United States Air Power from 1861-1918

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1. Background: Setting the Problem

This paper will define "Airpower" as "the use of powered flight to generate military force by or from a platform above the surface of the earth." There are a variety of different fields that an aircraft can be used in, if you take the perspective that it is a means to fly through the air.[1] The term "airpower" has frequently been used in the security realm when discussing military uses to ensure security. For example, Colin S. Gray has defined airpower as the "overall capacity of the state involved in the use of air." According to Gray, the term airpower included, in addition to the frontline military activities, the various logistic infrastructure required to support operations, the aircraft manufacturing industry, and the civil aviation transportation industry as well. This means Gray included the overall aviation capability of state.[2] Eliot A. Cohen focused solely on the military aspect when he defined airpower as "the military force produced by powered flight above the surface of the earth."[3] This paper will use Cohen's definition of airpower.

The 1991 Gulf War campaign brought to light once again the value of airpower. During the Gulf War the US military, which formed the core of the multinational forces, waged a campaign against the Iraqi military for about one month.

The Iraqi Army was not a force that could be ignored. The Iraqi Army ground forces contained approximately 1.1 million soldiers, 7,000 armored vehicles, and 700 fighter or attack aircraft. They also boasted cutting edge T-72 tanks and MiG-29 fighter aircraft and an air defense network that encompassed the entire country. Along with their weapon systems fairly comparable to those

of the West, they did have extensive combat experience.[4] Iraqi forces increased their forces in Kuwait to match the scale of the deployed multinational forces and built a multi-layered defensive line for about five months before the multinational forces shifted to offensive operations. Iraqi forces had stockpiled enough munitions for a long-term conflict and had taken scrupulous tactical preparations.[5] There was a distinct possibility that the multinational operations could end in failure.[6] Iraq's President, Saddam Hussein was said to have been optimistic about the chance of victory since the multinational ground force was not large.[7]

Nevertheless, the Gulf War ended in lopsided military victory for the multinational forces. Iraqi forces lost at least 3,847 armored vehicles during the multinational forces' attack, while US forces lost only 15 armored vehicles in combat. The Iraqi military lost 33 aircraft in air-to-air combat, while multinational forces aircraft only lost one aircraft. 86,000 Iraqi soldiers surrendered, and by some estimates approximately 10,000 - 12,000 were killed during the air campaign. During the war, 246 multinational forces' soldiers died.[8]

Multinational forces virtually annihilated the Iraqi military's air defense network in about 6 hours after the start of the war, achieving air superiority on the first day of operations.[9] During the first day of ground operations, the US Marine Corps attacked the Iraqi Army's main line of defense but they did not receive much resistance from Iraqi forces. The Marine Corps' main problem was evacuating the large number of Iraqi POWs.[10] The main coalition ground force marched over 250 miles into Iraqi Army controlled territory in just 100 hours, and defeated the Republican Guard armored corps, the elite force in the Iraqi Army.[11] According to the summary written by the United States Secretary of Defense, the multinational force achieved a remarkable military victory by overwhelming the Iraqi Army in all aspects of warfare.[12]

Why were the multinational forces able to achieve such a one-sided military victory? The focus of attention has been on the US Air Force's airpower presence. For example, the former United States President George HW Bush pointed out that the most important lesson of the Gulf War was the military effectiveness of airpower.[13] Certainly, other factors also had a significant impact on the results of coalition military operations. For example, several studies

place the emphasis on the influence of Iraq's strategic mistakes, of the ground operations etc.,[14] but the primary military history publications emphasize the dramatic influence of the coalition's effective use of airpower, and the main source of the coalition's airpower was the US Air Force.[15] All the coalition air force units were organized under a US Air Force headquarters, acting as the parent organization, and the majority of the headquarters and participating personnel were US Air Force Airmen. The backbone of the air operations plan was created by US Air Force staff officers.[16] US Air Force aircraft also accounted for about 60% of all coalition force sorties. The US Air Force also took the central role in the most difficult air operations, suppressing the air defense network and conducting the initial attacks on the most important strategic targets.[17] Furthermore, the US Air Force command and control system was said to be essential in ensuring the 2,000 aircraft sorties per day reached their planned target within 15 minutes of the intended time.[18]

US Air Force carried out large-scale, sophisticated air operations in the Gulf War. The power of the US Air Force now looks to have established an unrivaled, overwhelming military superiority. Airpower has made great strides in the 20th century.[19] According to Richard P. Hallion airpower performs a variety of strategy functions, such as "gaining air superiority," "providing mobility," "conducting air-to-ground attacks," and "providing situational awareness."[20] The airpower of the US Air Force is unrivaled in performing these functions. The Gulf War can be said to have been an opportunity to demonstrate that capability.

However, the question that I would like to answer in this paper is whether the US Air Force has been so successful because it enjoyed a significant historical lead. Though the predecessor of the US Air Force, the aviation department of the US Army, and the US Air Force combined have a history of more than a century, I believe the answer is "no." The US Air Force in its early days was not in a position that would enable it to currently lead airpower trends. As the details in this paper will show, the initial airpower leaders were in Europe. I learned that the US Army aviation branch, the predecessor of the US Air Force, was using European aircraft during the First World War because they were more advanced. It is clear that, at one time, the airpower of the US was far be-

hind that of the European countries' Air Forces.

In other words, one can view the results of the Gulf War as the fruition, a celebration, of the historical evolution of American airpower, to include the Army Air Corps era, as it caught up to other countries' Air Forces and then opened up a wide margin ahead of them. This paper will demonstrate that the unprecedented power of the US Air Force was achieved during this "dramatic evolution."

So, how was the US Air Force able to achieve such a "dramatic evolution" of its airpower? In an attempt to reveal the answer, this paper will focus on the early days of the US Air Force. By using concrete examples and case studies, along with the available historical research, I will clarify the reason how the US was able to transform its airpower from 1861 to 1918.

There is already a large variety of similar historical research that has been done by the US Air Force that was performed before this paper, and from which this paper benefits. The core documents I reference in this article are from historical studies performed by researchers at the Air Force Historical Studies Office, the Air Force Historical Research Agency, and the Air University. For an overview of this period there is the work of Bernard C. Nalty, Warren A. Trest, or Robert F. Futrell,[21] and I believe Juliette A . Hennessy's or I. B. Holley's work is a good representation of this period.[22]

This paper pursues the formation process of operational concept by relying on the historical research that is currently available. I will also analyze how the US Air Force has learned as an organization in order to form the operational concept. This paper is not attempting to reveal new historical data, but it will analyze known historical facts and aim from an independent viewpoint to frame the issue in a unique way.

2. Core Army Needs

When was US airpower born? Since at least the beginning of the Civil War, the US military has utilized aviation. In 1861 the Civil War in the United States broke out. During that year US Army soldiers flew a captive balloon for the first time. Both Northern and Southern armies used balloons to conduct aerial reconnaissance.[23] Privately-owned balloons were used in this effort. For exam-

ple, the balloon operator Thaddeus Lowe provided a mobile hydrogen generator and seven balloons to support the activities of the Union forces. At that time, the private sector had been developing commercial utilization of balloons. By the time of the Civil War, the private sector had conducted at least 3,000 balloon flights carrying 8,000 people.[24]

However, after the Civil War, airpower evolution became stagnant. For example, almost 40 years after the Civil War was over, the US Army had still only acquired eight balloons. During this timeframe, the US Army had repeated small-scale battles with the Native Americans in western North America, where balloons were never utilized.[25] One of the reasons why the US Army interest in balloons was so weak was due to the low reliability of the balloon. At that time, balloons could not fly whenever there were strong winds or if there was a fog. Due to the low reliability of the balloon there were strong criticisms within the US Army against dedicating personnel to support its use.[26]

However, rather than viewing the evolution of airpower as stagnant, it may be more appropriate to view the evolution of the entire US Army as stagnant. For example, cannon were one of the main weapons of the US Army. At that time, European militaries began using breech-loading cannons in earnest. Smokeless gunpowder was also taking the place of conventional black powder as the propellant of choice, masking the cannon's firing position while improving its range and accuracy. In 1865, Prussia manufactured smokeless gunpowder for the first time. It was soon adopted by France and other countries. However, during the Spanish-American War of 1898, the US Army was still using black powder.[27] Machine guns had even been put to practical use in 1860, and were capable of being mass produced, but the US Army did not organize a machine gun platoon until a half-century later, in 1906, and even then it was on a trial basis.[28]

