisely along a linear target can easily result in all of the bombs missing entirely. It is highly unlikely that an aviator of 1915 could hit a target of this type with any hope of success aside from the intervention of pure luck.

Overall, the doctrine recommended in the aviation supplement was an interesting combination of clear-eyed, well-informed positions and articles of faith. In some ways

²⁶ War College Division, “Statement of Proper Military Policy,” 51.

²⁷ *Ibid.*, 60.

²⁸ *Ibid.*, 51.

the document proved remarkably prescient: the necessity of pursuit aircraft to obtain control of the air over and beyond the battlefield, the ability of observation aircraft to coordinate and refine fires with the artillery, as well as airpower's ability to partially solve an enemy's adept use of camouflage and concealment. Other elements of the doctrine rested upon less solid foundations. As mentioned, the doctrine for air-to-ground strikes was largely aspirational. Despite the numerous experiments in bomb dropping that had occurred since 1914, significant technological hurdles remained.²⁹ Moreover, the logistical infrastructure necessary to organize, sustain, and employ the large formations that were required in order to conduct successful operations simply did not exist. All of the doctrine was generally short on the operational details necessary to bridge the gulf between theory and practice. This gap between the theoretically possible and the practically executable would characterize American airpower for the entirety of the conflict, and beyond.

From the standpoint of organization, the Signal Corps advocated for the primacy of observation as the principal role for military aircraft. This position makes sense given the state of aviation technology. The aircraft of the period lent themselves well to the observation mission, and observation was one of the few areas where aircraft were immediately capable of contributing to ground operations. The Signal Corps proposed heterogenous squadrons of 12 serviceable aircraft, consisting of eight observation aircraft, two pursuit, and two combat types.³⁰ In order to generate these 12 serviceable

²⁹ Holley, *Ideas and Weapons*, 29.

³⁰ War College Division, "Statement of Proper Military Policy," 59-60.

aircraft Brigadier General George Scriven, Chief of the Signal Corps, testified before the Senate Committee on Military Affairs in January 1916 that squadrons would ideally require a total of 36 aircraft to ensure aircraft availability.³¹ While perhaps appearing complex in terms of maintenance and logistical requirements, such an organization would have been a significant increase in combat power and capability over the generally ad-hoc arrangements that had characterized Signal Corps organization up to that point. The influence of European militaries is readily apparent in this organizational proposal. The military aviation supplement to the 1915 War College study on military policy described the differences between French and British aviation squadron organization, with the recommended heterogenous 12-aircraft squadron mirroring British practice exactly.³² In contrast, the French employed smaller six-aircraft squadrons of a single type.³³ These squadrons were to be assigned geographically and at echelon. Scriven recommended “one squadron in the Philippines, one in Hawaii, one in the Canal Zone, seven for use with the field armies [. . .], three squadrons for the Coast Artillery,” as well as a single aircraft and maintenance spare for every field artillery battery in the Army.³⁴ However, before this organizational change could be implemented, events on America’s southern border intervened.

³¹ War College Division, “Statement of Proper Military Policy,” 60-61.

³² *Ibid.*, 51.

³³ *Ibid.*

³⁴ *Ibid.*, 60.

During 1916, the situation on the US-Mexico border had deteriorated significantly. In response to Pancho Villa's raid on Columbus, New Mexico on 9 March 1916, the army dispatched General John Pershing on a punitive expedition with roughly 10,000 men and the 1st Aero Squadron.³⁵ The 1st Aero Squadron was commanded by Captain Benjamin Foulois, who would go on to play a prominent role in the battles of St. Mihiel and Meuse-Argonne. Equipped with 8 Curtiss JN-3 (progenitor of the famous JN-4 Jenny), the unit did not have an auspicious start. One aircraft was a total loss after a landing crash during the initial deployment to Mexico on 19 March.³⁶ This pattern of attrition and mishap would continue for the duration of the punitive expedition. Four days later a second aircraft was lost under similar circumstances, further reducing the number of serviceable aircraft available for operations.³⁷ The high density altitude of the region, high winds, and the 12,000-foot heights of the Sierra Madre Mountains were a continual problem for the 1st Aero Squadron. The low-powered engines routinely prevented the crews from ascending over even the foothills of the mountains, and the rough, rocky terrain often caused damage during landing and takeoff that required repairs and additional spare parts from the United States. The JN-3's inability to surmount the ridges of the Sierra Madres severely handicapped the unit's already limited radius of action. The

³⁵ Terry C. Treadwell, *America's First Air War: The United States Army, Naval, and Marine Air Services in the First World War* (Osceola, WI: Motorbooks International, 2000), 20-21.

³⁶ Benjamin Foulois, "Report of Operations of the First Aero Squadron, Signal Corps, with Punitive Expedition, U.S.A. for Period March 15 to August 15, 1916," quoted in Maurer, *Early Concepts of Military Aviation*, 75.

³⁷ *Ibid.*, 75.

situation was so abysmal that on 22 March, a mere six days after the squadron deployed, Foulois requested an additional 10 aircraft of 5 different (and improved) types from General Pershing in light of “the fact that the present airplane equipment of the First Aero Squadron is not capable of meeting the present military service conditions.”³⁸ In the interim, maintenance crews were obliged to cannibalize parts from the wrecked aircraft as the consumption of spares rapidly outpaced estimates. Problems were particularly prevalent with propellers, engine parts, and aircraft structural members.³⁹

Given the significant materiel and environmental obstacles facing the unit, Foulois used his aircraft in the only effective role they could be counted upon to perform: liaison. Thus, the 1st Aero Squadron spent the overwhelming majority of the 540 sorties it flew between 19 March and 20 April carrying mail, orders, and other sundries between the expedition’s base of operations in Columbus and the various remote outposts scattered around Northern Mexico.⁴⁰ Of the handful of reconnaissance missions that sortied in search of the enemy, none located anything of military value. In some aspects, the 1st Aero Squadron’s experience during the expedition reads like an adventure novel. Foulois was briefly imprisoned by the Carranzista’s after landing in Chihuahua to deliver dispatches to the American consul in the city.⁴¹ Another aircraft had holes burnt into its fabric with cigarettes, its wings slashed, and various metal fittings ripped off of it by an

³⁸ Foulois, “Report of Operations of the First Aero Squadron,” 76.

³⁹ *Ibid.*, 86.

⁴⁰ *Ibid.*

⁴¹ *Ibid.*, 82-83.

angry mob of Mexicans unsympathetic to the American presence.⁴² There was also a two-day survival epic after a pair of crewmen crash-landed 65 miles from base and made the trek back across the desert with neither food nor water.⁴³ The 1st continued operations until its last aircraft was finally lost on 19 April in yet another landing mishap, and the unfortunate unit redeployed to Columbus in trucks the next day, its replacement aircraft having never arrived.⁴⁴

The Mexican expedition, from an aerial perspective, left much to be desired. The equipment was woefully inadequate for the task at hand, and maintenance proved far more difficult than anticipated given the harsh environment and aggressive (compared to stateside) operations tempo. Foulois made sound decisions given the circumstances at hand, and he correctly assessed the situation from the outset by requesting improved aircraft only three days into the expedition. He preserved what little combat power he possessed through the judicious use of his aircraft in a role that they were actually capable of performing, rather than continuing to fight against the weather and physics. Indeed, given the baleful state of the aircraft and the inhospitable conditions, it is a testament to Foulois leadership acumen that no aircrew lives were lost. There were no significant lessons learned from a combat perspective, as there was no opposition save a few mobs of irate civilians, and no enemy forces were ever spotted. There was also no opportunity to test any of the doctrinal precepts codified in the aviation supplement of

⁴² Foulois, "Report of Operations of the First Aero Squadron," 84-85.

⁴³ *Ibid.*, 87.

⁴⁴ *Ibid.*, 86-87.

1915. Logistically, the experience demonstrated the necessity for a deeper pool of spare parts and underscored the challenges of operating from austere locations far removed from sources of support. How well these lessons were internalized is a matter of debate, however, as they could be easily dismissed given the small number of tired airframes employed and the short duration of the deployment. On a positive note, the poor performance of the JN-3's powerplant injected further energy into the development of improved engines that had begun in 1915. Against the backdrop of these humble beginnings, Army military aviation would soon go to war.

CHAPTER 3
FROM MEXICO TO ST. MIHIEL

The Aviation Section's lackluster performance in the Mexican Expedition underscored the necessity for meaningful reform in the field of aeronautics, as did the rapidly advancing state of the art in Europe and the deteriorating international situation. America's continued neutrality became more tenuous by the day, yet Congress remained anxious about foreign entanglements. As such, the National Defense Act of 1916 contained provisions for an expansion of the Aviation Section, but nothing approaching full-scale mobilization. The act specified an Aviation Section officer strength of "one colonel; one lieutenant colonel; eight majors; twenty-four captains; and one hundred fourteen first lieutenants," for a total of 148 officers.⁴⁵ To this total, the enlisted force was to be "limited and fixed from time to time by the President in accordance with the needs of the Army."⁴⁶ This was a generous increase from the 77 officers and 1,978 enlisted men previously authorized, but still far short of what would be needed should the United States become a belligerent.⁴⁷

Later that autumn Brigadier General George Scriven, Chief of the Signal Corps, outlined how he planned to use the additional manpower appropriated by Congress in his annual report to the Secretary of War. Scriven proposed to expand the Aviation Section's

⁴⁵ National Defense Act of 1916, H. Res. 12766, 64th Cong., 1st sess. (1916), 174.

⁴⁶ *Ibid.*, 175.

⁴⁷ George P. Scriven, "Report of the Chief Signal Officer, United States Army, to the Secretary of War," 1916, quoted in Maurer, *Early Concepts of Military Aviation*, 89.

organization into two aero squadrons (both stationed in the Southern Department), two aero companies (one each in the Philippines and the Canal Zone), and a school detachment in San Diego, California.⁴⁸ Each squadron was to be equipped with 12 aircraft organized into 3 companies, in keeping with the recommendations laid out in the 1915 military aviation supplement.⁴⁹ The emphasis placed on the training detachment was a step in the right direction, but there was no overarching plan for a mobilization-level expansion of the Aviation Section. Moreover, Scriven's insistence upon maintaining aviation companies of four aircraft stationed in the Philippines and the Canal Zone appears to ignore the Mexican Expedition's lesson on the necessity for adequate spares of aircraft and parts. Perhaps he viewed a handful of aircraft in these areas as more desirable than none, but four aircraft simply did not provide the margin and depth necessary for sustained operations. Shortly, international events would intervene, and the Signal Corps would enjoy funding far beyond what seemed possible mere months prior.

In January 1917 Scriven testified at budget hearings before Congress to discuss aviation's share of the 1918 fiscal year budget. The Signal Corps had requested \$16,600,000, a significant increase from the fiscal year 1917 budget, hence the necessity for Scriven's testimony.⁵⁰ During the hearings members of Congress, especially California Representative Julius Kahn, displayed an admirable grasp of both the problems

⁴⁸ Scriven, "Report of the Chief Signal Officer," 89.

⁴⁹ Ibid.

⁵⁰ Hearings before the Committee on Military Affairs, House of Representatives, 64th Cong., 2d sess., 5 January 1917, quoted in Maurer, *Early Concepts of Military Aviation*, 91.

facing the Aviation Section and the state of military aviation currently being employed by the belligerents in Europe. Members of Congress raised concerns on issues ranging from aircraft armament and aiming methods, individual aircraft cost, unit organization, and concepts for tactical employment.

Significantly, the discussion revolved around the problems associated with “fire control,” which was yet another contemporary term used to describe artillery cooperation or observation.⁵¹ During the hearings, the chaotic and ever-changing nature of the complex trench systems of the Western Front was cited as one of the primary reasons for observation work, along with the potential to adjust artillery fire should adequate procedures be developed. Congressman Kahn, in an impressive display of military acumen, astutely observed that the European air arms were already executing such tactics in battle.⁵² Scirven admitted that the Aviation Section’s techniques in this area were still being refined, but remained promising as experimentation continued. Similar guarded optimism was also expressed for the future of aerial bombardment, but the technical limitations of suspension and release components precluded meaningful accuracy in the immediate future. Additionally, Scirven impressed the importance of pursuit aviation to enabling observation work while denying the enemy the same, based upon the experiences of the belligerents on the Western Front.

The concepts and roles articulated in these hearings are important for several reasons. First, Scirven’s testimony reiterated the belief in the importance of observation

⁵¹ Hearings before the Committee on Military Affairs, 91.

⁵² *Ibid.*, 91.

as airpower's primary contribution to the Army's operations. The static character of combat on the Western Front relegated traditional reconnaissance operations associated with mobile warfare to a lesser role, and short-range tactical reconnaissance and artillery cooperation became preeminent. That the Signal Corps recognized this was a testament to their theoretical grasp of battlefield reality, even if they lacked combat experience. Next, pursuit aviation was at that point viewed as a means of enabling friendly observation work while preventing the enemy from doing the same. Prominently, there was no mention of which part of the pursuit equation was more important—protecting friendly aircraft supporting the ground battle or seeking and destroying the enemy's aircraft. While highly dependent upon the tactical situation, this lack of hierarchy would prove quite problematic once American ground forces were committed to battle en masse. Finally, significant interest was expressed in the potential of bombardment, but the numerous technical issues associated with operationalizing the concept forced bombing to take a back seat to the more pressing tactical concern of developing adequate and effective artillery cooperation procedures.

Among the Signal Corps contingent that testified in the January 1917 hearings was Colonel George O. Squier, the Chief of the Aviation Section who would later go on to succeed Scriven at the head of the Signal Corps. Squier had been sent to Britain as a military attache in 1914, and he quickly developed an appreciation for aviation and its contributions to combat operations.⁵³ It is likely that Squier's reports on British aviation weighed heavily in the recommendation for 12-aircraft squadrons in the 1915 aviation

⁵³ James J. Cooke, *The U.S. Air Service in the Great War: 1917-1919* (Westport, CT: Praeger/ABC-CLIO, 1996), 7.

supplement. As an observer from a non-belligerent nation, Squier was not granted access to sensitive intelligence data or the latest tactical innovations. However, he was provided with detailed information regarding British methods of organization, maintenance, and support. Squier noted the prodigious rate of aircraft, engine, and parts consumption associated with combat operations, and he grew to admire the British decision to provide echeloned support to aviation.⁵⁴ In the British model, an “air park” equipped with an ample supply of spare parts and supplies for routine maintenance and minor repairs was located close to the front to ensure that aircraft were not grounded for want of maintenance support.⁵⁵ Further to rear, at Le Harve, was an air depot that took care of major repairs and overhauls that could not be carried out at the individual squadrons or the air parks. This method simplified the logistical challenges of moving large amounts of equipment across already stressed lines of communication and concentrated the technical expertise necessary to conduct repairs in a handful of centralized locations. Incidentally, America would adopt the same construct when it began to send troops to France.

In February 1917 Germany resumed unrestricted submarine warfare, which further heightened tensions. That same month, the Signal Corps was asked by the army to produce a funding requirement estimate for supporting the entirety of the regular army, the national guard, and one million volunteers should the United States become a belligerent. They arrived at a figure of \$54,250,000, which provided for production of

⁵⁴ Cooke, *The U.S. Air Service in the Great War*, 8-9.

⁵⁵ *Ibid.*

roughly 3,700 aircraft per year and a concomitant number of aircrews.⁵⁶ The plan allocated the bulk of the additional aircraft strength to direct support of the ground units, with one squadron envisioned for each division and corps headquarters in the expanded Army program.⁵⁷ While this organizational vision implied a large number of observation aircraft relative to pursuit and bombardment, the estimate did not contain specific guidance on the envisioned composition of the expanded force.⁵⁸ The Aviation Section at this juncture still adhered to the notion that observation was the primary mission of military aviation, with pursuit occupying a supporting role. Bombardment was still considered largely aspirational. These precepts, as well as the suitability of the 3,700-plane force would soon be called into question, thanks in part to the intervention of the French.

Shortly after the declaration of war on 6 April 1917, Secretary of the Navy Josephus Daniels established the Joint Army-Navy Technical Board. This body was to minimize duplicative efforts by coordinating between the army and the navy and generating standardized requirements. As mentioned, the 3,700-aircraft plan did not specify the ratios or quantities of specific aircraft types. This ambiguity caused the Technical Board to focus on procuring training aircraft pending the arrival of more concrete guidance, which would at least provide a means of training the large numbers of

⁵⁶ Hearings before the Committee on Military Affairs, 100.

⁵⁷ *Ibid.*, 100-01.

⁵⁸ Holley, *Ideas and Weapons*, 40-41.

aircrew required.⁵⁹ Guidance of a sort soon arrived in the form of a cable from French Premier Alexandre Ribot. Ribot's cable proposed a force of 4,500 aircraft for operations with the Allies in 1918, supported by additional monthly production of 2,000 aircraft to replace combat and operational losses.⁶⁰ This request was passed to the Technical Board and formed the foundation for the 12,000-aircraft program that was the basis of America's contribution to the war in the air. However, there were some complexities to the information in the cable, and the results of the subsequent 12,000-aircraft program that would have far-reaching consequences for AEF.

