The War in the Air
Updated - Saturday, 9 August, 2003

Aircraft technology was little over a decade old when Archduke Franz Ferdinand's assassination in late June 1914 ultimately resulted in the outbreak of 'The Great War' a month later.

Initially deemed of little use to the armed services other than in a reconnaissance role, aircraft development exploded during wartime (all too often literally). For example, France had fewer than 140 aircraft when her war against Germany began; four years later that number had ballooned to approximately 4,500.

This section of the website examines the role of the aircraft and associated technologies during the First World War, viewed from all sides. In addition to an exploration of aircraft innovations - such as deflector and interrupter gear - the planes themselves are summarized, from fighter aircraft to bombers to Zeppelins to naval aircraft; and biographies are available for a great many of the war's air aces and commanders.

Use the **sidebar to the right** to access features within this section; you are recommended to start with Ari Unikoski's summary introduction to the subject (click here).

The War in the Air - Summary of the Air War
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When Archduke Ferdinand was assassinated on the 28th of June 1914, it was just over a decade since the Wright brothers first twelve second flight at Kittyhawk.

In the intervening years advances in range and reliability proved that the airplane was a viable, if still somewhat exotic, means of transport. In 1909 Bleriot made the first flight across the English Channel. In 1913 Roland Garros made the first cross Mediterranean flight, from the south of France to Tunisia.

There was also, in this period, some initial understanding of the military implications of the airplane. After Bleriot's flight H. G. Wells was to write, prophetically, that "…this is no longer, from a military point of view, an inaccessible island." In 1911 the Italians, at war with Turkey in Libya, became the first to make military use of the airplane, dropping grenades from a German-built monoplane. In 1912 they also dropped bombs from an airship.

When war broke out the number of aircraft on all sides and all fronts was very small. France, for example, had less than 140 aircraft at the start of the war. By the end of the war she fielded 4,500 aircraft, more than any other protagonist. While this may seem an impressive increase, it does not give a true indication of the amount of aircraft involved. During the war France produced no less than 68,000 aircraft. 52,000 of them were lost in battle, a horrendous loss rate of 77%.

The period between 1914 and 1918 saw not only tremendous production, but also tremendous development in aircraft technology.

A typical British aircraft at the outbreak of the war was the general purpose BE2c, with a top speed of 116 km/h (72 mph). Powered by a 90 hp engine, it could remain aloft for over three hours. By the end of the war aircraft were designed for specific tasks. Built for speed and maneuverability, the SE5a fighter of 1917 was powered by a 200 hp engine and had a top speed of 222 km/h (138 mph).

Britain's most famous bomber, the Handley-Page O/400, could carry a bomb load of 900kg (2000 lb) at a top speed of 156 km/h (97mph) for flights lasting eight hours. It was powered by two 360 hp engines.

In 1914 it was important that aircraft be easy to fly, as the amount of training that pilots received was minimal, to say the least. Louis Strange, an innovative pilot from the opening stages of the war, was an early graduate of the RFC (Royal Flying Corps) flight school. He began flying combat missions having completed only three and a half hours of actual flying time. For this reason aircraft were designed for stability. By the end of the war stability had given way to maneuverability. The famous Sopwith Camel was a difficult aircraft to fly, but supremely agile.

Not only did aircraft become faster, more maneuverable and more powerful, but a number of technologies that were common at the start of the war had almost disappeared by the end of it. Many of the aircraft in 1914 were of "pusher" layout. This is the same configuration that the Wright brothers used, where the propeller faced backwards and pushed the aircraft forward.

The alternative layout, where the propeller faces forwards and pulls the aircraft, was called a "tractor" design. It provided better performance, but in 1914 visibility was deemed more important than speed. World War One marked the end of pusher aircraft.

Another technology that scarcely survived the war was the rotary engine. In this type of engine the pistons were arranged in a circle around the crankshaft. When the engine ran, the crankshaft itself remained stationary while the pistons rotated around it. The propeller was fixed to the pistons and so rotated with them. Rotary engines were air cooled, and thus very light. They provided an excellent power-to-weight ratio, but they could not provide the same power that the heavier in-line water cooled engines could. Although they remained in use throughout the war, by 1918 Sopwith remained the last major manufacturer still using them.

The rapid pace of technological innovation was matched by a rapid change in the uses to which aircraft were put. If in 1914 there were few generals who viewed aircraft as anything more than a tool for observation and reconnaissance (and many of them had great reservation even to that use) by the end of the war both sides were integrating aircraft as a key part of their planned strategies.

While the plane did not play the decisive roll that it was to play in later conflicts, the First World War proved their capabilities. It was during this period that the key tasks that aircraft could perform were discovered, experimented with, and refined: observation and reconnaissance, tactical and strategic bombing, ground attack, and naval warfare. With the growing importance and influence of aircraft came the need to control the air, and thus the fighter was born.

The War in the Air - Observation and Reconnaissance
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General Foch is reported to have said that "aviation is a good sport, but for the army it is useless". This reflected a widely held scepticism about aircraft, which is not surprising considering how frail and unreliable they were in 1914.

The military did, however, see some value in taking advantage of the aircraft's height for an improved view of the battle-field. They were

influenced in this, perhaps, by the successful use in earlier conflicts of tethered lighter-than-air balloons, such as those used in the American civil war. The airplane, they felt, could augment and enhance the balloons – an airplane could see things on the far side of a hill that even a balloon could not - but they still felt that the most important tool for reconnaissance would be the cavalry.

Within the first months of the war – even before trench warfare completely sidelined the cavalry - the value of aerial reconnaissance proved itself. General John French acknowledged that without the timely information provided by the RFC, Von Kluck's army would have succeeded in encircling his forces at Mons.

Shortly after, at the crucial First Battle of the Marne, General Joseph-Simon Gallieni used information provided by the French *Armee de l'Air* to send troops to the exposed German flank.

On the Eastern Front, both the Russians and the Germans were flying reconnaissance missions. In the prelude to the Battle of Tannenberg, General Alexander Samsonov was to tragically ignore warnings provided by his pilots. Field Marshal von Hindenburg did not. Almost all of Samsonov's army was either killed or captured. Samsonov committed suicide. After the stupendous German victory von Hindenburg acknowledged that "without airmen there would have been no Tannenberg."

The Russians learnt their lesson, though, and from 1915 onwards had an excellent long distance reconnaissance aircraft in the Ilya Murometz (discussed in the section on bombing). In the Brusilov offensive of 1916 aerial reconnaissance provided the Russian army with detailed maps of enemy positions.

Reconnaissance missions were dangerous. They were usually carried out by a crew of two. The pilot was required to fly straight and level to allow the observer to take a series of overlapping photographs. There was no better target for anti-aircraft guns, no easier prey for stalking fighters.

Long range reconnaissance meant flying well behind the front lines. Navigation on such flights was often a problem, and should the plane develop any mechanical trouble (as they often did) a friendly field to put down in was a long distance away. The German reconnaissance pilots had an advantage over their French and British counterparts in this respect, as the predominant winds blew from the west.

Artillery observation also required a crew of two. It was a complex business. The wireless equipment was too bulky and heavy for planes to carry both a transmitter and a receiver, so the aircraft flew with a transmitter only.

A plane would service a particular artillery battery, and before takeoff the battery's target was confirmed. Once in the air the observer had to identify his battery and the target. He would then transmit a message ordering it to fire. He could usually differentiate shells that belonged to his battery by measuring the time from when they had fired till the explosion in the vicinity of the target.

From 1915 onwards the corrections, transmitted in Morse, were in the "clock code": a letter was used to indicate the distance from the target (the letters Y, Z, A, B, C, D, E and F representing distances of 10, 25, 50, 100, 200, 300, 400 and 500 yards respectively) and a number in the range 1-12 representing the direction from the target (with 12 indicating due north of the target, and 6 representing due south of the target).

