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Take Off to Superiority: The Evolution & Impact of U.S. Aircraft in War

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TAKE OFF TO SUPERIORITY:
THE EVOLUTION & IMPACT OF U.S. AIRCRAFT IN WAR

An Undergraduate Honors Thesis
Submitted in Partial fulfillment of
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University of Nebraska-Lincoln

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Abstract

Military aviation has become a staple in the way wars are fought, and ultimately, won. This research paper takes a look at the ways that aviation has evolved and impacted wars across the U.S. history timeline. With a brief introduction of early flight and the modern concept of an aircraft, this article then delves into World Wars I and II, along with the Cold, Korean, Vietnam, and Gulf Wars. The current War on Terrorism is then investigated, and finally, a look toward the future. Topics covered include the newest aircraft of each era, technological advancements, and how strategy and war planning was changed with these evolutions.

Key Words: Aircraft, Aviation, History, Impact, Innovation, War

Dedication

This paper is dedicated to all
the brave men and women
who have given their life
in the pursuit and protection
of freedom for their country.

All Gave Some...Some Gave All

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Take Off to Superiority: The Evolution and Impact of U.S. Aircraft in War

Intro

Thought to have been one of the most revolutionary inventions of the 20th century, the airplane has become one of the most pivotal machines in the world today. Touching almost every facet of society, aircraft impacts the transportation of people, packages, equipment, and nearly every known consumable. While they have become essential to life in peacetime, airplanes and other aircraft have also been proven indispensable in times of war, which will be the focus of this research. **Implementation and advancements in aircraft have significantly changed the face of major U.S. wars throughout time.** However, to get a firm grasp on just how significantly war has been changed, one must start at the beginning, that is, with the invention of early aircraft that led to the modern plane as we have come to know it.

Early Flight (Pre-1914)

Before planes and other craft, the dominating force in the sky were balloons and blimps, or “zeppelins” (Taylor & Guilmartin, 2018). These aircraft typically had an airtight canvas stretched over a light metal or wooden frame that would then be filled with hydrogen to float. While most balloons were small and stationary and used mainly for short-sighted recon missions, zeppelins were outfitted with motors and could deliver relatively heavy payloads some distance, capable of devastating ground attacks (Taylor & Guilmartin, 2018).

Finally, on December 17th, 1903, Orville and Wilbur Wright finalized the famous original Wright Flyer. Muslin cotton stretched over a wooden framework and a 12-horsepower engine, driving two propellers, yielded that first successful, manned, heavier-than-air flight (Hsu, 2019). Lasting a mere twelve seconds and roughly 120 feet, this short flight proved that man had the potential to conquer the skies. The original Wright Flyer flew three more times and set its final record at 59 seconds of flight and covered just over 850 feet (Hsu, 2019).

Five short years after inventing the first heavier-than-air craft, the Wright Brothers received the first contract for a military airplane from the U.S. government. One year later, in June 1909, they delivered an airplane listed as “Airplane No. 1, Heavier-than-air Division, United States aerial fleet” (Taylor & Guilmartin, 2018). This was only the beginning of military aviation and very far from the end.

As news of the first controllable, sustained flight spread around the world, developments in its use for war came sporadically. Countries began experimenting with better reconnaissance aircraft, implementing weapon systems, and even experimenting with bombs (Taylor & Guilmartin, 2018). The first use of an airplane in war was on October 23, 1911, during the Italo-Turkish War. An Italian pilot made a one-hour reconnaissance flight over enemy positions near Tripoli, Libya. The first “bombing” raid came nine days later when a pilot dropped four grenades on Turkish positions (Taylor & Guilmartin, 2018). Three short years after the new airplane saw its first “combat”, World War I broke out. This would be the United States’ first introduction to aerial warfare and where the evolution of their military aircraft would begin.



1903 Wright Flyer

Photo Courtesy of Smithsonian Institution

World War I (1914-1918)

Intro

When World War I broke out in 1914, zeppelins and balloons still controlled the skies. The new airplanes were mostly used for reconnaissance, with the occasional explosive ordinance dropped here and there. These emerging machines' engines were only big enough to carry a pilot and occasionally an observer for short periods of time (Taylor & Guilmartin, 2018). However, the recon missions were essential to changing the tide of battles. It soon became evident that denying the enemy this opportunity would change the outcome of war.