During the late 19th century, the US Army underwent significant disarmament. Without a major military threat either at home or abroad after the Civil War, there was no need to maintain a large US Army. After the Civil War, the number of troops in the US Army troops rapidly shrank. Immediately after the Civil War ended in May 1865, of the 1.03 million volunteers that had served in the Army, more than 800,000 were demobilized within the year. By 1866,

Congress established the Army's manpower at 54,000. However, by 1870 the number of personnel dwindled to 37,000, and steadily decreased to 27,000 by 1890.[29] The downsizing of the organization led to a stagnation of personnel, as the promotion opportunities for officers dwindled. In 1882, to curb the aging of the officer corps, the US Army instituted a mandatory retirement system wherein a commissioned officer must retire after 40 years of service, at the age of 64. However, this did not halt the aging of the officer corps. By the 1890s, the average age of a US Army Captain was 43, a Lieutenant Colonel was 57, and a Colonel was 62.[30]

Through this series of events, the US Army was placed in a position to learn from Europe about airpower. In 1890, Congress gave the mission of information gathering and communication to the US Army Signal Corps. As a part of this effort the Balloon Section in the Signal Corps was established in 1892. After establishing the Balloon Section, the US Army dispatched an officer to research the latest balloon trends in Europe, and even acquired a balloon from France. The balloon was equipped with a telephone so that it could to talk personnel on the ground. The Signal Corps commander recognized the advanced state of European aviation systems in his 1892 annual report, including a recommendation to actively acquire and incorporate the new aviation systems.[31]

The US Army turned to airpower again during combat in the Spanish-American War. However, it is difficult to say that the evolution of airpower accelerated in response to this war. At the time, the US Army considered balloons solely as a means of reconnaissance. In 1898, the US Army began using balloons in the Spanish-American War. The US Army brought balloons to Cuba, which reconnoitered the Spanish fleet at anchor in the Santiago harbor and the Spanish Army forces in the area from the air.[32] However, after the Spanish-American War, there was little movement in the US Army to investigate new balloon tactics or uses. To begin with, the US Army did not even fully own any equipment to produce the compressed hydrogen required for balloons. It was so rare for the balloons the US Army owned to fly that some were stored in a warehouse for more than two years, and entered such a state of disrepair that they could not fly again.[33]

In the 20th century, the evolution of air power began to accelerate in Europe.

In 1908, the US Army introduced for the first time the airship. However, major European countries had introduced the airship a few years before. European airship had been much higher in performance than that of the US Army. The airship The US Army acquired in 1908 (US Military I) had the full length of 29m, the speed of 32 km / h, and the mountable weight of 620kg, while the airship that was produced in Germany in 1910 (LZ7) the full-length of 148m, the speed of 60km / h, and the mountable weight of 6,800kg. In 1908, airship French Army has acquired (Republique), with the total length of 66m, the speed of 50km / h, and the mountable weight of 1,200kg, also exceeded the US Army's airship.[34]

In 1903, the aircraft was invented in the United States. However, the initial interest in using aircraft came not from the US Army, but from Europe. During this timeframe, aircraft were being developed in countries around the world. The US scientist Samuel P. Langley began the development of a powered aircraft in 1887.[35] In December 1903, the Wright Brothers in the United States (Orville and Wilbur Wright) were the first human beings to successfully pilot a powered aircraft in flight, the Wright Flyer. Its first flight was 12 seconds, and only traveled a short 35m distance.[36] The Wright Brothers embarked in the manufacture and sales of the aircraft. At that time, they touted the aircraft first and foremost to no one else but the US Army. In 1905, the Wright Brothers approached the US Army about acquiring their aircraft. However, the US Army was not interested in this offer. On the other hand, European countries, such as Britain, displayed an interest in the aircraft and inquired with the Wright brothers about the price of the aircraft and other matters.[37]

Why did the US Army not immediately introduce the aircraft into service? It could be said that one of the reasons could have been the role of the "Core Army," and their operational requirements. The term "Core Army" as used here means the US Army Chiefs of Staff, and the senior unit commanders, who made decisions on the basic matters regarding US Army operations.

The "Core Army" thought airpower was a means of reconnaissance. Therefore, their strategy was to pursue the most suitable aviation systems for air reconnaissance, which were airships, not aircraft. For example, in 1907, the Signal Corps commander, James Allen, sent a negative opinion on the military

utility of aircraft to the US Army weapons acquisition board. Allen claimed that the role required of aviation systems was air reconnaissance, and to conduct this mission it was necessary for these aviation systems to fly over enemy held terrain, at an altitude of more than 4,000 feet. France had an airship that had been put to practical use and therefore these aviation systems met their technical requirements.[38] The Signal Corps also expressed a high level of interest in the German Zeppelin airships, and actively collected information on their performance. They made a budget request for $25,000 to acquire an airship for the War Department.[39]

Therefore the selection of the airship over the aircraft was the result of a rational process based on the criteria that "aerial reconnaissance" was their operational need. The Core Army prioritized the needs of ground operations over the need to introduce aircraft into the service.

Then in 1908, the US Army introduced aircraft into the service for the first time, though on a limited scale. The US Army established performance parameters for aircraft, required speed was 40 miles per hour and a cruising range of 125 miles, and then acquired an aircraft produced by the Wright brothers. The US Army recognized that this aircraft met their flight performance standards.[40] The US Army requested $500,000 from Congress to acquire more aircraft. However, though this was requested in the 1909 budget, it had still not been approved by 1910.

The context behind this lack of approval was that the US Army was still in the middle of carrying out organizational reforms in the wake of the Spanish-American War. During the Spanish-American War the US Army had committed a number of military blunders. Following the war, a special Spanish-American War investigating committee questioned the inferior level of the US Army's tactical capabilities. In response to this committee, the US Secretary of the Army undertook a reform effort in 1899 by modernizing weapons, reducing weapon acquisition costs, and instituting organizational reforms in the US Army General Staff. For example, the infantry rifle used in the Spanish-American war, the Krag-Jorgensen rifle, was an old style firearm, and an effort to deploy the new bolt-action rifles, the Springfield, began in 1903. While this infantry weapon modernization was underway, and considering that

infantry weapons were essential to ground operations, all other weapon system acquisitions were given a lower priority, and so aircraft systems were severely restricted.[41]

Additionally, the US Army Signal Corps itself did not recognize the need to introduce aircraft into the field. The Signal Corps' annual report for Fiscal Year 1910, touching upon the neutral foreign policy of the United States, pointed out that the lack of an imminent military threat meant that there was no reason to aggressively introduce aircraft that were of limited military usefulness. It was stated that the most economical path forward was to wait and let other countries bear the burden of developing militarily effective aircraft.[42]

Overall, the US Army was cautious in introducing aircraft into its inventory, and it did not actively explore the new possibilities offered by airpower. As a result, the US Army gave a big lead to the major European countries in the introduction of aircraft into military service. When the First World War broke out in 1914, the following were the total number of available military aircraft held by the respective countries, France 260, Russia 100, Germany 46, United Kingdom 29, Italy 26, Japan 14, while the United States had only six aircraft. While the French had 171 pilots, the United States had only 14 people. As for the budget allocation for the aviation sector per year, France spent $7.4 million, Germany and Russia spent $5,000,000, the United Kingdom spent $3 million, while the United States spent merely $125,000.[43]

Why was the US Army so cautious in fielding aircraft? Why did they not have the will to seek out new strategies or aggressively find alternatives to the traditional aerial reconnaissance tactics? Given the information previously discussed, we will point out the influence of the strategic needs of the Core Army.

From the perspective of the US Army, the highest priority was the need to improve the ground forces, since their ability was directly linked to the success or failure of ground operations. The expected role for aviation was to merely provide aerial reconnaissance. The best aviation system to meet its aerial reconnaissance needs was the airship and not the aircraft. Aircraft were unknown weapons with poor combat effectiveness, and were viewed as being far from the needs of the Core Army.