The RFC pioneered successful artillery spotting at the Battle of the Aisne. A feature of this battle, which was quite typical of the entire Western Front, was that the Germans occupied higher ground. After the first two days the German gun positions were never visible to the British, being hidden behind the *Chemin des Dames* ridge. The daily reconnaissance and observation flights were an absolute necessity for the British gun batteries.

As in reconnaissance flights, artillery observation required the planes to fly steady, predictable routes. In addition to anti-aircraft fire and enemy fighters, observation aircraft suffered a third danger, and this was from the artillery shells themselves. They typically flew at an altitude similar to the apex of the artillery shell's flight, and they flew along a line between the guns and their targets.

It was not unusual for the pilot or observer to actually see the shell as it stopped at the top of its climb before plummeting downward. It was not unknown for the planes to be hit by those shells.

Artillery observation became so important that part of Falkenhayn's strategy at Verdun was to blind the French artillery by knocking out their observation planes and balloons. At the time the Germans had control of the air, and the losses suffered by the observation aircraft were appalling.

Nevertheless they continued flying and the French artillery was not blinded. The bravery of the airmen in fulfilling this dangerous and unglamorous work is seldom remarked.

There were some military problems that only a plane could solve. A prime example is the hunt for the German light cruiser the *Königsberg*. At the outbreak of the war she was based in Dar-es-Salaam in east Africa, from where she attacked British shipping.

Pursued by more powerful British warships, she entered the Rufiji river delta and hid upstream. The deeper draught British cruisers could not follow. Having lost contact with the *Königsberg* the navy acquired a Curtis flying boat – one of the only aircraft then in Africa – in order to search for the ship. The Curtis, using an improvised Ford motor car radiator to replace its own damaged one, located the *Königsberg* in November of 1914, but in a later flight the plane was brought down by rifle fire and the pilot captured.

The *Königsberg* remained trapped upstream until June of 1915 when the shallow draught river monitors *Severn* and *Mersey* could be brought out from Britain. They were accompanied by 4 aircraft of the RNAS (Royal Navy Air Service) – 2 Caudron G3s, and 2 Farman F27s.

These wireless equipped aircraft were to be used for spotting, as the *Severn* and *Mersey* could not risk coming within visual sight of the more powerful *Königsberg*. During late June the small force of aircraft practiced cooperation with the monitors, but one aircraft of each type was damaged during these practice runs.

The first artillery duel between the *Königsberg* and the monitors took place on the 6th of July 1915, and ended with neither side gaining a victory. The aerial spotting had been inaccurate, because the *Severn* and *Mersey* were firing together, and the observers could not differentiate which ship had fired which round. They were further confused because the shells often landed in soft mud and did not explode at all.

The *Severn* and *Mersey* returned on the 11th of July. This time each ship fired on its own, and the *Königsberg* was eventually bracketed and sunk under a withering fire. Before she went under she had her revenge on the planes. She managed to damage the Farman with one of her two remaining guns. As the plane descended to a crash landing the observer continued transmitting his clock code corrections to the *Severn*.

Perhaps the best reconnaissance plane of the war was the Italian Ansaldo SVA 5. This plane, produced in both single seater and two seater variants, had a range and altitude allowing it to cross the Alps, and with a top speed of 230 km/h (143 mph) it could fly fast enough to outrun enemy fighters.

On the 9th of August 1918 a flight of seven single seat SVAs and one two seater made a historic 1,126 km (700 mile) flight to Vienna to drop propaganda leaflets on the city. The observer in the two seater was the poet/airman Gabriel D'Annunzio, who had penned the text on the pamphlets.

The twin duties of artillery observation and reconnaissance remained the most important utilization of aircraft throughout the war. The number of sorties flown on these missions far outweighed the number of missions flown on all other missions combined. It was more important, if less romantic, for a fighter pilot to shoot down an observation plane than to shoot down another fighter. More than half of Manfred von Richthofen's record setting 80 victories were scored against reconnaissance and observation planes.

The War in the Air - Fighters: Early Experimentation
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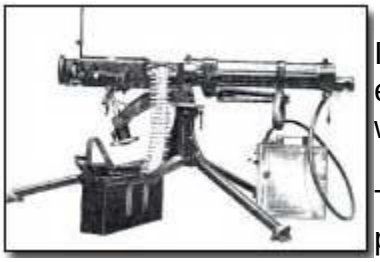

In November of 1912 the Vickers company received a contract for an experimental airplane to be armed with a machine gun. Vickers' response was the "Experimental Fighting Biplane 1" – nicknamed "Destroyer".

The EFB1 had a crew consisting of a pilot and a gunner. Vickers chose a pusher layout as it allowed them to place the gunner forward of the pilot with an uninterrupted field of fire ahead of the aircraft. It was armed with a single 0.303-in Maxim machine gun on a swivel mount. The weight of the Maxim made the EFB1 nose heavy, and it crashed on its first flight with the gun in place.

While the government gave Vickers further contracts to continue development, the concept of a fighting aircraft remained an esoteric experiment.

In the first weeks of the war the pilots and observers went up unarmed, and often would wave to one another if their paths crossed. But fairly quickly they began experimenting with means of attacking one another. Pistols and rifles proved to be ineffective, as did some of the more bizarre attempts such as throwing bricks, and trailing bombs or grappling irons behind the plane.

By October of 1914 many pilots were experimenting with machine guns. Louis Strange improvised a safety strap allowing the observer of his tractor driven Avro 504 to "stand up and fire all round over top of plane and behind". On the 5th of October 1914 a French Voisin III two-seater pusher biplane became the first plane to shoot down another when it encountered an Aviatik B.1. The shots were fired by the observer who stood up in order to fire a Hotchkiss machine gun.

Early 1915 saw pilots still attempting to find a practical technique. The first Vickers FB5 "Gunbus" aircraft, an evolution of the "Destroyer", had arrived on the Western front by February, but it did not

meet with much success. Aiming a machine gun from one plane moving in three dimensions, to fight another plane moving in three dimensions, was extremely difficult.

Moreover, the pusher FB5 was not fast enough, or nimble enough, to be an effective fighter. The perfect configuration, the pilots began to understand, would be a more maneuverable tractor aircraft. A fixed machine gun pointing forward would allow the attacking pilot to aim the entire aircraft. This would be easier than aiming a free-swinging machine gun as on the Gunbus, and would eliminate the need for an observer, making the aircraft smaller and lighter. The machine gun should be located close to the pilot to allow him to reload and service the gun should it jam.

There was only one problem with this configuration: the propeller.

Louis Strange experimented with a solution using a Martinsyde S I biplane. He fixed a Lewis gun on top of the upper wing, high enough to clear the airscrew. While this seemed quite a good solution, it introduced new problems, as Strange himself discovered on the 10th of May while attempting to shoot down an Aviatik. After firing off a whole drum from his Lewis gun he broke off in order to reload.

Unfortunately the drum jammed, and Strange stood up on his seat in order to try and pry it loose. The plane stalled, flipped over, and began to spin earthwards upside-down. Strange was flung out of the plane, and found himself dangling below the upper wing, hanging on by the very drum he had been trying to shake loose.

By swinging his legs wildly he managed to get a foothold inside the cockpit and drag himself back inside in time to right the plane and avoid a crash. In his wild thrashing he had smashed all the dials in his instrument panel and broken the seat.

(Despite such antics Strange was to survive the war, finishing the war as a Wing Commander. In the Second World War he flew in the volunteer reserve, and set up both the airborne forces parachute training course, and the fighter convoy defence unit.)