Prior to America's entry into the war, the French General Staff conducted a detailed study of what contributions were desired by the United States. This study was completely at odds with the existing American approach that gave precedence to observation and artillery cooperation, giving highest priority to anti-submarine aircraft, second to pursuit and bombing, and last to aircraft devoted to support for the ground armies.⁶¹ While superficially surprising, the French logic for this hierarchy was sound. By early 1917 the French and British air arms had been holding their own or better against the Germans, and it is likely that the French General Staff was assessing mission areas where the Allies could most benefit from American assistance. Additionally, the precise nature of America's military role in the war was still uncertain at this time. If the United States elected to limit its involvement to the naval war, the focus on

⁵⁹ Holley, *Ideas and Weapons*, 40-41.

⁶⁰ *Ibid.*, 41.

⁶¹ *Ibid.*, 42.

antisubmarine aircraft was eminently practical. It is also apparent from the study that the French were expecting the United States to take an amalgamated approach to the war, with American forces filling capability and manpower gaps for Britain and France. General John Pershing, future commander of the AEF, would later fight incessantly against this concept.

Prominently, Ribot's cable contained none of the information from the French General Staff study—his proposals were purely quantitative.⁶² This appears to have resulted from a timely proposal from a French field commander for the United States to field a force of 30 pursuit and 30 bombardment groups, made up of 6 squadrons of 12 aircraft (the current French organizational construct for a squadron).⁶³ Ribot likely expanded upon the total from this communique, 4,320 aircraft, and after making allowances for reserves, came upon the figure of 4,500.⁶⁴ Since neither the details of the French General Staff study were included in the cable, nor the organizational proposal for 30 pursuit and 30 bombardment groups, the Joint Technical Board was operating on a purely quantitative basis without the benefit of valuable background information based on French combat experience. Also absent from Ribot's cable was any mention of direct support aircraft for the ground armies, and it seems that the 4,500 aircraft figure was intended to be *in addition* to those aircraft earmarked for direct support roles.⁶⁵ As such,

⁶² Holley, *Ideas and Weapons*, 42-43.

⁶³ *Ibid.*, 43.

⁶⁴ *Ibid.*

⁶⁵ *Ibid.*, 43-44.

the Joint Technical Board moved forward with the 4,500 aircraft proposal from Ribot and arrived at the 12,000 aircraft program.

The lack of specific guidance from the French as to which aircraft types to procure left the Joint Technical Board to rely on the existing doctrine, inasmuch as it existed, to inform production plans. The initial plan from 29 May 1917 specified a force of 3,000 “reconnaissance and artillery control,” 5,000 “fighting,” and 1,000 for bombardment, plus reserves.⁶⁶ In this instance, “fighting” aircraft refers to pursuit aircraft. The preponderance of pursuit aircraft likely stemmed from a certain amount tactical naivety in the misplaced belief that single-seat pursuit aircraft could fulfill multiple mission roles suitably. Later doctrinal documents, such as Air Service Circular Number 1, reinforced this view. Additionally, the Royal Air Force’s trying experience during “Bloody April” 1917 may also have emphasized the need for additional pursuit aviation. The AEF’s own proposed force structures would show several changes during the course of the war. Later in 1917, the AEF settled upon a force of 120 pursuit, 80 observation, and 60 bomber squadrons.⁶⁷ On the eve of the St. Mihiel operation a year later, this force structure was radically altered to 60 pursuit, 101 observation, and 41 bomber squadrons.⁶⁸ This change reflected both hard-won battlefield experience as well as the burgeoning direct support requirements for the AEF’s growing number of combat

⁶⁶ Benjamin Foulois et al, “Report of the Joint Army Navy Aircraft Technical Board to the Secretary of War and the Secretary of the Navy, May 29, 1917,” quoted in Maurer, *Early Concepts of Military Aviation*, 105.

⁶⁷ Holley, *Ideas and Weapons*, 49.

⁶⁸ *Ibid.*

divisions. Lacking experience and clear guidance, the Joint Technical Board was making an educated guess. However, America's aviation industry, as it existed, was wholly incapable of meeting these production demands.

This discussion on force structure is important primarily because of the lead-times associated with fielding both the aircraft and personnel required to conduct different types of operations. Significant logistical and training infrastructure had to be in place in order to properly train and equip the envisioned force, and this was not easily retooled once underway. Proposed ratios of aircraft types in a force structure indicate, at least implicitly, a doctrinal concept for the employment of airpower. Thus, based on the 29 May 12,000 aircraft program, it appeared that the Joint Technical Board retained faith in the importance of artillery cooperation while also recognizing the necessity for increased pursuit aviation. Additional contact with the Allies would flesh out the Aviation Section's vague doctrinal ideas and help shape an articulate vision for the employment of airpower.

Furnishing a substantial portion of this vision was Major Frank Parker, a cavalryman sent to France as a liaison officer at the French General Headquarters shortly after the United States declared war.⁶⁹ That June, Parker was tasked with submitting a report on the tactical role of aviation. The resulting document was foundational to the development of the Aviation Section, which was recast by Pershing in the summer of 1917 as the Air Service.⁷⁰ Parker's report would later be disseminated across the AEF in

⁶⁹ Frank Parker, "The Role of Tactical and Strategical Employment of Aeronautics in the Army," Proceedings of the Board of Officers, 2 July 1917, quoted in Maurer, *Early Concepts of Military Aviation*, 119.

⁷⁰ Cooke, *U.S. Air Service in the Great War*, 19.

the spring of 1918 with a preface added by Lieutenant Colonel William Mitchell under the title “General Principles Underlying the Use of the Air Service in the Zone of Advance, A.E.F.”⁷¹

Parker divided military aeronautics into aviation (heavier than air) and aérostation (lighter than air), with aviation split into “tactical” and “strategical” classes.⁷² Tactical aviation directly supported ground formations, operating “in the immediate vicinity or directly attached to organizations of troops.”⁷³ In contrast, strategical aviation acted further afield than the ground troops and conducted independent missions.⁷⁴ 25,000 yards from the front line was the delineating distance between tactical and strategical operations.⁷⁵ Tactical aviation was further subdivided into observation, pursuit, and tactical bombardment.⁷⁶ Parker’s report does not explicitly state the relative importance of the various types and classes of aviation. Observation aviation was tasked with both reconnaissance and artillery cooperation, as well as liaison with the infantry during attacks. Some of the methods outlined for liaison include “wireless, optical signals, and horn,” but there is no additional detailed discussion on specific employment

⁷¹ Parker, “The Role of Aeronautics in the Army,” 119.

⁷² Ibid.

⁷³ Ibid.

⁷⁴ Ibid.

⁷⁵ Ibid., 121.

⁷⁶ Ibid., 120.

considerations or methods.⁷⁷ Pursuit aviation was responsible for offensive action designed to obtain “mastery of the air” through two principal methods: “destruction of enemy aeronautical material and personnel by combat in the air” and “creating diversions by attacking enemy personnel on the ground.”⁷⁸ The latter role is especially noteworthy in that it envisioned tactical utility for pursuit aviation outside of the widely accepted mastery of the air mission. The report also mentioned defensive operations to prevent enemy observation and allow friendly observation without undue interference, but this role is not one of the two explicitly numerated missions discussed above. Furthermore, Parker is silent on the idea of escort—pursuit was viewed through a highly aggressive and offensive lens, untethered from any protected friendly assets. Tactical bombardment was tasked with destroying enemy materiel “of all sorts,” antipersonnel strikes, and attacking aerodromes in order to force the enemy to give battle in aerial combat.⁷⁹ The last point reveals a sophisticated understanding of the attritional nature of air warfare. An enemy planning to husband his forces for a future attack at a time and place of his choosing must be made to give battle in order to maintain pressure and inflict losses, and attacking aerodromes near the front was one of the most accessible and reliable means of doing so in 1917.

Strategical aviation, characterized by independent operations beyond 25,000 yards from the front line, was tasked with destroying “enemy aircrafts, air depots, and

⁷⁷ Parker, “The Role of Aeronautics in the Army,” 120.

⁷⁸ *Ibid.*

⁷⁹ *Ibid.*

defensive air organization,” as well as enemy “depots, factories, lines of communication, and personnel.”⁸⁰ The report also delineated between which targets were best suited to day bombardment and night bombardment. Finally, Parker recommended a strategic pursuit aviation element to engage in air combat with enemy aircraft, but once again there was no mention of escort as a dedicated role for pursuit.

The report concluded with organizational recommendations for operations with divisions, corps, armies, and army groups, namely to keep air units flexible and not permanently assigned to any ground formation. This is the only section of Parker’s report that explicitly mentions the French, referring the reader to examine an annex of French General Headquarters regulations related to methods of tasking aircraft to support ground formations.⁸¹

French expertise figured prominently in the development of the Air Service’s tactical employment instructions. Correctly recognizing the AEF’s lack of tangible experience Pershing directed the translation of French field manuals for use across the force.⁸² These French manuals served as the foundation of the Air Service’s tactical methods. In some instances, such as documents concerned with artillery adjustment and infantry liaison, updated French editions reflecting the latest procedures were circulated through the AEF as soon as they were available.⁸³ The Air Service was perfectly

⁸⁰ Parker, “The Role of Aeronautics in the Army,” 120-21.

⁸¹ *Ibid.*, 121.

⁸² Cooke, *U.S. Air Service in the Great War*, 23.

⁸³ General Headquarters, AEF, “Instruction on Liaison for Troops of All Arms,” 15 June 1918, quoted in Maurer, *Early Concepts of Military Aviation*, 199.

comfortable adopting French employment doctrine wholesale, and it is quite likely that higher-level French doctrine had a heavy influence on Parker.

Parker's report was the most concrete conception of the employment of airpower yet articulated by Army aviation. The delineation between tactical and strategical aviation was a point of departure from the Air Service's previous position. While observation still figured prominently, in all of the combat roles aviation was envisioned conducting operations with greater independence than previously planned. The report depicted pursuit through a myopic offensive lens that lacked nuance and failed to articulate the utility of pursuit aviation in defensive roles. As written, Parker's report has pursuit aviation almost completely untethered from ground formations and other air elements, and this is the most prominent doctrinal shortcoming of the document. Colonel William "Billy" Mitchell would place the same overemphasis on offensive action at St. Mihiel and Meuse-Argonne. On the strategical aviation side, the focus on enemy air assets and infrastructure was insightful, but it lacked operational context regarding relative strengths and weight of effort. During AEF operations in the autumn of 1918, the desire for airpower to be everywhere and do everything led to a diminution of effort that compromised air operations and detracted from airpower's overall contribution. Conducting a strategical attack can be an appropriate use of airpower, provided that other important missions such as coordinating artillery fire and protecting friendly balloons are not left underresourced. Parker's report, combined with Mitchell's introduction to form the "General Principles," went on to form the bedrock of Air Service doctrine for the next year. The shortcomings and oversights present would not be fully addressed until after

the war's conclusion, and the influence would be keenly felt When the AEF launched the St. Mihiel operation on 12 September 1918.

CHAPTER 4

ST. MIHIEL

Overview

The Battle of St. Mihiel, which took place between 12 and 16 September 1918, saw the single greatest concentration of airpower employed during the First World War. A total of 1,481 American, French, British, and Italian aircraft deployed against the German salient anchored on the town of St. Mihiel, northwest of Verdun. The Germans had captured the salient during the initial offensives of 1914, and it served to protect vital rail links between the city of Metz and German forces deployed further west in northern France and Belgium, as well as the economically important Briey iron basin. Its reduction was intended to support the major offensive planned between the Meuse and Argonne forest later in the autumn and provide combat experience for the AEF as an independent force. Marshal Ferdinand Foch harbored doubts about the operation, concerned that it might jeopardize the success of his general offensive should it run into problems, but Pershing was insistent. Foch eventually relented, with the understanding that the AEF would be in place and ready for the main effort at Meuse-Argonne. St. Mihiel would be the first operation conducted wholly under an independent American command, and as such Pershing's preparations were thorough.

The Air Service considered St. Mihiel a success, and this assertion is generally true, albeit as a qualified success. The success of the operation arose from the confluence of several unique factors that would not be repeated later in the war: the overwhelming concentration of combat airpower in a limited geographic area, the very short time required to achieve the objectives, attacking into a salient which the Germans were in the

process of vacating and thus had committed little air support to the sector, and poor weather which kept many planes grounded (and thus prevented additional losses). Conversely, St. Mihiel masked problems to a certain extent: the sorely lacking motor transportation situation; poor or indifferent coordination between observation squadrons and artillery units; inadequate logistical support for a rapidly expanding Air Service committed to intense combat operations; shortages of trained aircrews, especially observers; and an overly-aggressive approach to employing pursuit aircraft that neglected defense and escort in favor of seeking out the enemy in the air and strafing ground units. Unfortunately, the rapid turnaround between the conclusion of the St. Mihiel operation and the opening of Meuse-Argonne campaign, a mere 10 days, meant that the Air Service was afforded precious little opportunity to implement many of the harsh lessons learned at great cost in the skies above the St. Mihiel salient.

Planning

The preponderance of airpower employed was made possible largely by the St. Mihiel operation being the only major military enterprise undertaken at the time. Following the culmination of the Ludendorff offensive earlier in the summer, Anglo-French forces were willing to assist in order to ensure that the American operation would conclude successfully prior to Foch's general offensive planned for late September. Moreover, Foch was adamant that the St. Mihiel effort strike "the heaviest possible blow" and thus ensured that the operation was well-supported.⁸⁴ From the French, Pershing

⁸⁴ Final Report of the Assistant Chief of Staff, G-3, GHQ, AEF, July 2, 1919, in Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, vol. 14, *Reports* (Washington, DC: Government Printing Office, 1948), 34.

initially requested 7 observation squadrons, 9 pursuit squadrons, 5 day bombardment squadrons, and 10 balloons.⁸⁵ As planning matured this number would later swell as to 44 pursuit and 24 observation squadrons, more than an entire French air division.⁸⁶ From the British, Foch was able to secure participation from the Royal Air Force's (RAF) Independent Force of bombardment aircraft, composed of single-engined DeHavilland DH.9s and four-engined Handley-Page O/400s, and he recommended further coordination with General Hugh Trenchard, RAF General Officer, Commanding, to facilitate British aerial support for the American operation.⁸⁷ For his part, Trenchard was concerned about inoperability and the training of his bomber force, writing that his airmen "had not had experience in close fighting amongst large numbers of machines and such as will be on the front that day and I fear they would not be of much use."⁸⁸ Thus, rather than focus on directly supporting troops crossing the line of advance, Trenchard's men would instead focus on distant targets more suitable to their composition and training. This left the Franco-American air component to pursue objectives directly supporting operations within the St. Mihiel salient. These allied aircraft would be placed

⁸⁵ Letter from General John J. Pershing to Marshal Ferdinand Foch, August 15, 1918, in Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, vol. 8, *Operations, St. Mihiel* (Washington, DC: Government Printing Office, 1948), 12.

⁸⁶ James H. Hallas, *Squandered Victory: The American First Army at St. Mihiel* (Westport, CT: Praeger, 1995), 32.

⁸⁷ Letter from Marshal Ferdinand Foch to General John J. Pershing, August 27, 1918, in Historical Division, *Operations, St. Mihiel*, 32-33.

⁸⁸ Letter from General Hugh Trenchard to General John J. Pershing, September 9, 1918, in Historical Division, *Operations, St. Mihiel*, 58.

under the tactical command of Colonel William “Billy” Mitchell, First Army Chief of Air Service.

On 19 August 1918 Mitchell issued Air Service Circular Number 1, which proved to be a seminal document in the Air Service’s conduct during the war. Circular Number 1 outlined routine procedures for observation, pursuit, and day and night bombardment units, as well as clarified methods for assigning and allocating missions to units and delineating the duties of Air Service commanders at various echelons. The procedures outlined in Circular Number 1 represented the most current tactical thinking within the Air Service. It was a combination of the tactical employment doctrine previously borrowed wholesale from the French and the hard-won lessons learned by the handful of American units with combat experience in France. Fully two-thirds of the document was devoted to observation operations, with detailed discussion on daily squadron operations, organization of observer’s rooms for intelligence exploitation and dissemination, methods for liaison between infantry and aircraft during an attack, and procedures for artillery coordination and adjustment particular to the First Army.⁸⁹ The high degree of specificity, perhaps bordering on micromanagement, evident in the Circular reflected both a burgeoning knowledge of waging war in the air and the necessity of providing prescriptive instructions for combat employment to the rapidly growing Air Service, the bulk of which would be entering combat for the first time at St. Mihiel. The limited

⁸⁹ Air Service Circular Number 1, quoted in Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. 3, *The Battle of St. Mihiel, 12 September 1918* (Washington, DC: The Office of Air Force History, 1978), 17.

experience of most American airmen necessitated very precise instructions in order to overcome the lack of exposure to the rigors of combat.