From the Core Army's perspective, there was no reason to explore the possi-

bilities of aviation systems and conduct a large-scale fielding of aircraft whose usefulness was still unknown. It is true that the US Army did introduce a limited number of aircraft. However, the Core Army's thinking at the time was focused around ground operations, and in that framework the use of aircraft was limited to aerial reconnaissance.

In other words, the needs of the Core Army affected the effort to form an airpower by solely focusing their strategies on the current form of airpower, aerial reconnaissance. On the other hand, this fundamental strategy did not help in the exploration of new directions or new possibilities for airpower.

3. Field Testing

So, before World War I the will to explore the new possibilities offered by airpower did not exist in the US Army. I would like to note here, that the "Core Army" was far removed from the ongoing utilization of aircraft in the field. In fact, in the aviation field at that time many young pilots, attracted by the challenges offered, sought out many creative solutions. I would like to discuss this point more below.

In 1907, the US Army established a new department with jurisdiction over all aviation systems, the Aeronautical Division, which was aligned under the Signal Corps. However, in the United States private sector, the National Aeronautics Association (Aero Club of America) had already been founded in 1905, and had started the training and assessment of aircraft pilots. However, the US Army still did not have such a systematic scheme in place. Therefore, the US Army needed to dispatch young officers to aircraft manufacturing companies in the private sector in order to learn how to fly, and relied upon the United States Airlines Association to provide them their qualification.[44]

The pilots who used aircraft out in the field, and understood the problems related to aircraft operations, began to lead the introduction of aircraft into the Army. For example, one of these first, initial pilots was Henry H. Arnold, who later went on to become the commander of the US Army Air Forces during the Second World War. In 1911, Arnold was a second lieutenant in the infantry, but was dispatched to the Wright Brothers aircraft manufacturing company to master his piloting skills. At the time, the US Army pilots and maintenance

personnel had not been trained. Second Lieutenant Arnold and his comrades learned piloting techniques and maintenance tradecraft from the Wright Brothers. Then, Arnold conducted flight tests in the field, trained other soldiers to become pilots, and was even involved in the planning effort to introduce aircraft to the Department of the Army.[45]

At the time, the structure of the aircraft structure was weak and was not reliable, so it was not uncommon for an aircraft to require three weeks of repair after just one week of use. Moreover, an aviation logistics system had not been established to supply the maintenance elements in the field. Aviation officers in the field were often very busily engaged trying to find ways to repair their aircraft when it broke, and since the aviation maintenance budget was also very limited during this time, there were occasions when the officer would have to pay for the repairs out of their own pocket.[46] Arnold recalled the state of affairs at the time, saying:

> "Our mission was not still clear...during our time at Dayton (Ohio, site of the Wright Brothers Company), we rarely received any instructions from the US Army General Staff, and their goals for the introduction of aircraft into service were vague."[47]

Before long, in accordance with the growing recognition of the hazards of the field and the professionalism required to maintain aircraft, aircraft pilots began to establish a position in the military profession. At that time, in addition to the low reliability of the aircraft, standardized flying techniques had not yet been solidified, resulting in numerous flying accidents. Therefore, the US Army recognized the degree of expertise required and the risks entailed in flying an aircraft and in 1912 adopted a system to certify a person, with the requisite training and, experience as a professional "Military Aviator." The following year, the US Army established the emblem (badge) for aircraft pilots, institutionalized the special allowances for pilots, and their treatment began to gradually improve.[48]

Around this time aircraft pilots in the field began to claim that the aviation sector was unique and individuals opposed to the "Core Army" began to seek their independence from it. In 1913, the US Army was ordered to respond to Mexico's political unrest, and dispatched nine aircraft to Texas. The commander of this aviation force was not a pilot. From the perspective of the pilots, it

was contrary to reason that a person other than a pilot should take command of an aviation element, and they raised their voices in criticism. An officer who was not a pilot, who had not learned the hard way of the risks entailed with flying an aircraft, would tend to neglect efforts to improve the safety of the aircraft. The pilots lobbied for the dismissal of the commander. On the other hand, the Signal Corps commander, George P. Scriven, did not hesitate to declare that the aircraft pilots were making a mistake, since they were Army officers, by becoming publicly rebellious.[49]

While pilots in the field were allowed to fly their aircraft to conduct aerial reconnaissance and communications sorties, the exploration of air-to-ground bombing tactics and other new possibilities were carried out on the pilots' own initiative. For example, while conducting aerial reconnaissance, the pilots tested out ways to photograph ground forces with a camera that brought on board the aircraft. In the communications realm, pilots tested out different methods for aircraft and ground forces to communicate information to each other. In 1910, the US Army held its first aerial bombing trials.[50]

On the other hand, the "Core Army" continued to regard airpower's sole purpose to be aerial reconnaissance. The US Army field service regulations enacted in 1910 specifically defined the role of airships and aircraft as aerial reconnaissance.[51] In 1912, the US Army had only two aircraft classifications. There was a high-speed reconnaissance "Speed Scout" and a regular reconnaissance "Scout" classification. Both were only intended to conduct reconnaissance. The "Speed Scout" was a high-speed single-seat aircraft whose role was to discover distant enemy ground forces. The "Scout" was a two-seat aircraft intended to detect nearby enemy ground forces.[52] While conducting these reconnaissance activities, these aircraft were also expected to perform artillery spotting and adjustment. In 1912, the Signal Corps conducted tests to evaluate how to pass artillery correction information from a reconnaissance aircraft to an artillery unit. They determined that the best method was for the reconnaissance aircraft to pass the target's distance and direction from the artillery unit. They also tested various communications methods, including dropping flares, dropping written instructions, and radio. The radio was determined to be the most practical.[53]

The "Core Army" was not able to quickly realize the potential value of aviation's striking power. The "Core Army's" interest in a bombing campaign was generally weak. For example, in 1911 the Signal Corps performed a bombing test using a bombing sight, successfully dropping a bomb with great accuracy within 10 feet of its target. When the French heard about the test results they immediately acquired these bombing sights. On the other hand, the US Army General Staff Headquarters, did not acquire the bombing sight and did not see a need for further testing of bombing sights.[54]

However, there were pilots in the field who did focus on the potential striking power of aviation. One of these pilots, Paul W. Beck, focused on the potential of a bombing campaign by conducting flight tests, and testified to the efficacy of the concept to Congress. Through the use of flight testing, he was able to focus on the potential value of the concept before others in the US Army. He argued that an independent aviation unit separate from the Signal Corps should be created and that professional aviation officers should be placed. In 1913, Congressman James Hay supported Beck's claims and submitted a bill to Congress authorizing an aviation unit independent from the Signal Corps.[55] During the hearing on the bill, Beck testified the details of the bombing tests he had carried out himself and insisted upon the military usefulness of an aerial bombing campaign.[56]

In addition, the modified bill passed by Congress in July 1914, increased the size of the Signal Corps Aviation Section, officially putting 60 officers and 260 non-commissioned officers on the books.[57]

However, the "Core Army" was still cautious on the issue of using airpower in an attack role. For example, the command of the Signal Corps (Scriven) testified to Congress that the sole purpose of aircraft was to conduct aerial reconnaissance. He was opposed to an independent aviation division.[58]

It should be noted that, in later years, William "Billy" Mitchell, became known as the enthusiastic support of airpower. During this time he made a careful evaluation of the potential of airpower in an offensive role. He testified during the Congressional hearing on the matter as follows, "We know absolutely that aeroplanes are valuable for reconnaissance service." On the other hand, "the offensive value of this thing has not been proven. It is being experi-

mented." However, given the results of Germany's bombing tests, the direct effects of the bombing campaign "will be entirely local."[59]

Here, we want to piece together the different parts of our discussion. If you follow the air power formation process of the US Army, one can see that are two different concepts that had to coexist. The first was the accepted "current paradigm" held by the Core Army on the development of airpower. The "current paradigm" was the conventional perspective on airpower, which held that its role was limited to aerial reconnaissance. This concept was valuable to the US Army as an expedient way to meet its current tactical needs. The second concept, which was born in the field, cast a doubtful eye on the "current paradigm" and sought to create an airpower capable of offensive operations.

It should be noted, that these different ideas seemed capable of existing within the same organization. It seems that diverse perspectives were grown within the same organization, as different ideas didn't eliminate each other but held each position.