The War in the Air - Fighters: Deflector and Interrupter, The Birth of the Fighter
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Roland Garros, the French pre-war aviator, had come to the conclusion that a fixed, forward firing machine gun was the right answer to the problem of using machine guns from within aircraft (see Fighter Aircraft - Early Days).

His first attempt at a solution was to fix a machine gun at an oblique angle in order to miss the propeller, but this was too difficult to aim. On a visit to Paris he met up with Raymond Saulnier, of the Morane-Saulnier company, manufacturer of the tractor powered monoplane he was flying.

Before the war Saulnier had considered the problem of firing forward through the airscrew, and had experimented with an interrupter gear. The idea was that the position of the propeller would control the machine gun – preventing it from firing if the propeller was in front of the muzzle. The machine

gun he used was the Hotchkiss, but its rate of fire was too erratic, and he abandoned the idea, as had a number of other pre-war experimenters.

When Garros and Saulnier talked, early in 1915, they considered another approach – to attach steel deflector plates that would deflect any bullets that hit the propeller. These were triangular in shape, with the apex pointing to the pilot – the idea being that the bullets would be deflected off at an angle, but forwards of the aircraft, rather than bouncing back at the pilot.

Garros tried out this arrangement for the first time on 1st of April, 1915 with immediate success, shooting down a two seater reconnaissance plane on his first pass. This was followed up with victories on the 13th and the 18th.

The French press immediately picked up on this success, and he was the first pilot to be labelled an "ace". At the time the term was a generic one describing someone particularly skilled in a certain area. Shortly after this the term became formalized to mean anyone who has shot down five or more aircraft, a designation which has remained to this day.

The French equipped a small number of their planes with deflector gear, and sold some deflector equipped Morane-Saulnier's to the RFC.

But Garros' luck was running out. On the 19th of April, while attacking the Courtrai railway station, a bullet fired by a rifleman on the ground pierced Garros' fuel line. He managed to put the aircraft down safely, but failed in his attempt to set it alight before he was captured. (Garros later escaped, only to be killed in action one month before the end of the war.)

The Germans passed on the captured plane to Anthony Fokker, provided him with a Parabellum machine gun, and ordered him to produce something similar.

Fokker, a Dutchman, was the manufacturer of the "Eindecker" (Monoplane) aircraft, which were being used at the time as a communications plane. Ironically, the Eindecker was an aircraft which Fokker had designed after being impressed with the Morane-Saulnier's capabilities, and its engine was a copy of the French Gnome rotary engine.

Fokker was unimpressed with the deflector gear. Whether he was aware of the work done by others on interrupter gear, whether perhaps he was already working on his own, or whether, as he claimed, he had a moment of inspiration, is not known. What is known is that within 48 hours he returned with an Eindecker equipped with interrupter gear.

Fokker first demonstrated it from the ground. The German officers were sceptical, some of them believing it was a trick. They demanded that Fokker demonstrate it from the air, which he did. Still sceptical, they demanded that Fokker actually shoot down an aircraft.

In July of 1915 Fokker himself flew a number of sorties, looking for a victim, but when he finally stumbled across an unarmed Farman observation plane he found that he could not bring himself to pull the trigger. He returned to the airfield at Douia and informed the Germans that they would have to prove the interrupter gear's potential for themselves.

The task was given to Lieutenant Oswald Boelcke. Within a few days, on the 1st of August 1915, Boelcke made his first kill. Now completely convinced, the *Idflieg* (Inspectorate of Flying Troops) immediately placed orders for interrupter-gear equipped Eindeckers. The Germans began to enjoy immediate success – especially Boelcke and his second in command Max Immelmann.

Just as the French press had earlier lauded Garros now Boelcke and Immelmann became darlings of the German press. Thus began the period on the Western Front known as the "Fokker Scourge".

The War in the Air - Fighters: The Fokker Scourge
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In spite of its innovative use of deflector gear the German Eindecker was in many ways an unexceptional aircraft.

In April of 1916 a captured Eindecker was tested by the Allies, and found to be inferior in performance to its Morane-Saulnier opposite number. The interrupter gear was also far from perfect – both Boelcke and Immelmann survived shooting off their own propeller.

The impact of the interrupter-gear Eindecker, however, was enormous. The heretofore appreciated stability of the Allied aircraft became a liability as they could not escape the more manoeuvrable Eindecker. The French were forced to curtail their successful day bombing operations and turn to night bombing. The RFC began to suffer losses approaching two a day.

The great German offensive against Verdun began in early 1916. In accordance with the German plan to bleed the French army dry, Falkenhayn determined to use their control of the air to do the same thing to the *Armee de l'Air*, and to blind the French artillery by shooting their observer aircraft out of the skies.

Boelcke, who had done much to develop the tactics of aerial warfare, was moved to Rethel, nearer to Verdun, to command a new *Kampfeinsitzerkommando* – a single seater detachment. Immelmann remained in command at Douia.

For the opening six months of 1916 the Germans maintained control of the air. It was wrested from their grasp, but slowly. By the opening of the Battle of the Somme in July, the Eindecker was obsolete. Boelcke was to refer to July and August of 1916 as "the blackest days in the history of German military aviation."

The Eindecker, ironically, was unseated by aircraft already available before Fokker's invention of the interrupter gear, and none of them ever had interrupter gear installed. It was the combination of four types of aircraft that defeated the Eindecker.

Three of them were British, and they were all pusher aircraft – the Gun Bus, the FE2b, and the DH2. The fourth was the altogether far more impressive French Nieuport 11 "*Bebe*" (Baby). This was a tractor sesquiplane (a biplane, but with the lower wing significantly smaller than the upper wing.)

Its armament consisted of a Hotchkiss or Lewis gun mounted on the upper wing, much in the same configuration as that tried out by Louis Strange, but on a sliding mount allowing the pilot to pull the machine gun down towards him. This was intended to allow the pilot to shoot upwards at an angle, in addition to removing the need to stand when reloading or servicing the weapon.

The French officially adopted the "ace" system during the battle of Verdun. Many of these pilots were concentrated in a famous squadron, the *Cigognes* (Storks), and the aces Navarre, Nungesser and Guynemer, all flying Nieuports, became household names.

It was not just the aircraft themselves that returned control of the air to the Allies. It was only during 1916 that these aircraft appeared at the front in significant numbers and that they were organized into fighter units.

The Allies, with the French taking the lead, learned the value of flying in defensive formations of four to five aircraft, matching the three to four plane offensive patrols of the Germans.

If the Fokker Scourge was symbolically opened by Boelcke's first victory, it was symbolically closed when Max Immelmann was killed during a fight with an FE2b on June 18th 1916. Whether he was shot down, as claimed by the Allies, or shot away his own propeller, as claimed by the Germans, is still a matter of debate.

The War in the Air - Fighters: Spad, Pup and Albatross, the Intermediate Generation
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The desire for stable, easy-to-fly aircraft had given way to a call for manoeuvrable fighters with fixed machine guns and a good rate of climb.

It was clear on both sides of the trenches that the current aircraft were not adequate. By autumn of 1916 the first custom-built tractor fighters began to appear on the front. The most successful British fighter of this period was the Sopwith Pup with a single synchronized (i.e. controlled by an interrupter gear) machine gun and powered by a rotary engine.

The French Spad VII also had a single synchronized Vickers gun, but used a more powerful inline engine, and as did the German Albatros D I and D II, which were armed with twin synchronized guns.

Late in 1916 Oswald Boelcke was killed in a collision with another German aircraft. German and Allied imagination was soon captivated by a new rising star. A month after Boelcke's death Manfred von Richthofen, a protégé of Boelcke's, shot down the British ace Lanoe Hawker.