The plan of employment for the Air Service in the St. Mihiel operation, devised by Mitchell, was broken into four stages: early preparation, preparation immediately preceding the attack, attack, and exploitation.⁹⁰ The early preparation stage intended to conceal the preparations for the operation by maintaining a normal level of bombardment while also denying German reconnaissance aircraft the ability to operate over allied lines through “an absolute barrage of the front.”⁹¹ Additionally, the plan tasked reconnaissance units to collect preparatory information for the artillery fire that would precede the main attack. For the preparation immediately preceding the attack, which began with the start of the operation’s preliminary artillery bombardment, the Air Service focused its efforts as far as the German detraining points. Ostensibly, this would sow chaos and confusion in the German rear, isolate the battlefield, and prevent German reinforcement from arriving in a timely manner. Simultaneously, pursuit units would attack enemy aviation and balloons wherever they were encountered in order to control the skies over the salient.

The attack phase continued the work of the previous stage while also shifting to directly supporting the friendly ground troops. Prominently, the plan directed pursuit patrols to “attack with bombs and machine guns, either enemy reinforcements marching

⁹⁰ Headquarters, First Army, AEF, Annex Number 3 (Field Orders Number 9), Plan of Employment of Air Service Units, American First Army, September 7, 1918, in Historical Division, *Operations, St. Mihiel*, 215.

⁹¹ *Ibid.*, 216.

to the attack, or enemy elements retreating.”⁹² Finally, the exploitation phase called for keeping up the pressure on the Germans and preparing to be flexible as the situation developed. Flexibility would be achieved by maintaining standing aerial patrols and keeping units on an alert status to react as tasks emerged.

The exposed St. Mihiel salient and the number of aircraft available, even at a reduced serviceability rate, offered Mitchell a unique opportunity for a creative operational approach. While adhering to the plan of employment outlined in Annex Number 3 to Field Orders Number 9, Mitchell resolved to mass his airpower and maintain continuous pressure by attacking from both sides of the salient while sowing chaos in the enemy’s rear areas with bombardment aircraft.⁹³ His overall approach was summarized in the orders he issued to his units on the eve of battle:

TAKE THE OFFENSIVE AT ALL POINTS WITH THE OBJECT OF DESTROYING THE ENEMY’S AIR SERVICE, ATTACKING HIS TROOPS ON THE GROUND, AND PROTECTING OUR OWN AIR AND GROUND TROOPS [original emphasis].⁹⁴

While this message was aggressive and motivating to the combat crews, Mitchell’s approach sought to have the Air Service being everywhere, doing everything. This diminution of effort provided the Germans with numerous opportunities to strike where and when they were able; it was also taxing on the Air Service and depleted combat power, especially in areas with critical shortages such as spare parts or observers. Despite

⁹² Headquarters, First Army, AEF, Annex Number 3 (Field Orders Number 9), Plan of Employment of Air Service Units, American First Army, September 7, 1918, 216.

⁹³ Hallas, *Squandered Victory*, 32-33.

⁹⁴ Headquarters Air Service, First Army, AEF, Battle Orders Number 1, 11 September, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 137.

the shortcomings addressed above, Mitchell's plan exploited the geography of the battlefield to the utmost and leveraged the combat power of the allied air arms to the maximum. For the conduct of the battle itself, this research will explore the employment of observation, pursuit, and bombardment aviation in their respective roles, beginning with observation.

Observation Employment

The observation units committed to battle at St. Mihiel displayed considerable courage and professionalism, given the challenges posed by the terrible weather and the indifferent air cooperation training within the supported infantry units. When the artillery barrage that heralded the start of the operation began on the night of 11-12 September 1918, the weather was abysmal. The first observation sorties encountered "a high west wind, and a ceiling of about 300 meters [,] these conditions prevailed throughout the greater part of the day, with low-hanging, heavy clouds and intermittent, heavy showers."⁹⁵ Thanks to weather like this, only 13 reconnaissance sorties were able to be carried out successfully on the first day of the operation..⁹⁶

Of arguably greater concern were the mixed results obtained by the infantry contact patrol sorties that managed to get airborne. In each instance listed in squadron

⁹⁵ Leland M. Carver, Gustaf A. Lindstrom, and A. T. Foster, *The Ninetieth Aero Squadron, American Expeditionary Forces: A History of Its Activities During the World War, from Its Formation to Its Return to the United States* (Nashville, TN: The Battery Press, 1990), 25.

⁹⁶ Headquarters, First Army Corps, Summary of Operations for the day of 12 September 1918, Number 3, 13 September 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 225.

reports, the cause for unsuccessful contact patrols was the infantry's failure to display their signaling panels properly. As expected, veteran units like 2nd and 42d Division gave the best performance in this area, while the newly arrived 90th Division failed to display a single panel during the course of the entire day.⁹⁷ Adherence to air-ground protocols would remain a problem for the AEF until the Armistice.

Visibility was too poor to properly adjust artillery fire during the first two days, and it also precluded message dropping, leaving radio as the sole remaining means of coordination with the ground. Even these were adversely affected by the atmospheric conditions associated with the bad weather, further hindering communications. Poor radio communications would prove a common theme throughout St. Mihiel and Meuse-Argonne. In some cases the weather drove extreme responses from the aircrews, such as an unnamed pilot of the 1st Pursuit Group, tasked with an infantry contact mission because he was one of the few aircraft able to get into the air. The low ceiling forced him within 10 meters of the ground to obtain positive identification of friendly troops, an astoundingly low altitude that exposed the aircraft to substantial risk from small arms fire.⁹⁸

On 14 September the weather improved markedly, and German aerial reinforcements began to arrive in the sector. For the first time since the beginning of the battle, continuous observation and reconnaissance were possible throughout what

⁹⁷ Headquarters, First Army Corps, Summary of Operations for the day of 12 September 1918, Number 3, 13 September 1918, 225.

⁹⁸ Headquarters, Air Service, First Army, Operations Report Number 4, 19:00 September 12th - 19:00 September 13th, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 356.

remained of the salient as well as deep reconnaissance of more distant targets such as Metz and Conflans.⁹⁹ This provided First Army Headquarters with a better understanding of the current disposition of forces, as well as giving subordinate commanders an accurate picture of their units' limit of advance. However, air-ground cooperation between the infantry and aircraft remained inconsistent, with infantry units not displaying the proper signal panels, or aircraft being unable to make contact at all.¹⁰⁰

15 September saw even better weather than the preceding day, and the high tide of German aerial opposition, although the bulk of their resistance was directed against the unescorted bombardment units. Once again, troops from the experienced 2nd Division showed good adherence to air-ground procedures, allowing contact patrols to keep the division command post informed.¹⁰¹ Overall, the general performance of the observation squadrons improved from previous days, despite the increase in German air activity.

As the St. Mihiel operation wound down to a close, the observation units began to shift to moving forces to be in position for the Meuse-Argonne campaign that would begin shortly. The problems encountered by Air Service observation squadrons would persist throughout Meuse-Argonne. Experienced infantry units, aware of the benefits

⁹⁹ Headquarters, Air Service, First Army, Operations Report Number 15 19:00 September 13th - 19:00 September 14th, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 474.

¹⁰⁰ Headquarters, First Army Corps, Summary for Operations for the day of 14 September, 1918, Number 5, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 455.

¹⁰¹ Headquarters, First Army Corps, Summary of Operations for the day of 15 September, 1918, Number 6, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 554.

conferred by Air Service contact patrols and artillery coordination sorties adhered to the prescribed procedures for the most part. Conversely, new units often failed to even bring their signal panels with them once they went over the top. Furthermore, the limited opportunities to coordinate artillery fires meant that radio communications problems with the ground batteries went largely overlooked. Radio troubles were attributed to the poor atmospheric conditions, rather than the real culprit—the artillery’s radio equipment. This issue would reemerge at Meuse-Argonne and would never be fully solved. Despite increases in German aerial opposition as St. Mihiel progressed, observation units never suffered excessive losses. This seemingly justified the decision to use organic observation aircraft as escorts, and the Air Service maintained the arrangement throughout the Meuse-Argonne campaign. Finally, shortages of trained observers, examined in greater detail below, remained an intractable problem that would plague observation units until the Armistice. In spite of these challenges, Air Service observation aviation performed reasonably well. Overall, observation aviation contributed significantly more to the success at St. Mihiel than their comrades in the pursuit units.

Pursuit Employment

As mentioned above, Mitchell tasked pursuit aviation with denying German aviation access over the American lines with an aerial barrage during the early preparation and preparation immediately preceding the attack phases. Once the attack began, pursuit’s role was to take the offensive and attack German aviation and balloons wherever they were encountered. Following this, the focus shifted to supporting the ground troops through a combination of strafing and bombing, principally by pursuit units.

The order to employ pursuit aircraft in a ground attack role requires additional discussion. With the vast majority of the Air Service's more suitable aircraft tasked with either observation duties or bombing distant targets to the enemy's rear, Mitchell chose to allocate a portion of his pursuit aircraft to ground strafing during the attack phase. While the decision was understandable to a certain extent, this was a highly risky endeavor without total control of the air. Pursuit aircraft operating close to the ground at a low energy state were very vulnerable to enemy fighters pouncing from above, as well as being more exposed to antiaircraft and small arms fire. Furthermore, every pursuit sortie earmarked for ground strafing is a sortie that was not directly contributing to gaining control of the air, protecting observation, reconnaissance, and bombardment sorties, or preventing enemy aircraft incursions. Finally, the pursuit aircrews were not thoroughly trained in ground strafing tactics, techniques, and procedures. The use of pursuit aircraft in this role had been in a purely ad hoc basis prior to St. Mihiel. While German air strength in the St. Mihiel sector was modest when the attack began, the *Luftstreitkräfte* was not yet a defeated foe and could rapidly redeploy forces to threatened areas. This oversight would extract a significant toll in aircrew lives and airframes lost during the operation.

As early as the preparatory bombardment, some of the pursuit units were already shifting to strafing missions, rather than air combat, as the Germans evacuated the salient and the *Luftstreitkräfte* held back, awaiting reinforcements.¹⁰² Other pursuit units

¹⁰² Operations Office, Third Pursuit Group, Operations Order Number 43, 13 September, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918* 279.

reequipped with bomb racks and sat on ground alert, awaiting targets of opportunity.¹⁰³ This premature switch to missions that did not contribute to winning control of air gave the Germans enough tactical leeway to conduct two separate reconnaissance missions in force over allied lines while remaining active in close proximity to their antiaircraft emplacements for mutual support.¹⁰⁴ The Germans developed a habit of refusing to give battle when confronted by a superior force unless caught by surprise.¹⁰⁵ This was a perfectly logical approach for the *Luftstreitkräfte*—preserve the force available and concentrate that force at a chosen time and place beneficial to Germany. Although augmented a few days into the offensive, German air strength in the St. Mihiel sector could not hope to challenge the allied aerial armada. Thus, the *Luftstreitkräfte* was content to let antiaircraft fire exact a steady toll on allied airpower while German pursuits focused on ensuring the success of a limited number of reconnaissance missions and preying upon unprotected aircraft caught on their own.

As the weather improved on 15 September, the First Pursuit Wing experienced aggressive action by Fokker D.VIIs operating in large formations and attempting to penetrate the allied frontline to attack observation aircraft and balloons.¹⁰⁶ Reports

¹⁰³ 103rd Aero Squadron, Flying Orders for September 13th, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 281.

¹⁰⁴ Air Service, First Army, Hostile Movements, Changes and Conduct, September 13th, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 364.

¹⁰⁵ Air Service, First Army, Hostile Movements, Changes and Conduct, September 14th, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 482.

¹⁰⁶ Headquarters, First Pursuit Wing, Air Service, Operations Report Number 15, From 17 h 00 September 14th to 17 h 00 September 15th, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 548.

indicated stiffening opposition, with “practically every pursuit patrol which crossed the line [. . .] engaged in combat with the enemy.”¹⁰⁷ Despite the aggressive response of the *Luftstreitkräfte*, numerous pursuit squadrons continued to be engaged in strafing missions rather than focusing on the enemy air force that finally decided to make its presence felt.

There were a few high points for the pursuit squadrons, principally in the form of Lieutenant Frank. Luke began his meteoric if short-lived combat career by downing a German observation balloon after a running fight against three German Fokker D.VIIIs.¹⁰⁸ Additionally, the inherent aggressiveness of the pursuit pilots meant that often pursuit aircraft made up the bulk of the sorties that managed to get airborne during the periods of particularly bad weather. Given the paucity of assets in the air and the requirement for accurate and timely reconnaissance, the Air Service pressed many pursuit sorties into reconnaissance missions, a role for which they were neither trained nor particularly well-suited. Downward visibility was not as good in a pursuit aircraft as it was in an observation type, and the pilot had to divide his attention between flying the aircraft, observing the ground situation, and making notes. Furthermore, pursuit aircraft did not carry radios.

Although showing considerable verve and aplomb in roles for which they were not trained, the pursuit units struggled. Hampered by poor weather, with their efforts diluted in strafing and reconnaissance missions, the pursuit units failed to prevent the

¹⁰⁷ Air Service, First Army, Hostile Movements, Changes and Conduct, September 15th, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 571.

¹⁰⁸ Cooke, *U.S. Air Service in the Great War*, 147.

Germans from successfully penetrating American lines to attack observation aircraft, balloons, and the doughboys. Despite the preponderance of airpower available, the Air Service never fully wrested control of the skies from the *Luftstreitkräfte*. Moreover, thanks to inadequate allocation to escort, the pursuits also failed to adequately protect the bombardment aircraft.

Bombardment Aviation

The plan for Air Service bombardment units focused on targets in the enemy rear, specifically detrainment points, depots, and enemy aerodromes and air parks. The Royal Air Force's Independent Force focused on more distant objectives, such as Metz and the Briey Basin. Of the three bombardment units committed to the St. Mihiel operation, only the 96th Aero Squadron had significant prior combat experience.

Bad weather kept most of the bombardment aircraft grounded for the first few days of the offensive, and the sorties that launched struggled to locate their primary targets, forcing them to attack secondary targets or in some cases, any German military target that presented itself. Invariably, these opportunistic attacks against alleged ammunition dumps and troop concentrations were touted as successful if there were any secondary explosions or objects in the area caught on fire.¹⁰⁹

Additionally, bombardment aircraft braving the weather also had to contend with German pursuits covering the withdrawal from the salient. The *Luftstreitkräfte* managed to inflict heavy losses on the unescorted day bombardment aircraft sent on raids in

¹⁰⁹ Raid Report, 96th Aero Squadron, September 13, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 339.

squadron strength or smaller. Further reducing effectiveness, many bombardment crews jettisoned their bombs once they were attacked in attempts to gain additional maneuverability and survive the engagement.¹¹⁰

As the offensive progressed and the weather improved, the number of aircraft dispatched on raids increased, but the attacks were still mounted at squadron strength against different objectives. The lack of mass and concentration left the bombardment crews highly vulnerable to German formations, which were often of equal or great strength and flying the excellent Fokker D.VII. As noted previously, German air resistance began to slacken during the final day of the operation, as it became apparent that the St. Mihiel's operation's objectives were limited to the salient. Mitchell attributed the drop in German opposition to effective bombing, which was invariably characterized in nearly every report as good to excellent throughout the operation. Given the poor weather over much of the battle, the lack of post-raid damage assessment, and the inexperience of all of the bombardment squadrons except the 96th Aero Squadron, it is highly likely that bombing assessments were inflated by green crews.

With the bad weather, lack of concentrated attacks in group strength, stiff German resistance, and poor bombing accuracy, Air Service bombardment aviation had very little to show for its sacrifices. Despite these setbacks, the bombardment units correctly identified many of these deficiencies and would take measures to correct them prior to

¹¹⁰ Summary of Operations, Day Bombardment Group, September 13, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 340.

Meuse-Argonne.¹¹¹ However, the most prominent shortcoming, the lack of consistent pursuit escort, would remain a problem until the war's conclusion. In addition to the problems encountered during execution by Air Service observation, pursuit, and bombardment aviation, there were significant issues with the materiel situation.

Materiel

Concentrating and sustaining this force in such a relatively small geographic area posed increasing problems for the AEF. The French had to relinquish no fewer than 16 aerodromes to the Air Service in the weeks preceding the operation while still maintaining their own aerial commitments in the sector.¹¹² More pressingly, the scale of the air forces dedicated to the operation prevented the French from providing the number of service units requested by the AEF.¹¹³ Indicative of the confusion that characterized the buildup was the experience of the 20th Aero Squadron, which was moved to the front to become part of the 1st Day Bombardment Group a few days prior to the St. Mihiel operation. The 20th was among the first units equipped with the American version of the DeHavilland DH.4 two-seat bomber with a Liberty engine that was more powerful than the Rolls-Royce power plant that equipped the British version. Perhaps because of this marginal edge in performance (or an unhealthy dose of wishful thinking), the 20th's

¹¹¹ First Day Bombardment Group Historical Summary, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 340.