4. The First World War

Along with the outbreak of the First World War, the aviation state-of-the-art began to rapidly improve. For example, the British equipped a reconnaissance aircraft with a radio and flew it in combat in 1914, and it began to observe and coordinate artillery fire. After reconnaissance aircraft began to fly frequently over the battlefield, both sides wanted to find a means to shoot down the scout aircraft. Initially, flight crews attempted to shoot down enemy planes with rifles and pistols. However, since the probability of successfully shooting down an aircraft in that manner is very low, an alternative attack method to entangle enemy planes in the cables attached to aircraft was devised. Before long, a machine gun was mounted in the nose and put to practical use. The aerial combat capability of fighters was dramatically improved. To install a machine gun in the nose, there was a need to prevent the machine gun bullets from hitting the propeller. For this purpose, it was necessary to adjust the machine gun to fire "in tune" with the rotation of the propeller. The Germans quickly adopted this technology (in Fokker Eindekker III) and in 1915 employed it in combat, where it was used to shoot down a large number of Allied aircraft. The flight

performance of fighters also dramatically improved. For example, in 1914 the typical British army fighter (BE-2c) was capable of 75 miles per hour with a service ceiling of 10,000 feet, but the fighter in use at the start of 1917 (Sopwith Camel) was capable of 130 miles per hour and had a service ceiling of 19,000 feet. Fighter performance had almost doubled.[60]

The improvement in the aviation state-of-the-art, combined with the increase of combat experience, began to accelerate the evolution of airpower into an offensive force. For example, on the sixth of August 1914, immediately after the outbreak of the war, the German Army used Zeppelin airships to attack the Belgian fortress at Liege. Defensive air operations, to intercept attacking enemy aircraft, became a regular activity. At the beginning of the war, the German Army deployed 12 airships to the Western Front, of which three were shot down within the first month of war.[61]

Bombing operations against enemy urban areas, the so-called strategic bombing, was also carried out from the very beginning of the war. On the 19th of January 1915, a German Navy Zeppelin airship bombed the British mainland for the first time, claiming two citizen victims. After that, Zeppelin airships repeatedly bombed British urban areas. In May 1917, the German Army used twin-engine bombers for the first time to bomb the United Kingdom mainland.[62] All of the major European countries continued to improve the technical capabilities of its aviation component as the war progressed, establishing air-to-air combat and bombing capabilities, and began to use a wide variety of aircraft.

In April 1917, the United States entered the war, three years after the First World War began. During those three years, the qualitative and quantitative level of US Army airpower, compared to that of the major European countries, had lagged even further behind. In 1914, responding to the outbreak of the First World War, the US Army moved to promote the expansion of the aviation department. However, this movement was influenced by the fact that the United States had publicly declared its neutrality, so the Army's movement came to naught. For example, the Signal Corps Aviation Section portion of the aviation-related budget was about $1 million in the 1916 fiscal account budget requests sent to the Secretary of War. Since its budget in the previous year had

only been $250,000, it can be seen that the Signal Corps Aviation Section intended to dramatically expand its operations. Scriven, the commander of the Signal Corps, went to the House of Representatives Armed Services Committee to discuss the 1916 fiscal accounting budget, and pointed out that the aviation-related budget of the German army was $45 million, and he requested to increase their aviation-related budget. After all was said and done, the Congress approved budget only allowed for $300,000 of the $1,000,000 requested for aviation.[63]

However, as the possibility of US entrance into the war approached, the US Army sought to rapidly increase the number of aircraft in its inventory. For example, if you look at the number of aircraft the US Army acquired in the nine years from its first acquisition in 1908 until its entry into the war in 1917, it purchased a total of 300 aircraft. On the other hand, if you look at the one and a half years from April 1917 until the end of the First World War, they purchased about 13,900 aircraft.[64] Although it is not possible to do a simple comparison, the Royal Air Force acquired 50,0000 aircraft during the war.[65]

At the same time, the US Army also began to improve the quality of its aircraft. For example, in 1916, the United States was sending troops on a military expedition to Mexico.[66] During that expedition, the aircraft the US Army used were not able to cross over mountains, due to inadequate flight performance, and were therefore unable to perform their reconnaissance role. Although this aircraft was a biplane equipped with a 90hp engine, its basic flight performance was insufficient to fly through the turbulent air over the Mexican mountains. In 1916, of the 83 aircraft the US Army acquired, 68 of the aircraft were trainers. In other words, the US Army at the time did not only have a limited number of aircraft, they had an even more limited number of combat capable aircraft.[67] In May 1917, the United States sent a survey team to Europe to determine the types of aircraft it should deploy with the American Expeditionary Force (AEF). The investigation team selected four types of aircraft to be used by the AEF. They would use the DH-4 for aerial reconnaissance and daytime bombing missions, the British Bristol and French SPAD for aerial combat missions, and the Italian Caproni for strategic and night bombing missions.[68] By obtaining advanced aircraft from the major European countries, the US Army was able to

improve the qualitative level of its aircraft.

However, it is interesting to note that at this point, even as the qualitative and quantitative improvement of its airpower progressed dramatically, the "Core Army" persisted in viewing the fundamental role of airpower to be "aerial reconnaissance." The Core Army held a poor view of the idea to try to a full-scale application of air power as an offensive force. In September 1915, the US Army General Staff Headquarters, based on the situation in Europe, researched the potential future structure of the US Army and published a report. According to this report, aircraft were to be assigned to, and utilized by, Army divisions. Each Army division would be assigned eight aircraft for reconnaissance, two aircraft each for long-range reconnaissance and air-to-air combat, and two aircraft for strike operations. The emphasis was still on aerial reconnaissance. When the report was written, the average weight of bombs ranged from 15 to 35 pounds, and given the limited flight performance of the aircraft at the time, the Army was skeptical of the military effectiveness of any bombing campaign.[69]

In reality, positive opinions on, and evaluations of, the military effectiveness of a bombing campaign had also been reported to the Core Army, but these comments did not have much influence on it. For example, in August 1914, the Signal Corps Aviation Section tested a bombing sight and bombing equipment. The standard ammunition, 3 inch shells, were dropped from 1,000 to 2,000 feet and almost hit their targets precisely. Additionally, the shrapnel from the bombs was scattered over 300 yards, confirming the effectiveness of a aerial bombing. The personnel that conducted the tests came to appreciate the potential of aircraft as bombers, and proposed to acquire dedicated bombers, bombing equipment, and to increase the number of officers specializing in aerial bombing. However, since Scriven, the commander of the Signal Corps, believed that the fundamental role of the aircraft was to provide tactical reconnaissance, he did not recognize the need for their proposal.[70]

In 1914, US Army officers were dispatched to the United Kingdom as observers. One of the officers, George O. Squier, observed that due to the appearance of trench warfare, aerial reconnaissance was the only means of understanding the enemy's situation and the extent of his entrenchments. The appre-

ciation of the value of aerial reconnaissance and its various applications grew.[71] In its annual report for 1915, the Signal Corps established the standard strength of a squadron as eight reconnaissance aircraft, two pursuit aircraft, two fighter aircraft, and a static balloon.[72] In January 1917, the Signal Corps commander (Scriven) attended the Congressional hearing for budget deliberations, and testified that the military value of armed aircraft was still uncertain.[73]

As we have seen so far, the Core Army, despite the large-scale use of airpower in an offensive role during the First World War, continued to reject the potential of airpower in this role. So, the US Army went to war without having kept up-to-date on the progression of airpower concepts.

Here in this paper I would like to point out, that as the war approached, pilots "on-site" were reporting on the effectiveness of airpower when used in an offensive role, and these reports began to influence the entire US Army. For ex-ample, in April 1917, a US Army officer named Frank Parker was dispatched to the General Headquarters of the French Army. He submitted a written opinion to the US Army Advisory Committee, which was analyzing the best way to organize the AEF. In his written opinion he classified air operations as "Tactical Aviation" and "Strategic Aviation." Tactical Aviation was defined as reconnaissance in close cooperation with the ground forces, pursuit operations, and tactical bombing. Strategic Aviation were the air operations to be carried out independently of the ground forces, the bombing of enemy logistics facilities 25,000 yards and beyond from Allied ground troops.[74]

The investigation team, in addition to the previously mentioned issue of model selection, focused on the military effects of bombing operation. The investigation team's report was submitted in August 1917, and it pointed out that aircraft which were not used for training or supporting the ground troops should be appropriated by a "strategic offensive force." The leader of the study, from his investigations into the combat situation in Europe, pointed out the military effectiveness of the bombing campaigns and the significant impact they had on over-all strategy.[75]

There was also the suggestion to conduct a bombing campaign, using large bombers, against the center of an enemy's heartland. Major Edgar S. Gorrell was a member of the AEF and was responsible for the acquisition of aircraft.