In celebration he decided to paint his Albatros entirely red, from which stems his nickname of "The Red Baron". Soon after this he was given command of Jasta (Squadron) 11. In spring of 1917 the Albatros D III arrived at the front. It was a development of the earlier Albatros planes, but with a smaller lower wing that was inspired by the Nieuport Bebe.

Control of the air was returning to the Germans. April was particularly disastrous to the allies, and became known as "Bloody April". Jasta 11 alone accounted for over 80 planes, an astonishing 21 of these being shot down by Richthofen himself. The British lost 75 aircraft in the first week.

The average lifetime of a pilot as the front was a mere two months, hardly surprising considering that at this time the RFC was sending pilots to the front with little more that 17 hours tuition behind them.

Richthofen's success prompted the Germans, in June, to promote him to command a fighter wing comprising four different squadrons. He recruited the best pilots to Jagdgeschwader I, (JG I) which quickly became famous, or infamous, depending on which side of the lines you were.

All the pilots painted their plans in bright colours, and JG I soon earned the nickname of "The Flying Circus". Rather than being located at the one spot, the Germans moved this crack unit up and down the front.

The War in the Air - Fighters: From Triplane to Camel, the War's Best Fighters
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Towards the end of "Bloody April" in 1917 (click here for details) the RNAS began to equip their squadrons with a new and astonishing aircraft – the Sopwith Triplane. This was a development of the Sopwith Pup, but the triplane configuration gave the plane unprecedented manoeuvrability and rate of climb.

The undisputed masters of the Sopwith Triplane were the pilots of the all Canadian "Black Flight," commanded by Raymond Collishaw. In June and July of 1917 the Black Flight shot down no less than 86 aircraft for the loss of three, of which two were lost to anti-aircraft fire. This was all the more impressive as they were flying against JG I. (Collishaw was Canada's second highest scoring ace, and survived the war with 68 confirmed victories to his credit. He served as a commander of a Fleet Air Arm Fighter Group in the Second World War.)

The nimble triplane must have held incredible appeal for a virtuoso pilot such as Richthofen, and with his forces suddenly facing a superior aircraft it is not surprising that he pressed the *Idflieg* to provide a similar aircraft.

The response of the German and Austrian manufacturers was astonishing. They produced more than a dozen different triplanes, usually adaptations of existing designs. But of all these planes the most successful was the Fokker Dr I, designed by Fokker's chief engineer Reinhold Platz. Richthofen was delighted, saying the planes "are manoeuvrable as the devil and climb like monkeys".

Ironically by this stage the Allies had abandoned production of the Sopwith Triplane, after a production run of a mere 150 planes. The British had two new, more potent aircraft – the SE5a and the Sopwith Camel.

At about the same time the French were also re-equipping with the Spad XIII, an excellent development of the Spad VII. Like the Spad the SE5a was powered by an inline engine. H.P. Folland, the designer of the SE5a, chose this type of engine as it avoided the problems of torque inherent in the rotary engine, making the plane easier to fly.

Powered by a 130 horse-power rotary engine, the Sopwith Camel was slower and much more difficult to fly – almost as many Camel pilots were killed by crashes as by German fighters. A further development of the Sopwith Pup, the designers had concentrated all the weight in the front half of the fuselage, on or around the centre of gravity.

This gave the Camel tremendous manoeuvrability. Coupled with the engine's torque the Camel had a lightening fast turn to the right. In fact it could turn a three quarter turn to the right in the same time as it could make a quarter turn to the left. In the hands of an experienced pilot the Camel was probably the most potent fighter in the allied arsenal.

All three of these aircraft were armed by twin machine guns. The Spad and the Camel had twin synchronized guns, while the SE5a had one synchronized gun and one gun firing over the upper wing in similar style to the Nieuport Bebe.

The first prototype of the Dr I triplane was delivered to Werner Voss, commander of Jasta 10, a part of the Flying Circus. Richthofen had two quick victories in his triplane, but on September 15th he lent it to Kurt Wolff, the commander of Jasta 11, who was shot down by a Sopwith Camel of the Black Flight.

Voss, for his part, enjoyed tremendous success in his plane, but by late September he was also brought down in an epic single-handed dogfight against seven SE5a's.

The Germans were delighted in the plane, until in October 1917 they began to disintegrate in mid-air under the stress of air-combat. The planes were grounded, only to return to the air, modified and strengthened, in early 1918.

By this stage, however, the Camels, SE5a's and Spads had appeared in large numbers, and unless in the hands of an expert flyer the Dr I was no real match. Only 320 of these planes were produced. Their fame far outstrips their true importance, probably due to the fact that the Dr. I remained Richthofen's personal favourite. It was in this plane that he was brought down in April 1918. Whether he was shot down by ground fire or by another aircraft remains unclear, but he fell behind Allied lines and was buried by the British with full military honours.

Anton Fokker was to produce one more aircraft during the war, and this was to be, in the eyes of many, the best fighter plane built during the conflict. This was the Fokker D VII, the winner of a German fighter competition held in January of 1918.

Powered by a 160 horsepower inline engine it was slower than the SE5a and Spad XIII but faster than the Camel. Another plane designed by Reinhold Platz, it had the perfect combination of strength, speed, high ceiling and manoeuvrability, and might have upset the balance back in the German's favour, had it been produced in numbers comparable to the production of the Allies.

But by this stage in the war German industry was suffering severe shortages, and less than a thousand of these planes reached the front, in comparison to the more than 8,000 Spads, 5,000 SE5as and 5,000 Camels.

So impressive was this plane that the Armistice settlement specifically mentioned that all examples of the D VII, and all its manufacturing facilities, be handed over to the Allies. Fokker had other ideas. He quickly disassembled his factory and hid it on farms in the vicinity until he could bribe enough people to smuggle his entire factory by train back to his native Holland. Fokker was still producing and selling this aircraft well into the 1920s.

The table below shows the important fighter types, their top speeds and the number of machine guns carried. The table is ordered by top speed.

Airplane	**Country**	**Speed km/h**	**Speed mph**	**Armament**
FB5 Gunbus	Britain	113	70	1
Eindecker III	Germany	140	87	1
Moraine-Saulnier Type N	France	144	89	1
FE2b	Britain	147	91	1
DH2	Britain	150	93	1
Nieuport *Bebe*	France	156	97	1

Albatros III	Germany	175	109	2
Sopwith Pup	Britain	179	111	1
Sopwith Camel	Britain	185	115	2
Fokker DR I	Germany	185	115	2
Sopwith Triplane	Britain	187	116	1
Fokker D VII	Germany	188	117	2
Spad VII	France	212	132	1
SE5a	Britain	222	138	2
Spad XIII	France	222	138	2

The War in the Air - Bombers: Russia
Updated - Saturday, 9 August, 2003

Long before his pioneering work on helicopters, Igor Sikorsky became interested in multi-engined aircraft. This interest was sparked in 1911 after he nearly crashed when an insect caught in the carburettor of his single engined plane.

In 1913 he built the world's first four engined airplane, the "Grand" and he followed this experimental aircraft with the "Ilya Murometz" in late 1913. Named after a medieval Russian folk hero, the Ilya Murometz was an astonishingly sophisticated plane for one built a mere ten years after *Kitty Hawk*.

Designed as a civil transport, the Murometz featured a number of extraordinary features: an enclosed cabin capable of holding 16 passengers; heating provided by channelling exhaust gases through radiator pipes; electric lighting powered by an on-board wind generator; there was even an on board toilet. Sikorksy even provided for in-flight access to the engines – a sign of his lack of faith, and their general unreliability.

The Murometz was produced by the "Russo-Baltic Wagon Company." Its director, Mikhail Shidlovsky, was an ex-navy man with connections to the Russian military. He managed to convince the Imperial Russian Air Force (IRAF) to utilize the Murometz for reconnaissance and bombing purposes.