U.S aviation technology in World War I was still in its infancy. As the United States did not enter the war until 1917, they were significantly behind their European Allies when it came to military aircraft use and production. America was capable of mass-producing engines and vehicles but airplane design was still new and considered more of a novelty (Bergs, 2017). As a result, American aviators relied heavily on France, the leader in aircraft production at the time. By the end of the war, Americans had received 5,151 French aircraft, while only 1,213 of which were American-made (Bergs, 2017). Even though airplanes were primitive, there were a few noteworthy progressions in their development due to WWI.

Pivotal Aircraft

Aircraft	Type	Year
Curtiss JN-4 “Jenny”	Trainer	1915
Wright Model L	Reconnaissance	1916
Thomas-Morse S-4	Trainer/Recon	1917
Curtiss H-16	Seaplane	1917
Standard J	Trainer/Recon	1917
Martin MB-1	Bomber	1918

Advancements

While the first airplanes were used strictly for reconnaissance, advancements came quickly enough. The most important improvements were to power and maneuverability. With larger engines and more reliable wings, the new airplanes were able to carry more weight, including more people, radios, and, most importantly, armament. Prior to engine improvements, enemy pilots could exchange little more than smiles and waves. Now pilots could carry weapons and others trained to shoot in order to take down enemy aircraft. Finally, on October 5, 1914, French pilot, Louis Quenault, opened fire on a German aircraft with a machine gun for the first time and the era of air combat was underway (Weist, 2014).

Another important advancement, improved communication techniques, allowed observers to communicate with the ground more effectively. While relatively primitive methods were used at first, such as signaling and dropping notes, they were still

effective. Observers could call out enemy positions, patrols, artillery, and vulnerabilities. This important intel allowed for commanders on the ground to make crucial strategy changes when attacking, making these attacks more successful and deadly. One example was on 22 August 1914, British Pilot Captain Charlton, reported that the German army was preparing to surround friendly forces. The British High Command took note of the report and started to withdraw from Mons, saving the lives of 100,000 soldiers (Weist, 2014). While WWI's use of aircraft was significantly rudimentary, it was a fundamental stepping stone for innovation in the years to come, especially when it came to military power.



Curtis JN-4

Photo Courtesy of Smithsonian Institution

World War II (1939-1945)

Intro

Merely twenty-eight years after “the war to end all wars” concluded, World War II broke out across the globe. While the U.S. had adopted a feeling of isolationism after the first war, Japan’s surprise bombing of Pearl Harbor on 17 December 1941 prompted American forces into action (History, 2009b). Luckily enough, the American military aviation industry underwent a complete transformation. From the feeble, crude aircraft of WWI, these new and improved planes had undergone significant improvement and advancements (Taylor & Guilmartin, 2018). These advancements and innovations will be mentioned next.

Pivotal Aircraft

Aircraft	Type	Year
Douglas B-23 Dragon	Bomber	1939
Lockheed Hudson	Bomber/Recon	1939
Brewster F2A (Buffalo)	Naval Fighter	1939
Boeing P-26A	Fighter	1934
Boeing B-17 Flying Fortress	Bomber	1937
Boeing B-25 Mitchell	Bomber	1941
Boeing B-29 Superfortress	Bomber	1943
Douglas A-26	Attack	1944
Lockheed P-38 Lightning	Attack	1939
Vought OS2U Kingfisher	Recon Seaplane	1940

Advancements

Easily the most important evolution was in the very structure and composition of the airplanes. According to Encyclopedia Britannica, the typical aircraft in 1918 was a fabric-covered, externally braced biplane with fixed landing gear and open cockpits (Taylor & Guilmartin, 2018). By 1939, the first-line combat aircraft of the major powers were all-metal monoplanes with retractable landing gear.

What made this structural change possible? The answer: better engines. The best WWI planes had engines that produced 250 horsepower and top speeds of 120 mph. WWII planes were now powered by engines that developed 1,000+ horsepower and fighters were capable of exceeding 350 mph. Some bombers even flew faster than 250 mph at full capacity (Taylor & Guilmartin, 2018).

Furthermore, better flight instruments and powered cockpits allowed for flying at night and in poor weather conditions. These advanced, closed cockpits also allowed for pressurization and oxygen could be supplied for flying at higher altitudes. Radio communications between aircraft and ground control were significantly improved, thus making it possible to communicate by voice instead of signals (Taylor & Guilmartin, 2018).