He also investigated the actual conditions of the bombing campaigns in Europe, and summarized his results in a report. The war on land and sea had continued for three and a half years in Europe, causing extensive damage to the countries upon whose territory the battles were fought. He believed this large scale destruction must be avoided somehow. He proposed a method, to conduct an organized bombing campaign against the industrial cities of Germany, against their heartland.[76] In June 1918, US Army Director of Military Aeronautics submitted a report on strategic bombing to the US Army Chief of Staff. This report stated that a large, four-engine bomber would need to be produced as soon as possible in order to bomb the industrial heartland of Germany.[77]

One of the pioneers among US Army pilots was Benjamin Foulois. He was appointed to be the commander of all airpower under the AEF. He also focused on the offensive potential of airpower. Foulois visited the country in order to meet the Royal Air Force Chief of Staff (Hugh Trenchard) and the commander of the French Army (Philippe Pétain). They investigated the current status of air operations and exchanged views. On the basis of his inspection, Foulous submitted a report in December 1917 to the AEF Chief of Staff. In his written opinion he referenced the potential psychological effect of the bombing campaign on the enemy. The German bombing of the United Kingdom led to an increased demand to retaliate with a bombing campaign against Germany. Foulois focused on the fact that the German bombing campaign had changed British war policy. Foulois had also himself experienced the German bombing while he was in London. He experienced the spectacle of a large number of citizens who took refuge in a subway station, he witnessed their fear of returning home, the fear of bombing, and became aware of the psychological effects of a bombing campaign.[78]

The pilot Billy Mitchell also strongly argued for the value of airpower as an offensive force, and he would go on to lead the creation of US Army airpower. Mitchell was responsible for planning air operations for the AEF Commander, General John J. Pershing, and Mitchell would later become commander of the AEF air force. He also conceived of airpower through the two concepts of "Tactical Aviation" and "Strategic Aviation." He defined "Tactical Aviation" as the aerial reconnaissance and artillery observation missions that were assigned

by division or corps headquarters. On the other hand "Strategic Aviation" were operations directly led by the AEF commander to attack the enemy heartland. Mitchell thought that these air operations would be able to have a decisive strategic influence.[79] Mitchell visited European Air Force officials to collect a variety of lessons on air operations.[80]

Mitchell insisted the AEF Air Corps be organized along these more aggressive lines. On July 11, 1917, Pershing made his official decision on the organization of the AEF's Air Corps. However, the organization demonstrated Pershing thought little of airpower's offensive potential. Pershing approved an organization containing 59 squadrons overall, including 39 reconnaissance, five bombing, and 15 pursuit squadrons. This was closer to the conventional thinking that the principal role of air power was aerial reconnaissance. By contrast, Mitchell had in mind an organization containing 41 reconnaissance, 55 bombing and 201 pursuit squadrons. He thought such a large-scale, aggressive Air Corps would be necessary to execute the bombing campaign. By October 1917, the final decision on the organization of the Air Corps was made, and it was much closer to Mitchell's initial proposal, as it contained 260 total squadrons, including 80 reconnaissance, 60 bombing, and 120 pursuit squadrons.[81]

Mitchell was on the European front as the commander of the AEF Air Service,[82] when in April 1918, he published the General Principles Underlying the Use of the Air Service in the Zone of the Advance AEF. Mitchell said the following in its preamble:

> 1. The issue of war depends primarily on the destruction of an enemy's military forces in the field. To bring this about all elements of a nation's military power are employed to bring about a decision on the field of battle in the shortest time possible. 2. An army is composed of various arms and services whose complete interdependence and working together is necessary for efficiency. No one arm alone can bring about complete victory. 3. The efficiency of an army is measured by its ability to carry destruction to the enemy's forces. 4. The efficiency of any arm is dependent upon its military training, experience and direction. 5. The Air Service of an Army is one of its offensive arms. Alone it cannot bring about decision. It therefore helps the other arms in their appointed mission. The measure of this help is its efficiency in its mission.[83] (Underlining is the author's)

Before long, the Core Army began to recognize the value of airpower's of-

fensive capability. In December 1918, the US Army has established a training manual for air operations, the Provisional Manual of Operations. In this training manual, one of the duties given to pursuit aircraft units was to "attack ground troops." Such a mission was to bring a "valuable result" for military operations. The training manual also defined the goal of attack aircraft as the "defeat of the frontline enemy infantry, and the disruption of enemy artillery."[84]

Late in the war, the US Army was making full use of the offensive potential of airpower, and conducted large-scale air attacks. Due to the fact that United States participation in the war was delayed, the Air Corps was only able to take part in a few operations including the Battle of Saint-Mihiel and the Meuse-Argonne Offensive, which were part of the final Allied offensive. However, during the attack of Saint-Mihiel the American Air Corps fell under the control of the Allied Forces command, which had a total of 1,481 aircraft and carried out the largest air operations, including close air support, on the western front to date. Previous air operations had deployed a similar number of aircraft, but never so focused on such a small front. The central figure behind this new strategy was Billy Mitchell.[85] On November 1918, the First World War ended with a truce. During the war, the Air Service had shot down 753 enemy aircraft and lost 357 aircraft. In addition, it dropped 275,000 lbs. of bombs in combat during 150 bombing missions.[86]

5. Investigation

Up to this point, we have been following the evolution of the US Army's operational concept creation process from the mid-19th century to the beginning of the 20th century. Below is my analysis of this process.

How does an organization acquire knowledge or adjust its activities? According to some researchers, the learning process can be classified into two categories, "single-loop learning" and "double-loop learning." In single-loop learning, the existing premise is taken as a given, and learning is based on modifying one's behavior based off that premise. Double-loop learning involves the modification of existing premises.[87] In trying to describe this concept it is useful to use an analogy, so I will use setting the temperature of an air conditioner. If the air conditioner only has one option, "Set Room Temperature,"

wherein the temperature is predetermined to be 26 degrees (Celsius) the air conditioner will compare the actual room temperature to this predetermined setting and seek to adjust the air temperature accordingly. This is single-loop learning. On the other, hand if you can modify the "Set Room Temperature" to a temperature to something other than 26 degrees, then this situation corresponds to double-loop learning. If you cannot modify the "Set Room Temperature" option, you cannot challenge the validity of the 26 degree setting, so it is single-loop learning. Challenging the validity of the 26 degree setting leads to double-loop learning.

Using this framework, the operational concept formation process we have seen up to this point, as exhibited by the Core Army, has been single-loop learning; but we would point out that the personnel working with aviation out in the field exhibited double-loop learning.

The Core Army's central, and unalterable, premise was that airpower's sole role was to conduct aerial reconnaissance. The devotion to this single principle forced restricted them to single-loop learning. As a result their strategy rested solely on air reconnaissance, and their only adjustments to their strategy was to strengthen their cooperation with the artillery unit in adjusting artillery fire. In essence they were being treated as just another ground element.

On the other hand, the aviation work being down in the field was critically examining the central premise through double-loop learning, leading to the concept that airpower could act as an independent offensive force. The pilots operating the aircraft in the field everyday, in constant contact with the aircraft, began to question the existing premise that airpower could be used as a means of aerial reconnaissance. They noticed the potential of airpower, and began searching for a new operational concept. However, the attempts of these aircraft pilots were not made by the instructions and guidance they received from the Core Army. Moreover, they were not meeting the needs of the organization or the past performance.