An order was immediately placed for some planes, and in December 1914 Shidlovsky himself, with the rank of Major General, took over command of the "Squadron of Flying Ships", the *Escadra Vozdushnykh Korabley*, known as the EVK. Shidlovsky, apparently as shrewd a businessman as Fokker, remained the sole manufacturer. Nobody in pre-soviet Russia seems to have considered this unethical.

The first couple of months of the EVK were almost their last. The pilots were unused to flying such large aircraft, the ground crew were unable to maintain them, and the Murometz rapidly gained a poor reputation. Shidlovsky brought Sikorsky to his base and together they managed to overcome the teething problems.

The EVK's first operations began in late February of 1915. At this stage they only had one operational aircraft, and it carried out the EVK's first

reconnaissance sortie, which was followed shortly after by a pair of bombing raids against Villenburg station.

In these two raids nineteen men and a number of horses were killed, the station along with rolling stock was destroyed, and there was widespread panic. After dropping the bombs the crew took reconnaissance photos.

The success of their early missions was so great that the EVK was ordered to report directly to the *Stavka* (Supreme High Command of the Russian Military). This was in keeping with Shidlovsky's vision of an independent force operating along lines similar to that of a naval fleet. As the war progressed the EVK developed its own photographic unit for the development and distribution of reconnaissance photos, and it also had its own meteorological unit and flight school.

The EVK's success also brought orders for more planes. Sikorsky continued to develop the Murometz until Russia withdrew from the war in 1917. These later variations were designed with military, as opposed to civilian, requirements in mind.

As a bomber the Murometz was far ahead of its time. It could carry a bomb load of up to 800kg (1760lb), with a range of approximately 500km (310 miles). (The exact performance figures differ from variation to variation.) Equipped with bomb sights, the Murometz was reputed to be more than 60% accurate. The EVK flew both reconnaissance and bombing missions, flying more than 400 bombing sorties.

They flew in all the Russian theatres of conflict, bombing mainly transportation, supply and communications targets. The planes were well known to the Germans, who set up special anti-aircraft batteries when they knew that the EVK was operating in the area. Often these batteries themselves became prime targets of the EVK.

The heaviest bomb the Murometz ever carried was 240 kg (530lb), but usually it carried a mix of explosive and incendiary bombs. It was slow, but sturdy and heavily armed. Its unprecedented size was also an advantage, as it led German pilots to misjudge their distance from it.

The Murometz holds a unique record for any bomber in any conflict: it shot down more enemy fighters than were lost to enemy fire. While only one Murometz was ever lost to enemy aircraft (on the 26th of September 1916), at least ten fighters succumbed to her defensive fire. It is no wonder the German pilots nicknamed the plane the "Hedgehog".

One other Murometz crashed over Russian territory, probably as a result of enemy anti-aircraft fire, and one more was lost due to pilot error.

This is not to say that the planes did not suffer severe battle damage, but Sikorsky had designed an extremely tough aircraft. More than once a Murometz returned to base on two engines only. Sometimes the planes had to be scrapped after bringing the crew back safely. Suffering severe supply shortages throughout the war, the EVK cannibalized the scrapped aircraft.

The main problem with the Murometz was with the engines. The pre-war Murometz was designed to use German-built engines, which obviously were not available. Sikorsky experimented with a range of Russian and British engines, but never achieved the desired level of performance. These

problems, together with the low level of Russian manufacturing, meant that only 75 of this outstanding aircraft were produced during the war.

Shidlovsky decided, after the revolution, that he had no future in Russia, and he convinced Sikorsky to leave also. Shidlovsky, together with his son, was captured trying to cross the border into Finland. They were shot. Sikorsky was luckier. From Murmansk he managed to escape by ship to London.

The War in the Air - Bombers: Italy
Updated - Saturday, 9 August, 2003

The frontier between Italy and Austria was different to any other frontier in the First World War. To the north the Alps protected the Austrian heartland. To the east the Austrian navy sat just across the Adriatic: its chief port was at Pola and it had major ship-building yards at Trieste.

The Italians controlled the air throughout almost the entire war, and waged an innovative and aggressive air campaign. It was the only county other than Germany to use lighter-than-air craft for bombing purposes. The Italian airships were "semi-rigid dirigibles," they were different to the "rigid" Zeppelins in that they had a keel only, as opposed to an entire frame as favoured by the Germans.

Their first bombing raid was on the 26th of May, 1915, three days after entering the war, when they crossed the Adriatic to attack Sebenico, which was attacked by a dirigible again the following day.

The airships were used throughout the war, attacking railway yards and enemy encampments and the naval base at Pola. By the end of the war they had 20 dirigibles. Their 'M' class airships could carry a 1,000 kg (2200lb) bomb load and reach an altitude of 15,000 feet.

They were not however immune to attack. On the 8th of July 1915 the *Citta di Ferrara* was shot down by an Austrian seaplane, and on the 5th of August the *Citta di Jesi* was lost to anti-aircraft fire. Austrian seaplanes bombed the Italian airships at their bases in Jesi and Ferrara.

As opposed to Germany, Italy did not base its major bombing campaigns on the airship. From the opening days of the war the *Corpo Aeronautico Militare*, CAM, made use of the Caproni bomber designed by Gianni Caproni. The CA32 series of bombers were powered by three inline engines: two tractors located in the wings, and one pusher at the rear of the central nacelle.

These planes could carry a crew of three and a load of about 450kg (1,000 lb). The three engine design not only provided great lifting power, it also provided safety as the Caproni could remain aloft with only two engines running. In addition to his design work, Caproni also produced a number of papers discussing the rationale and technique for bombing operations, urging the Italian government to pursue a strategic campaign against transport and industrial targets.

The first Caproni bombing sortie was on the 20th of August 1915, against the Aisovizza aerodrome, dropping explosives and incendiaries. By October they had four bomber squadrons, and by early 1916 CAM was operating seven bomber squadrons.

In February they made their first long distance bombing raid, against Ljubljana, in reprisal for an Austrian attack on Milan. In September they made a 22 plane raid across the Gulf of Vienna to bomb the arsenal and

seaplane base at Trieste. No less than 540 bombing sorties were flown in 1916 alone, and by early 1917 the Italians were regularly flying missions comprising upward of thirty bombers on both day and night missions.

In 1917 the Italians made large use of the Caproni in direct support of the troops. At the tenth battle of Isonzo they began the offensive with two waves numbering over sixty aircraft each. At the eleventh battle of Isonzo they began with an attack of 145 aircraft, and flew well over 200 hundred sorties a day.

Towards the end of 1917 the United States sent a detachment of five hundred men to be taught military flying. After their training most of them were sent to France, but a detachment of about 75 remained in Italy, under the command of Captain Fiorello La Guardia, future mayor of New York, where they flew missions within the overall framework of CAM. These were the first ever bombing missions carried out by Americans.

In addition to tactical bombing, the Caproni bombers continued their strategic campaign. In particular they targeted Pola, the shipyards of Trieste and the Whitehead torpedo factory at Fiume, sometimes massing over 100 aircraft for a single raid. This campaign continued right through to the end of the war.

In 1918 Caproni produced a small number of CA 42 bombers. This was the only triplane bomber used in the war, and it made its debut at the last great battle on the Italian front, the battle of Vittorio Veneto. It was more heavily armed than its predecessors, and could deliver a 1,450 kg (3,197 lb) bomb load.

The RNAS took delivery of a flight of six of these aircraft, and the US Navy contracted to have them built under license in the United States. None of these US built bombers made it to Europe in time for the fighting. Italy built about 250 CA32s and about 30 CA42s.

