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**The Impact of Air Power on 20<sup>th</sup> Century Warfare**

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This thesis will trace the origins and development of the military aeroplane from the beginning of the 20<sup>th</sup> Century to its end. It will also examine the role and effect such machines had on 20<sup>th</sup> Century warfare and how technologies and tactics evolved to take full advantage of the aeroplane.

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## The Impact of Air Power on 20<sup>th</sup> Century Warfare.

Just as the horse-drawn chariot, the trebuchet and the arquebus changed the face of warfare in their own time, no weapon has come to define 20<sup>th</sup> century warfare more than the aeroplane. While the invention of the tank most certainly revolutionised land warfare, the aeroplane allowed for entirely new methods of waging war to be developed, from aerial reconnaissance (which had previously been conducted in some instances by slow, vulnerable balloons), to strategic bombing, to that classical form, the dogfight, which has endured in the public imagination, though it has changed a lot since the days of „Flying Circuses“ in the First World War. Indeed, to a pilot circa 1915, today’s aerial weapons (radar-guided missiles, smart munitions etc) would have been inconceivable, and yet they form an essential part of modern warfare.

While most of the romanticism of aviation (particularly in a military context) has been erased following the devastation of the Second World War, military aeroplanes still enjoy remarkable public appeal, with thousands (if not indeed several million) flocking to airshows such as Farnborough every year, often just to catch a glimpse of their favourite decommissioned war machine, and names such as Fokker, de Havilland and Grumman instantly recognisable, as are those of so-called „ace“ pilots, such as Douglas Bader, Eddie Rickenbacker, and of course, Manfred von Richthofen. Indeed, one would have to go very far to find someone who has never even heard of the Spitfire, widely regarded to be the ultimate symbol of Britain’s defiance in its darkest hour, though it had less of an impact on the Battle of Britain than the smaller Hawker Hurricane, the Spitfire, with its distinctive elliptical wings and Rolls-Royce Merlin engine<sup>1</sup>, passed into the public consciousness as one of the most famous aircraft of the Second World War, along with the North American P-51 Mustang and Mitsubishi A6M Reisen (better known as Zero).

However, it must not be forgotten that these machines are, above all else, weapons of war, products of humanity’s search for ever more efficient means of proving one’s superiority through the annihilation of one’s enemies. In this thesis, I will examine the development of the military aeroplane from the days of flimsy wooden biplanes to the sophisticated missile platforms of today, and their impact on warfare. Along the way, we shall see how aircraft engines, weaponry, even the design of the machines themselves, have evolved over the last 100 years, and also how some developments have led to entirely new spin-off technologies such as missiles, nuclear bombs, and even the Space Shuttle. Interspersed throughout will be extracts from official documents, pilot testimonials, and historian’s

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<sup>1</sup> [www.youtube.com](http://www.youtube.com)

perspectives on the use of aircraft in warfare, and also links to video clips of some of these machines in action (in the case of some older designs this will be mostly simulator footage), after all, it does little good to merely state that one aircraft performs better than another, it must be seen for oneself. This is certainly true in the case of some of the experimental designs I shall mention, many of which never entered service, but which historians and former pilots agree would have been very successful if they had. Rest assured however, this kind of „alternate history“ speculation will be kept to a minimum, and only used in the case of a single viable design.

Given that the 20<sup>th</sup> century saw some of the largest and bloodiest conflicts in the entire historical record, I have chosen five which I believe best illustrate the changes in aircraft design, tactics and weapons development which ensured that the aircraft involved were extremely influential in the course of, and eventual outcome of that conflict. The conflicts I shall focus on are the two World Wars (dealt with separately, of course), the Vietnam War, The Falklands War, and the wars of the 1990s, namely the Gulf and Balkans wars. I shall also be mentioning the likes of the Spanish Civil War and the Arms Race between the Cold War superpowers, to illustrate the development of better weapons and other technologies which are essential to today’s aerial warfare. However, to begin we must first examine the origins and history of aerial warfare up until the outbreak of war in 1914.

## Chapter I: Origin

It is widely accepted that the first aerial weapons were ancient Chinese kites, used primarily for reconnaissance and psychological warfare. According to the Chinese “*Record of Strange Events*”, Emperor Wu Di attempted to signal for help when he was surrounded by rebels at Taicheng, but this kite was intercepted by the enemy.<sup>2</sup> Chinese legends also portray the kite being used as a means of lifting a soldier into the air to spy enemy troop movements, and also as a means of spreading demoralising propaganda, a technique which would be repeated centuries later using aircraft. It was not until Marco Polo brought kites back from the East that the technology became widespread in Europe, from which point the device began to see use both scientifically (most notably Benjamin Franklin’s experiments) and militarily, as during the American Civil War, when they were used as a means of communication between forces, and also as a form of psychological warfare.

The manned balloon, too, became a successful reconnaissance tool, seeing widespread use among both Union and Confederate armies in the American Civil War. One can easily appreciate the value of these devices in warfare, giving commanders the ability to accurately map out the surrounding landscape, and observe the movements of enemy forces in the area. However, both kite and balloon have a set of common drawbacks: they cannot be deployed in adverse weather without being damaged or lost, they are extremely vulnerable to enemy fire should the enemy come into range, and their

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<sup>2</sup> [www.sacu.org/kitehistory](http://www.sacu.org/kitehistory)

mobility is severely limited due to their often being tethered to the ground for safety. It was clear that these restrictions limited the use of these devices, but it was not until the 20<sup>th</sup> century that aerial warfare would really take-off (pun intended).

Following the Wright Brothers' first successful powered flight of a heavier-than-air vehicle in December 1903, several countries began exploring the potential military uses of this new technology. However, there were many sceptics who believed that the aeroplane was of little to no military value; Canadian Minister of Militia and Defence, Sir Sam Hughes, said in 1914:

“The aeroplane is an invention of the devil and will never play any part in such a serious business as the defence of the nation”<sup>3</sup>

This kind of rhetoric did not deter the likes of Britain, which established the Royal Flying Corps in April 1912. The first use of aeroplanes in war, however, was by Italy, who used them for reconnaissance of Turkish positions in October 1911, and the first aerial bombing was conducted by Giulio Gavotti that November. However, it was with the outbreak of the First World War in 1914, that military aviation would start to come into its own.

## Chapter II: The Great War

Upon the outbreak of war in Europe in 1914, each of the participant nations fielded their own air forces, to be used in a tactical reconnaissance role. As aircraft proved to be quite successful in this role, it became clear that the ability to deny one's enemy the same success would be advantageous. To this end, pilots began carrying small arms (pistols, carbines and the like), in an effort to shoot down the enemy, however this proved ineffective, as aircraft were often simply flying too fast to be hit by anything short of a lucky shot. This led to the almost comically gentlemanlike situation where two opposing airmen would circle each other firing whatever weapon they had brought with them until they had expended their ammunition, whereupon they would wave to each other, disengage, and fly back to their own lines. However, one weapon was to make aerial warfare much more vicious. The machine-gun, with its high fire rate, was realised to be the optimum weapon for bringing down enemy aircraft, however, mounting the weapon would prove a significant challenge. Vickers had designed an aircraft using a pusher configuration, with the propeller at the rear, to free up the nose for a 7.7mm Lewis gun mounted in front of the pilot's cockpit. However, this „Gunbus“, as it was nicknamed, had relatively poor performance, largely owing to the increased drag created by the tail boom, which was attached directly to the wing section. Aircraft with a tractor configuration (with the propeller at the front) had a serious problem regarding forward-firing guns, in that the pilot risked shooting off his own propeller. The French were the first to attempt to design a solution to this problem, when Roland Garros fitted steel plates to his propeller, which deflected rounds away that otherwise would have

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<sup>3</sup> Jarrett, p.69

damaged it. This system was, although effective, dangerous for Garros, nevertheless, he achieved 3 shoot-downs (or „victories“) with it, becoming the first „ace“ pilot in history.<sup>4</sup> The need for a more efficient system became apparent, however, and the Germans looked to Dutchman Anton Fokker to come up with a new design. Fokker devised a mechanical „interrupter gear“, which stopped the machine-gun from firing whenever one of the propeller blades passed in front of the barrel, and the first confirmed victories were achieved by Lieutenants Max Immelmann and Oswald Boelcke in August, 1915. Using Fokker’s EI Eindecker monoplane, Germany’s best pilots, among them Immelmann and Boelcke, devised a series of offensive tactics that made best use of these new „fighting scouts“, leading to the infamous „Fokker Scourge“, when Germany enjoyed relative air superiority over the Allies.