¹¹² Field Letter 1081 from Field Armies of the North and Northeast, Air Service to the Commander of the American Expeditionary Forces, GHQ, 24 August 1918, in Historical Division, *Operations, St. Mihiel*, 157.

¹¹³ *Ibid.*

leadership believed that they would be employed as a “biplace pursuit organization” and thus had no bombs on hand when they were tasked with their first raid on 12 September.¹¹⁴ Fortunately, the arrival of bomb release hardware rectified the situation, and the 20th was ready by 13 September.¹¹⁵

Mitchell’s force, while expansive, did not have all of the types and quantities of equipment on hand to fulfill all of its missions. Notably absent from the tables of organization and equipment was a dedicated ground attack or close support aircraft. In this regard the Germans were well ahead, having fielded the all-metal and armored Junkers J.I as a dedicated ground attack and infantry liaison aircraft with *Infanteriefleiger* units in late 1917.¹¹⁶ In contrast, the Americans had to rely on multipurpose aircraft for observation, bombardment, and ground attack such as the DH.4, Breguet 14, and Salmson 2.

While Mitchell was a gifted tactician and inspiring leader, administration, supply, and logistics were not among his strongest talents. Mitchell tended to emphasize training and tactical operations, areas he was more familiar with, at the expense of sustainment. As such, Patrick stepped in to mitigate the supply situation during the buildup for St. Mihiel. On 28 August, Patrick directed that no American aero squadrons earmarked for the operation be moved into the area until the supporting air depots were adequately

¹¹⁴ Clarence G. Barth, *History of the Twentieth Aero Squadron: The “Mad Bolshevik” Squadron of the First Day Bombardment Group* (Nashville, TN: The Battery Press, 1990), 34.

¹¹⁵ *Ibid.*, 34-35.

¹¹⁶ Peter Gray and Owen Thetford, *German Aircraft of the First World War* (London: Putnam, 1962), 154-157.

supplied with spares that could be sent forward to the mobile parks that supported the squadrons directly.¹¹⁷

The Air Service's spares and maintenance organization in France at the tactical and operational levels consisted of groups, mobile parks, and air depots.¹¹⁸ The groups and mobile parks were under the control of the Air Service, the air depots fell under the Service of Supply. At the lowest level, groups were tasked with the routine maintenance and servicing of the squadrons' aircraft. Groups had little ability to conduct major repairs or overhauls. In the next echelon were the mobile parks, which were subdivided into a supply section and a repair and salvage section. These organizations were intended to provide spare parts and more complex repairs for up to nine squadrons and were to be maintained so as to be able to relocate within 24 hours in order to react to the enemy or support friendly forces.¹¹⁹

In the chaotic supply situation that existed prior to Patrick's intervention, parts had been transferred between squadrons instead of coming from the supporting mobile park. This spare parts shell game had a pernicious, but not immediately apparent, effect on aircraft readiness.¹²⁰ In general, cannibalizing parts from one aircraft for another can be an effective method in certain circumstances, such as salvaging spare parts from an

¹¹⁷ Cooke, *U.S. Air Service in the Great War*, 122-123.

¹¹⁸ James G. Harbord, *The American Army in France, 1917-1919* (Boston: Little, Brown, & Co., 1936), 502.

¹¹⁹ Memorandum Number 37 from Chief of Air Service to Headquarters, Services of Supply, AEF, August 9, 1918, quoted in H. A. Toulmin, Jr., *Air Service: American Expeditionary Air Force, 1918* (Nashville, TN: The Battery Press, 2004), 133.

¹²⁰ Cooke, *U.S. Air Service in the Great War*, 122-123.

airframe that has been catastrophically damaged in an accident or combat. However, in most cases cannibalization resulted in short-term readiness gains at the cost of long-term fleet health. When the Air service was unable to address this problem, aircraft availability plummeted. Fundamentally, poor supply and spares management forced the squadrons to take expedient measures to keep their aircraft flying, albeit to their own long-term detriment. Unfortunately, lack of spare parts would prove to be a persistent problem for the Air Service that only became worse as combat operations intensified later in the autumn.

Yet another materiel issue negatively affecting the Air Service was the paucity of ground transportation. The buildup for St. Mihiel placed a premium on all manner of transportation, and the Air Service was simply one of many organizations competing for resources. Mitchell lamented the “state and amount of transportation” as “extremely unsatisfactory” and this state of affairs was a prominent factor in the challenges to keep the Air Service adequately supplied.¹²¹ Previously, the Air Service had been given wide latitude to procure its own transportation and it had been relatively successful in this endeavor, almost to the detriment of other branches.¹²² Despite the Air Service’s early success in securing its own transportation, it could not rightly lay claim to an abundance of vehicles when they were desperately needed all over France. Thus, the GHQ

¹²¹ Memorandum from the Chief of Air Service, First Army, to the Commanding General, First Army, August 28, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 60-61.

¹²² H. A. Toulmin, Jr., *Air Service: American Expeditionary Air Force, 1918* (Nashville, TN: The Battery Press, 2004), 311.

consolidated control of all motor transportation and centralized control of allocation.¹²³

While this negatively affected the Air Service's transportation situation—in some instances Air Service units were forced to reduce rations in addition to spare parts woes—it was the correct military decision for the AEF as a whole.¹²⁴ Another impact of the ground transportation situation was the problems it caused for the mobile parks that Patrick had envisioned.¹²⁵ Shortages of motor vehicles, especially the specialized machine shop and workshop trucks that were required for maintenance at the lower echelons, meant that squadrons, groups, and mobile parks in many cases temporarily ceased to be mobile organizations as intended.¹²⁶ This reduced operational flexibility considerably and presented risk in the unlikely event of another German offensive.

The net result of this litany of materiel problems was the Air Service's increasing difficulty in keeping its aircraft serviceable, even before the St. Mihiel operation began. For example, one day prior to the start of the operation, when aircraft serviceability should have been at its peak, the Air Service had only 487 of its 611 planes available—a

¹²³ General Order Number 72, General Headquarters, AEF, May 11, 1918, in Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, vol. 16, *General Orders, GHQ, AEF* (Washington, DC: Government Printing Office, 1948), 321.

¹²⁴ Toulmin, *Air Service*, 312.

¹²⁵ Method of Supply of 1st Army Squadrons, Memorandum from Headquarters, Air Service, First Army to Colonel William Mitchell, August 30, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 70-71.

¹²⁶ Toulmin, *Air Service*, 314.

rate just shy of 80%.¹²⁷ For the combined serviceability of the allied air forces at St. Mihiel, only 959 aircraft of 1481 on-hand were fit for service, for an operational rate of 64.7%.¹²⁸ This already precarious logistical situation at the start of St. Mihiel would continue to grow progressively worse as high-intensity combat operations continued throughout the autumn, and by 31 October only 475 serviceable allied aircraft were available in the AEF's sector.¹²⁹ Air Service strength actually peaked on 16 September, with 644 aircraft on hand compared to 611 at the start of the operation, but availability rates declined despite the uptick in total numbers.¹³⁰ The Air Service logistical apparatus at this juncture was able to replace losses but it lacked the depth necessary to sustain the force during a protracted campaign. Moreover, the fighting at St. Mihiel had been isolated to a relatively small geographic area, so the logistical strain of relocating the mobile air parks while continuing operations was never felt. The supply situation exposed during St. Mihiel remained largely unsolved through Meuse-Argonne and up to the Armistice. Aside from these materiel problems, the Air Service also struggled with training shortcomings.

¹²⁷ Air Service, First Army Report on Aircraft, 11 September, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 127.

¹²⁸ Memorandum from the Chief of Air Service to the Chief of Air Service, Army Group, October 31, 1918, in Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, vol. 9, *Operations, Meuse-Argonne* (Washington, DC: Government Printing Office, 1948), 362.

¹²⁹ *Ibid.*

¹³⁰ First Army, Plane Situation, Document 492, September 16, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 654.

Training

The Air Service's limited experience with artillery cooperation prior to St. Mihiel had left much to be desired as far as the artillery branch was concerned.¹³¹ However, problems in this realm were not limited to the Air Service; inexperienced ground units also required significant training in air-ground coordination. New units like the 82nd and 90th divisions went through a crash course in cooperation with equally green Air Service units like the 50th Aero Squadron, which itself had only started training on 9 August.¹³² Further complicating the matter was the fact that fully-trained observers were already in short supply. Observer training for the Air Service was unique in that the initial cadre were artillery officers detailed to French units for training.¹³³ This method generated a very small number of qualified personnel, but it was not intended to be the primary means of producing observers. By June of 1918, it was becoming readily apparent that observers were not being produced in sufficient quantities or to desired quality. As Major General Mason Patrick, AEF Chief of Air Service, outlined in his final report: "of 725 observers called for in June and July [1918], only 145 arrived in August, 86 in

¹³¹ Frank P. Lahm and Alfred F. Simpson, ed., *The World War I Diary of Colonel Frank P. Lahm: Air Service, A.E.F.* (Maxwell AFB, AL: Air Force Historical Research Division, 1970), 118.

¹³² Daniel P. Morse, *50th Aero Squadron, A.E.F.* (New York: Blanchard Press, 1920), 24-25.

¹³³ Final Report of Chief of Air Service, American Expeditionary Forces, in Historical Division, Department of the Army, *United States Army in the World War, 1917-1919*, vol. 15, *Reports* (Washington, DC: Government Printing Office, 1948), 263.

September, and 149 in October, or a total of 380 who could be made available for front line work before the cessation of hostilities.”¹³⁴

To help solve the problem, the AEF continued to detail officers from the artillery to observer duty with the Air Service, 825 of which went on to pass their physicals and begin the 68-hour accelerated training program.¹³⁵ Some of these men performed very well in training, but overall nearly one third of those in observer training failed to successfully complete the course. Much of this stemmed from the diverse skillsets required by aerial observers, ranging from morse code signaling, radio operation, navigation, aerial gunnery, visual recognition, and photography.

The Air Service also faced challenges in maintaining the proficiency of observers already in operational units. So, to retain the skills listed above, some units tailored observer training to better align it with their combat expectations. Somewhat counterintuitively, gunnery was often the first area of training that was deemphasized in favor of tactical skills such as map reading and radio operation.¹³⁶ Circular Number 1 and the prevailing guidance issued to both observation and pursuit units indicated a belief that other observation aircraft within a unit could provide sufficient protection organically. Moreover, there was little point in sending up an observation aircraft at all if the observer on board was not thoroughly trained to perform his primary mission. From a holistic perspective, taking risk by emphasizing core observation duties at the expense of

¹³⁴ Final Report of Chief of Air Service, American Expeditionary Forces, 263.

¹³⁵ Cooke, *U.S. Air Service in the Great War*, 127.

¹³⁶ *Ibid.*, 127-128.

gunnery was probably the correct decision, but it further exacerbated the observer shortage as aircraft were shot down. Patrick called the observer training crisis “one of the most difficult problems facing the Air Service” during the war.¹³⁷ Another difficult problem that faced the Air Service during both St. Mihiel and Meuse-Argonne was the weather.

Weather

Weather hampered the effectiveness of Air Service operations significantly during St. Mihiel. Indeed, bad weather was present for at least part of the day during the entire operation. Reports from the morning of 12 September are replete with descriptions of poor visibility and thick cloud cover. The ceiling appears to have been around 500 meters, forcing aircraft tasked with observation and liaison very low in order to have any hope of obtaining visual contact with troops on the ground.¹³⁸ Additionally, the heavy rain caused widespread propellor damage as aircraft loped along, sliding in the mud, which further aggravated the already stressed supply situation.¹³⁹

The weather also played havoc with formation integrity within the pursuit units, with many pilots becoming separated and disoriented.¹⁴⁰ The weather was so bad on the

¹³⁷ Final Report of Chief of Air Service, 263.

¹³⁸ 13th Aero Squadron, Reconnaissance Report, 12 September 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 186-87.

¹³⁹ Headquarters, Air Service, First Army, Operations Report Number 3, 19:00 September 11th - 19:00 September 12th, 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 257.

¹⁴⁰ 93rd Aero Squadron, Reconnaissance Report, 12 September 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 203.

first day of the operation that only 13 reconnaissance sorties were able to be carried out successfully, an appallingly low number given the preponderance of airpower at Mitchell's disposal and the size of the ground force committed.¹⁴¹ Poor visibility hampered infantry contact patrols, made navigation difficult, precluded artillery cooperation, and negatively impacted bombing accuracy. As discussed above, bombardment missions often had to attack secondary targets of questionable value when the primary was unidentifiable due to cloud cover.

With the technology of 1918, the problems posed by the weather were simply insurmountable. No means of instrument navigation, deicing, or blind bombing existed, so aircrews had to take immense risks trying to fulfill their assigned missions. In this regard the Air Service's conduct was superb. The attitude of the airmen who fought at St. Mihiel is captured well in a line from the 90th Aero Squadron's history: "Aviation [. . .] was a very essential part of the attack, and whatever the weather, the missions were to be performed as long as it was physically possible for the planes to take off."¹⁴²

Assessment

Mitchell wrote a brief summary of Air Service operations at St. Mihiel, in which he drew several conclusions. Regarding pursuit, he states: "experience proved that the best results are obtained from pursuit when employed to maintain a barrage constantly over the front in conjunction with strong combat patrols dispatched to areas in which

¹⁴¹ Headquarters, First Army Corps, Summary of Operations for the day of 12 September 1918, Number 3, 13 September 1918, quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 225.

¹⁴² Carver et al, *Ninetieth Aero Squadron*, 24.

enemy activity is reported.”¹⁴³ This emphasis on the need for defensive patrols, in contrast to Battle Order Number 1 from 11 September, revealed a sound grasp of combat reality, as did Mitchell’s call for increased liaison between pursuit aviation and the protected force. Interestingly, and in subtle contradiction to his statements above, he maintained that employing pursuit aircraft in ground strafing was a worthwhile endeavor due to its perceived effect upon enemy morale—a point that was extrapolated by reports of American infantry units’ responses to German air attack. While praising the overall effectiveness of the bombardment units, Mitchell pointed out their inexperience and offered some tactical suggestions to mitigate this, such as having the entire formation release its bombs on cue from the flight lead. This recommendation, in particular, implies that accuracy left much to be desired. Finally, he lamented the persistent problems with infantry liaison, which necessitated the contact patrol aircraft flying extremely low in order to identify units (sometimes by the patches on their uniform) independent of any signaling from the infantry.

From an Air Service perspective, Patrick’s final report was a bit less sanguine than Mitchell’s initial observations. While praising the courage and ingenuity of the force for attempting to overcome the weather and to a lesser extent, inexperience, Patrick explicitly mentioned poor bombing accuracy and the heavy losses incurred by the bombardment squadrons.¹⁴⁴ He proposed that there was a silver lining to this, advancing the argument that the bombardment aircraft occupied the German defenders, allowing the

¹⁴³ William Mitchell, “Summary of Air Service Operations St. Mihiel - September 12th to 20th, 1918,” quoted in Maurer, *The Battle of St. Mihiel, 12 September 1918*, 710.

¹⁴⁴ Final Report of Chief of Air Service, 230-231.

observation aircraft to conduct their work largely unmolested.¹⁴⁵ He also mentions the perceived effectiveness of pursuit aircraft in strafing operations, citing an instance in which a number of motor trucks were destroyed. The decision to prematurely commit pursuit units to ground attack operations was likely the biggest tactical misstep of the operation. Weak German showings in the air on 12 and 13 September coupled with the overwhelming numbers lulled the Air Service into thinking that the *Luftstreitkräfte* was a defeated force in the St. Mihiel sector. Pursuit aircraft assigned with strafing missions should have been retasked later on the 14 September, when it became apparent that the Germans had reinforced their air units. Doing so would have freed up pursuit aircraft to assist the bombardment aircraft and enabled greater attrition of German pursuit units. Moreover, the pursuit units tasked with strafing missions were not decisive to the overall success of the operation, and they could have been better employed shooting the *Luftstreitkräfte* out of the sky and protecting friendly aircraft.

While the operation was ultimately a success, the overwhelming allied air force that was assembled ensured that, at least from an aerial perspective, the outcome was never in doubt. Unfortunately, the qualified success at St. Mihiel masked problems that would come to a head during the fight for Meuse-Argonne. The sorely lacking motor transportation situation, poor or indifferent coordination between observation squadrons and artillery units, inadequate logistical support, shortages of trained aircrews, especially observers, and an overly-aggressive approach to employing pursuit aircraft that neglected

¹⁴⁵ Final Report of Chief of Air Service, 230-232.

defense in favor of seeking out the enemy in the air and strafing ground units would reemerge in the coming weeks with great consequences.