The War in the Air - Bombers: Germany, Zeppelins
Updated - Saturday, 9 August, 2003

Balloons had been used in wars prior to the First World War, notably by the Americans in the civil war and the French during the siege of Paris in 1870. This technology had been advanced by the development of dirigibles – cigar shaped airships with frames, containing many gas balloons. Powered with multiple engines, these craft could be flown in specific directions rather than just follow the direction of the wind.

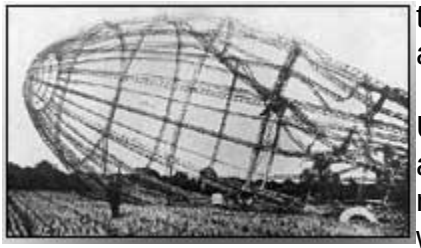
Germany had two dirigible manufacturers, the Schutte-Lanz Company, and the larger and better known Zeppelin Company. The latter was headed by Ferdinand von Zeppelin, the world's foremost designer of airships. To this day his name remains synonymous with dirigibles in general.

Airships of his design had already proven themselves capable of flying as far as England and back. This fact was not lost on the Allies, who from the very outset targeted the airship sheds. It was also not lost on the British public, where rumours and reported sightings of Zeppelins were frequent, though unfounded, throughout 1914.

At the outbreak of the war the German army had six operational dirigibles, and the navy had one. The army was quick to experiment with them – bombing Liege and Antwerp – despite the fact that at this stage no specially designed aerial bombs existed. But the army's initial

experience was not encouraging - they lost three airships in the first months of the war to anti aircraft fire.

Despite this the navy was very enthusiastic. They saw the Zeppelin as a solution to their reconnaissance problems. If the army traditionally used the cavalry for reconnaissance, the navy traditionally used the light cruiser. Germany had very few such ships, and an airship was viewed as being cheaper and less vulnerable.



Under the command of Korvettenkapitan Peter Strasser the navy quickly acquired more airships. Throughout 1914 these were used for reconnaissance patrols over the North Sea, but the German Admiralty was pressing for permission to use them for attacks against England. The Kaiser, somewhat reluctantly, granted such permission and on the 19th of January the Germans carried out the first Zeppelin raid against Britain, killing two and injuring sixteen.

This was the first of many raids, which continued at a rate of about two per month, in parallel with the continuing reconnaissance patrols. The German Admiralty was very enthusiastic about the results, and asked for permission to bomb London. This was only granted by the Kaiser after a series of raids by French bombers on German cities. On the 31st of May 1915 the first raid was carried out against London, killing seven and injuring thirty five.

The most successful Zeppelin raid on London in the entire war was on the 8th of September 1915. This raid caused more than half a million pounds of damage, almost all of it from the one Zeppelin, the L13, which managed to bomb central London. This single raid caused more than half the material damage caused by all the raids against Britain in 1915.

On the night of 6-7 June 1915 Rex Warneford, a lieutenant in the RNAS, flying a Morane-Saulnier, was on a bombing mission against the Zeppelin sheds at Evere. When he spotted a Zeppelin returning from a bombing raid against London he decided to attack it. He tried shooting his carbine at it, his only armament, but he was driven off by the Zeppelin's defensive machine guns.

The airship began climbing, leaving the little plane behind, but Warneford, unbeknown to the Zeppelin crew, continued the pursuit, climbing slowly over two hours to an altitude of 13,000 feet. At this stage the airship began to descend in the direction of Brussels, and seizing his opportunity Warneford, now above the Zeppelin, dived towards it and from about two hundred feet above he dropped his six bombs on its roof.

The resultant explosion destroyed the Zeppelin, and almost destroyed Warneford's fragile monoplane.

He was forced to put the plane down, behind enemy lines, but he managed to make sufficient emergency repairs to take off again and return to his base. LZ 37 was the first Zeppelin brought down by an airplane.

Warneford was awarded the Victoria Cross by the British, and the Knight's Cross of the Legion d'Honneur by the French, but his triumph was short-lived. He was killed ten days later in a flying accident.

This was an isolated incident. Throughout the remainder of 1915 the Zeppelins raided London frequently, and with impunity. They flew too high for most planes, and when they were intercepted by aircraft the ammunition in use at the time had

little effect. Despite this impunity the material effect of the raids, with the exception of L13's success, was relatively slight.

Navigation was very primitive, and as the war progressed the British use of blackouts made it even harder. Bomb aiming was far from accurate. It is estimated that only 10% of the bombs dropped from Zeppelins actually hit their target. The psychological impact of these raids, however, was enough to cause the British to tie up 12 squadrons on home defence.

The Germans also bombed Paris. The first raid was on 21st of March, when two Zeppelins caused 23 deaths and injured 30. Although the Zeppelins continued to raid Paris, London was actually a preferred and easier target. The nearest Zeppelin base to Paris was at Metz, which meant flying close to 320 km (200 miles) over French territory each way, giving the defending airforce and anti-aircraft guns much more time to organize.

Raids against London had to cover nearly twice the distance, but most of the approach was over friendly territory and the sea. Paris was also protected by barrage balloons, a measure only taken by the British later in the war.

1916 did not start well for the Zeppelins. Four of them were lost carrying out bombing raids during the Battle of Verdun, and this marked the last use of airships for tactical bombing. But Strasser remained confident. The Zeppelin factory was producing a new generation of airships – larger, more powerful, and with more engines.

But it was also a year of change on the British side as well. Disappointment with the RNAS' failure to stop the Zeppelins resulted in the responsibility of home defence being given to the RFC. Happily for them this coincided with the arrival of improved ammunition.

Towards mid 1916 the British planes were armed with a mixture of explosive and incendiary bullets. This mixture would prove to be deadly to the airships: the explosive bullets could pierce the Zeppelin's tough outer skin and cause leaks on the inner gas bags. The incendiary bullets could set those leaks on fire, and once on fire a Zeppelin was doomed.

William Leefe-Robinson, flying a BE2c, was the first to shoot down a dirigible over Britain, on the 2nd of September, 1916. The massive fire of the burning airship was visible for over a hundred miles. This was during a raid of twelve naval airships which were, somewhat unusually, accompanied by four army airships. Leefe-Robinson became an instant hero. He survived the war, only to die a month later in the influenza epidemic.

Strasser's confidence remained unshaken. Leefe-Robinson had shot down the SL11. It was an army airships, not one of Strasser's, and moreover an old Schutte-Lanz dirigible with a wooden frame.

But Strasser's confidence was misplaced. Three weeks later he was to lose two airships, out of a total of twelve taking part in a raid. There were no comforting explanations. They were naval airships. They were the most up to date Zeppelins available.

The L33 had been hit by anti aircraft fire. She did not catch fire, but she was forced to land in England. The crew all survived, and set her alight before capture. The L32 was shot down by a plane, and as in the case of Leefe-Robinson's SL11, it caught fire. Nor were these the last losses in 1916.

Despite flying almost four times as many sorties as in 1915, and dropping almost five times as many bombs, Strasser's fleet caused only about two thirds as much damage as they had in 1915.

The German military was becoming disillusioned with the Zeppelins, and began using the new Gotha and Giant bombers to attack Britain, but Strasser remained convinced. The answer was to fly higher, above the defending aircraft. Thus was conceived the third generation of Zeppelins, the "Height Climbers", airships capable of reaching an altitude of 20,000 feet.

In order to reach these heights defensive armaments were reduced, as was the strength of the frame. Flying at such altitudes produced a whole new set of problems. The extreme cold and thin oxygen affected both the engines, and the crew's capability to function.

Bomb aiming and navigation became even harder. But with the renewed immunity the height seemed to offer, it seemed worth the price. Indeed, when on the night of October 19th 1917 a fleet of eleven Height-Climbers crossed the English coast they were too high to be heard, and their raid was a total surprise.