The final important advancements that WWII brought was the introduction of the helicopter and the jet engine. While they were very primitive, the introduction of both

concepts laid the groundwork for very viable military machines. Neither of them would be refined by the end of the war but were extremely lucrative ideas for their time.

Changes in Strategy

Aside from physical changes in aircraft, WWII also brought around an onslaught of transformations in the way wars were waged. Thanks to the new and improved aircraft, tactics and uses of these planes were significantly changed. New importance was placed on air superiority, as in controlling the airspace over the enemy. This allowed for uncontested and relentless attacks.

The biggest change in tactics that the air war saw in WWII was the use of strategic bombing to take out significant military targets. Formations of bombers would be sent, typically at night for an element of surprise, to destroy everything from factories to docks and other military targets. These massive formations were never meant to evade enemy countermeasures, but rather, just overpower them with numbers (Maclsaac, 2016). However, these early bombers were still slow and vulnerable to enemy planes. To help mitigate losses of bombers, often the formations were escorted by the smaller, lighter fighters that would engage enemy aircraft well before they got to the formation (Maclsaac, 2016).

Another important tactical shift was the use of airpower to assist ground forces. This applied to both attacking enemy ground forces and supplying allied forces with

transport and airborne troops. Reinforcements and rations could be dropped from planes in order to maintain forces on the ground. American fighter-bombers, such as the P-51 and P-38 could fly fast and low, avoiding radar and could attack enemy infantry positions with ease, helping allied forces progress rapidly (Buckley, 2003).

With the onset of the jet age toward the end of World War II, strategy and tactics would no doubt change again soon.



B-17 Flying Fortress Formation

Photo Courtesy of American Air Museum

Cold War (1947-1991)

Intro

The Cold War was a period of tension between the U.S.A. and the U.S.S.R. Both countries at the time were competing to outgun the other in terms of nuclear armament. It is hard to investigate which aircraft were developed for the “Cold War” because it was not a “war” in and of itself. However, it led to major conflicts that were, namely the Korean and Vietnam Wars (History, 2009a). The advancements and changes in strategy will be investigated for those respective wars, while a general ideology change will be focused on for the Cold War.

Pivotal Aircraft

Aircraft	Type	Year
Bell AH-1 SuperCobra	Attack Helicopter	1971
Boeing KC-10 Extender	Refueler	1981
Lockheed Martin U-2 Dragon Lady	Reconnaissance	1955
Lockheed SR-71 Blackbird	Reconnaissance	1966
Lockheed P-38 Lightning	Attack	1939
SM-65 Atlas	ICBM	1957

Shift in Purpose

While the U.S. and the U.S.S.R. were allies against the Axis Powers in WWII, Americans soon began to feel aggression toward the Soviets due to their communistic beliefs and blood-thirsty dictator, Joseph Stalin (History, 2009a). Americans were worried that the Soviets' expansion into Europe was just the beginning of world-wide communism. To prevent this spread, U.S. leaders adopted a "containment strategy." America's only choice was the "long-term, patient but firm and vigilant containment of Russian expansive tendencies," according to President Truman (History, 2009a).

To help support this mission, U.S. military aviation leaders Boeing and Lockheed Martin stepped up to the plate. American military leaders needed to know what the Soviets were doing at all times in order to take preventative measures. Thanks to the new jet engines (further discussed in the "Korean War" section), planes could fly higher and faster than ever before. The U.S. took advantage of this when developing two new reconnaissance aircraft, the SR-71 Blackbird and U-2 Dragon Lady. The SR-71 was capable of flying three times the speed of sound and the U-2 was capable of flying above 70,000 feet. Both were used exclusively for spying and intelligence gathering (Kucher, 2010).

Another innovation in aircraft, thanks to the Cold War, was the Inter-Continental Ballistic Missile (ICBM). This missile was capable of delivering trans-oceanic, nuclear payloads and a formidable force for both the U.S. and U.S.S.R. By the end of WWII, both countries had developed their own versions of atomic bombs. The

tensions between the countries lead to a nuclear arms race, each trying to outnumber the other in atomic weapon stocks (History, 2009a).

The final change due to the Cold War was the evolution of spacecraft. On 4 October 1957, the U.S.S.R. launched Sputnik, the world's first artificial satellite and the first man-made object to be placed into the Earth's orbit (History, 2009a). The U.S., worried to lose ground to the Soviets, launched its own satellite in 1958, thus starting the "Space Race." The Americans eventually won the race when Alan Shepard became the first human in space. Neil Armstrong, also an American astronaut, was the first man to walk on the moon on July 20, 1969 (History, 2009a).