CHAPTER 5

MEUSE-ARGONNE

Overview

The offensive at Meuse-Argonne, which began on 26 September 1918 and lasted until the Armistice on November 11, was the largest and bloodiest campaign in American military history. More than a million American troops would participate in the campaign, of which 95,786 were wounded and 26,277 killed.¹⁴⁶ This butcher's bill constituted roughly half of all American casualties suffered during the First World War.¹⁴⁷ In terms of scale, Pershing would feed 22 divisions, roughly 2400 artillery pieces, 324 tanks, and most notably, 840 aircraft into the battle.¹⁴⁸

Conceptually, the operation was part of Marshal Foch's overall plan for several counterattacks along the allied front. Initially, Foch intended to capture the initiative from the Germans and seize key terrain and infrastructure that would allow the allies to launch the planned 1919 offensive from positions of relative advantage. However, the success of the allied offensives revealed cracks in German morale and fighting ability, and Foch expanded his aims. Now believing that the war could be won in 1918, Foch envisioned a large-scale envelopment with attacks launched from the Somme and Champagne-

¹⁴⁶ Richard S. Faulkner, Center of Military History Publication (CMH Pub) 77-8, *Meuse-Argonne, 26 September-11 November 1918* (Washington, DC: Center of Military History, United States Army, 2018), 7.

¹⁴⁷ Edward G. Lengel, *To Conquer Hell, The Meuse-Argonne, 1918* (New York: Henry Holt & Co., 2008), 4.

¹⁴⁸ *Ibid.*

Argonne sectors, supplemented by additional advances across the front to maintain pressure on the Germans.¹⁴⁹ With the Americans providing the bulk of the offensive power for the eastern pincer, the AEF was crucial to Foch's plan to bring the war to a successful conclusion.

From the outset, the campaign at Meuse-Argonne was hobbled by Pershing's insistence on mounting the operation against the St. Mihiel salient. While St. Mihiel provided the AEF with some much-needed combat experience, it caused immense logistical problems by forcing the AEF to shift its operational focus 40 miles to the west over a mere 10 days. Additionally, Pershing committed his best divisions to St. Mihiel in order to maximize the potential for success and assuage Foch's doubts about the operation. These units would not be available in time for the start of the Meuse-Argonne offensive.¹⁵⁰

The Air Service, for its part, would not have the preponderance of combat power it had enjoyed at St. Mihiel. The allied aircraft that supported the AEF at St. Mihiel were needed to support operations elsewhere, and as noted earlier the Air Service would have to get by with only 840 aircraft to support a much larger operation in both scale and scope. Moreover, the Air Service continued to fly combat missions between the two major operations, which allowed for precious little time to assess and implement lessons learned from St. Mihiel, and continued to cause attrition and stress the sustainment apparatus. Although some units instituted ad-hoc training programs to correct

¹⁴⁹ Faulkner, *Meuse-Argonne*, 9.

¹⁵⁰ *Ibid.*, 12.

deficiencies in the previous operations, such initiatives were inconsistently implemented across the service. Additionally, the logistics and maintenance shortfalls exposed during St. Mihiel would reemerge during Meuse-Argonne, but the Air Service would not receive a respite after four days of operations as they had in early September. Of arguably greater impact was Mitchell's failure to reassess the Air Service's approach to operations. His continued insistence upon offensive operations against German rear areas and strategic targets at the expense of defense often left American balloons, bombers, observation aircraft, and the doughboys on the ground to fend for themselves and allowed the *Luftstreitkräfte* far more freedom of action over AEF lines than should have been permitted.

Planning

The plan of employment for the Air Service at Meuse-Argonne was relatively straightforward as far as the First Army was concerned, and was remarkably similar to the scheme implemented at St. Mihiel. The Air Service's concept of operation was divided into four distinct phases: preparation until the day of the attack, air observation during the artillery preparation, support during the attack, and exploitation.¹⁵¹ During the preparation phase, the plan emphasized the need for surprise and directed Air Service units to conduct themselves with great secrecy in order to mask movements and concentrations. As part of this endeavor, the plan tasked pursuit units with preventing German incursions over allied lines as well as hindering enemy observation balloons, as

¹⁵¹ Annex No. 4, Field Orders No. 20, "Plan of Employment of Air Service Units," Chief of Staff, First Army, A.E.F., September 20, 1918, in Historical Division, *Meuse-Argonne*, 99.

part of 1st Army's operations security plan. The plan of employment also focused on the role of reconnaissance aircraft during the preparation phase, assigning missions to meet information requirements at the army and corps level. Bombardment missions would continue apace as part of the overall deception effort and to maintain pressure against the Germans. Notably absent was any specific provision for providing bombardment aircraft with escorting pursuit aircraft—an interesting omission given the rough handling the *Luftstreitkräfte* inflicted on bombardment units during St. Mihiel.

During the artillery preparation phase the need for secrecy became irrelevant. Bombing objectives shifted from the mix of interdiction and strategic targets to those more directly supporting the offensive, namely attacks on “concentrations of enemy troops, convoys, [. . .] aviation, railroad stations, command post, and dumps.”¹⁵² All reconnaissance aviation focused on supporting the artillery and infantry, with the exception of army-level reconnaissance, which would perform long-distance reconnaissance missions. Pursuit aviation, specifically the 1st Pursuit Wing, was given somewhat contradictory objectives. First, to ensure an “absolute barrage of the front and protect our observation aviation at every altitude,” and second, to “attack concentrations of enemy troops, convoys, and enemy aviation and balloons.”¹⁵³ As at St. Mihiel, using pursuit aircraft in a ground attack role negated many of the positional and performance advantages gained from maintaining a patrol at altitude.

¹⁵² “Plan of Employment of Air Service Units,” 100.

¹⁵³ *Ibid.*

The same general employment prescribed during the first two phases was maintained during the attack phase. During exploitation, the emphasis shifted to destroying the enemy's air force as the primary mission, followed by attacking enemy troops and protecting friendly troops. The fact that destroying the *Luftstreitkräfte* was elevated to the highest priority mission only during the exploitation phase offers some insight into how the Air Service perceived its ability to gain control of the air. From the standpoint of command and control, gaining a coherent picture of precisely how the ongoing struggle for the air was proceeding was both difficult and untimely. The Germans were exceptionally adept at moving *Luftstreitkräfte* units from one area to another on short notice undetected, and often the first indication of a new *Jasta*'s presence in a sector was encountering an aircraft with unusual unit markings in combat. Similarly, confirmation of kills and losses could take days if not weeks to trickle in, and aircrews in the heat of combat were apt to misperceive events, even from their own narrow apertures, further confounding the work of developing accurate estimates.

Misperceptions also characterized the air war at the operational level. As revealed during the fighting over the St. Mihiel salient, a lack of German air activity did not necessarily equate to the destruction of enemy air forces in a sector. On the contrary, the dilution of effort in attacking targets at all echelons at varying distances from the front lines worked in the German's favor to a certain extent. While the *Luftstreitkräfte* often conceded the air locally when encountering a superior force, they also carefully husbanded their airpower to strike at opportune times and places of their choosing. This helps to explain why the unescorted bombardment planes of the 1st Day Bombardment Group suffered so heavily at St. Mihiel, and why the Germans were able to attack

American ground forces practically up to the Armistice—the Air Service simply could not be everywhere, doing everything, at the same time. With only about half of the aircraft he had for the much smaller St. Mihiel operation, Mitchell could not afford to be as profligate at Meuse-Argonne.

Arguably one of the most prominent shortcomings in the plan of employment was the direction for pursuit aircraft to simultaneously prevent German incursions over the American lines while also attacking enemy ground targets. Pursuit units were the only ones optimized for air-to-air combat, while observation and bombardment squadrons could both conduct ground attack missions. Pursuit aircraft conducting ground attack missions were more vulnerable to ground fire and enemy aircraft attacking from above, unless covered by additional friendly aircraft. If they were protected by another flight, those were additional pursuit aircraft that would not be flying defensive sorties to prevent German incursions. The Air Service must have believed that preventing such incursions was possible, given that they explicitly ordered the task. First Army certainly believed it was possible, since they directed the Air Service to “attack and defeat the hostile Air Service while screening our army front from hostile observation and attack” as their highest priority task.¹⁵⁴

This difference in priorities, as spelled out in the First Army Field Orders Number 20 and the Air Service Annex can largely be traced back to the respective authors of the two documents. Lieutenant Colonel Frank Lahm wrote the Air Service portion of the

¹⁵⁴ Field Orders No. 20, “Initial Attack of Meuse-Argonne Operation,” Chief of Staff, First Army, A.E.F., September 20, 1918, in Historical Division, *Meuse-Argonne*, 89.

First Army document, whereas Mitchell penned the Air Service annex.¹⁵⁵ Mitchell's propensity for offensive action was articulated regularly in the battle orders he issued daily during the Meuse-Argonne operation. Consistently, Mitchell encouraged his airmen with the exhortation, "our air service will take the offensive at all points," in his battle orders on practically a daily basis throughout the campaign.¹⁵⁶ With less regularity he emphasized "protecting our own ground and air troops," and in no instance was a defensive mission of any type placed as the highest priority task between 25 September and 11 November.¹⁵⁷ To a certain extent, Mitchell's predilection towards offensive action was the product of his experience with French and British air doctrines, which he considered to be overly defensive.¹⁵⁸ Mitchell also favored massing aircraft for large-scale actions. One of the problems with coordinating a large number of aircraft was the time it took to assemble the formation. The British had the same experience in 1940, when RAF Fighter Command was riven by the debate between "big wings" and more reactive but dispersed point defense. From a defensive standpoint, massed formations of pursuit aircraft were less timely to react to enemy incursions—by the time they arrived in the sector of interest the Germans had often already departed. While a fixation on the

¹⁵⁵ Maurer, vol. 2, 231.

¹⁵⁶ Battle Orders No. 7, Chief of Air Service, First Army, A.E.F., September 25, 1918. Quoted in Maurer, *Early Concepts of Military Aviation*, 247.

¹⁵⁷ Battle Orders No. 23, Chief of Air Service, First Army, A.E.F., October 13, 1918. Quoted in Maurer, *Early Concepts of Military Aviation*, 248.

¹⁵⁸ Lengel, *To Conquer Hell*, 72.

offensive characterized the AEF as a whole, Mitchell's aggressive conception of airpower was at odds with Pershing's vision.

There was significant tension between Mitchell and Pershing on airpower's role. Mitchell was adamant that the Air Service be untethered from the ground forces to the maximum extent practical, while Pershing desired closer cooperation, if not subservience.¹⁵⁹ Mitchell, never shy to share his opinions on what he perceived as the misallocation of airpower, alienated himself from several important members of Pershing's staff, notably First Army's Chief of Staff, Colonel Hugh Drum. In the end, these conflicting visions of the Air Service's role contributed substantially to the manner in which airpower was employed at Meuse-Argonne. Eventually reality intervened, and by 1 November the Air Service was employed in a manner more in line with Pershing's vision than Mitchell's. Heavy Air Service attrition and low maintenance rates, along with displeasure at First Army and Pershing's headquarters, drove Mitchell to suspend deep penetrations and focus his efforts directly over the front lines.¹⁶⁰

Eventually, after the 1 November tactics retool, Mitchell finally decided to refocus his offensive efforts from interdiction targets to those immediately in front of the advancing doughboys. Liggett also encouraged his infantry and artillery commanders to coordinate more closely with the Air Service units dedicated to their direct support. By doing so, Mitchell made the Air Service's presence distinctly felt by the *Luftstreitkräfte* during the waning days of the war—something that should have happened six weeks

¹⁵⁹ Lengel, *To Conquer Hell*, 72.

¹⁶⁰ Memorandum from the Chief of Air Service to the Chief of Air Service, Army Group, October 31, 1918, in Historical Division, *Operations, Meuse-Argonne*, 362.

earlier.¹⁶¹ However, the *Luftstreitkräfte* remained a formidable and relatively effective force through the Armistice, ending the war with over 2,700 aircraft.¹⁶² With the operational context and planning discussion complete, an examination of the various Air Service combat roles at Meuse-Argonne is necessary, beginning with observation.

Observation Employment

The overall concept of operations for observation aviation at Meuse-Argonne was closely tied to the intelligence assessments and requirements generated by First Army G-2. Generally, observation tasks were divided into three basic categories: photographic reconnaissance, infantry contact patrols, and artillery cooperation. The shortages of trained observers, discussed in the previous chapter, remained acute.

Reconnaissance at the corps level focused on key terrain associated with German crossing points along the Meuse, demarkation areas, and lines of communication. Corps observation was responsible for up to 8 kilometers beyond the front line, and was specifically instructed not to penetrate further than 5 kilometers without pursuit support.¹⁶³ This appears to be the only instance in any of the Air Service plans for Meuse-Argonne where pursuit protection was directed, in this case by Mitchell. The high importance and strategic value of long-range photographic reconnaissance missions

¹⁶¹ Lengel, *To Conquer Hell*, 418.

¹⁶² John H. Morrow, Jr., *German Air Power in World War I* (Lincoln, NE: University of Nebraska Press, 1982), 140.

¹⁶³ Appendix II, Annex No. 4, Field Order No. 20, "Observation Plan," Chief of Air Service, September 17, 1918, quoted in Maurer, *Early Concepts of Military Aviation*, 238.

usually involved the most experienced crews in the tasked squadron. Although Annex No. 4 to Field Order No. 20 made allowances for pursuit protection, in numerous instances observation units provided their own escort organically, flying additional aircraft from the squadron to act as protection for the reconnaissance aircraft. This self-generated escort had the additional benefit of providing photographic redundancy in case the primary reconnaissance aircraft aborted or was shot down.¹⁶⁴ However, organic escort provided by another two-seat observation aircraft was still less capable than an escort of pursuit aircraft. Furthermore, this exposed highly-trained, low-density observation crews to additional risk in aircraft that were not optimized for air-to-air combat.

Throughout the campaign, the weather was a prominent factor hindering the effectiveness of reconnaissance missions. The prevailing west-east weather patterns led to cloud cover over target areas while American aerodromes had clear skies. Often, aircraft were kept on alert and launched at the slightest indication of potential success. In other instances, aircraft sortied in the hopes that weather in the target area would clear. The net result of these meteorological setbacks was that photographic coverage was inadequate in certain areas—not a happy state of affairs for corps and army-level G-2s.¹⁶⁵

Artillery cooperation between air and artillery units during Meuse-Argonne had a mixed record. Artillery cooperation missions were subjected to the same meteorological

¹⁶⁴ “Tactical History of Corps Observation, Part VIII: The Corps Air Service in the Argonne-Meuse Offensive,” quoted in Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. 1, *The Final Report and a Tactical History* (Washington, DC.: The Office of Air Force History, 1978), 250.

¹⁶⁵ *Ibid.*, 249.

challenges that the reconnaissance missions faced, with the added peril of occasionally flying through artillery barrages to maintain visual contact or to stay clear of the weather. The “Tactical History” summarizes the results of artillery cooperation as “unsatisfactory,” due principally to problems with radio communications.¹⁶⁶ Toulmin described the unfortunate situation: “radio work was far below a proper standard, and in fact nothing but dropped messages, the simplest but slowest of methods, proved successful.”¹⁶⁷

This issue had been identified during the St. Mihiel operation, and observation units took steps to rectify the problem. Every radio set was tested while airborne over the field with a local ground radio prior to departing for the mission area, which initially eliminated the possibility of an aircraft radio issue. Unfortunately, the exposed nature of the crew areas and the aggressive maneuvers that were sometimes required during combat had a jarring effect on the delicate radios. Once aircraft radio functionality was confirmed, any artillery ground station that failed to respond to a radio message was noted in a memorandum sent to the corps chief signal officer upon landing.¹⁶⁸ While this method theoretically isolated faulty radios after several iterations, the radios in the constantly moving artillery batteries were subjected to many of the same hardships as the airborne devices. Thus, radio remained an unreliable communication method between air and artillery, despite procedural efforts to mitigate the problem.

¹⁶⁶ “Tactical History of Corps Observation, Meuse-Argonne Offensive,” 255.

¹⁶⁷ Toulmin, *Air Service*, 380.

¹⁶⁸ “Tactical History of Corps Observation, Meuse-Argonne Offensive,” 248.

A 50th Observation Squadron experience on 29 September is illustrative of redundant and often desperate measures taken to obtain communications with the artillery:

One of our planes received a signal rocket from the ground to the effect that our barrage was falling on our troops. The message was wirelessed in and also dropped at the 77th Division panel at Florent and rushed by motorcycle courier direct to the Corps, where steps were at once taken to lift the barrage.¹⁶⁹

Tragic situations like the aforementioned continued long after they were recognized, thanks in part to unreliable communications.