Boelcke is an extremely important figure in this period, as it was he who devised a plan to reorganise the German air force into dedicated fighter groups, or *Jagdstaffeln*, to escort their tactical support aircraft which engaged ground targets, and also to attack enemy fighters to achieve air superiority. Boelcke also designed a set of tactics for use in air combat, the *Dicta Boelcke*, which are as follows:

- “1. Try to secure the upper hand before attacking. If possible, keep the sun behind you.
2. Always continue with an attack you have begun.
3. Open fire only at close range, and then only when the opponent is squarely in your sights.
4. You should always try to keep an eye on your opponent, and never let yourself be deceived by ruses.
5. In any type of attack, it is essential to assail your opponent from behind.
6. If your opponent dives on you, do not try to get around his attack, but fly to meet it.
7. When over the enemy’s lines, always remember your own line of retreat.
8. Tip for squadrons: In principle, it is better to attack in groups of four or six. Avoid two aircraft attacking the same opponent.”<sup>5</sup>

It is a testament to Boelcke’s vision that the *Dicta Boelcke* remains a key foundation for modern air combat tactics, even though the face of such combat has changed immensely from Boelcke’s day. These tactics allowed for large-scale engagements between entire squadrons, the first dogfights, which ensured that aces such as Manfred von Richthofen and Albert Ball would become infamous, and squadrons such as Boelcke’s *Jasta 2* became legendary. Indeed, the success of the *Jagdstaffeln*

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<sup>4</sup> Leinburger, p.17

<sup>5</sup> Boelcke, 1916

led to the creation of the first *Jagdgeschwader* (Fighter Wing), which became known as the „Flying Circus“, in particular *JG I*, known as von Richthofen’s Flying Circus after its commander, the Red Baron himself (incidentally the highest scoring ace of the war, with 80 confirmed victories). However, the emergence of better Allied aircraft, such as the Sopwith Camel, and the deployment of US forces in Europe began to turn the tables on Germany’s air superiority, until, by early 1918, following the breakdown of the stalemate caused by the trenches, Germany launched multiple offensives, in an effort to regain the initiative. These offensives proved ultimately futile, as by this stage Germany’s fighter aircraft, including the Fokker Dr.I Triplane and Albatros D.V biplane were becoming obsolescent<sup>6</sup>, especially following the introduction of the Sopwith Snipe.

While the First World War allowed for a significant step forward in military aviation (namely in the evolution from scouts to pure fighters), aerial reconnaissance still had a significant impact on this conflict. Both sides recognised the value of such reconnaissance, being able to accurately map out the layout of enemy trenches and fortifications. To this end, pilots began carrying cameras onboard their aircraft, and aerial photographs of the trenches could be processed and passed along to commanders to inform their strategies. Indeed, this kind of reconnaissance work would prove influential in the Battle of Tannenberg in August 1914, when the German 8<sup>th</sup> Army under Field Marshall Paul von Hindenburg defeated the Russian 2<sup>nd</sup> Army under Gen. Alexander Samsonov. Hindenburg, upon his victory said that “without airmen there would have been no Tannenberg”<sup>7</sup>. However, aerial observation was not limited to reconnaissance, indeed, aircraft served a very important role for ground-based artillery, being able to direct the crew’s fire by observing where a shot landed, and, at first dropping signal flares to provide the crew with a visual marker, and then, as wireless technology advanced, by telegraphing the crews with messages on the accuracy and direction of the shot. This allowed artillery to become incredibly accurate and deadly weapons, which devastated the battlefield on a scale that had never before been seen. In this regard, the observer aircraft may be considered the first examples of the close-support aircraft that would be seen in later conflicts, and which have proven to be a valuable asset for ground forces around the world.

However, aerial warfare during this period was to see another great change, with the emergence of dedicated bomber aircraft. While air-dropped bombs had been used before the war, there were no aircraft capable of carrying large quantities of these munitions. The Germans had, in 1915, begun launching raids on Britain using Zeppelin airships, equipped with both incendiary and explosive bombs. The incendiaries would be used to „mark“ the target area so the crews knew where to direct the rest of their payloads. British anti-aircraft guns at the time were largely ineffective against this threat, which had an enormous impact on British morale. However, a countermeasure soon emerged when fighters armed with incendiary rounds were scrambled against Zeppelins. These rounds proved

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<sup>6</sup> <http://www.youtube.com/watch?v=CDvB6BBCxzg>

<sup>7</sup> [www.firstworldwar.com/airwar/observation](http://www.firstworldwar.com/airwar/observation)

lethal, piercing the airship's outer „skin“ and igniting the hydrogen gas bags used to keep them aloft. Ultimately, the airship raids were a failure, their effect being more psychological than strategic. Both sides then began to look to aircraft as a means of delivering a payload of bombs, and the concept of „strategic bombing“, which targeted the enemy's cities and industrial centres, came into being. Various aircraft were used as bombers, such as the Avro 504, used by the British Royal Naval Air Service to attack the German Zeppelin hangars. The Imperial Russian Air Force operated the Ilya Muromets, a converted four-engine passenger craft, and formed the first strategic bombing unit, equipped with this aircraft. The British also developed the Handley Page Type O, which was for its time, one of the largest aircraft in the world. The Type O was used primarily for daylight raids, being able to accommodate up to 907kg (2000lbs) of bombs, and was also used for night-time attacks on Turkish positions in the Middle East. This aircraft proved itself as not just a strategic bomber, but also as a tactical support bomber, as in the Middle East, where the Type O flew in support of the infamous T.E. Lawrence (Lawrence of Arabia). The Germans also began developing bombers to replace the Zeppelins, most notably the Gotha and Friedrichshafen models, to attack British targets across the English Channel. The success of this policy of strategic bombing was to set the standard for future conflicts, and also led to improvements in anti-air defences, such as anti-air artillery (AAA) and barrage balloons, which were tethered to the ground using solid, heavy cables, intended to damage aircraft that attempted to fly through them in an effort to attack ground targets.

While it can be argued that air power was to have only a minor role in the First World War, the aeroplane nevertheless proved its worth as a weapon, with the first examples of purpose-built aircraft like fighters and bombers, designed to perform specific tasks either by itself or in support of ground or naval units. This paved the way for the rapid development of the aeroplane that was to be seen over the next 20 years after the First World War.