While the Cold War was the overarching instigator in this era of aviation evolution, the Korean and Vietnam Wars carried their own respective transformations and innovations.



SR-71 Blackbird

Photo Courtesy of Smithsonian Institution

Korean War (1950-1953)

Intro

The first major conflict that saw U.S. intervention during the Cold War was the Korean War. The United States Air Force (USAF) had become a separate branch only three years before North Korea invaded South Korea. Furthermore, the Korean War was the first war that the USAF was put to the test on its own, prompting several changes in aircraft and tactics. The modern face of the USAF was built on foundations laid in the Korean War (USAF, n.d.).

After WWII was finished, the United States accepted the surrender of the Japanese in Korea, south of the 38th parallel, while the Soviet Union accepted the Japanese surrender to the north (USAF, n.d.). After governments had been established, the Soviet's planned on leaving and challenged the US to do the same. However, thanks to Cold War tensions, the Soviets prepared a standing army in North Korea while the Americans only had a weak presence in South Korea (USAF, n.d.). In the summer of 1950, North Korea marched down past the 38th parallel, invading South Korea and starting the Korean War. During the march, six Yak-9Ps of the Korean People's Armed Forces Air Force flew to Kimpo airfield, near Seoul, and destroyed an American Douglas C-54 Skymaster. First blood had been drawn against the United States (Bonalume, 2018).

Pivotal Aircraft

Aircraft	Type	Year
Boeing B-50 Superfortress	Bomber	1948
Fairchild C-119 Flying Boxcar	Transport	1949
Lockheed Martin P-80 Shooting Star	Fighter	1945
McDonnell F2H Banshee	Fighter	1947
North American F-86 Sabre	Fighter	1949
North American F-28 Twin Mustang	Fighter	1946
Sikorsky H-19 Chickasaw	Utility Helicopter	1950

Advancements

With the advent of the Korean War, yet another era of aircraft arrived with it. The Korean War was the last major war that propeller-driven fighters were used. With the introduction and refinement of jet engines after WWII, American aviation shifted to pursuing the development of jet-powered fighters for their superior speed and maneuverability. By the 1950s, both the Soviet-backed North Koreans and the United States had near-sonic speed, swept-wing fighters (Buckley, 2003).

The U.S. had developed the F-86 Sabre to combat North Korean MiG-15's and would escort the B-50 Superfortress on long-range bombing missions. While the MiG-15 could climb higher and faster, the US Sabre was better armed and more accurate with six 50-caliber, radar-ranging machine guns (Buckley, 2003). US pilots also had the added advantage of their newly developed G-suits, specially designed to allow these

pilots to withstand more G's (the force of gravity) and out-maneuver the MiG-15's (Buckley, 2003).

The last major advancement of the Korean War was the extensive use of helicopters in combat. While Jeeps were the main method of transportation in WWII, helicopters dominated the movement of troops and supplies across the battlefield. Although they weren't refined enough for attack use, medical, troop, and cargo transportation times were greatly mitigated due to helicopter use (Hughes, 2016).

Changes in Strategy

The first and most obvious change in strategy was the new face of aerial warfare due to new jets. Dogfighting strategy shifted from slow-paced "cat and mouse" chasing techniques to highly-advanced, tactically maneuvered formation fighting. The jet fighter tactics used today were developed during dogfights between North American F-86's and enemy MiG-15's over Korea (Clarke, 2004). Newer technology was also inspired such as aerial fighter refueling, night flying techniques, and swept-wing advantages (Dorr, 2014).

The next lesson learned from the Korean War was the need for rapid deployment over vast distances. When the war began, the US was not ready to deploy across the ocean. It was evident they needed to rethink their outlook on global readiness (Dorr, 2014). The Pentagon, at the time, thought aircraft carriers would be obsolete after World

War II. However, the carriers proved to be a decisive asset when it came to forward presence by providing rapid movement and flexibility of operations (Dorr, 2014).

Another lesson learned and implemented due to the Korean War was the emphasis placed on forward air control. Because the new jets flew too fast to be able to identify accurate targets, liaisons were needed to direct their attacks. Eventually, slower aircraft were procured to loiter over the airfield and direct jet attacks, making them incredibly effective. It was easy to see that forward air control tactics would be used well into the future (Dorr, 2014).