Another artillery coordination task requiring timely communications was directing fires against fleeting targets of opportunity, something contemporaneously referred to as “fugitive targets.” On occasion, certain batteries were tasked by a higher echelon to provide on-call artillery fire against fugitive targets, whether directed by the infantry or Air Service. However, the general lack of mobility associated with the Meuse-Argonne campaign meant that often there were no batteries to spare for fugitive targets. They were either on the move or directly supporting the infantry. Furthermore, unreliable radios essentially negated the possibility of timely communications, and by the time an aircraft-dropped message arrived at the battery by courier, the fugitive target was typically gone.¹⁷⁰ In the realm of artillery cooperation, Air Service observation units proved capable of performing their role as part of an air-ground team, but the character of the battle, the weather, and the poor state of radio communications prevented them from achieving the degree of coordination that planners had envisioned.

¹⁶⁹ Morse, *50th Aero Squadron*, 39.

¹⁷⁰ “Tactical History of Corps Observation, Meuse-Argonne Offensive,” 250-51.

Far and away the most prolific use of observation aircraft during Meuse-Argonne was in infantry liaison or contact patrols. Here, Air Service observation performed admirably. After the decidedly spotty performance during St. Mihiel, the Air Service expended significant effort to improve cooperation with the infantry. Widespread training and education initiatives were carried out to ensure an adequate baseline for the infantry in skills such as visual recognition, flare signals, panel operations, and communications.

Unfortunately, the rapid turnover of divisions in the line meant that the intended standard of training was never fully realized. Indeed, as late as October 7th there was still widespread confusion among the doughboys as to what national markings American aircraft carried. Many infantrymen incorrectly believed the US roundel consisted of two concentric circles with a white star between them, rather than the correct three concentric circles.¹⁷¹ Some observation units resorted to painting large, highly-visible division symbols on their aircraft in an attempt to make their allegiance known. Units also printed pamphlets and circulars which they dropped to the infantry to clear up identification and procedures. While interesting, and perhaps effective stopgap measures, they were no substitute for a solid training foundation.¹⁷²

Observation squadrons also began cultivating liaison programs to foster greater teamwork with the infantry. Observers spent two to three days living with the infantry in order to gain a better appreciation of conditions on the ground, and to capitalize on the opportunity to conduct training and education. Similarly, infantry officers visited

¹⁷¹ Percival Gray Hart, *History of the 135th Aero Squadron, from July 25 to November 11, 1918* (Nashville, TN: The Battery Press, 1990), 107.

¹⁷² "Tactical History of Corps Observation, Meuse-Argonne Offensive," 253.

aerodromes and were taken on familiarization flights. These efforts achieved a measure of success, but units working together over long periods of time typically had the closest cooperation—there was only so much training and team building that could occur in the middle of combat.¹⁷³

The terrain and weather conditions often drove infantry contact patrols to conduct operations at extremely low altitudes of 100 feet or less. From these circumstances a tactical innovation emerged, “cavalry reconnaissance.” Here, an observation aircraft made contact with the infantry, descended to treetop height or lower, and flew ahead identifying obstacles, machine gun nest, bunkers, or other noteworthy feature and then dropped a message to alert the advancing doughboys. The cavalry reconnaissance patrols proved both popular with the infantry and quite effective; so much so that Patrick’s final report deemed them worthy of mention as an avenue for future potential development.¹⁷⁴

The performance of observation aviation was quite possibly the Air Service’s high point during the Meuse-Argonne offensive. Their aggressive conduct, willingness to fly in appalling weather, ability to reform and educate, and steadfast commitment to the hard-pressed doughboys were worthy of praise. Although hamstrung by poor radios and bad weather, the observation crews were generally successful at conducting reconnaissance and infantry contact missions, and their efforts contributed positively to

¹⁷³ Final Report of Chief of Air Service, 233.

¹⁷⁴ Ibid.

eventual victory in the campaign.¹⁷⁵ Pursuit aviation, in contrast, had a spottier record during the Meuse-Argonne.

Pursuit Employment

The use of pursuit aviation was in line with Mitchell's instructions from 25 September. From the opening of the offensive up until the change in tactics on 1 November, pursuit units divided their efforts between mounting offensive sweeps to a depth of 10-12 kilometers beyond the German front lines and maintaining the aerial barrage to protect friendly forces. Generally, one pursuit group from a wing would be responsible for conducting offensive missions in the morning, while another group would maintain the aerial barrage. The groups on station were relieved by the units that had remained inactive during the morning, and all units would maintain an on-call alert during inactive periods to carry out any emerging tasks that might arise.¹⁷⁶

While superficially this appears to be a relatively balanced use of pursuit aviation, during execution the concentrations necessary for successful defensive patrols were never fully realized. Typically, only three to four flights actively patrolled the entire wing's sectors of responsibility at any given time, creating uneven coverage that allowed the Germans to attack American infantry and observation aircraft regularly. The offensive patrols at least had the benefit of mass, operating in concentrated formations beyond the German lines in group strength. Oddly, observation units generally expected to provide

¹⁷⁵ Morse, *50th Aero Squadron*, 24-25.

¹⁷⁶ Pursuit Wing Plan, Headquarters, First Pursuit Wing, Air Service, A.E.F., 25 September, 1918, quoted in Maurer, *Early Concepts of Military Aviation*, 244.

their protection organically, instead of having dedicated pursuit units assigned. Per the planning, the only time pursuit could expect to fly escort for observation missions was when observation squadrons were unable to do so themselves. In most encounters, the Salmson 2As and DH-4s in the observation squadrons flew at a distinct disadvantage against their German tormentors, and assigning American pursuits as escorts would have proven far more effective from an air-to-air combat perspective.

Bombardment support appears to be another blind spot in pursuit employment during the Meuse-Argonne. Neither Field Orders No. 20 nor any of the annexes made provisions for the direct support of bombardment aircraft. However, the First Pursuit Wing's plan of employment outlined bombardment operating procedures, with their employment altitudes, formations, and target types explained in detail. This appears to have been for situational awareness, identification, and deconfliction purposes—not to enhance the bombers' protection with escort by pursuit aircraft.¹⁷⁷

Mitchell also played a prominent role in the conduct of pursuit aviation. He would often retask units based on personal impressions, which caused problems with mission planning and unity of effort. For example, on the opening day of the battle, Mitchell noticed a massive traffic jam with vehicles and carts packed together for miles. Concerned about the vulnerability this chaotic scene presented to German aviation, he ordered his forces to concentrate against the enemy's immediate rear, in the hope of forcing the *Luftstreitkräfte* to rise up to meet the American force. The extent of the risk to the First Army's logistical support was debatable at best, given the Germans' reluctance

¹⁷⁷ First Pursuit Wing Plan, 245.

to penetrate deeply behind allied lines, and Mitchell's orders left the infantry on the front lines completely uncovered except for their assigned observation aircraft, which were at a distinct disadvantage against German pursuit planes.¹⁷⁸

The consequences of Mitchell's interventions were most keenly felt by the infantry. The experience of 58th Infantry Regiment of the 4th Division, launching an attack through the Bois de Fays northeast of Monfaucon, was typical. The unit's official history describes the harrowing experience: "enemy aeroplanes, encountering apparently no opposition, swooped down upon the advancing lines dropping bunches of hand grenades and "strafing" the troops with machine guns."¹⁷⁹ The German aircraft were also able to direct effective artillery fire on the 58th, inflicting additional losses. The 58th suffered similar attacks later, on 3 October as well.

Col Frank Lahm observed a similar state of affairs from the ground during a visit to the front lines on 3 October, where he saw the porousness of the aerial barrage over American lines and the continued aggressiveness of the *Luftstreitkräfte's* airmen.

At one time two Boche planes flew over us not more than 300 feet, over and over. For some reason they did not seem to see us. One fired his Very pistol and drew Boche artillery fire on the hill to the east of us.[. . .] Then he did the same on the west of us—again the Boche shelled it. Boche pursuit planes were circling round at a high altitude. We were almost ready to get down and pray for an American plane, and like the Cambells at Lucknow, it came. A Salmson just about the same altitude as the Boche observation plane. In a second they spotted the latter, attacked him, and drove him back over his own lines.¹⁸⁰

¹⁷⁸ Lengel, *To Conquer Hell*, 124.

¹⁷⁹ George L. Morrow, *The Fifth-Eighth Infantry in the World War: 1917-1918-1919* (Privately printed, 1919), 100-101.

¹⁸⁰ Lahm, *World War I Diary*, 135-136.

Lahm's experience on 3 October is representative of the general state of affairs in the air over Meuse-Argonne. The German observation and pursuit aircraft were not only able to successfully overfly American troops, they were able to do so with impunity for an extended period of time. Moreover, the American aircraft that eventually arrived on the scene was a Salmson 2—a two-place observation aircraft rather than a pursuit plane flying a dedicated defensive patrol. Furthermore, the high-altitude German pursuit formation remained over American lines and did *not* attack the lone Salmson; an indication that even at this late stage in the war the *Luftstreitkräfte's* airmen maintained commendable flight discipline. In an interesting coda to Lahm's experience laid out above, a large formation of American pursuit aircraft arrived on the scene later in the same day and engaged the German aircraft, without apparent loss to either side.¹⁸¹

Infantry units observed similar experiences. An intelligence report produced by the 90th Division G-2 claimed that the air was “continuously” filled with German aircraft. In one example from October 28th, a large formation of American pursuit aircraft engaged a group of Fokker D.VIIs over the 90th in another inconclusive engagement that resulted in no losses to either side. However, other German pursuit aircraft were able to destroy a pair of American observation balloons in the 90th's sector.¹⁸² While the 90th was not attacked by German aircraft on the 28th, the

¹⁸¹ Lahm, *World War I Diary*, 136.

¹⁸² Lonnie J. White, *The 90th Division in World War I: The Texas-Oklahoma Draft Division in the Great War* (Manhattan, KS: Sunflower University Press, 1996), 129.

Luftstreitkräfte's strong presence reveals that even in the last fortnight of the war, the allies still did not control the air.

An additional factor hindering the performance of American pursuits was the caliber of their opposition. The *Luftstreitkräfte* deployed two of its elite pursuit units to the Meuse-Argonne sector, *Jagdgeschwader* I of Manfred von Richtofen fame (under the command of *Oberleutnant* Hermann Goering following von Richtofen's death in April), and *Jagdgeschwader* III, commanded by *Hauptmann* Bruno Loezer.¹⁸³ The German airmen serving in these two *Jagdgeschwaden* were the best in the *Luftstreitkräfte*, some with years of experience.

In part, this experience was preserved with the help of the weather. The prevailing westerly winds over the front meant that many German airmen who were shot down were able to glide back behind their lines, while allied flyers had to contend with the opposite situation. Further mitigating losses was the nature of the defensive war the Germans were fighting in the autumn of 1918. Their defensive posture did not necessitate continual deep penetrations over enemy lines for the purposes of reconnaissance and attack, unlike the AEF. Correctly recognizing the attritional nature of the fight presented to them, the *Luftstreitkräfte* judiciously husbanded its men and airplanes. When advantageous opportunities presented themselves, the Germans concentrated and struck. Finally, there was the matter of the aircraft themselves. The Germans enjoyed a solid advantage with

¹⁸³ Douglas V. Mastriano, *Thunder in the Argonne: A New History of America's Deadliest Battle* (Lexington, KY: University Press of Kentucky, 2018), 166-167.

the excellent Fokker D.VII, possibly the finest pursuit aircraft of the entire war.¹⁸⁴ This will be discussed further in the examination of materiel factors.

There were some bright spots in pursuit aviation's performance. During the opening phase of the operation the American pursuits wrought havoc against German observation balloons, with luminaries such as Captain Eddie Rickenbacker and Lieutenant Frank Luke figuring prominently.¹⁸⁵ Luke was particularly noteworthy, downing 19 enemy balloons in a combat career spanning a mere 30 hours in the air.¹⁸⁶

Overall, pursuit aviation employment during the Meuse-Argonne left much to be desired. Mitchell's approach saw pursuit aircraft diverted to ground attack and reconnaissance missions, which had a pernicious effect on the number of aircraft available for protection and counterair missions. This caused undue losses among the bombardment and observation units, and left the infantry exposed to German air attack. From the perspective of the doughboys, Edward J. Lengel's summation of their views on the Air Service is not entirely incorrect when considering American pursuits: "[the] fliers never showed up when it mattered."¹⁸⁷

Bombardment Employment

The force committed to the AEF's bombardments effort was a combined affair, with Mitchell having a pair of French night bombardment groups at his disposal in

¹⁸⁴ Morrow, *German Air Power*, 124-125.

¹⁸⁵ Mastriano, *Thunder in the Argonne*, 60-62.

¹⁸⁶ Treadwell, *America's First Air War*, 120-22.

¹⁸⁷ Lengel, *To Conquer Hell*, 6.

addition to the Air Service's First Day Bombardment Group. The AEF's bombers focused their attacks by day against "troop concentrations and convoys wherever found in a zone approximately 10 to 30 kilometers back of the lines," as well as railheads, dumps, and command posts.¹⁸⁸ For their part, the French focused their night bombardment attacks against railroad centers and German aerodromes. Aside from the notable absence of the British heavy bombers of the Independent Force, this concept of operations was quite similar to the approach taken at St. Mihiel, where interdiction took precedence over other forms of bombardment.

Following the heavy losses suffered by the bombardment units at St. Mihiel, the 1st Day Bombardment Group displayed a commendable willingness to learn and adapt. A conference between leaders in the group during the short lull between St. Mihiel and Meuse-Argonne determined that many of the losses could be traced back to employing bombardment aircraft in small formations. Moving forward, the group directed that combat missions would preferably be flown in large formations composed of multiple squadrons, ideally at group strength, in order to provide maximum mutual support and defensive firepower. This would also have the added benefit of increasing the offensive bomb load employed against a target and somewhat mitigate bombing errors.¹⁸⁹ In practice, however, the mixed composition of the 1st Day Bombardment Group caused problems with formation integrity. The 96th Aero Squadron, the most experienced in the

¹⁸⁸ Appendix III, Annex No. 4, Field Orders No. 20, "Plan of Bombardment Aviation," Chief of Staff, First Army, A.E.F., September 20, 1918, Historical Division, *Meuse-Argonne*, 101.

¹⁸⁹ "Tactical History of Day Bombardment, Part III: The Meuse-Argonne Offensive," quoted in Maurer, *The Final Report and a Tactical History*, 371.

group, was equipped with the French-built Breguet 14, while the other squadrons flew the DH-4. Differing performance between the two aircraft meant that the faster DH-4s either spent more time over the lines than was necessary or abandoned the slower Breguets.¹⁹⁰ Had time and equipment limitations allowed, a homogenous group composed of DH-4s would have been far more tactically efficient. However, given the critical supply and personnel situation that existed during the Meuse-Argonne, a mixed group of four squadrons remained more desirable than a standardized group of three squadrons. The time to cross-train aircrews from the Breguet 14 to the DH-4 simply did not exist.

The conference also recognized the critical importance of gunnery training, as effective defensive fire typically kept German pursuits far enough away to reduce their accuracy. Poorly trained gunners and loose formations allowed enemy aircraft to approach much closer, with obvious consequences for the defending bombers. Thus, bombardment units increased gunnery training at the squadron level during the interlude between St. Mihiel and Meuse-Argonne, and called for enhanced instruction for trainee gunners at the Air Service training depots. However, the shortage of trained replacements remained acute.

Compared to reforming tactics within the bombardment community, efforts to enhance coordination with pursuit units proved more challenging. Patrick later claimed that “better cooperation was secured with pursuit [which] reduced our own losses and increased those of the enemy,” however, this was far from universal.¹⁹¹ For example, in

¹⁹⁰ “Tactical History of Day Bombardment, Part III: The Meuse-Argonne Offensive,” 375.

¹⁹¹ Final Report of Chief of Air Service, 234-35.

the 20th Aero Squadron's Operations Diary, there are only two instances between 26 September and 11 November where effective pursuit support is mentioned.¹⁹²

On bombing missions where pursuit escort was provided, the results were inconsistent. Lahm, who wrote the Meuse-Argonne plan for bombardment aviation, observed the challenges facing bombardment units first-hand, even when protected by an escort. On a 26 September mission to Dun-sur-Meuse, only about 10 miles north of the initial line of departure, a combined bombing force of the 96th, 20th, and 11th Aero Squadrons attacked with the support of the 3d Pursuit Group.¹⁹³ The 20th Aero Squadron lost five aircraft out of seven, all to German pursuits.¹⁹⁴ Additionally, one of the two aircraft that survived returned with a dead observer, bringing the butcher's bill for the 20th to 11 men on the opening day of the offensive.¹⁹⁵ The 96th also lost an observer, and nearly every bomber dispatched on the mission returned with damage from German pursuits or antiaircraft fire—a high figure even by First World War standards.

The 20th would never recover the same degree of combat power it enjoyed on 26 September for the remainder of the war, indicative of both the steady rate of personnel losses and the less acute materiel problems with replacement aircraft and spares. This problem afflicted all bombardment units during the campaign. By the Armistice the 20th had flown 23 missions during the Meuse-Argonne, and only 7 of the 28 aircrew who

¹⁹² Barth, *History of the Twentieth Aero Squadron*, 83-97.