### Chapter III: The Second World War

The inter-war years are widely referred to as aviation's „golden age“, the time when civil and commercial aviation really came into their own, and the pace of technological development was to match this, allowing for many advances in the field of aviation, such as Charles Lindbergh's solo crossing of the Atlantic in 1927, and contests such as the Schneider Cup providing competition for manufacturing firms, leading to the development of better and better designs. While in the 1920s military aviation was rather slow to catch up, the 1930s would see rapid and widespread changes in this field. By this time, most of the world's air forces were making the change from obsolete biplanes to monoplanes, which, thanks to racing competitions such as the Schneider Cup, now had improved engines, which allowed them to fly faster, further and higher than ever before. There was also a move away from wood and canvas towards aircraft built entirely from metal, one of which, the Bell P-26, would be the first all-metal monoplane to enter service with the US Army Air Corps (USAAC) in

1934. Germany, which under the terms of the Treaty of Versailles, was forbidden from possessing an air force, nevertheless established the Luftwaffe in 1935, under the control of Reichsmarshal Hermann Goering (who had been part of von Richthofen's handpicked squadron in the Great War). The first aircraft to enter service with this new force were all converted civil and commercial aircraft, most notably the Dornier Do17 (originally a mail plane), and Heinkel He111 (a passenger plane), which were both pressed into service as medium bombers. German participation in the Spanish Civil War from 1936-39 also allowed for the development of tactics which were to be used in the Second World War, for example the bombing of Guernica on the 27<sup>th</sup> of April, 1937 showed that inflicting mass casualties on civilians could be used to demoralise the enemy, and break their will to fight, indeed, this policy, thankfully now consigned to history, was to see widespread use during the Second World War, on both sides. The Spanish Civil War also proved the effectiveness of using light strike bombers to provide close support for ground operations, in particular the German Junkers Ju87 Stuka dive bomber, which would, using specialised dive brakes fitted to the wings to reduce speed, and thus, drag (without these brakes the pressure on the wing caused by air rushing past in a dive would literally rip them off), perform a near-vertical dive on a target, dropping its payload with lethal precision (plus the additional kinetic energy created by the dive). This technique would form a core part of the *Blitzkrieg* (Lightning War) doctrine tested in Poland (and first used in the invasion of France). This combined force doctrine relied on armoured columns advancing deep into enemy territory using fighters to provide air superiority (if not supremacy), with bombers essentially acting as mobile artillery, striking any targets the ground forces were impeded by. Following this, mechanised infantry units would be brought in to mop up remaining enemy forces. Blitzkrieg relied on constant communication between the units involved to be effective (radio proved more than adequate for this), and, as a result, the tactic proved to be extremely successful, not just militarily, but psychologically, particularly given the speed of the advance (and the design of the Stuka bomber: two air intakes on the wheel spats acted as a siren when the aircraft went into a dive).

The Blitzkrieg doctrine was first tested in the September 1939 invasion of Poland, however, its first „proper“ usage came during the invasion of France, whereby the German Panzer Divisions were able to bypass the French defences (in particular the heavily defended, but static Maginot Line) by simply outflanking them. The Battle for France lasted only six weeks, with the final surrender coming on the 22<sup>nd</sup> of June, 1940, during which time the German Wehrmacht and Luftwaffe defeated not just the French military, but also the British Expeditionary Force that had been deployed, and forced to retreat at Dunkirk, leaving behind the bulk of their heavy weapons and vehicles. The success of Blitzkrieg in France gave Germany the opportunity to focus entirely on defeating Britain, prompting plans for a proposed invasion codenamed Sealion. This paved the way for the now legendary „Battle of Britain“.

The Battle of Britain is particularly noteworthy as it was the first battle in history to be fought exclusively in the air, and indeed for being one of the Second World War's most decisive campaigns.



The initial objective given to Luftwaffe commanders in July 1940 was to achieve air superiority over the English Channel to pave the way for a full invasion. To this effect, small groups of Messerschmitt Bf109E fighters flew sorties over the Channel to lure the RAF into scrambling their fighters, leaving airfields and coastal targets vulnerable to attack by German bombers. However, engagements between RAF Spitfires and Hurricanes and the German Bf110 used to escort the bombers, served to illustrate the flaws in the 110's design; being a twin-engine heavy fighter (nicknamed the *Zerstörer*, or Destroyer), it was vulnerable to attack by the much lighter single-engine RAF fighters, despite the 110's heavier armament. Similarly, the fuel constraints on Luftwaffe escorts meant that, on average, they had at best 20mins of fuel to engage the RAF defenders. The RAF's Chain Home radar network too, allowed for squadrons to be scrambled exactly where they were needed to deal with incoming enemies. This prompted a change of tactics among Luftwaffe commanders, and a concentrated attack on Britain's defences was planned, known as *Adlerangriff* (Eagle Attack). This attack began with a strike by Bf110 *Jabos* (fighter-bombers, a role that actually suited the aircraft) on coastal radar stations on the 12<sup>th</sup> of August, with the planned assault due to go ahead the next day, however, that morning, Goering cancelled the attack due to poor weather being forecast. Not all units got the message, however, which led to one group of Do17s arriving over the target with no escort.

The successive failure of Luftwaffe tactics led to a complete turn-around following the 25<sup>th</sup> of August, 1940, when RAF Bomber Command launched an attack on Berlin, despite claims that such a situation would never come to pass. This prompted the Luftwaffe to switch from bombing military targets, to British cities, giving the RAF (who by this stage were suffering unsustainable losses), the reprieve they needed. This shift in focus eventually led to the indefinite postponement of *Sealion*, the end of the Battle of Britain, while German High Command turned their attention towards a new foe; the Soviet Union.

Despite possessing two diametrically opposed ideologies, Nazi Germany and the Soviet Union had, before the war, signed a Non-Aggression Pact, and had even divided Poland up between them following the 1939 invasion. Hitler, however, still made plans for a full invasion of the Soviet Union, with the objective of acquiring *lebensraum* (living space) for the German people. This invasion, codenamed *Barbarossa*, began on the 22<sup>nd</sup> of June, 1941, and once again, the *Blitzkrieg* tactic proved astonishingly successful, particularly in the air, where Luftwaffe bombers were able to attack Soviet airfields, destroying hundreds of aircraft on the ground (800 on the first day, according to the Luftwaffe)<sup>8</sup>, while Bf109E and F fighters enjoyed total superiority (the main Soviet fighter was the obsolete Polikarpov I-16). The Eastern Front allowed for the emergence of many great pilots, such as Erich Hartmann, Germany's Ace of Aces, who achieved most of his 352 confirmed victories on the Eastern Front, and Hans-Ulrich Rudel, who destroyed no less than 500 Soviet tanks in Ju87s, and who

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<sup>8</sup> Newdick, p.94

would be awarded the Knight's Cross with Oak Leaves, Swords and Diamonds, Germany's highest military honour.

Indeed, air-to-ground operations would characterise the Eastern Front, with German aircraft such as the Henschel Hs129 and Ju87G designed specifically for tank-busting (indeed both aircraft carried 37mm anti-tank cannon for this purpose), and Soviet equivalents such as the Bell P-39 Airacobra given under the Lend-Lease programme, and the Ilyushin Il-2 Sturmovik, a heavily armed (and armoured) attack aircraft, capable of carrying cannon, bombs, or even underwing rockets. These kind of aircraft would prove decisive in the Battle of Kursk, widely regarded to be the largest tank battle in history, where the effectiveness of the Sturmovik had a great impact on the Soviet offensive, destroying dozens of German Panzers. Stalin himself had said that "the Sturmovik is at least as essential to the Red Army as oxygen and bread"<sup>9</sup>. Following not just the defeat at Kursk, but also at Stalingrad (where the Luftwaffe failed to adequately supply German forces), and Leningrad, Germany was on the defensive, and would never achieve air superiority over the Soviets again, particularly after the introduction of better fighters such as the LaGG-3, La-5 and Yak-9. At the same time, Germany was increasingly forced to divert more and more aircraft to defend their own territory from Allied bombing campaigns, further weakening the German war effort.