F-86 Sabre Formation

Photo Courtesy of ThoughtCo.

Vietnam War (1965- 1975)

Intro

Another momentous conflict, caused by the Cold War tensions, was the Vietnam War. After the Korean War, President Dwight D. Eisenhower declared that “never again would the United States become involved in a war such as the one in Korea in which the full capability of the US armed forces could not be employed.” As a result, military strategists focused on nuclear deterrence and massive retaliation instead of conventional warfare (Purdham, 2003). Starting potentially the most controversial war the US has entered, President Lyndon B. Johnson ordered U.S. Marine battalions to defend the American airbase at Da Nang, Vietnam, in March 1965. This move was intended to ban communism and protect political interests, officially engaging the United States in the Vietnam War (McNamara, 2019).

Pivotal Aircraft		
Aircraft	Type	Year
Bell UH-1 Huey	Utility Helicopter	1959
Boeing B-52 Stratofortress	Bomber	1955
Boeing CH-47 Chinook	Transport Helicopter	1962
Boeing KC-135 Stratotanker	Refueler	1957
Boeing RC-135 Rivet Joint	Reconnaissance	1962
Convair F-106 Delta Dart	Fighter	1959
Lockheed AC-130 Spectre	Gunship/CAS	1972
Lockheed C-130 Hercules	Cargo	1956
McDonnell Douglass F-4 Phantom II	Fighter	1960

Advancements

While the Vietnam War actually started in 1955, just three short years after the Korean War ended, the US did not enter until a decade later. Due to the relatively short period between the wars, there were no significant changes in the type of aircraft used in the war, however, there were a few noteworthy improvements. Hot on the tail of the Korean War, helicopters were still crucial to the battlefield.

The first advancement of that note was the changing face and uses of helicopters. While originally used primarily for troop and cargo transport, Vietnam transformed helicopters into much more. Principally, the Bell UH-1 “Huey”, was converted into a heavily armed gunship to provide support for progressing ground troops (Gross, 2002). Due to the heavily forested areas of Southern Vietnam, fast-moving jets rarely were able to accurately help. Helicopters often picked up the slack and delivered decisive firepower (Gross, 2002).

Helicopters were not the only aircraft that saw utilization changes specifically for Vietnam. Fixed-wing aircraft were also adapted to provide better support in the jungle theater. Cargo planes, slower and capable of carrying heavy payloads, were quickly modified into gunships as well. Due to their airlifting capabilities, they could carry more ammunition and fuel than the standard attack plane, allowing them to support troops for longer amounts of time. The AC-130 “Spectre”, a weaponized C-130, is the most famous of these cargo-gone-gunship conversions and is still used to support ground troops to this day (Gross, 2002).

Finally, Vietnam was the debut of space capabilities to support combat operations. Clouds and heavy rainstorms were very common in the region and disrupted low-level aircraft operations. Satellites could deliver almost real-time weather information that was critical to mission planning and success. Satellite communication was also used to deliver important, time-sensitive information around the globe. Simply by providing these two utilities, spacecraft solidified its military importance for future operations (Gross, 2002).

Changes in Strategy

Because Vietnam is quite geographically diverse, separate strategies were needed for Northern areas of Vietnam versus the South. Fighting in Southern Vietnam was contained in forested areas while the North is filled with mountainous terrain. Jets were able to operate more effectively in the North, leaving the south primarily to foot soldiers and helicopters.

Vietnam led to a new class of airmobile troops, and the introduction of "Air Cavalry" in the U.S, culminating in the extensive use of the aforementioned Huey helicopter, which would become a symbol of that war (Gross, 2002). Troops were able to land unexpectedly, attack, evacuate the wounded, and leave again in a matter of minutes. The Air Cavalry itself was not a forward attack force. Rather, they would wait to be called upon and then quickly mobilize – this led to the first glimpse of a rapid deployment strike force that war would see in the years to come.

Northern Vietnam saw a much different strategy, one that had been used for years previously – strategic bombing. The B-52 heavy bomber was developed in the late 1940s by Boeing and allowed the US to drop a volume of bombs unlike anything that had been seen before. Ordered by President Richard Nixon under the name Operation LINEBACKER II, 129 B-52 bombers dropped over 20,000 tons of explosives on Hanoi and its surrounding areas in 1972 (Marages, 2017). Operation LINEBACKER II bombings caused massive Vietnamese casualties and are typically credited as leading to the Paris Peace Accord that was signed the next month, ending the conflict.