The US Army's preparation to fight in the First World War, provided the pilots in the opportunity to accelerated their double loop learning, and to take the lead. Eventually the US Army came to recognize the value of airpower as an offensive force. Until then, the US Army had lagged behind in both the quality

and quantity of its aircraft when compared to the major European countries. The Core Army still considered the primary role of airpower to be aerial reconnaissance. On the other hand, the pilots had been able to observe airpower on the European front-lines and learned of its offensive potential first-hand. They began to assertively state the importance of airpower's offensive power within the US Army. Billy Mitchell was a central presence among these pilots. Mitchell joined the European front as the commander of the American Expeditionary Force Air Service Corps, and was involved in enacting the strategic principles and training manuals throughout the Air Service Corps. The publication of these documents, considering the role of airpower to be greater than just aerial reconnaissance, launched the concept that airpower could be used as an offensive force.

Both single-loop learning and double-loop learning had to coexist in the US Army. It was this co-existence of different learning loops that led to a multi-faceted understanding of airpower.

The interesting point here is that the Army was seeking to establish the operational concept through a different learning loop. To begin with, the integrity of a military organization is dependent upon hierarchy, which is a highly prized value. Strict obedience from the top-down is taught throughout the organization. However, despite this, learning of a different nature and spontaneously occurred within the Army's organization.

In the study of military organizations, it is commonplace for double-loop learning to be neglected while the organization becomes obsessed with single-loop learning. According to some researchers, military organizations find it easy to adjust existing operational concept in order to achieve their goals or to improve efficiency. They can also intentionally twist negative feedback to make it more suitable and match existing operational concept. As a result, military organizations shut themselves out of ways to explore alternatives to existing operational concept.[88]

However, the US Army allowed autonomous exploration out in the field, exploring new operational concept. The autonomous exploration out in the field was not performed through selfishness and disobedience, or by ignoring the needs of the organization. Rather, the work was not restricted by the stereotypes

and groupthink of the age, it was able to work towards its goals with an objective view of reality and through rational thought, without needing to wait for instructions or guidance from above. They still had the drive and desire to focus their efforts on contributing to the organization.

Indeed, the degree of autonomy those out in the field had caused another problem. Needless to say, strategies that are created by the central body have to be faithfully executed in the field. Moreover, this faithfulness permits military organizations to exhibit high combat effectiveness under combat conditions. If you respect the autonomy in the field too much, it will affect the integrity of the organization and will interfere with organized combat action.

On the other hand, if there is too much respect for the central body, it will also interfere with the thinking done out in the field and therefore the integrity of the organization. In this case, if the Core Army has intervened against the various experiments conducted out in the field, several initiatives would have been suppressed and the evolution of airpower would have stagnated. Again, the Core Army regarded airpower solely in the role of aerial reconnaissance. Therefore, if the Core Army micro-managed the work out in the field, they would have likely suppressed many of the experiments and they would have lost what it was that they really needed.

Up to this point in the discussion, we have dealt, in a sense, with the question, "Who is or was involved in the formation of the operational concept?" As we have seen in the previous discussion, there were a variety of different persons in different positions who were involved in the creation of an independent operational concept. Both in the Core Army and out in the field, a variety of different people had been groping about blindly trying to find the way forward for airpower. Various different persons, each exerted their own awareness and knowledge into both single-loop and double-loop learning processes, within the same organization. The co-existence of the different learning loops lead to a multi-faceted understanding of airpower, which in turn led to creative operational concept formation.

In other words, the variety of perspectives brought about an independent, distributed intellectual quest that promoted the creation of the best operational concept. By this process, the US Air Force was able to achieve a dramatic evo-

lution in its airpower potential. Daring to use a simplification, each and every organization that is thinking seriously about the future of airpower should see the advantages in this method. Rather than having "one hundred step in," it would be better for an organization to see airpower through "one hundred single steps."

6. Conclusion

What will be required for a military organization to effectively proceed with operational concept development?

In this regard, the discussion in this paper would suggest that organizations should encourage their members to think independently when conducting their activities. Of course, although there would naturally be limitations due to the characteristics of military organizations, a certain amount of discretion and freedom must be allowed for intelligent development to be conducted within the organization. In particular, in a security environment where structural change and technological innovation has been progressing rapidly, it is difficult to determine the direction a military organization should aim in. In such an environment it is necessary to consider a number of alternatives. However, it is difficult to consider a number of different alternatives if only certain departments are designated to look into them. The only way to achieve results is to enable its members to conduct their own autonomous activities.

Footnotes

1 Aircraft are classified into light aircraft and heavy aircraft. Light aircraft use static buoyancy gases lighter than air such as hydrogen have, exemplified by balloons and airships. Heavy aircraft use dynamic lift of wing. Wing shape distributes them into fixed-wing aircraft and movable-vane aircraft. Fixed-wing aircraft are non-powered one (glider) and powered one (propeller plane and jet plane). 日本航空宇宙学会『航空宇宙工学便覧』増補版、丸善、1983, pp.51-52. In view of the purpose of this research, "aircraft" is used as a concept of fixed-wing aircraft.

2 Colin S. Gray, *Explorations in Strategy*, Praeger, 1996, pp. 62-65.

3 Eliot A. Cohen, "The Meaning and Future of Air Power," *Orbis*, Vol. 39, No. 2, Spring 1995, pp. 190-191. Cohen shows 2 definitions in both broad and narrow senses. The broad sense definition is shown in this text. The narrow sense definition is "ability to deliver lethal fire power from the air." Cohen says air power doesn't include objects which fly in a certain trajectory flying objects such as bullets, shells and ballistic missiles, while air power includes cruise missiles which can change flight routes freely.

4 Eliot A. Cohen ed., *Gulf War Air Power Survey, A Statiscal Compendium* [hereafter *GWAPS, A Statistical Compendium*], Government Reprints Press, 2002, pp. 18-19; Department of Defense, *Conduct of the Persian Gulf War: A Final Report to Congress* [hereafter *CPGW*], U.S. Government Printing Office, 1992, p. ii; Bernard C. Nalty ed., *Winged Shield, Winged Sword: A History of the United States Air Force*, Vol. 1, United States Air Force, 1997, p. 444.

5 Anthony H. Cordesman and Abraham R. Wagner, *The Lesson of Modern War, The Gulf War*, Vol. 4, Westview Press, 1996, pp. 116-117; *GWAPS, A Statistical Compendium*, p. 44; Eliot A. Cohen ed., *Gulf War Air Power Survey, Effects and Effectiveness* [hereafter *GWAPS, Effects and Effectiveness*], U.S. Government Printing Office, 1993, pp. 193-197.

6 For example, the US Department of Defense had predicted the number of the multinational force's casualties would be scores of thousands scale. They say the commander of the multinational forces had anticipated about 5,000 combat fatalities. A lot of military experts had estimated the number of US casualties as from 12,000 to 30,000. Benjamin S. Lambeth, *The Transformation of American Air Power*, Cornell University Press, 2000, p. 2; John H. Cushman, "Pentagon Report on Persian Gulf War: A Few Surprises and Some Silences," *New York Times*, April 11, 1992, p. 4; Cordesman and Wagner, *The Lesson of Modern War*, p. 338; Colin S. Powell and Joseph E. Persico, *My American Journey*, Ballantine Books, 1996, p. 485.

7 Norman Cigar, "Iraq's Strategic Mindset and the Gulf War: Blueprint for Defeat," *Journal of Strategic Studies*, Vol. 15, No. 1, March 1992, pp. 1-29.

8 Cordesman and Wagner, *The Lesson of Modern War*, pp. 338-339; Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare?: Air Power in the Persian Gulf*, Naval Institute Press, 1995, pp. 49-51. The number of the Iraqi force war dead varies a great deal by estimation methods. The books below are good on various estimation methods. Cordesman and Wagner, *The Lesson of Modern War*, pp. 342-343; Lawrence Freedman and Efrain Karsh, "How Kuwait was won," *International Security*, Vol. 16, No. 2, Fall 1991, p. 18.The number of the Iraqi force war dead is cited from *GWAPS, Effects and Effectiveness*, pp. 220-221.

9 Eliot A. Cohen ed., *Gulf War Air Power Survey, Operations* [hereafter *GWAPS, Oper-ations*], U.S.

Gov ernment Printing Office, 1993, p. 337; *GWAPS, A Statistical Compendi-um*, p. 235, 642; Keaney and Cohen, *Revolution in Warfare?*, p. 48; Norman H. Schwarzkopf and Peter Petre, *It Doesn't Take a Hero*, Bantam Books, 1993, p. 482.