¹⁹³ Cooke, *U.S. Air Service in the Great War*, 185.

¹⁹⁴ Lahm, *World War I Diary*, 132

¹⁹⁵ Barth, *History of the Twentieth Aero Squadron*, 37.

began the campaign remained with the unit—a testament to the high casualties suffered by the 1st Day Bombardment Group.¹⁹⁶

Like their approach to observation escort, pursuit units generally expected bombardment units to provide their own escort organically. While bombardment formations could protect themselves to an extent, indeed, 46 German aircraft were shot down by American bombers during the campaign, the extended time spent over enemy lines during a bombing mission provided enemy pursuit aircraft ample opportunity to conduct multiple attacks on the bomber formations in the absence of friendly escort.¹⁹⁷ Unlike the low-flying and more discrete observation aircraft, a group-sized formation of American bombers penetrating German lines at high altitude compelled the *Luftstreitkräfte* into action. Unfortunately, Mitchell diverted pursuit units into too many disparate directions to sustain a concentrated protection effort for bombardment aviation, and an opportunity to further attrit German air strength was missed.

Intelligence and targeting proved to be another shortcoming for the bombers. The timeline between a target of opportunity being identified by a reconnaissance aircraft and an attack launched was usually measured in days. Typically, bombardment missions were based upon photographic intelligence that had been developed and interpreted. More rarely, strikes would be dispatched on the basis of visual reports. As mentioned

¹⁹⁶ Barth, *History of the Twentieth Aero Squadron*, 97.

¹⁹⁷ Toulmin, *Air Service*, 384.

previously, the shortage of fully-trained, experienced observers meant that many visual reports were dubious as best.¹⁹⁸

Possibly the most prominent and controversial employment of bombing in the AEF occurred on 9 October. Mitchell received reports of German troop concentrations on the east bank of the Meuse, which ostensibly posed a threat to the flank of General Bullard's corps. Recognizing that time was of the essence, Mitchell dispatched a sizable raid of French and American aircraft to strike the troop concentration, without any coordination with Pershing, his staff, or Bullard's corps.¹⁹⁹ Pershing's Chief of Staff, Hugh Drum, viewed the entire affair as a missed opportunity.²⁰⁰ Greater coordination could have led to an opportunity for exploiting the ensuing confusion, and Mitchell's decision served mostly to solidify his reputation as an impulsive maverick among the other staff officers.²⁰¹ While visually spectacular, the impact of the raid itself is questionable. Although Mitchell makes much of the event in his memoirs, the reactions captured in many other sources are rather muted. Lahm makes no mention of the 9 October raid in his diary—something that he likely would have done if the raid was as important as Mitchell claimed. The "Tactical History of Bombardment Aviation" mentions successful raids on September 29, October 4, and October 18, but there is

¹⁹⁸ "Tactical History of Day Bombardment, The Meuse-Argonne Offensive," 371-72.

¹⁹⁹ William Mitchell, *Memoirs of World War One: From Start to Finish of our Greatest War* (New York: Random House, 1960), 265-6.

²⁰⁰ Cooke, *U.S. Air Service in the Great War*, 192.

²⁰¹ *Ibid.*, 191.

nothing about a massive raid on 9 October.²⁰² The one senior officer best-positioned to appreciate the effects of Mitchell's opportunistic strike was Bullard. In his memoirs, he recalled a large formation of roughly 120 aircraft going through his sector to attack the enemy rear around 9 October. However, Bullard does not mention an imminent threat from across the east bank of the Meuse, nor does he discuss the results of the large raid he witnessed.²⁰³ While a large raid certainly took place on 9 October, based upon corroborating sources it appears that Mitchell's postwar memoirs somewhat exaggerate the mission's impact.

Mitchell was not alone in his propensity to exaggerate the impacts of bombardment missions. Contemporary assessments of bombing effectiveness often relied upon wishful thinking more so than accurate and timely damage assessments. A vignette from Lt Lucien Thayer recounting the results of a bombing attack against an alleged troop concentration is illustrative:

Although the mission was believed to have been accomplished, the machine did not return, but was brought down in flames south of Commercy. It was later found with Lieutenant Gundelach's body some distance away; possibly he jumped. The fact that no bombs were found in the wreckage indicated that they had been dropped successfully on the objective.²⁰⁴

It does not take great effort to imagine a host of other possible explanations for the lack of weapons on the fallen aircraft, aside from Thayer's conclusion. There are numerous

²⁰² "Tactical History of Day Bombardment, The Meuse-Argonne Offensive," 372-73.

²⁰³ Robert Bullard, *Personalities and Reminiscences of the War* (Garden City, NY: Doubleday, 1925), 278-9.

²⁰⁴ Lucien H. Thayer, *America's First Eagles: The Official History of the U.S. Air Service, A.E.F. (1917-1918)* (Mesa, AZ: Champlin Fighter Museum Press, 1983), 195.

other examples of this type of rosy bombing assessment, with virtually any secondary explosion or fire chalked up as a successful mission.

On 1 November, there was a fundamental shift in how bombardment was employed. Instead of concentrating on more distant interdiction targets, Mitchell redirected the bombers to focus their efforts in a direct support role at the front line.²⁰⁵ This shift should have arguably happened much earlier. As discussed previously, the ability to locate, identify, and attack targets in a timely manner were questionable, as was the overall accuracy and effectiveness of the strikes themselves. Deep bombardment missions forced the *Luftstreitkräfte* to divert a portion of its pursuit aviation to defense behind the front lines, but all too often there was inadequate American escort to capitalize on the attritional opportunity. Usually, the bombardment aircrews were left to defend themselves, often at great price. During the Meuse-Argonne campaign, the price paid the bombers was not worth the dubious impact of their interdiction strikes. The technology and the targeting apparatus were not mature enough for the task, and it is likely that the bombers would have been better employed in a direct support role from the outset. However, there were other challenges facing the Air Service beyond employment concepts, principally materiel and training.

Materiel

The materiel shortcomings that came to light during St. Mihiel reemerged with a vengeance at Meuse-Argonne. Along with the shortage of trained aircrew, materiel

²⁰⁵ Thomas Withington, "Airpower during the Meuse-Argonne Offensive: 26 September-11 November 1918," in Edward G. Lengel, ed., *A Companion to the Meuse-Argonne Campaign* (Hoboken, NJ: Wiley-Blackwell, 2014), 318-19.

problems significantly limited the Air Service's effectiveness. The ten days between the two operations may have been enough to reconstitute somewhat if a massive reorientation from St. Mihiel to Meuse-Argonne had not been necessary. The transportation shortfalls that revealed themselves prior to and during the St. Mihiel operations continued to plague Air Service operations during Meuse-Argonne. The situation was further exacerbated by the operational requirement to shift multiple divisions and their associated support in minimal time from the now-reduced St. Mihiel salient to the Meuse-Argonne sector. Lahm observed the chaos first-hand and wrote in his diary, "war is slightly hell, as demonstrated by movements of troops in the rear areas. Several overturned motor trucks and broken up autos, the result of so much traffic."²⁰⁶ He continued to note the prevalence of traffic jams and the number of dead horses lying by the roads during the redeployment in his diary; a testament to both the contracted nature of the communication lines and the paucity of motor transportation.

The abysmal transportation system persisted until the eve of the Armistice, demanding significant effort from Air Service officers. Lahm commented on the transportation situation after taking command of the Air Service units of the Second Army. Writing on 9 November (Lahm was so busy with his duties that there had been no diary entries since 23 October) he observed that the Second Army Air Service "has grown as rapidly as the lack of transportation and a few other essentials would permit."²⁰⁷ While this was perhaps due to Second Army's lower priority relative to First

²⁰⁶ Lahm, *World War I Diary*, 128.

²⁰⁷ *Ibid.*, 160.

Army, it illustrates that transportation requirements routinely exceeded capacity, and transportation shortcomings are a persistent theme in Air Service documents.

Mitchell also observed examples of the transportation challenges first-hand while observing the battle from the air. Flying near Avocourt, in the AEF's rear, Mitchell spotted tremendous congestion on 26 September. As he described in his memoirs:

Columns of our transportation stood several miles long on three roads running into Avocourt, where they all came together. Not a wheel could be turned, either to the front or to the rear, because the trucks were in no-man's land [sic] and if they did not stick to the roads they would immediately mire down for good. Never have I seen such a congestion on a European battlefield. It was a terrible example of inefficiency on the part of the staff of our center corps.²⁰⁸

While traffic jams such as the one described by Mitchell may have been less prevalent near the Air Service's aerodromes, the tremendous need for materiel at the front meant that motor transportation remained in short supply, and the Air Service was not always the highest priority. Mitchell was perhaps being a bit harsh berating the staff for the limitations imposed by both the abominable weather and the limited communications infrastructure in the sector. However, transportation remained a critical bottleneck that severely curtailed the Air Service's ability to keep flying.

The high tempo of operations and concomitant consumption of airframes and spare parts was more than the already stressed communications infrastructure could handle, and aircraft availability began to suffer. The situation came to a head on 31 October, when only 475 aircraft out of 716 on hand were available for operations.²⁰⁹ This

²⁰⁸ Mitchell, *Memoirs*, 257.

²⁰⁹ Memorandum from the Chief of Air Service to the Chief of Air Service, Army Group, October 31, 1918, in Historical Division, *Operations, Meuse-Argonne*, 362.

situation arose due to a confluence of factors, including combat losses, reduced airframe life due to moisture, lack of spare parts, and the aggressive pace of operations. The Air Service was essentially operating at a rate that outpaced its sustainment capability. Given the magnitude of the task set before the Air Service, something had to give or the force would soon consume itself. The rapidly declining aircraft availability situation, in conjunction with displeasure at First Army, forced Mitchell to revise his tactics on 1 November. Lower priority missions like bombardment and offensive pursuit patrols were sharply curtailed in favor of operations that directly supported the infantry in the vicinity of the immediate front lines. This had the added benefit of reducing exposure to anti-aircraft fire and thus, further wastage. More importantly, it also addressed widespread calls for additional protection from German attack aircraft over American lines.

Air Service flyers also contributed mightily to aircraft losses. Many combat aircraft First World War vintage were quite challenging to fly, and accidents at the hands of hastily-trained aircrews were prodigious. In some cases, this phenomenon took on an almost comic tone:

Although we had no aces of our own, we claimed the distinction of harboring a “German Ace” in our midst. Christopher Columbus Seale earned this unenvied title by crashing the requisite number of Liberties [5]. The most spectacular exhibition he put on was a little affair in which he made a bad landing, tried to take off again, only to have his motor fail, and then crashed through the roof of a canvas Bessaneau hangar. As the terrified onlookers rushed across the field to extricate the supposed victims from the plane, which had completely disappeared from view, they were greeted by Seale and his observer, Sutton, calmly walking out to meet them. Needless to say the inside of the hangar was a shambles, but the only damage to the fliers [sic] was a huge bump of Sutton’s forehead.²¹⁰

²¹⁰ Hart, *History of the 135th Aero Squadron*, 118.

Commanders tolerated accident-prone men like Seale in all but the most egregious cases because of persistent aircrew shortages. Seale enjoyed the additional benefit of displaying exceptional bravery in the face of the enemy on a routine basis, which perhaps enticed his superiors to overlook his careless approach to pattern operations. Nonetheless, accidents contributed significantly to the materiel situation.

Problems with hardware existed as well, particularly with radios and cameras. As discussed earlier, radio reliability was not a problem simply confined to aircraft, but a much wider issue that affected the entire communications network. The damp weather played havoc with the delicate radio sets, as did the continual moving and jostling that combat operations subjected them to. Reliability was so poor that virtually all observation crews reverted to inefficient and time-consuming message drops.

Cameras brought their own set of frustrations. Early models required the observer to crouch at the bottom of the fuselage and change out plates and make exposures between photographs. This diverted the observer's attention from what was occurring outside of the aircraft, affecting both defensive gunnery and general observation and reconnaissance work. By Meuse-Argonne, sufficient numbers of French De Ram cameras were available to equip most observation units. Ostensibly, the De Ram was an improvement over the earlier, more demanding cameras; it could be loaded with multiple plates which were cycled automatically with each photograph, negating the requirement to swap individual exposures and reducing the time spent in enemy airspace. Unfortunately, these proved very unreliable on actual missions, often jamming between plates or developing uneven exposures. As a result, numerous reconnaissance missions

were unsuccessful and had to be flown again thanks to faulty hardware, a situation that exposed men and machines in additional danger.²¹¹

The Meuse-Argonne campaign almost pushed the Air Service to the breaking point materially. The combination of high attrition, poor transportation, and spotty delivery of spare parts and aircraft to the pursuit, bombardment, and observation units saw aircraft availability plummet as the offensive progressed. Had the Armistice not intervened, it is highly probable that the Air Service would have needed an operational pause, like the rest of the First Army, to replenish its stocks of men and materiel. This could have brought the entire offensive to a halt, or forced the infantry and artillery to fight on with even less aerial support. In addition to materiel challenges, the Air Service and infantry also suffered from training problems during the Meuse-Argonne offensive.

Training

The structural problems with aircrew training throughput, especially observers, as previously discussed during the St. Mihiel operation remained unresolved by Meuse-Argonne. Moreover, the high tempo of operations, poor weather, effects of the Spanish Flu, and steady losses exacerbated the issue. Replacement aircrews trickled in at an inconsistent rate, if at all, due to the training infrastructure's inability to keep pace with demand. For example, the last appreciable cohort of replacements received by the 20th

²¹¹ "Tactical History of Army Observation, Part III: The Argonne-Meuse Offensive," quoted in Maurer Maurer, ed., *The U.S. Air Service in World War I*, vol. 1, *The Final Report and a Tactical History* (Washington, DC: The Office of Air Force History, 1978), 278-79.

Aero Squadron occurred on 2 October, over a month before the Armistice, and these were mostly pilots.²¹²

In an attempt to alleviate the training situation during the brief lull between St. Mihiel and Meuse-Argonne, the AEF was replied heavily upon French assistance. American observers flew with French pilots in French aircraft to become acquainted with operations and the terrain.²¹³ However, as noted previously, the weather often precluded effective training. As the campaign got underway, losses among observers began to mount steadily due to the dangerous nature of the missions and the requirement, in many instances, to support multiple ground units. The increasing pace of operations meant that observers were often flying more than the pilots in the same squadron. This exposed them to greater risk and loss, further exacerbating the observer shortage. Observation squadrons were compelled to begin flying ill-trained mechanics and other enlisted ground crews as an emergency measure, which degraded both combat performance in the air and maintenance capability on the ground.²¹⁴

A similar situation existed with the aircrews in the bombardment units, but apparently to a lesser extent. Although many of the men performing ground crew duties eagerly volunteered to fly combat missions, the necessity of maintaining a corps of trained mechanics typically triumphed and only a handful were allowed to fly.²¹⁵ By

²¹² Barth, *History of the Twentieth Aero Squadron*, 39.

²¹³ Thayer, *America's First Eagles*, 205-06.

²¹⁴ "Tactical History of Day Bombardment, The Meuse-Argonne Offensive," 375.

²¹⁵ Barth, *History of the Twentieth Aero Squadron*, 37.

October, losses among the bombing observers and the paucity of replacements led bomber units to assign enlisted gunners and mechanics to fly in their stead, with predictable results to bombing accuracy. In some instances, however, the performance of the ad-hoc observers proved laudable, as in the case of Sergeant Fred C. Graveline of the 20th Aero Squadron. Graveline proved a crack shot, downing two aircraft over the course of fourteen grueling raids, and earned Distinguished Service Cross for his deeds.²¹⁶ However, Graveline's experience was the exception, rather than the rule, and the fact that he was flying at all illustrates the dire nature of the aircrew availability situation.

While aircrew numbers were the Air Service's most pressing concern, the quality of training also worried commanders. Training and cooperation between observation units and their supported infantry and artillery units cause particular anxiety. Upon taking command of the Air Service for Second Army on 13 October, Lahm met with Major General Robert Lee Bullard, the commander of Second Army, to discuss Bullard's vision for the employment of airpower. During the meeting, Bullard expressed considerable concern regarding proficiency in air-ground cooperation and insisted on improving infantry liaison instruction.²¹⁷ For his part, the mercurial Lahm visited the divisions assigned to Second Army over the next several days with an entourage of instructors to perform panel exercises with the infantry in a stop-gap effort to improve cooperation. These efforts, coupled with dropping instructional pamphlets on visual recognition and ground-to-air signaling cleared up some of the confusion. However, these ad-hoc

²¹⁶ Thayer, *America's First Eagles*, 223.