F-4 Phantom II

Photo Courtesy of AirFacts

Gulf War (1990-1991)

Intro

When Iraqi leader, Saddam Hussein, ordered the invasion of Kuwait in August 1990, fellow Arab powers such as Saudi Arabia and Egypt called on the United States for help. Hussein defied United Nations Security Council's demands to withdraw from Kuwait by mid-January 1991, and the Persian Gulf War began with a massive U.S.-led air offensive known as Operation DESERT STORM (History, 2009c).

After 42 days of relentless attacks by the allied coalition in the air and on the ground, U.S. President George H.W. Bush declared a cease-fire on 28 February 1991 (History, 2009c). Modern airpower had effectively paved the way to a quick victory on the ground. The Gulf War was the first war arguably won solely due to the effectiveness of early air superiority.

Pivotal Aircraft

Aircraft	Type	Year
Boeing AH-64 Apache	Attack Helicopter	1986
Lockheed F-117 Nighthawk	Stealth Fighter	1982
Lockheed Martin F-16 Fighting Falcon	Fighter	1978
Boeing AV-8B Harrier II	Fighter	1985
Boeing AH-6 Little Bird	Attack Helicopter	1980
Boeing F-18 Hornet	Fighter	1983

Pivotal Aircraft Cont.

Aircraft	Type	Year
Boeing F-15E Strike Eagle	Fighter	1988
Sikorsky MH-53 PaveLow	Transport Helicopter	1981
Boeing E-3 Sentry	Air Control	1977
Fairchild Republic A-10 Thunderbolt II	Close Air Support	1976
Rockwell B-1 Lancer	Supersonic Bomber	1986
BGM-109 Tomahawk	Cruise Missile	1983

Advancements

In the nearly 20 years between the Vietnam War and the Gulf War, there were several technological leaps that translated directly to the world of aviation. Modern computers were able to be programmed capable of making calculations well beyond that of a human. Jets and other aircraft were continually outfitted with new technology such as radar and better communications and weapons systems. However, antiaircraft weapon systems were also making the same leaps in technology. This led to the emergence of two new tactical systems in the US Air Force's arsenal – stealth fighters and cruise missiles.

Because radar and other aircraft detection systems were constantly being improved, it was becoming harder and harder for aviators to gain the element of surprise. Realizing surprise was a decisive element, the US Air Force, along with Lockheed Martin, had been hard at work on the cutting edge of aviation technology – stealth. Stealth aircraft are designed to avoid detection using a variety of technologies that reduce the reflection/emission of radar, infrared, visible light,

radio frequency, and sound (Rao & Mahulikar, 2002). Lockheed Martin designed the F-117 Nighthawk, a stealth bomber, for the USAF just seven years before the Gulf War in 1983. Capable of entering enemy lines virtually undetected, F-117's were able to cripple Iraqi air defenses, allowing a hole for coalition forces to power through (Boyne, 1997).

Another impactful leap in technology was the invention of the cruise missile. Developed in 1983 as well, the BGM-109 "Tomahawk" is a long-range, all-weather, jet-powered, subsonic cruise missile that is primarily used by the United States Navy. Essentially a pilotless, flying bomb, the Tomahawk could be launched from ships and submarines in the Persian Gulf. Also, due to their incredible versatility, cruise missiles could be outfitted with numerous warheads, from conventional bombs all the way to a nuclear payload. Used in unison with F-117's and a few F-4's left from Vietnam, this trio of weaponry carved the path to a swift victory in the Gulf War.

Changes in Strategy

One of the biggest strategic changes due to the Gulf War was mobility - how the US moved countless troops and pieces of equipment in a very short amount of time. Within 38 hours of the deployment notice, the first F-15 aircraft had landed in Saudi Arabia and were ready to defend the Persian Gulf area (PBS, 2014). Desert Storm was the largest airlift since World War II. By the cease-fire, airlift had moved over 482,000 passengers and 513,000 tons of cargo into the area of operations (PBS, 2014).

Thanks to effective mobility and both strategic and operational planning, air power was the first fully usable power on the scene. It arrived quickly and in strength to a theater halfway round the world. Once there, it was able to strike effectively at long range (Winnefeld & Johnson, 1994). However, it is not enough to reach globally and to deploy power quickly; power must be sustainable after it arrives. The establishment, on short notice, of a massive support system for such a large force over an extended time was unique in the history of warfare (Winnefeld & Johnson, 1994).