10 It is said that the USMC captures more than 8,000 Iraqi soldiers on the first day of the ground operation. Michael R. Gordon and Bernard E. Trainor, *The General's War: The Inside Story of the Conflict in the Gulf*, Little, Brown and Company, 1995, p. 363.

11 Republican Guard Forces Command was organized for the purpose of securing the stability of the regime and had the highetst training and equipment in all Iraqi forces. Detailed in *CPGW*, pp. 11-12.On the 4th day of the ground operation, Feb 27, the US Army 7th Corps did 1,350 tank and 1,224 infantry combat vehicle damage to 5 divisions(armored division and mechanized division), Republican Guard Forces Command included, while the 7th Corps damage was only 36 vehicles. Robert H. Scales, *Certain Victory: The United States Army in the Gulf War*, Brassey's, 1994, pp. 291-302; Stephen Biddle, "Victory Misunderstood: What the Gulf War Tells Us about the Future of Conflict," *International Security,* Vol. 21, No. 2, Fall 1996, pp. 144-147; *CPGW*, pp. ii-iii.

12 Ibid., pp. ii-iii, 411.

13 Ibid., p. 117.

14 For example, it corresponds to the research below. Freedman and Karsh, "How Kuwait was won," pp. 36-41; Stephen Biddle, "Victory Misunderstood," pp. 139-179; Stephen Biddle, "The Gulf War Debate Redux: Why Skill and Technology Are the Right Answer," *International Security,* Vol. 22, No. 2, Fall 1997, pp. 163-174; Daryl G. Press, "The Myth of Air Power in the Persian Gulf War and the Future of Warfare," *International Security,* Vol. 26, No. 2, Fall 2001, pp. 5-44.

15 The 1992 DoD report points out that USAF's high-tech weapons have military edge and that its air-power brought in marvelous military effect, ensuring the victory in the Gulf War. *CPGW*, pp. xiv-xv. The *Gulf War Air Power Survey* published in 1993 by the Gulf War air power investigation commission, points out that multinational force's airpower weakened the morale and capacity of the Iraqi ground forces, clinching military victory. *GWAPS, Effects and Effectiveness*, pp. 370-377. *Gulf War Air Power Survey* is a report made by an investigation commission organized by military and civilian specialists, and presided over by Cohen, Johns Hopkins University. The books below detail the making of the survey. Gian P. Gentile, *How Effective Is Strategic Bombing?: Lessons Learned from World War II to Kosovo*, New York University Press, 2001, pp. 171-173. The books below show the military effect of air power. William J. Perry, "Desert Storm and Deterence," *Foreign Affairs*, Vol. 70, No. 4, Fall 1991, pp. 66-77; James A. Winnefeld et al., *A League of Airmen: U.S. Air Power in the Gulf War*, RAND, 1994, pp. 285-288; Eliot A. Cohen, "The Mystique of U.S. Air Power," *Foreign Affairs*, Vol. 73, No. 1,

January/February 1994, pp. 123-124; Stephen T. Hosmer, *Psychological Effects of U.S. Air Operations in Four Wars 1941-1991: Lesson for U.S. Commanders*, RAND, 1996, pp. 141-175; Robert A. Pape, *Bombing to Win: Air Power and Coercion in War*, Cornell University Press, 1996, pp. 240-250; Thomas G. Mahnken and Barry D. Watts, "What the Gulf War Can(and Cannot)Tell Us about the Future of Warfare," *International Security,* Vol. 22, No. 2, Fall 1997, pp. 151-152; Thomas A. Keaney, "The Linkage of Air and Ground Power in the Future of Conflict," *International Security,* Vol. 22, No. 2, Fall 1997, pp. 147-150.

16 Keaney and Cohen, *Revolution in Warfare?*, pp. 124-137; Eliot A. Cohen ed., *Gulf War Air Power Survey, Planning* [hereafter *GWAPS, Planning*], U.S. Government Printing Office, 1993, pp. 223-232.

17 69,406 of 118,661 (58%), the total sorties of multinational forces aircraft was USAF. Keaney and Cohen, *Revolution in Warfare?*, pp. 156-157.

18 Eliot A. Cohen ed., *Gulf War Air Power Survey, Command and Control* [hereafter *GWAPS, Command and Control*], U.S. Government Printing Office, 1993, pp. 7-24; *GWAPS, Operations*, pp. 98-110.

19 Gray, *Explorations in Strategy*, pp. 67-77, 101-103.

20 Richard P. Hallion, "Air Power Past, Present and Future," in Richard P. Hallion ed., *Air Power Confronts an Unstable World*, Brassey's, 1997, p. 3.

21 Bernard C. Nalty ed., *Winged Shield, Winged Sword: A History of the United States Air Force*, 2 vols., Air Force History and Museums Program(United States Air Force), 1997; Warren A. Trest, *Air Force Roles and Missions: A History*, Air Force History and Museums Program(United States Air Force), 1998; Robet F. Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, 2vols., Air University Press (United States Air Force), 1989.

Air power books written in Japanese are, for example, 石津朋之他編著『シリーズ軍事力の本質① エア・パワー』芙蓉書房、2005；石津朋之、Williamson Murray 共編著『21 世紀のエア・パワー　日本の安全保障を考える』芙蓉書房、2006. The former examines the history and future prospect of century-long air power and the latter enters into the air power issues in relation to the security issues of our country. These two books put together briefly how air power came to occupy the high position in the US security. Introductory books for general readers are 郷田充『航空戦力』上下巻、原書房、1978；生井英考『空の帝国　アメリカの 20 世紀』講談社、2006；源田孝『ストラテジー選書③アメリカ空軍の歴史と戦略』芙蓉書房、2008；田中利幸『空の戦争史』講談社現代新書、2008.

22 Juliette A. Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, United States Air Force, 1958; I.B. Holley Jr., *Ideas and Weapons*, Yale University Press, 1953.

23 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 1-11; Richard P. Hallion,

Taking Flight: Inventing the Aerial Age from Antiquity through the First World War, Oxford University Press, 2003, pp. 66-70; Leonard Cottrell『気球の歴史』西山浅次郎訳、大陸書房、1977, pp.136-137. Several new weapons were used in the Civil War, which changed greatly the aspects of military operations, such as machine gun, submarine, and field telegraph. J.F.C. Fuller, *Armament and History: A Study of Armamnt on History from the Dawn of Classical Warfare to the Second World War*, Da Capo Press, 1998, pp. 118-119.

24 Roger E. Bilstein, *Flight in America: From the Wrights to the Astronauts*, Johns Hopkins University Press, 1994, p. 6.

25 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 11-14.

26 Daniel T. Davis, "The Air Role in the War Between the States: The Civil War Balloon Activities of Professor Thaddeus S.C. Lowe," *Air University Review*, July/August 1976, http://www.airpower.au.af.mil/airchronicles/aureview/1976/julaug/ddavis.html.

27 Russell F. Weigley, *History of the United States Army*, The Macmillan Company, 1967, p. 291

28 David A. Armstrong, *Bullets and Bureaucrats: The Machine Gun and the United States Army, 1861-1916*, Greenwood Press, 1982, pp. 209-214. They disliked carrying dismantled machine guns in the Indian Wars, so the US Army seldom used machine guns. John Ellis, Social History of Machine Gun, translated by Michio Ochi, Heibonsha, 1993, p.121.

29 Weigley, *History of the United States Army*, p. 567; Richard W. Stewart ed., *American Military History: The United States Army and the Forging of a Nation, 1775-1917*, Vol. 1, United States Army, 2005, pp. 304-340, http://www.history.army.mil/books/AMH-V1/index.htm; Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, p. 11.

30 Ronald J. Barr, *The Progressive Army: US Army Command and Administration 1870-1914*, Macmillan Press, 1998, pp. 5-6; Weigley, *History of the United States Army*, p. 291. At that time, they pointed out that the British Army oldest Artillery captain was younger than the US Army youngest Artillery captain.

Russell F. Weigley, *Towards an American Army*, Greenwood Press, 1974, p. 139.

31 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 12-13.