It was widely believed during the inter-war years that the bomber was the pinnacle of military aviation, flying too high, too far and too fast to ever be stopped. However, as the Second World War proved, the reality was very different. The vulnerability of the bomber in daylight raids was made apparent early in the war, and the development of dedicated night-fighters (particularly by the Luftwaffe), making night-time raids little safer. Despite this, strategic bombing of enemy cities and industrial centres was still considered a viable tactic for damaging the enemy's capacity to wage war. To this end, RAF Bomber Command, under Arthur „Bomber“ Harris, adopted a policy of sending out large formations, often of hundreds of aircraft, to attack strategic targets within the Third Reich. Four-engine heavy bombers such as the Avro Lancaster (the same aircraft used by 617Sqn in the Dambusters Raid) and Handley Page Halifax proved ideal for this, being able to carry large payloads, along with the US Army Air Force's B-17 Flying Fortress, an extremely durable and heavily armed aircraft. However, these aircraft were still vulnerable to Luftwaffe interceptors such as the Bf109G and Focke-Wulf Fw190 (considered to be the best German fighter of the war), and required escort fighters which could stay with the formation to and from the target. These long-range fighters would not arrive until the development of the Republic P-47N Thunderbolt and North American P-51D Mustang (which used the Merlin engine), both of which had the fuel capacity for these escort missions. The introduction of these „Little Buddies“ certainly cut the number of bombers being lost over Germany, forcing the Luftwaffe to look to other designs to counter this threat. These included

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<sup>9</sup> Stalin, Josip V., 1941

the jet-powered Me262 Schwalbe, a revolutionary swept-wing fighter which, had it entered service earlier, would have exacted a heavy toll on Allied aircraft, and the Me163 Komet, a short-range rocket-powered interceptor, that was as dangerous to the pilot as it was to the enemy (the fuel mixture was unstable, and had an annoying tendency to spontaneously explode). Add to this the Komet's lack of proper landing gear (all it had was a skid) and low ammo capacity (two 30mm cannon holding 60 rounds each, roughly 3 seconds of firing time in total), and one can easily see why the Komet had such little impact (though it scared the hell out of the Allied crews who saw it: it was the fastest thing in the skies).

The constant pressure put on Germany by the Allied bombing campaigns virtually demolished German industry, and as a result, the German war machine grew steadily weaker as the war progressed. However, a different strategy would be needed to defeat the other major Axis power, Japan.

The Pacific War officially began on the 7<sup>th</sup> of December, 1941, with the attack by Japanese naval aircraft on the US base at Pearl Harbor on Oahu. The attack, planned by Admiral Yamamoto Isoroku, was carried out by aircraft from the carriers *Kaga*, *Akagi*, *Soryu*, *Hiryu*, *Shokaku* and *Zuikaku*, and was intended to cripple the US Pacific Fleet. Despite the success of this surprise attack, resulting in the loss of several US ships, including *USS Arizona*, and the destruction of many aircraft on the ground at Wheeler, Hickam, Ewa and Ford Island airfields, and the Kaneohe Naval Air Station, the attack failed in its objective to sink US carriers, specifically *USS Lexington* and *Enterprise*, which were on manoeuvres. The Japanese aircraft, which included D3A Val dive-bombers and B5N Kate torpedo-bombers, also failed to damage the repair facilities, and, most crucially, the oil stores at Pearl, which could have bought up to a year before America was ready to counterattack. The attack on Oahu coincided with multiple Japanese invasions all over the Pacific region, most of which were successful, although a small force at Wake Island (including only four F4F Wildcat fighters who bore the brunt of the invasion attempt) held out against successive attacks from the 8<sup>th</sup> to 23<sup>rd</sup> of December, 1941. However, Japan's success was limited, and the tide soon turned, with the loss of the light carrier *Shoho* in the Coral Sea, and, more devastatingly, the loss of all four main carriers, *Akagi*, *Soryu*, *Kaga*, and *Hiryu* at Midway in June, 1942 (although *Hiryu*'s aircraft did manage to cripple the US carrier *USS Yorktown*, which later sank). This, coupled with the „island-hopping“ US offensive, led to the adoption of the *Kamikaze* suicide strategy (named after the Divine Wind that destroyed the Mongol fleet in 1281, during their second attempt to invade Japan). This involved pilots flying their aircraft (which would be packed with explosives) into the deck of an enemy ship. There was even an aircraft specifically designed for this purpose, the MXY7 Ohka (Cherry Blossom), a piloted bomb where the operator, upon getting in would literally be sealed into the cockpit to prevent the „cowardly“ practice of trying to save his own skin to fight again. As a result, Japan lost most of their best pilots through this and the emergence of superior US fighters such as the P-38 Lightning (incidentally it was

a Lightning that shot down Admiral Yamamoto's transport plane in 1943), the F6F Hellcat, and F4U Corsair. This left Japan without aircraft to defend itself from numerous US raids, including the fire-bombing which destroyed large parts of Tokyo, however the real *shusui* (the name given to the death-blow from a katana when decapitating one's foe, incidentally also the name for the Japanese Ki200, a copy of the Me163 Komet) came on the 6<sup>th</sup> of August, 1945, when the B-29 Superfortress „Enola Gay“ dropped an atomic bomb named Little Boy on the city of Hiroshima, almost wiping it off the map, and killing roughly 70,000 people in a matter of seconds, and a second device dropped from „Bock's Car“ on Nagasaki three days later. These attacks, using the most destructive weapon ever seen, coupled with the threat of an attack from Russia, forced Emperor Hirohito to surrender unconditionally on the 15<sup>th</sup> of August.

There is little doubt that the aeroplane played a decisive role on all fronts in the Second World War, performing a variety of tasks. The war served to highlight the importance of several different kinds of aircraft, such as high-speed interceptors, strategic bombers (which would play an integral part in the Cold War), close-support ground-attack aircraft, and highly manoeuvrable (and often heavily armed) dogfighters. This kind of specialisation was not seen in the First World War, at least not to this extent, and still remains today (though many aircraft now can be considered „multirole“ machines: over the last 30 years, the fighter and interceptor have become one and the same). The Second World War had an enormous impact on warfare, particularly in the air, with developments such as the jet engine, the atomic bomb, the ballistic missile (Germany's V2, used as the basis for all future rocket development), and the growth of large strategic bomber forces, all of which were to play an important part in the Cold War that followed. While the US and Soviet Union had been allies during the war, once the Axis threat had been dealt with, both immediately became suspicious (or paranoid, in Stalin's case) of the other's industrial and military strength. This was further hampered by America's atomic weapons programme, which offset the balance of power, prompting other nations (notably the Soviet Union and China) to begin their own atomic programmes, to level the playing field. When the Soviet Union conducted their first atomic test in 1949, the threat of nuclear war (a concept that still horrifies the public today), became very real. However, throughout the Cold War, despite several crises (such as in Cuba), and constant posturing from the superpowers, the main forces of both the United States and the Soviet Union never directly clashed. Instead, various proxy conflicts were fought, in Korea, Vietnam, and Afghanistan. Of these, only Korea could be considered a traditional conflict, the others being fought between a large, well-coordinated military, and a guerrilla force. The Vietnam, in particular, highlights the failure of conventional military tactics against a guerrilla style opponent, and in many ways, such failures were repeated in the air, however, some exceptions in the air war would prove vital to the US war effort.

#### Chapter IV: The Vietnam War

The Vietnam War is, in many ways, due to America's desire to stop the spread of Communism wherever it could, as, under the Domino Theory, when one country „falls“ to Communism, its neighbours become increasingly likely to follow suit. The Communist Viet Minh organisation, which had overthrown the French in the 1950s, and were given control of the Northern half of Vietnam, represented a serious threat to US interests in the area (particularly in South Vietnam), such that, when US vessels in the Tonkin Gulf were reportedly attacked by North Vietnamese torpedo boats in 1964, US President Lyndon Johnson sanctioned an escalation of US involvement in Vietnam, including airstrikes on North Vietnamese Army (NVA) targets.