But on the return journey, over the European mainland, almost half the airships were shot down by British and French fighter aircraft as they descended towards landing. The L55 had attempted to avoid this risk by keeping at 20,000 feet till it had cleared the western front, but this caused other problems. The morning sun heating the hydrogen forced the L55 to a record-breaking 24,000 feet. With most of the crew disabled by oxygen deprivation it was a struggle to bring her under almost partial control. The L55 crash landed in central Germany.

The total amount of material damage caused by the airships in 1917 was less than 90,000 pounds.

1918 started badly for the beleaguered airship fleet, when a series of unexplained explosions at the airship base in Ahlhorn blew up four Height-Climbers, one Schutte-Lanz airship, and four sheds. German manufacturing by this time had been greatly reduced, and they could not replenish such losses.

On the 5th of August Strasser himself led the last big raid against Britain, leading a fleet of five Height-Climbers. Strasser was flying in L70 – his most advanced airship, capable, he hoped, of flying bombing missions against New York. But by this time the British had aircraft that could operate at about 20,000 feet as well, and L70 succumbed to a two man DH4 piloted by Egbert Cadbury. (He was a member of the famous chocolate manufacturing family.)

The fatal shots were fired by his gunner, Robert Leckie, whose hands were almost frozen because he had not had time to put on gloves when he and Cadbury had scrambled to chase the Zeppelins. The rest of the airships dropped their bombs on what they thought were "targets of opportunity", but in fact they dropped them in the sea.

The Zeppelin attacks had a profound psychological impact on the Allies. The Germans were ordered, under the treaty of Versailles, to hand over all their airships, but their crews preferred to destroy as many of them as they could.

The need to tie up numerous squadron in home defence can be marked as the Zeppelin's greatest achievement, for as a weapon of

war they proved themselves unsatisfactory. Of the 115 Zeppelins employed by the Germans, 53 were destroyed and a further 24 were too damaged to be operational. Strasser's crews suffered a 40% loss rate. The cost of constructing those 115 Zeppelins was approximately five times the cost of the damage they inflicted.

The War in the Air - Bombers: Germany, Gotha and Giant
Updated - Saturday, 9 August, 2003

During the last two weeks of 1914, before the first Zeppelin attack on Britain, there were a small number of abortive raids against the Dover area by German seaplanes.

A more successful bomber force of 36 airplanes was organized in the Bruges region, which carried out its first night raid, against Dunkirk, in January of 1915. This unit was planning to run raids against Britain, but before they could about half of them were transferred to the Eastern Front and provided tactical support to the German breakthrough at Gorlice-Tarnow.

The Germans then concentrated their bomber activities on the Zeppelin fleet, until by mid 1916 it was clear to all (excluding Strasser, the naval airship fleet commander) that the airships were not succeeding as expected.

In the autumn of 1916 the Germans began to equip with the Gotha twin engined bomber. Of a pusher layout, these aircraft could fly at 15,000 feet, above contemporary fighter's maximum height. With a range of 800 km (500 miles) and a bomb load of up to 500 kg (1,100 lb), the Gothas were designed to carry out attacks across the channel against Britain.

A group of four squadrons was established in Belgium, and they carried out their first bombing raid towards the end of May, 1917. This 22 plane sortie, against the town of Folkestone, caused 95 deaths. In mid June a force of 18 Gothas attacked London in broad daylight. They were met by over 90 British fighters, but not one Gotha was brought down. This bombing raid caused 162 deaths.

On the 7th of July 1917 over a hundred defensive sorties were flown against a 22 plane Gotha raid. In this case one Gotha was shot down, and three were damaged, at the cost of two fighters shot down by the Gotha's defensive gunners. It was only when the RFC began to equip their home defences with Sopwith Camels that the Gothas began to suffer serious losses and were forced to switch to night attacks.

From mid-September the Gothas were joined by an even larger, more potent bomber. The Zeppelin-Staaken *Riesenflugzeug* "Giant" bomber was a four engined tractor biplane with enclosed cabin that may have been inspired by the Russian Murometz. The Giant certainly deserved its title – its wing span of 42 metres (138 feet) was only one metre (3 feet) shorter than Boeing's famous B29 Superfortress of World War II fame, and its tailplane was roughly the same size as a Sopwith Pup.

It could carry a maximum bomb load of 2,000 kg (4,400lb) but for long range flights, such as against London, this was reduced to half that. It had a range of about 800km (500 miles). Like the Murometz, the engines could be serviced in mid-flight.

The Gotha/Giant night raids continued throughout 1917, almost unscathed, until December when the British began to have success in intercepting the Gothas at night. Anti-aircraft fire was also becoming more effective and increased use of barrage balloons

affected the bombers.

By the end of the war a 50 mile long line of barrage balloons surrounded London.

On the night of the 28th-29th of January 1918, after the loss of one Gotha over Britain and four more to crash landings back in Belgium, the Gotha squadrons were withdrawn for reorganization and training. When they became operational again in March they were employed primarily for tactical support during Germany's last great offensive on the Western Front.

In the meantime the Giants continued a small but influential campaign against London. On the 16th of February, during a four plane raid, a Giant dropped a 1,000 kg (2,200 lb) bomb – the largest used by anyone in the war – and blew up a wing of the Chelsea hospital.

During the same raid another Giant survived colliding with the cable of a barrage balloon and falling 1,000 feet before the pilot could regain control. The following evening a single Giant returned and scored a direct hit on St. Pancras station. The crew of this airplane reported that they saw anti-aircraft fire as far as twenty miles away - an indication of the psychological impact of attacks on urban targets.

The last raid of the war was carried out on the night of the 19th-20th of October 1918. This was a combined Gotha/Giant raid, and of the 38 Gothas taking part three were shot down by fighters and a further three were brought down by anti-aircraft fire.

No Giants were ever lost to British fighters or anti-aircraft guns, even though some were intercepted. A number were badly damaged by accidents during landing. The Giants were extremely complicated to build, and only 18 were ever completed.

The Germans hoped to cause widespread panic and even uprising with these raids. In this they failed, but the raids tied down a large number of aircraft, anti-aircraft guns and personnel that otherwise could have been used directly on the Western Front. The need for a coordinated air defence was one of the major reasons for the formation of the RAF in April of 1918.

One of the conditions of the armistice was that the German would hand over all their night bombers. When the British saw how few of these aircraft there actually were they initially suspected the Germans of hiding some of them.

The seeming invincibility of the bombers, especially in 1917, had a great influence on British military thinking well into the Second World War, for it was here that the British concept that "The heavy bomber will always get through" was born.

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The War in the Air - Bombers: Britain
Updated - Saturday, 9 August, 2003

Just prior to the outbreak of war the RNAS had been given the responsibility of protecting England from air attack. It was a responsibility they felt, at the beginning, unprepared for. Churchill, bleakly prophetic, told the Cabinet that, "…I cannot feel that our arrangements to cope with it are yet in a satisfactory state. Loss and injury, followed by much public outcry, will probably be incurred in the near future."

The threat of Zeppelin attack hung heavy on the minds of Churchill and Captain Murray Suerter, director of the air department of the Royal Navy. Nobody had any idea how to intercept a Zeppelin in the air, and so Churchill and Suerter concentrated on attacking the airship bases.

The Zeppelin sheds were very large, presenting a relatively easy target. If the shed contained an airship at the time, all the better, but destroying these hangers was in itself beneficial. They were essential for storing the Zeppelins which needed protection from high winds when not in flight.

On the 22nd of September four aircraft took off from Antwerp to bomb the Zeppelin sheds at Cologne and Dusseldorf. Due to heavy fog only one of the planes found its target and though the pilot managed to drop his bombs little damage was done.