²¹⁷ Lahm, *World War I Diary*, 156.

measures were not satisfactory solutions for fundamental shortfalls in the length and quality of instruction. With the exception of a handful of veteran units like the 1st and 42d Divisions, most of the AEF was committed to battle in the Meuse-Argonne with less training than desired. The infantry units typically viewed air cooperation instruction with less urgency than more salient subjects like tactical movement and weapons training. Mitchell was particularly unsparing with his criticism of the infantry, arguing that they demonstrated a complete lack of proficiency in the use of signal panels and were apt to identify every plane overhead as German.²¹⁸

Distrust was a two-way street. Infantry and artillery commanders were often skeptical of corrections passed from observation aircraft, due to a toxic mixture of entrenched conservatism and previous disappointments. Arguably the most egregious example was that of Brigadier General Lucien Barry, commander of the 35th Division's artillery brigade. His refusal to heed correction instructions from Air Service spotters (as well as a propensity to disregard targeting updates and cause friendly fire incidents) brought him under investigation and eventually led to his relief.²¹⁹

The Air Service's ability to recognize and attempt to correct training gaps was laudable, but the corrections too often were of an ad-hoc nature. The 1st Day Bombardment Group's emphasis on gunnery and the formation training it enjoyed was perhaps the most successful example of adaptation, but even this proved insufficient to overcome flawed employment concepts. Placing liaison officers with infantry units also

²¹⁸ Lengel, *To Conquer Hell*, 198.

²¹⁹ Mastriano, *Thunder in the Argonne*, 129.

paid some dividends, but the fact that Air Service units were willing to send aircrews already in short supply to enhance training with the infantry was a testament to the generally poor state of training across the AEF. In addition to these training problems, the Air Service also had to contend with mother nature.

Weather

Poor weather figured prominently during the Meuse-Argonne campaign, just as it had at St. Mihiel. Over the entire campaign, there were only 10 days during which the weather did not negatively impact air operations.²²⁰ Lt Lucien Thayer, who witnessed the conditions first-hand, summarized the weather on 26 September: “the opening day of the drive was one of severe weather, low clouds and wind and rain made it the worst flying day in many weeks.”²²¹ Descriptions like this pepper practically every first-hand account of the battle. A diary entry from 1st Lieutenant Hunter McDonald of the 135th Aero Squadron on 22 October highlights the brutal conditions aircrews often faced:

Photo with Krout [observer]. We gained an altitude of about 12,000 feet and started over. Archie was as bad as it usually is on photos. I exposed one magazine, when we had to return on account of engine trouble. We had a cake of ice on the radiator as big as my head. Coming down it melted off, flew back and hit me, almost knocking me out.²²²

²²⁰ Headquarters, First Division, “War Diary, Headquarters, First Division, 9 June, 1917 to 31 December, 1918,” in *World War Records, First Division A.E.F.*, vol. 16, *Hq. 1st Division, 1st Inf. Brigade, 16th Inf. Regiment, 18th Inf. Regiment* (Washington, DC: First Division Historical Section of the Army War College, 1928), 316-325.

²²¹ Thayer, *America’s First Eagles*, 195.

²²² Hart, *History of the 135th Aero Squadron*, 124.

During the preparation for the battle, the poor weather was particularly disruptive for the observation crews. The transition from St. Mihiel meant that the bulk of the aircrew required area familiarization flights to acquaint themselves with the local geography. Fog, thick cloud cover, and rain prevented much of this training from taking place, so units found themselves flying observation missions once the campaign began with only a map study of the terrain.²²³

Weather also played havoc with aircraft serviceability. Almost none of the American aerodromes had adequate hangar facilities, and aircraft were typically parked in the open, exposed to the elements. This led to warpage on wooden airframe structures, waterlogged and stretched canvas, and occasionally even rot. The overworked ground crews, already in short supply, had to expend additional effort repairing these aircraft savaged by mother nature, compounding the already precarious materiel situation

The appalling weather described so often in accounts of the Meuse-Argonne campaign appears in some instances to not have affected the Germans to the same extent it affected the Air Service. On 27 September, the 362d Regiment of the 91st Infantry Division, attacking the village of Epinonville just to the west of Montfaucon, was forced to withdraw after sustained attacks by German aircraft flying in weather that the Air Service deemed too poor for operations.²²⁴ To some extent this can be attributed to the prevailing weather patterns over the Meuse-Argonne. A front moving generally from

²²³ “Tactical History of Army Observation, The Meuse-Argonne Offensive,” 275.

²²⁴ Lengel, *To Conquer Hell*, 133.

west to east might cover an American aerodrome while leaving the *Luftstreitkräfte*'s fields unaffected.

Despite the challenges presented by bad weather, the American aircrews displayed considerable aggressiveness and dedication. Crews routinely took off in horrendous weather if there was the faintest hope of assisting the doughboys, and many were lost to crashes and navigational errors. With considerable skill, infantry contact and observation sorties braved both enemy and friendly small arms fire, artillery barrages, and rugged terrain at extremely low altitudes of less than 100 feet to carry out their missions. The airmen's impressive courage, despite the immense risks, was a high point in the Air Service's performance during the war.

Assessment

Nearly every challenge facing the Air Service during the Meuse-Argonne campaign emerged in nascent form at St. Mihiel. Issues with training throughput, materiel organization, and sustainment infrastructure were masked during St. Mihiel due to the preponderance of air forces committed, the unique geometry of the battlefield, and the short duration of the operation. During the brief interlude prior to Meuse-Argonne, units engaged in varying degrees of critical assessment. Efforts to refine bomber tactics and training, as well as enhance air-to-ground cooperation were commendable, but ultimately insufficient to overcome deeper structural problems and misguided operational approaches. Mitchell in particular clung to an overly offensive concept of employment that diluted his much-reduced forces into too many disparate efforts. This sacrificed bombardment aircraft for relatively little gain, left observation aircraft unprotected, expended ill-suited pursuit aircraft in ground attacks, and allowed the *Luftstreitkräfte*

greater freedom of action than a shrewder use of his forces would have allowed. It was not until the situation arrived at a crisis in late October that Mitchell relented and altered his approach. Overall, the Air Service's contribution to the Meuse-Argonne campaign was less than expected, given the resources allocated. Observation aviation conducting infantry contact patrols and reconnaissance was probably the most effective example of airpower during the campaign, but artillery coordination never achieved the level of cooperation necessary. Bombardment suffered heavy losses for negligible benefit striking interdiction targets, while the pursuit units failed to gain control of the skies from the Germans. Despite the myriad of difficulties facing the Air Service, the airmen and ground crews displayed stalwart dedication and high morale throughout the campaign. Given the obstacles placed before them, it is incredible that they achieved what they did.

CHAPTER 6

CONCLUSION

The Air Service's performance at St. Mihiel and Meuse-Argonne demonstrated a host of contradictions. What the Air Service was able to achieve by November 11, given its baleful condition when America entered the war, was nothing short of remarkable. Conversely, much of the Air Service's employment was colored by Mitchell's predilection towards wide-ranging offensive action and stymied by materiel and training shortfalls. St. Mihiel, as the first major operation for the independent American army, was resourced generously from an air perspective, in part to bring the operation to a successful conclusion in time for the main offensive at Meuse-Argonne. Furthermore, the unique geography of the salient coupled with the fact that the enemy was already in the process of withdrawal created a unique set of circumstances where the Air Service's generally positive performance masked deeper flaws that would only become telling during the struggle in the Meuse-Argonne. St. Mihiel took only four days from start to completion, and this short timeline allowed the Air Service to work through its shortcomings without undue effects upon combat capability.

By Meuse-Argonne, Mitchell's predisposition towards offensive operations, inadequately developed training programs, and materiel shortcomings coalesced to prevent the Air Service from providing the degree of support that was expected of it. Plummeting aircraft availability, manpower shortages, heavy bombardment losses for little benefit, and a pursuit force too thin on the ground to meet all of its tasks directly contributed to the 1 November tactics reform. Mitchell sharply curtailed long-range bombing missions and offensive pursuit patrols; instead, he focused his forces on directly

supporting the troops on the frontlines. This provided greater protection for observation and bombardment aircraft, as well as the hard-pressed doughboys. German aircraft, flown by skilled veteran aviators were routinely able to penetrate American lines while Air Service pursuits were busy conducting ground strafing and reconnaissance, in addition to seeking out the *Luftstreitkräfte*. While Mitchell's tactics change probably came too late to have a pronounced impact on the battle's conduct, the renewed focus and concentration of forces showed what could have been possible with a more well-developed plan of employment at the beginning of the battle. Despite being very different operational situations, the plans for the two operations were remarkably similar.

The AEF was almost entirely reliant upon the allies for combat aircraft, with the exception of the American DH-4s powered by the Liberty engine. Even these underwent final assembly in French factories. Vis-a-vis the Germans, American equipment left much to be desired. While fast, tough, and a solid gun platform, the SPAD XIII was outclassed by the exceptional Fokker D.VII—quite possibly the finest pursuit aircraft of the entire war. Similarly, the DH-4s and Salmson 2As of the observation units were adequate for the task at hand, but were not as well-suited as the heavily armored Junkers J.I and Hannover CL.III battle planes of the *Schlachtstaffeln*, bane of the doughboys.

Sustainment and transportation also figured prominently in the Air Service's performance. The pivot from St. Mihiel to Meuse-Argonne was a triumph of staff work and planning, but it taxed the infrastructure to the limit. Underdeveloped lines of communication and atrocious, damp weather caused massive congestion, backups, and delays. When combined with severe shortages of motor transportation, the ability of air parks and depots to provide spare parts and replacement aircraft to the combat units was

reduced substantially. Along with profligate aircraft employment, transportation limitations directly contributed to the aircraft availability issues that culminated on 31 October.

In the realm of training, observation units performed yeoman's work in countering misunderstandings, educating the troops, and enhancing cooperation. However, these praiseworthy efforts could not overcome the pressing need for replacement infantrymen at the front, fully trained or not. As a result, air cooperation was often given low priority in the already truncated infantry training programs. More severe was the shortage of trained aircrew, especially observers. The training infrastructure and the challenging nature of the observers' course meant that observer production never fully kept up with demand. Additionally, observers suffered higher casualties than pilots due to their more exposed position in the aircraft, further exacerbating manning problems.

Weather was a persistent problem throughout the autumn during both St. Mihiel and Meuse-Argonne. High winds, low clouds, regular precipitation, and occasional hail battered the airmen continually. Additionally, fog often lingered in the low areas of the ravines and valleys, complicating liaison and precluding photographic reconnaissance.

There are several areas related to the campaigns that are ripe for further research. A dedicated study focusing solely on the French influence upon the Air Service training program and its relationship to post-war American doctrine would provide due credit to the immense assistance and intellectual influence the French provided to the fledgling Air Service. A detailed examination of the 9 October raid against alleged troop concentrations on the east bank of the Meuse would go far to dispel some of the

confusion surrounding the event. Mitchell's memoirs are at odds with many other sources, and a thorough reconstruction of the day's events would be both interesting and clarifying. Further research is also needed to ascertain the precise origins of Scriven and Parker's recommendations for the employment of airpower, aside from the general influence of the European belligerents. Ideally, this research should identify the British and French source documents that shaped Scriven and Parker's ideas.

Professional airmen and students of warfare can learn much from the Air Service's experience at St. Mihiel and Meuse-Argonne, despite the events having taken place over a century ago. Air forces remain highly technical organizations with tremendously long logistical tails and massive requirements for fuel, ammunition, spare parts, and replacement airframes when employed in large-scale combat operations against peer enemies. The rate of aircraft losses during operations, a phenomenon observed as early as the Mexican Expedition, was truly prodigious once the AEF was committed to major operations in the autumn of 1918. Because of the character of conflicts in the post-Vietnam era, today's airmen have become imbued with a mindset that emphasizes force preservation and risk mitigation. Large-scale, high intensity combat against a peer enemy will likely lead to heavy combat losses, even if not on the same scale as the First World War. Prevailing in such a conflict will require a shift in attitude and an acceptance that combat losses, in both men and airplanes, are part of the cost of doing business when fighting against a capable adversary. Commanders at all levels will require steadfastness and courage in order to lead their units to success in this environment, and they can look to the airmen that served at St. Mihiel and Meuse-Argonne for sterling examples of proper conduct.

Similarly, there are lessons in the areas of training and equipment that linger. America lacked the infrastructure to organize, train, and equip the Air Service on the scale necessary, which led to a heavy reliance on the British and especially the French for assistance. Today, the number of primary contractors capable of designing and manufacturing combat aircraft has dwindled to just a handful, and having the capacity to generate combat power with sufficient margin to maintain effectiveness in the face of heavy losses is a concern. Furthermore, the Air Service had no reserve to speak of, as it grew almost overnight from just a few dozen regular officers. Heavy losses taxed the Air Service mightily, and it is highly probable that an operational pause would have been necessary over the winter of 1918-19 to allow adequate replacements to refill cockpits. Forging combat aircrews is among the most costly and time-consuming military training endeavors that a nation can undertake, and a large-scale conflict with a peer enemy may very well inflict losses at a pace beyond what the training enterprise is capable of replacing within the time required. Thus, a continued commitment to maintaining a sizable body of experienced reserves is an absolute imperative for an air force potentially performing large-scale combat operations. Without manpower margin and sufficient training throughput, instruction begins to be curtailed out of necessity, as it was in 1918. This begins a vicious spiral begins as less trained crews are more apt to become casualties, further compounding the situation. In addition to trained reserves, a peacetime training infrastructure with sufficient capacity for expansion is a necessary prerequisite for successful operations in high-intensity air combat.

St. Mihiel and Meuse-Argonne also underscore the importance of properly arranging operations and the criticality of sustainment. Political and military factors alike

both deeply influenced the St. Mihiel operation's genesis, and while the operational shift to Meuse-Argonne was a triumph of staff planning and organization, the immense difficulties encountered in conducting two operations in such close temporal proximity reduced margin and presented an additional risk to the Meuse-Argonne campaign, which was the main effort. Even relatively mature theaters, such as France in 1918, can prove difficult to integrate into and stress sustainment infrastructure and capacity. As aerial weapons systems continue to increase in complexity and effectiveness, so does the support network necessary to sustain them in battle. Complex weapons, avionics, propulsion systems, and airframes require significant investments in personnel, training, spares, and repair infrastructure. When these requirements are coupled with the need for fuel and ordnance, as well as sustainment for forces operating in the land domain, logistical congestion could prove to be as much of a problem in a 21st century European conflict as it did in the First World War. There also exists the distinct possibility, given current and future adversary weapons systems, that rear areas will be under attack. Thus, sustainment margin, mass, and timeliness will be vital to supporting the Air Force in a future conflict.

The fundamentally attritional nature of air warfare is also apparent in the two offensives. Without overwhelming numerical advantage and lacking a concentrated and sustained counter-air effort, the Air Service struggled to control the skies over the Argonne. Indeed, the *Luftstreitkräfte* remained a threat up to the final hours of the war. The rough handling the Air Service experienced at German hands emphasized the necessity of securing air superiority in order to enable other aerial lines of effort to achieve success without undue losses. The airmen at St. Mihiel and Meuse-Argonne

attempted to do this against an enemy that outmatched them technologically, which is a situation that today's airmen may also face in the future. America has enjoyed an immense technological advantage in the air since Operation Desert Storm, but adversaries are closing this gap in innovative and startling ways. The prevalence of industrial and military espionage has increased the perishability of technological advantages, as have asymmetric offsets in areas such as information operations and cyber. The latter is particularly worrisome, as it can potentially negate exquisite technologies that consumed significant resources to develop and field. The psychological shift to engaging with a peer enemy in the air from a position of parity or disadvantage will require strong leadership and high morale in order to prevail.

St. Mihiel and Meuse-Argonne also began a debate over airpower's role that lingers to the present. Mitchell saw the potential of what airpower could achieve, but the technology was too immature to enable him to realize his vision. Army leaders like Pershing and Liggett took a more pragmatic and realistic approach, believing that the Air Service could be of greater use by directly supporting the ground fight. Command relationships between supported and supporting commanders during different phases of an operation remain contentious, as does airpower's greater role in the military. The previous 20 years of conflict have accustomed both airmen and soldiers alike to support ground units as airpower's primary role, but future conflicts will likely challenge this view and cause friction between commanders. Once again, strong leadership, communication, and teamwork will be critical to ensuring the success of the joint force.

American airpower was forged in battle in the skies over St. Mihiel and Meuse-Argonne, and the seeds of the massive aerial armadas of World War II, the might of

Strategic Air Command, and the triumph of the 1991 Gulf War can all be traced back to the formative experiences of 1918. The Air Service of the First World War set a standard for courage and dedication that continues to influence the Air Force's warrior culture to the present day, and the service is deeply indebted to the legacy of those brave men.

GLOSSARY

Aerial Barrage. Contemporary term for a combat air patrol of pursuit aircraft intended to deny the enemy access to a designated piece of airspace

Luftstreitkräfte. Imperial German Air Force.

Schlachtstaffeln. German air units organized, trained, and equipped for dedicated close support of infantry and artillery units.

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