This led to the adoption of a continuous strategic bombing policy known as „Rolling Thunder“, carried out by large bombers such as the B-52 Stratofortress, designed to cripple NVA supply routes into South Vietnam (where the Viet Cong were waging their own guerrilla war in support of the North). In principle, this policy was sound, however, the reality was that no matter how much damage could be done to NVA supplies, they would simply receive more from their Soviet and Chinese allies. It was successful in some respects, however, often B-52s, designated Arc Light, flew too high to be detected from the ground. This meant that VC troops would have no warning that the area around them was to be obliterated by several tons of bombs, however, given the extensive intelligence network the VC had access to, on many occasions the B-52s were destroying nothing but jungle. While in some instances (particularly in attacks on the infamous Ho Chi Minh Trail), this was a desirable objective, it was of no military value, and the ethics of using weapons such as napalm, chemical defoliants and cluster munitions are still debated today. Rolling Thunder can ultimately be considered a failure, as it did not diminish the NVA's capacity to wage war, as it had China and Russia, as Walter Boyne puts it; „who competed with each other like jealous suitors in lavishing aid on North Vietnam“<sup>10</sup>. It also allowed the NVA to build up its anti-air defence network, including an arsenal of Soviet SA-2 Guideline Surface-to-Air Missiles (SAMs), which locked onto the target's radar signature. This was the same system that shot down Francis Gary Powers' U-2 Dragonlady spy plane in 1960, and which was now racking up kills in Vietnam. Despite the threat posed by these SAMs, they were not approved as targets, forcing US strike aircraft to operate below the missile's minimum ceiling of 914m (3000ft), which left them vulnerable to conventional anti-air weapons. This in turn led to the creation of „Iron Hand“ units (better known as Wild Weasel), armed with the AGM-45 Shrike anti-radiation missile, which locked onto the Guideline's radar system when it „pinged“ the aircraft. The result was a weapon that targeted the enemy's very targeting system to destroy it.<sup>11</sup> This was not a perfect system, however, as the Shrike could be deceived if the enemy simply switched off their radar before it struck, leading to the development of the improved AGM-78 Standard, which addressed the Shrike's shortcomings.

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<sup>10</sup> Boyne, p.332

<sup>11</sup> <http://www.youtube.com/watch?v=aIJ7C34j4e8>

In air-to-air combat, the US also faced problems. Lessons learned in the Korean War led to the conclusion that, as jets became faster and faster, the machine-gun would become less and less effective, more inaccurate, and less damaging given the new aircraft's sturdier construction. This resulted in aircraft being designed solely as missile platforms, most notoriously the F4 Phantom, which was armed with AIM-7 Sparrow medium-range radar-guided missiles, and the AIM-9 Sidewinder, a short-range infrared guided missile which would track the largest heat source it could find, such as an enemy's engine wash, however, both missiles were limited in their effectiveness- the Sparrow would lose radar lock if the enemy manoeuvred too hard, or dipped below the radar cone of the firing aircraft, and the Sidewinder had a tendency to switch targets to track such hot objects as the sun, or even the ground. Given that the Phantom had not been equipped with onboard cannon, even if it was behind an enemy MiG, if the pilot's missiles failed, they would have no choice but to disengage (which is no doubt galling, having been in such an advantageous position). While US pilots did achieve some victories in their all-missile craft, Soviet-built MiG-17 and MiG-19s, with their onboard cannon, exacted a heavy toll on US fighters. As a result, the Phantom was upgraded to carry a 20mm cannon mounted on an external pod, and the US Navy established the Fighter Weapons School (known as Top Gun), to train pilots in classic dogfighting techniques.

Of particular significance to the air war in Vietnam (certainly in the minds of the general public) was the helicopter, which had been developed in the Second World War. However, the machine didn't see widespread use until Korea, where helicopters were used for transporting supplies and as casualty evacuation (CASEVAC) vehicles, which saved dozens (if not hundreds) of US soldiers. The same was the case upon the outbreak of the Vietnam War, where utility helicopters such as the UH-1 Iroquois (known as Huey) acted as MEDEVAC for US forces, and as infantry transports (such mobility was vital in a region which had such inhospitable terrain; jungle proves a significant obstacle for wheeled and tracked vehicles), however the vulnerability of Huey transports to enemy fire prompted the creation of new „gunship“ helicopters to escort them, and provide close fire-support for infantry on the ground. This led to the establishment of new „Air Cavalry“ divisions, such as the 101<sup>st</sup> AirCav, which made excellent use of these armed helicopters, including Huey gunships, armed with door-mounted machine-guns (M60 Pigs), forward-firing rockets or even linked guns, to devastate enemies on the ground. There was even a helo (Air Force slang) designed specifically for attack, the AH-1 Cobra, armed with a three-barrel 20mm rotary cannon, and hardpoints on the stub wings for rockets or other disposable weaponry. The success of the gunship in Vietnam would set the standard for all subsequent military helicopters, particularly attack helos, leading to famous designs such as the American AH-64 Apache, the Russian Mi-24 Hind and Kamov Ka-50 Black Shark. However, in a move that was to cause controversy in the years after the war, many helicopters were used to deploy chemical weapons on the jungles of Vietnam, most notoriously Agent Orange, and these defoliants were used in conjunction with massive napalm „Daisy Cutter“ bombs, which wiped

out entire areas of jungle, to attack suspected enemy targets (which prompted the VC in particular, to build an enormous tunnel network in which to hide). Despite these incidences (which are looked upon as unethical today), the helicopter's contribution to the Vietnam War cannot be understated, as it came to influence the manner in which such weapons would be used in future conflicts throughout the 20<sup>th</sup> century, and even today.

Despite the failure of Operation Rolling Thunder, in the last year of the war, another major bombing campaign, codenamed Linebacker, was launched. Linebacker, unlike its predecessor, followed a more traditional strategic bombing pattern, attacking NVA assets, proving itself to be much more successful, and paving the way for the eventual cessation of hostilities in January 1973, finally ending US involvement in Vietnam. While it cannot be said that either side „won“ the Vietnam War, thanks to the prevalence of aircraft, US losses were much fewer than they potentially could have been (although the casualty figures were still high). While America was unable to defeat the Communist Vietnamese forces, it is, in many ways, thanks to aircraft, both fixed- and rotary-wing, that the US was not defeated, particularly given the success of bombers and helicopters. These kind of large-scale conflicts were (thankfully) rare during the Cold War, given the concepts of deterrence, which held that having immense destructive capabilities (ballistic missiles, hydrogen bombs, Tsar Bomba etc.) would result in enemies who were simply too scared to attack for fear of retaliation, and MAD (Mutually Assured Destruction), which stated the simple impracticality of a nuclear war, as the inevitable retaliatory strike would ultimately result in the annihilation of both combatants.

While these concepts prevented the superpowers from confronting each other directly, other nations saw fit to wage their own wars during this period, and perhaps the most significant of these (from a military aviation standpoint, at least), was the Falklands War in 1982.