F-117 Nighthawk

Photo Courtesy of Lockheed Martin

War on Terror and Beyond (2001- Future)

Intro

After the terrorist attacks on the World Trade Center on September 11, 2001, President George W. Bush declared a global “War on Terror.” “Every nation in every region now has a decision to make,” he said in a national address. “Either you are with us or you are with the terrorists” (History, 2019). American military aviation was ready to step up to the plate and answer the call to arms. The Air Force continued to design and produce new weapons systems that could face modern problems on all fronts.

Pivotal Aircraft

Aircraft	Type	Year
Boeing C-17 Globemaster III	Cargo	1995
Northrop Grumman E-8	ABM	1996
Northrop Grumman B-2 Spirit	Stealth Bomber	1997
Boeing F/A-18 Super Hornet	Naval Fighter	1999
Northrop Grumman RQ-4 Globalhawk	Recon Drone	2001
Raytheon T-6 Texan II	Trainer	2001
Lockheed Martin F-22 Raptor	Fighter	2005
General Atomics MQ-9 Reaper	Attack Drone	2007
Lockheed Martin F-35 Lightning II	Fighter	2016

Continuing the Legacy

Similar to the short span between the Korean and Vietnam Wars, the limited time between the Gulf War and War on Terror left little room for the advancement of technology and strategy. Fought throughout the Middle East, the War on Terror has been focused mainly in Iraq but also had conflicts in Iran and Afghanistan. During the 2003 invasion of Iraq, to defeat the regime of Saddam Hussein, aerial warfare continued to be vital (History, 2019). Tomahawk missiles were still being used (nearly 800 of them) and almost 14,000 combat sorties were flown in the Iraqi skies. Anti-aircraft weapons could not reach our high-altitude B-52's and could not detect the newest stealth bomber, the B-2 Spirit. By mid-April 2003, Iraqi resistance had largely ended (History, 2019).

The addition of 5th generation fighters and various drones has helped the United States continue to reign supreme on the aerial front. The F-22 Raptor and F-35 Lightning II, released in 2005 and 2016 respectively, are the US Air Force's current top-of-the-line fighters that are used in combat today. With unparalleled avionics and systems, they own the skies against foreign threats. Unmanned drones controlled from pilots on the ground such as the MQ-9 Reaper and RQ-4 Globalhawk provide reconnaissance and ground support without putting human lives in danger in the event of an accident.



Photo Courtesy of MilitaryMachiene

Looking to the Future

While the War on Terror may never come to a definitive end, the United States has continued researching and developing the aircraft of tomorrow's wars. The F-35 is set to be the multipurpose fighter for quite some time, but each of the military branches is in the development of some airframe or another as we speak. With the Air Force rolling out a new trainer and bomber in the next five years, they are leading the way for innovation. Within the next 10 years, the Navy has its eyes set on another new, multirole combat aircraft, while the Army and Marines are hard at work on helicopters. While advancements and changes in strategy will not be certain until they are written in history books in years to come, each branch currently has an aircraft in the making. All of the services (with exception of the Coast Guard) have announced innovative airframes coming within the next decade shown in the table below.

Upcoming Aircraft

Plane	Branch	Type	Year
Sikorsky VH-92	Marine Corps	Presidential Transport	2020
Boeing T-X	Air Force	Trainer	2023
Northrop Grumman B-21 Raider	Air Force	Stealth Bomber	2025
F/A-XX Program	Navy	Multirole combat aircraft	2030
H-X	Army	Multirole Helicopters	2030

Conclusion

In conclusion, it is easy to see how the role of modern aircraft has changed over the last century. From the dawn of the new flying machine in 1903 to the high-tech, weaponized jets today, aircraft continue to improve and diversify to meet the needs of changing fronts. From World War I and II, to the Cold War conflicts, the Gulf War, and the War on Terror, the weapons in the sky have been adapted and improved to help win wars. Advancements and changes in strategy that followed these wars and impacted aircraft were also discussed. Finally, a look toward the future was investigated, leaving the question as to where these sophisticated weapons of war will lead wide open. After all, the sky is no longer the limit.