32 Ibid., p. 13.

33 Ibid., pp. 13-14. It was 1906 that US Army obtained a compressed hydrogen producer.

34 Ibid., p. 16; Lennart Ege, *Balloons and Airships 1783-1973, The Pocket Encyclopedia of World Aircraft in Colour*, Blandford Press, 1973, pp. 135-149. For example, German Army introduced an airship in 1903, French Army in 1905.

35 Charles H. Gibbs-Smith, *Aviation: An Historical Survey from Its Origins to the End of World War II*,

Her Majesty's Stationery Office, 1985, pp. 63-68.

36 Ibid., pp. 94-104.

37 Holley Jr., *Ideas and Weapons*, p. 26; Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, p. 25.

38 Robert F. Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force 1907-1960*, Vol. 1, Air University Press, 1989, p. 16.

39 Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, pp. 11-12.

40 Holley Jr., *Ideas and Weapons*, p. 27.

41 Ibid., pp.27-28; Stewart ed., *American Military History*, pp. 365-372; Allan R. Millett and Peter Maslowski, *For the Common Defense: A Military History of the United States of America*, Free Press, 1984, p. 326.

42 Trest, *Air Force Roles and Missions*, p. 2.

43 Holley Jr., *Ideas and Weapons*, p. 29.

44 James J. Cooke, *The U.S. Air Service* 44 *in the Great War, 1917-1919*, Praeger, 1996, p. 3.

45 Henry H. Arnold, *Global Mission*, Harper & Brothers, 1949, pp. 16-17, 30-31.

46 John F. Shiner, *Foulois and the U.S. Army Air Corps 1931-1935*, United States Air Force, 1983, p. 6.

47 Arnold, *Global Mission*, p. 31.

48 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 58-59; Daniel L. Haulman, *One Hundred Years of Flight: USAF Chronology of Significant Air and Space Events 1903-2002*, United States Air Force, 2003, p. 10.

49 Maurer Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, United States Air Force, 1978, p. 91; Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, pp. 28-30.

50 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 40-45.

51 Futrell, *Ideas, Concepts, Doctrine*, Vol. 1, p. 16.

52 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, p. 58.

53 Ibid., pp. 72-73.

54 Hallion, *Taking Flight*, pp. 300-302.

55 Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, p. 27; Maurer ed., *The U.S. Air Service in World War I* , Vol. 2, p. 8.

56 Ibid., p. 9.

57 Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, p. 28; Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 109-110. However, the aviation department continued to be positioned under the control of the communication division, and Beck's assertion that the aeronautical section

should be independent of the communication division did not come true.

58 Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, p. 3.

59 Ibid., pp. 10-12.

60 Williamson Murray, *War in the Air 1914-1945*, Collins, 2005, pp. 36-40; Gibbs-Smith, *Aviation*, pp. 172-174.

61 Futrell, *Ideas, Concepts, Doctrine*, Vol. 1, p. 18.

62 Murray, *War in the Air 1914-1945*, pp. 73-78.

63 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, p. 128.

64 Ibid., p. 196; Maurer ed., *The U.S. Air Service in World War I* , Vol. 2, p. 411. The size of US ArmyAir Force at the time of war entry was 65 officers and 1,100 NCOs. At the time of cease-fire, 17 months later than that, it was 7,726 officers and 70,769 NCOs. Department of the Army, *United States Army in the World War 1917-1919: Reports of Command-in-Chief, A.E.F., Staff Sections and Services*, 1948, p. 236.

65 Robin Higham, *Air Power: A Concise History*, Redwood Press, 1973, p. 29. ; Hallion, *Taking Flight*, p.377. French Army Staff Department was studying the size and formation of air unit which they should expect from the United States while US war entry was approaching. The study showed they had expected US Army Air Force to maintain the front line power of 4,500 aircraft and to supply 2,000 aircraft per month for that. The Joint Army-Navy Technical Board dispatched an investigating commission to Europe in May 1917, which was established in US for researching demand for aircraft production in relation to war entry. The investigating commission reported the expected size of air unit was 3,000 reconnaissance planes, 5,000 fighters and 1,000 bombers. Holley Jr., *Ideas and Weapons*, pp. 42-45.

66 This dispatch originated from an incident where an American was killed after a group led by Mexican revolutionist Pancho Villa crossed the border from Mexico to US. Then, US sent troops to Mexico for reciprocal attack over Mexico.

67 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, 67 pp. 167-168, 197; Maurer ed., *The U.S. Air Service in World War I* , Vol. 2, pp. 75-78; Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, p. 28.

68 Holley Jr., *Ideas and Weapons*, pp. 59-60. The US National Advisory Committe for Aeronautics requested US Army Communication Division to send an investigating commission for researching air situations in Europe. Then, an investigating commission headed by Colonel R.C.Bolling was dispatched.

69 Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, pp. 41-51.

70 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp. 125-127.

71 Cooke, *The U.S. Air Service in the Great War*, p. 7. Schia became a person in charge of Aeronautical Department of Communication Division after he came back from Britain.

72 Hennessy, *The United States Army Air Arm, April 1861 to April 1917*, pp.128-129. The pursuit plane mentioned here was an airplane that had a large body equipped with 2 or 3 machine guns, filling the role of escorting a reconnaissance plane. The fighter plane had the role of eliminating enemy planes, making use of its small size and excellent mobility.

73 Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, p. 93. For example, he maintained that the striking power of machine guns carried by aircraft was still in inspection stages. Scriven introduced his experience as military attaché of the United States in Italy, and notice the military merit of reconnaissance operation by captive balloons, while he scarcely mentioned the military merit of aircraft as striking power.

74 Ibid., pp. 119-123. When the US announced its war entry, 5 US Army air officers had been stationed overseas. Three of them were receiving training in France, another was a military attaché aide in Britain and the other had been dispatched to watch the fight of the French Army. His name was William Mitchell. Holley Jr., *Ideas and Weapons*, p. 37.

75 Ibid., p. 135.

76 Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, p. 141. Maj. Gorrell became Chief of the Technical Section, Air Service, American Expeditionary Forces on 15 August 1917.

77 Holley Jr., *Ideas and Weapons*, pp. 140-145.

78 Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, pp. 161-162. The organization and Chief of Air Service, AEF were changed several times. For example, Chief of Air Service , AEF, was changed from William L. Kenly, Benjamin D. Foulois to Mason L. Patrick. Mitchell had great powers over operations of Air Service, AEF, as Commander of Zone of Advance. The following details the organization of Air Service, AEF. Nalty ed., *Winged Shield, Winged Sword*, Vol. 1, pp. 60-62.

79 Alfred F. Hurley, *Billy Mitchell: Crusader for Air Power*, Indiana University Press, 1975, pp. 28-30; Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, pp. 107-108.

80 Hurley, *Billy Mitchell*, pp. 25-28. Especially, it is said he was strongly influenced by Trenchard, Royal Flying Corps. Trenchard is said to have directly told Mitchell the importance of large-scale and consecutive bombing operations.

81 Holley Jr., *Ideas and Weapons*, p. 48.

82 The Air Support Squadron was an organization which was made up temporarily by an air unit dispatched to Europe. The Air Support Squadron which had been established as wartime exceptional

measures was formally systematized in 1920. This Air Support Squadron was later expanded and re-formed into US Army air Division or US Army Air Force.

83 Air Service, A.E.F., *Bulletin of the Information Section*, Vol. 3, No. 132, 30 April 1918, quoted in Maurer ed., *The U.S. Air Service in World War I*, Vol. 2, p. 175.

84 Headquarters, Third Army American Expeditionay Forces, *Provisional Manual* 84 *of Operations*, 23 December 1918, quoted in Maurer ed., *The U.S. Air Service in World War I* , Vol. 2, pp. 286-292.

85 Department of the Army, *United States Army in the World War 1917-1919*, p. 230; Greer, *The Development of Air Doctrine in the Army Air Arm 1917-1941*, pp. 5-6.

86 Department of the Army, *United States Army in the World War 1917-1919*, p. 225.

87 Chris Argyris and Donald A. Schön, *Organizational Learning II: Theory, Method, and Practice*, Addison-Wesley, 1996, pp. 20-25.

88 Williamson Murray, "Innovation Past and Future," in Williamson Murray and Allan R. Millett ed., *Military Innovation in the Interwar Period*, Cambridge University Press, 1998, pp. 322-324.