## Chapter V: The Falklands

The Falklands War broke out when Argentina's military government chose to assert their strength (and divert public attention away from domestic problems), by invading the historically contested Falkland Islands (known as Las Malvinas in Argentina), which was a British territory (incidentally, following a referendum this year, the population voted overwhelmingly to remain British). The Argentine government underestimated the British response, however, expecting that, at the very least, that the British administration (under PM Margaret Thatcher), would be slow to respond. Instead, Thatcher ordered the deployment of a RN task force to retake the islands and defeat the Argentine forces in the area. This force included the carriers *HMS Hermes* and *Invincible*, whose onboard fighters would prove immensely influential in the conflict. As the task force ventured southwards, its progress was almost continuously monitored by Argentine reconnaissance aircraft, including Boeing 707s, however, the two sides did not clash until an Argentine submarine, the *Santa Fe*, was spotted

and engaged by a RN Wessex anti-sub helicopter which deployed depth charges (an old weapon, but still the most effective means of damaging a sub, being able to breach its hull underwater). This forced *Santa Fe* to surface, where it was engaged by Wasp and Lynx helicopters using torpedoes, AS.12 anti-ship missiles and machine-guns, damaging the sub so badly that its crew were forced to abandon ship. The anti-ship missile, which became famous during the Falklands, was almost never developed, as, following the Second World War, it was assumed that no missile could ever damage the hull of a heavily armoured surface ship, and, as a result, many nations abandoned the idea, with some exceptions; the Soviet Union, and notably, France, which designed the superb AM.39 Exocet missile in the 1960s. Argentina had five Exocets which it had acquired from France, and the missile was to achieve notoriety when, on the 2<sup>nd</sup> of May, the destroyer *HMS Sheffield* was hit by an Exocet launched by an Argentine Super Etendard attack aircraft (*Sheffield* later sank). The supply vessel *Atlantic Conveyor* and destroyer *HMS Glamorgan* were also sunk by Exocets during this conflict, earning the missile a place in the history books, and proving, once and for all, the value of anti-ship missiles. However, despite this, conventional weapons („dumb“ bombs, mostly) were used to great effect on both sides, with the RN using them in support of ground troops. Indeed, the value of such „dumb“ weapons has gone undiminished throughout the history of aerial warfare, even though there are plenty of precision weapons, often suited to attacking the same targets, and this was also the case in 1982. Free-fall bombs would be used to attack one of the most important targets of the entire Falklands conflict.

Perhaps the most vital military asset in the Falklands was the runway at Port Stanley airfield. Whoever controlled that runway would hold the upper hand in the air, perhaps even complete air dominance. Therefore, the British chose to deny the runway to the Argentine forces, and prevent them from using it, instead of a potentially costly operation to recapture it. To this end, a strike mission was planned to destroy the runway, and the aircraft chosen to carry out this mission was the Avro Vulcan. The Vulcan had been part of the UK's V-bomber programme, which was to be the UK's nuclear deterrent; three large, long-range bombers capable of dropping a nuclear device on the Soviet Union, should the need ever arise. These bombers were the Vulcan, the Handley Page Victor, and Vickers Valiant, with Vulcan being the most successful of the three, remaining in active service for over 20 years, and was much-loved by its crews for its overall high performance (for a bomber). It was thanks to the Vulcan's range that it was chosen to carry out the strike mission on Port Stanley's runway, using conventional free-fall bombs, a technique which would have been instantly familiar to any World War Two bomber crew. A large formation of aircraft were to take part in the operation, most of them Victors converted into airborne refuelling tankers, as the Vulcans had to fly first to Wideawake Base on Ascension Island, the closest British base to the Falklands (which was still 8000 miles away). Shortly after take-off, one of the Vulcans had to return to base due to a breach in the cockpit canopy. Only one Vulcan managed to make it to the target, releasing its payload over the airfield at Port



Stanley. While only one of the bombs scored a direct hit, the resulting crater denied Argentina the opportunity to make use of the runway, forcing the Argentine Air Force to operate from the mainland, at the limits of their aircraft's range (and fuel capacity), thereby reducing the time they could spend in an engagement before hitting bingo fuel (the minimum required to return to base). To add insult to injury, the runway was further damaged in strikes by RN aircraft using cluster munitions, and the attack aircraft Argentina had stationed there were sabotaged by the SAS. The attack on Port Stanley, conducted at the extreme end of the bomber's range (and which was only made possible by the Victor tankers), proved that traditional bombing tactics using „old-school“ munitions were still far from obsolete.

The Falklands War is particularly noteworthy for providing the Royal Navy with an opportunity to demonstrate the capabilities of a revolutionary new aircraft, the Harrier „jump jet“ capable of vertical take-off and landing (VTOL). The quest for VTOL capabilities came out of the realisation that, in any first strike in the Cold War, airfields would be some of the first targets to be hit, thus crippling a nation's air force right from the start. To counter this, military planners proposed a fixed-wing aircraft that could take-off from virtually anywhere, be it a forest clearing or a car park. However, designing a VTOL aircraft would prove a significant engineering challenge. While various solutions were tested, including tilt-rotors (which are used in the modern V-22 Osprey), it was the Hawker P.1127, which used vectored-thrust, that laid the foundations for the most famous VTOL aircraft in the world, the Harrier (and also influenced the Yak-141 Freestyle and F-35 JSF). The vectored thrust configuration allowed the pilot to direct the thrust from the engine in multiple directions via nozzles on the underside of the wing, not only giving the aircraft VTOL capability but also increased mobility (at the cost of speed). It was the Royal Navy's Sea Harrier which bore the brunt of Argentine fighter attacks in the Falklands. Despite being heavily outnumbered, the Harriers had one major advantage over the enemy; an improved version of the Sidewinder, the AIM-9L, which allowed them to not only go toe-to-toe with Argentine fighters (mostly French-built Mirage IIIs and other licence-built copies of Mirages), but gain the upper hand, despite the Harrier's inferior speed and mobility in „normal“ flight (however, a creative pilot can extend the aircraft's mobility using its thrusters, this allowed for all-new manoeuvres). As a result, Harriers achieved 23 air combat victories in the Falklands, an impressive result against such supposedly overwhelming Argentine numbers. The success of the Harrier in the Falklands even led to its adoption by the US Marine Corps as the AV-8, to be used as close support for Quick Reaction Forces (QRFs). The Harrier, in all its forms, has endured as an immensely successful aircraft today, however it is for the aircraft's role in the Falklands that the Harrier has become legendary.

The Falklands War ended following the surrender of Argentine forces and conclusion of hostilities on the 20<sup>th</sup> of June, 1982. It was the first conflict since the Pacific War in which the carrier would prove decisive, the final nail in the battleship's coffin, which had rapidly been made obsolete following the

Second World War, as many nations focused on developing their carrier forces to be the backbone of their navies (incidentally leaving the Japanese Super-Battleship *Yamato* as the largest warship ever constructed, it was sunk en route to Okinawa in 1945 by no less than 300 aircraft). The conflict also prompted the development of improved anti-air weaponry for ships, to the extent that SAMs are now commonplace on military vessels. The Falklands also highlighted the speed and range at which air power could be projected, as seen in the attack on the runway at Port Stanley, which denied that asset to the enemy, a desirable (if not vital) objective in any conflict.

## Chapter VI: The Gulf and Balkans Wars

As the 20<sup>th</sup> century progressed, and technology advanced, air power began to play a more decisive role in warfare. Two conflicts in the 1990s illustrate this perfectly; the Gulf War in 1991 and the Balkans Conflict from 1993-99. The Gulf War began when Iraqi forces, under the dictatorship of Saddam Hussein, invaded the small but oil-rich nation of Kuwait, which borders Iraq. This prompted the international community to form a Coalition and pool their collective military resources as part of Operation Desert Shield. This was designed to facilitate a massive buildup of Coalition forces while a diplomatic solution could be sought. The first units to arrive in the region were USAF F-15C Eagle air superiority fighters, and F-15E Strike Eagles, designed as a multirole fighter/attack aircraft. These aircraft were deployed in Saudi Arabia, as Saddam had posted nine elite Republican Guards brigades on the border with Kuwait, ready to attack Saudi Arabia. The Eagles were tasked with patrolling Saudi airspace, to prevent a potential Iraqi attack to capture Saudi-held oil fields. These aircraft were equipped with both air-to-air missiles (mostly Sparrows and Sidewinders) and Mk 20 Rockeye bomblet dispensers, which released dozens of small munitions over a wide area, capable of inflicting enormous damage on enemy infantry and light armour. The various members of the Coalition fielded dozens of different aircraft between them, none more so than America, which fielded no less than 50<sup>12</sup> different types, from fighters, bombers and ground attackers to electronic warfare, tanker and reconnaissance aircraft, and helicopters. This would lead to the offensive Operation Desert Storm.