Bibliography

- Bergs, C. (2017, April 10). The History of the U.S. Air Service in World War I. Retrieved from <http://centenaire.org/en/autour-de-la-grande-guerre/aviation/history-us-air-service-world-war-i>
- Bonalume, R. (2018, July 23). A New Era in Aerial Warfare Began During the Korean War. Retrieved from <https://www.historynet.com/a-new-era-in-aerial-warfare-began-during-the-korean-war.htm>
- Boyne, W. J. (1997). *Beyond the Wild Blue* (1st ed.). New York: St. Martins Griffin.
- Boyne, W. J. (2003). *The Influence of Air Power upon History*. New York: Pelican.
- Buckley, J. (2003). *Air Power in the Age of Total War*. London: UCL Press.
- Clark, M. A. (2004). The Evolution of Military Aviation. *The Bridge*. Retrieved from <https://www.nae.edu/File.aspx?id=7351&v=fdd1a810>
- Dorr, R. F. (2014, April 8). Air Power Lessons from the Korean War. Retrieved from <https://www.defensemedianetwork.com/stories/air-power-lessons-from-the-korean-war/2/>
- Gross, C. J. (2004). *American Military Aviation: The Indispensable Arm*. Texas: Texas A & M University Press.
- Head, R. G. (2016). WWI Aviation History Timeline. Retrieved from <https://www.worldwar1centennial.org/1181-timeline-of-wwi-aviation-history-demo.html>
- History.com Editors. (2009a, October 27). Cold War History. Retrieved from <https://www.history.com/topics/cold-war/cold-war-history>
- History.com Editors. (2009b, October 29). Pearl Harbor. Retrieved from <https://www.history.com/topics/world-war-ii/pearl-harbor>
- History.com Editors. (2009c, November 9). Persian Gulf War. Retrieved from <https://www.history.com/topics/middle-east/persian-gulf-war>
- History.com Editors. (2019, February 1). A Timeline of the U.S.-Led War on Terror. Retrieved from <https://www.history.com/topics/21st-century/war-on-terror-timeline>
- Hsu, J. (2019, June 17). The First Airplane: Wright Flyer. Retrieved from <https://www.space.com/16596-wright-flyer-first-airplane.html>
- Hughes, K. (2016, October 28). Army helicopters in Korea, 1950 to '53. Retrieved from https://www.army.mil/article/177302/army_helicopters_in_korea_1950_to_53

- Kucher, P. R. (2010). U-2 Dragon Lady. Retrieved from <https://www.sr-71.org/aircraft/u-2.php>
- MacIsaac, D. (2016, July 18). Air warfare. Retrieved from <https://www.britannica.com/topic/air-warfare>
- Marages, K. (2017, February 16). 6 Ways Aircraft Changed the Course of the Vietnam War. Retrieved from <http://mentalfloss.com/article/92288/6-ways-aircraft-changed-course-vietnam-war>
- McNamara, R. (2019, July 3). Why Did the US Enter the Vietnam War? Retrieved from <https://www.thoughtco.com/why-did-us-enter-vietnam-war-195158>
- PBS. (2014, April). air performance in operation desert storm. Retrieved from <https://www.pbs.org/wgbh/pages/frontline/gulf/appendix/whitepaper.html>.
- Purdham, A. E. (2003, October). America's First Air Battles. *The Cadre Papers*, 1(16). Retrieved from https://media.defense.gov/2017/Nov/21/2001847049/-1/1/0/CP_0016_PURDHAM_FIRST_AIR_BATTLES.PDF
- Rao, G.A., & Mahulikar, S.P.: (2002) "Integrated review of stealth technology and its role in airpower", *Aeronautical Journal*, v. 106(1066): 629–641.
- Taylor, J. W. R., & Guilmartin, J. F. (2018, October 31). Military aircraft. Retrieved from <https://www.britannica.com/technology/military-aircraft>
- Trueman, C. N. (2015, March 27). The Air War in Vietnam. Retrieved from <https://www.historylearningsite.co.uk/vietnam-war/the-air-war-in-vietnam/>
- USAF. (n.d.). KOREAN WAR. *NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE*. Retrieved from https://www.nationalmuseum.af.mil/Portals/7/documents/education/teacher_source_korean_war.pdf
- Wiest, A. A. (2014). *The Illustrated History of World War I*. London: Amber.
- Winnefeld, J., & Johnson, D. (1994, January 1). Air Power in the Gulf War. Retrieved September 8, 2019, from https://www.rand.org/pubs/research_briefs/RB19.html.