In the air, Coalition forces faced a significant threat in the Iraqi Air Force (IrAF), which was the pride of Saddam's military, and which the dictator had personally seen to in terms of equipment. The IrAF operated a potent mix of air superiority and attack aircraft, even several bomber squadrons (which operated the Tu-22 Backfire, one of the Soviet Union's best bomber designs). These included French Mirage F.1s, Russian Sukhoi Su-24 Fencers, an effective ground attack aircraft, and several types of MiG: MiG-21 Fishbed fighters, MiG-23 Flogger attackers, MiG-25 Foxbat interceptors, and the deadly MiG-29 Fulcrum, one of Russia's best air superiority fighters. The Fulcrum had originally been designed as a short-range fighter to defend Soviet airspace, and counterpart to the Su-27 Flanker, which was intended to be the Soviets' main frontline fighter. These aircraft were roughly equivalent

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<sup>12</sup> Newdick, p. 270

to the US F-16 Fighting Falcon and F-15 Eagle respectively. However, the US designs had a major advantage in their advanced electronics, including fly-by-wire control systems, which connected a computer to the aircraft's control surfaces, allowing for much greater mobility and stability than traditional mechanical systems. These superior electronics allowed US aircraft to detect Iraqi aircraft at much greater ranges than they themselves could be detected. In addition, US fighters, particularly the Eagle, carried the new AIM-120 AMRAAM (Advanced Medium-Range Air-to-Air Missile), an update of the AIM-7 Sparrow. While the Sparrow was a semi-active radar-guided missile, which meant that the pilot had to keep their radar focused on the target, the AMRAAM was equipped with its own radar, meaning that once the pilot had locked on and launched the weapon, the missile would guide itself to the target, allowing the pilot to switch and engage another enemy. It is thanks to weapons like the AMRAAM and advanced electronics that the Eagle has a combat record of 101.5 victories to zero losses, unprecedented in the history of aerial warfare. The closest any F-15 came to being lost was during an Israeli training exercise, when one Eagle's wing snapped off, however, in a testament to its solid design (and the skill of the pilot), he was able to successfully land the crippled fighter without further damage.

The success of Coalition fighters in the air paved the way for the systematic bombing of Iraqi military targets and infrastructure, carried out by various different attack aircraft. One of the most important was the F4G Wild Weasel, an improved version of the Vietnam-era Phantom, which carried out Suppression of Enemy Air Defence (SEAD) missions, designed to knock out Iraqi air defence capabilities such as SAMs, AAA and radar installations. The US used unmanned drones to overfly Iraqi targets, forcing a response which would show the positions of active threats, which were promptly destroyed by AGM-88 High-Speed Anti-Radiation Missiles (HARMs), an update of the AGM-78 Standard used in Vietnam. These SEAD missions greatly reduced the effectiveness of the Iraqi air defence network, leaving only man-portable weapons (dubbed MANPADS), such as the SA-7 (equivalent to the Stinger missile used by the US, which was also given to the mujaheddin during the Soviet-Afghan War), remained, and, while these weapons still posed a significant threat, it was not enough to turn the tide in Iraq's favour. Iraqi infrastructure, including power stations, was also being systematically destroyed by Coalition attackers, most notably the F-117 Nighthawk, the infamous „Stealth Fighter“ (though it is far too slow and sluggish to be a fighter). The Nighthawk had been developed in secret at the infamous „Skunk Works“ following the success of the „Have Blue“ prototype, which demonstrated a greatly reduced radar signature thanks to its angular design and composite radar-absorbent materials (contrary to popular belief, stealth does not render an aircraft invisible to radar, it minimises the cross-section to something no bigger than a bird, or, in recent years, a bee). In Iraq, the F-117 saw its first „official“ military use, and proved extremely effective as a ground attack aircraft and tactical bomber, particularly during the assault on the Iraqi capital Baghdad, where the Iraqi defences were obliterated by precision-guided munitions (PGMs), Tomahawk cruise

missiles and even B-52 bombers, though it had been thought that Baghdad's air defences (the most extensive in the world) were impenetrable.

The same successes against ground targets were also enjoyed by the AH-64 Apache gunship, designed to provide mobile fire support for Coalition forces, while also being capable of standalone missions, particularly armed with the advanced AGM-114 Hellfire missile, which could be locked onto any target designated by the helo's crew, along with its turret mounted cannon and underwing rocket pods. The massive, all-encompassing offensive by the Coalition ensured the almost total destruction of Saddam's military, indeed, the dictator himself had referred to it as "the Mother of all Battles"<sup>13</sup>, and it has been speculated that Iraq lost its capacity to develop Weapons of Mass Destruction (WMDs) following the offensive and the „Scud Hunt“ which destroyed Iraq's long-range missile units, however US Intelligence later claimed Iraq still possessed such weapons, and the means to construct them, prior to the 2003 invasion of Iraq. Following the ceasefire at the end of the Gulf War, however, Saddam's regime was allowed to continue its rule, as it was believed that removing the dictator would destabilise the region and lead to another war (in fact, as we now know, another war broke out anyway, and the region is still plagued with instability).

However, the Persian Gulf was not the only region to face instability and conflict in the „90s. Following the end of the Cold War, and the breakup of the Soviet Union, many former Soviet territories were left in a state of flux without Moscow's control. Similarly, its neighbours, including the Federal Republic of Yugoslavia (FRY) in the Balkans (which had been an independent Communist state under Marshall Tito), also faced crisis. The FRY was divided into Bosnia-Herzegovina, Croatia, Slovenia, Macedonia and Yugoslavia (which contained the territories of Serbia and Montenegro). These divisions exacerbated ethnic tensions in the region, compounded by Serbian aggression under Slobodan Milosevic, and, in response, a No-Fly Zone was placed over Bosnia-Herzegovina as part of a United Nations Security Resolution. UN Peacekeepers were also deployed in the hopes of stabilising the area. The No-Fly Zone, called Operation Deny Flight, was designed to prevent aircraft of the former FRY air force (or at least the remnants of that force in Serb hands) from attacking Bosnia, specifically its Muslim population. The operation involved aircraft from numerous NATO (North Atlantic Treaty Organisation, the Western equivalent of the Warsaw Pact) member states flying countless patrols. However, the situation deteriorated to the point that NATO sanctioned airstrikes on Serb targets, including the Udbina airfield in Croatia, which was bombed by a „strike package“ of 30 aircraft. As a result of increasingly hostile Serb actions, such as the mortar attacks on the Markale market in Sarajevo, the Bosnian capital, a dedicated bombing campaign, Operation Deliberate Force, was commenced in August 1995. These strikes, while hampered by political desires to avoid collateral damage, at the expense of military gains, proved extremely effective in destroying

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<sup>13</sup> Hussein, S. 1991

Serb armour and supplies, particularly using the GBU-15, a TV-guided bomb which transmitted an image back to the launch aircraft, whereupon it could be „steered“ to the target. Despite a ceasefire being agreed in the 1995 Dayton Accords, the situation was to escalate once more, in 1997.

When conflict broke out again in the Balkans, another No-Fly Zone was placed over Bosnia-Herzegovina. This time, however, Milosevic’s Serb forces were focused on a different target, namely the Albanian population of Kosovo, which was in Serbia itself. The Serbs embarked on another campaign of genocide, as they had in Bosnia, and the initial NATO response was to send aircraft to act as a deterrent, however it was made clear that NATO would attack if the Serbs didn’t pull out of Kosovo. Despite these warnings, Milosevic made no such moves, leaving NATO with little choice but to begin another military operation, named Allied Force. The initial strikes were launched by B-52s armed with AGM-86C air-launched cruise missiles, while F-15Es and F-16s provided SEAD support to eliminate the Serbian air defences, while F-15Cs ensured NATO’s air superiority over Kosovo. Another revolutionary new aircraft was to make its official debut during this period, the B-2 Spirit bomber, another part of America’s Stealth programme. This aircraft’s flying wing design had its origins in earlier aircraft built by its parent company, Northrop (who had since merged to become Northrop Grumman), during the 1940s, and also bears similarities to the Gotha Go229 Flying Wing designed by the Horten brothers during the Second World War, intended to become part of Germany’s Amerika Bomber programme (one example of this aircraft was captured by US forces and is stored in the National Air and Space Museum in Washington, D.C. A replica, designed for display in the museum, was built with the help of National Geographic). Despite the potential of early flying-wing designs (and rumours that Kenneth Arnold saw a prototype over Mount Rainier in 1947), the B-2 remains the only flying wing to enter service. The Spirit proved quite successful in the Balkans, where it was used to drop large quantities of JDAMs (Joint Direct Attack Munitions), a new form of guided bomb that used GPS to accurately plot its path to the target.

While the Balkans conflict can be considered a relatively small one compared to say, the Gulf War, it is nonetheless extremely important as it is the first conflict in history whose pace and outcome from the offset was dictated by air power. Indeed, there were virtually no ground engagements between NATO and Serb forces throughout the conflict, which proves the truly decisive nature of the aircraft as a weapon. It is also important as the testing ground for the B-2, which now forms the backbone of the US’ strategic bomber force along with the B-52H and B-1 Lancer.

## Chapter VII: Modern Warfare (Conclusion)

There is no doubt today that the military aeroplane is an essential part of warfare, and this is thanks to over a century of development, fine-tuning, and in some cases, downright mad experimentation (the

US X-plane programme, for example, which sought to create the first supersonic aircraft. The X-15 still holds the world airspeed record at Mach 6.72).

However, as is often the case, it is war that encourages advances in technology, and can lead to entirely new discoveries, a new weapon or vehicle that would come to influence future military strategy. In the First World War, aircraft were used initially as scouts, and encounters between opposing scouts led to the first armed aircraft, and the need to escort these „fighting scouts“ led to the first true fighters, designed specifically to engage the enemy, leading to entirely new approaches in the use of military aircraft. Similarly, the development of the first strategic bombers would have an enormous impact, not just in the First World War, but on warfare itself. The inter-war years saw a shift away from wooden biplanes to metal monoplanes, which became widespread in the Second World War. New weapons and engines allowed for new tactics, such as Blitzkrieg (which influenced the modern US AirLand Battle Doctrine), which took full advantage of the aeroplane’s potential. The Second World War saw the emergence of the jet fighter, which changed military aviation completely, the first multirole aircraft, and, perhaps most significantly, the first massive strategic bomber forces, which would play a major role in the Cold War. In Vietnam, the two superpowers had an opportunity to demonstrate their strength, and the capabilities of their industry and technology. Vietnam also allowed the US to demonstrate the effectiveness of its strategic bomber force, albeit with mixed results (a Daisy Cutter can only do so much), and also allowed for the development of the gunship, a concept later copied around the world. As a result of Vietnam, the USAF began researching better weapons and technologies to rectify mistakes made in that conflict. The Falklands demonstrated the capabilities of VTOL aircraft, and showed that aircraft could be used to bear the brunt of a conflict while ground forces made gains. The Gulf War showed the pure havoc that could be caused by aircraft, as Saddam’s forces were systematically wiped out, along with his country’s industrial infrastructure. It was also the first conflict where Stealth aircraft were revealed to the public (and I was fortunate enough to grow up in a time when the concept of such aircraft was still a novelty). Similarly, the Balkans conflict saw aircraft take centre-stage, an unprecedented move in the history of warfare, and also saw the debut of the first Stealth strategic bomber, the B-2. I doubt many people at Kitty Hawk in 1903 foresaw aviation coming this far in less than a century, and it is a testament to modern industry that we have advanced from wood and canvas to the Space Shuttle (sadly now decommissioned), or its Russian counterpart, Buran.

But where does that leave military aviation today? The old concepts of fighter and bomber still exist, but theUCAV (Unmanned Combat Aerial Vehicle) has risen to prominence, capable of precision strikes on any target the operator designates. These craft, such as the infamous Predator and Reaper drones, and most recently the Centurion, while solving the problem of minimising casualties for one’s own forces, have limits, notably in the numerous instances of collateral damage caused (and which the media have devoured like sharks in a feeding frenzy). This being said, I believe that guidance and

target identification systems will improve to the point where incidents like these will be extremely rare, although, when one's enemy resorts to cowardly tactics like hiding among civilians, unfortunately, people are going to get in the way. The limitations of current UCAVs highlight the important role that the human pilot will always have to play. To this end, several 5<sup>th</sup> Generation fighters have been developed (and are still being developed, in some cases). Of these, only the US F-22 Raptor has entered service, and this aircraft, which boasts advanced electronics, high manoeuvrability and a large internal weapons bay, coupled with moderate stealth properties, is regarded by many as the best fighter in the world (despite the programme being cancelled because each aircraft costs \$120 million). In Russia, several designs have been developed, such as the MiG 1.44 (recently given the production designation MiG-39), the Su-47 Berkut, an exceptionally manoeuvrable (but rather unstable) fighter with a forward-swept wing (something which hasn't been seen since the US X-29 prototype), and the Sukhoi T-50 PAK FA, although these projects, which have been in the works for several years, may be cancelled due to lack of funds. Of these, the PAK FA looks most likely to enter service, in which case it would be not only Russia's first 5<sup>th</sup> Gen aircraft, but also the first Stealth aircraft built outside America (and personally I think the PAK FA may prove superior to the F-22). In the last few years, there have also been reports of a Chinese 5<sup>th</sup> Gen fighter in development, the J-20, and even test footage of the aircraft in flight.

Most recently, however, have been the rumours that Lockheed Martin are working on the first 6<sup>th</sup> Gen fighter, nicknamed „Miss February“, so, at any rate, it looks like military aviation has a bright future ahead of it.

### Appendix: The Magnificent Lightning

The 3<sup>rd</sup> of August, 1945. The Japanese Empire conducts the first flight tests of the Second World War's most advanced piston-engine fighter. It was the Kyushu J7W1 Shinden (Magnificent Lightning), a brilliant design, of canard configuration (a pusher propeller in the rear of the aircraft, with the wings set just before it on either side of the engine). The aircraft was designed by Capt. Tsuruno Masaoki as a potential counter to the threat of the B-29 Superfortress, and as such, was armed with four 30mm Type 5 cannon in the nose, the weight of which balanced the engine in the rear. The Shinden was designed to outperform all existing fighter designs, however, it came too late. Three days later, the first nuclear bomb was dropped on Hiroshima, and the war ended not long afterwards. The delay in testing the Shinden was caused by a parts shortage due to the worsening situation in Japan, under constant threat from US bombers. However, it is estimated that the Shinden, had it entered service when it was ordered into production in April 1945, would have begun exacting a heavy toll on US bombers, perhaps even making it too dangerous for them to attack Japan. This is pure speculation, of course, but perhaps the devastation of Hiroshima and Nagasaki could have been prevented had the Shinden been in the skies. It would not have changed the course of the war (Japan

would still have surrendered in the face of both Soviet and US attacks, possibly even invasions. Honour is a great thing, but when one is Emperor, the safety of the people is paramount), but it may have prevented all those deaths which, in my mind (and I understand the reasons for them), were completely unnecessary. Of course, there are many other possible outcomes to this hypothetical situation, but I believe the Shinden (which, as you no doubt have guessed, is my favourite aircraft, for its elegance and performance)<sup>14</sup>, would have been the best thing to happen to Japan since Sekigahara.

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<sup>14</sup> <http://www.youtube.com/watch?v=dkq3KpVwz3c>