The RNAS tried again on the 8th of October 1914 with more success, destroying a Zeppelin at Dusseldorf. On November 21st a flight of Avro 504s bombed the Zeppelin works at Friedrichshafen. On Christmas Day, 1914, they flew seven seaplanes off from three seaplane tenders and attempted to attack the Zeppelin sheds at Cuxhaven and Wilhelmshaven.

The raid failed to do much damage, but proved the viability of using ships to extend the bombing range of aircraft. These early experiences prompted the RNAS to order the development of a bomber capable of carrying a large bomb-load. In Suerter's words, the RNAS needed "a bloody paralyzer of an aeroplane."

The innovative Louis Strange of the RFC was also experimenting with bombing techniques. He managed to destroy trucks by dropping petrol bombs from his plane, but dissatisfied with dropping bombs by hand he came up with the idea of attaching the bombs to racks on his wings, and dropping them by pulling a release wire.

He tried this out on his BE2c with great success in March of 1915, attacking a train at the station of Courtrai, and thus impeding the flow of German reinforcements during the Battle of Neuve-Chapelle. This bombing raid was also the first RFC bombing raid that was planned from photo reconnaissance.

As 1915 progressed the RFC lost control of the air to the German Eindeckers. The BE2cs, RE7s and Martinsydes suffered increasingly heavy losses until the British regained control of the air and received the next generation of aircraft.

The most important of these was the Sopwith 1½ Strutter which arrived at the front in early 1916. It was produced both as a two seater fighter and as a single seater bomber. The latter variant carried a 118kg (260 lb) bomb load. Together with the less effective RE8 this plane carried the role of tactical bomber through the transition year of 1916 until more potent bombers arrived on the front.

(As a fighter the 1½ Strutter was also important as it was the first in a chain of winning Sopwith fighter designs culminating in the Camel. The plane's strange designation originated as a nickname, describing the one full inter-plane strut and the additional half strut connecting the upper wing to the fuselage. Nicknaming Sopwith aircraft became something of a tradition. The "Pup" was so nicknamed because it seemed to be a baby, or 'puppy', 1½ Strutter. The "Camel" was named after the way the fuselage "humped" over the breeches of its twin Vickers guns. In each case officialdom had frowned on the names but had been forced to eventually accept them.)

In November of 1916 the RNAS took delivery of the Handley Page O/100. This twin-engined inline tractor plane, with a range of about 965 km (600 miles) and a bomb-load of 812 kg (1,790 lb), was Britain's first multi-engined warplane, and it was the fulfilment of Suerter's request for a "bloody paralyzer".

The RNAS initially used the O/100 for reconnaissance purposes, but from March of 1917 it began using it with great effect as a night bomber against tactical targets. It was joined by the DH4, Britain's most successful day bomber of the war, which had a range of 676 km (420 miles) and could carry a bomb load of 210 kg (460 lb).

One O/100 was flown 3,220 kilometres (2,000 miles) to the island of Lemnos in the Aegean sea, where it took part in an offensive against Turkey. On the 9th of July 1917 it bombed Constantinople. Over the next months it was employed in tactical bombing raids and anti-submarine reconnaissance, but it returned to Constantinople on the 30th of September 1917.

This raid, however, ended in disaster. Engine failure forced the plane down and the crew were captured. The pilot of this plane was John Alcock.

A veteran of the RNAS, Alcock had mentored Collishaw of "Black Flight" fame when the latter arrived at the front with less than nine hours flying training. In 1919 John Alcock and Arthur Brown became

the first men to fly across the Atlantic non-stop. Brown had also been a prisoner of war, having been captured by the Germans. Sadly, Alcock was to die in an air crash six months after that record breaking flight.

In October 1917 Hugh Trenchard, commander of the RFC in France, was ordered to commence a strategic bombing campaign against German industrial targets. To this end the 41st Wing was formed, taking squadrons from both the RFC and the RNAS. The 41st flew DH4s, O/100s and the venerable Fe2B pusher which was proving its worth as a night bomber and ground strafer. They later began re-equipping with the O/400, an improved version of the O/100 with a 910 kg (2000 lb) bomb load and a range of 965 km (600 miles).

For the first few months the 41st wing concentrated on attacking local targets, but they made their first long-distance raid when 10 Handley-Pages attacked the towns of Mannheim and Ludwigshafen.

By February of 1918 they were capable of mounting the first "round the clock" bombing raid, against the town of Trier, with the DH4s attacking by day and the Handley-Pages attacking by night. In March they carried out a number of day raids, including raids of Mannheim, Mainz and Stuttgart, but this was at the price of six of the Handley-Pages, as the Germans were increasing their anti-aircraft fire and bolstering their fighter defence.

When the RAF was formed on the 1st of April 1918, the decision was made to increase strategic bombing activities. Trenchard was placed in charge of this enlarged force, which became known as the "Independent Force, RAF".

Trenchard preferred to bomb a number of targets, rather than concentrate on one. He also preferred daylight bombing rather than night bombing, as he felt the day bombers were more accurate, but conditions in the field overruled him.

By July of 1918 his day bomber squadrons were suffering too high an attrition rate, and could not operate without fighter escort. The bulk of the bombing effort was eventually carried out by the Handley-Page night bombers, which by September of 1918 were carrying Britain's largest bomb, weighing 750 kg (1,650 lb).

These aircraft dropped two thirds of the 558,000 kg (1,230,000 lb) of bombs dropped by the Independent Force in the latter half of 1918.

At the signing of the armistice the RAF had just taken delivery of its most advanced bomber. The Handley Page V/1500 was a four engined plane that could carry a bomb load of 3,400 kg (7,500 lb) from East Anglia to Berlin, but the plane was never used.

The War in the Air - Bombers: The Missionaries of Bombing
Updated - Saturday, 9 August, 2003

In September of 1918 the American general Pershing commanded the first US led attack of the war against the salient of St Mihiel not far from Verdun.

His Chief of Air Service at this battle was Billy Mitchell. Mitchell was an early enthusiast of aviation and had headed the aviation section of the US Signal Corps. In 1917, before America's entry into the

war, he had been sent to Europe as an observer. During this period he was befriended and influenced by Hugh Trenchard.

For the upcoming battle Mitchell gathered together the largest concentration of aircraft of the entire war. He had over 1400 planes at his command. More than 300 of them were day bombers and almost 100 were night bombers. About 40 percent of this force were American pilots, the rest being made up by French, British and Italians.

Mitchell's plans were thwarted, however, as the crucial first two days of the battle were fought in bad weather, preventing the kind of mass air attack that Mitchell had intended.

In the immediate aftermath of the war Hugh Trenchard, Billy Mitchell and the Italian Giulio Douhet (who had commanded Italy's first aviation unit from 1912 to 1915) all published influential papers pushing the idea that the bomber would change warfare forever.

What would decide future conflicts, they claimed, was not the forces on the ground but the forces in the air. Trenchard remarked that while there had been only seven bombing raids against Trier, there had been over one hundred alerts, with the accompanying affect on morale and production. Given a large bomber force, Trenchard and the others argued, the effect would be war winning. Future wars would be won by strategic bombing aimed at destroying the enemy's industrial centers and breaking civilian morale.

Trenchard commanded the RAF for ten years, from 1919 onwards, and his influence lasted well beyond that. Billy Mitchell clashed with his superiors, was court martialed and resigned, but nevertheless he deeply affected American military thinking.

In the Second World War the Germans had superb tactical bombers, and used them as a weapon of terror against civilian targets. The British and Americans, however, were the only combatants who flew four engined heavy bombers. They were the only ones would could mount a sustained strategic bombing campaign, and they succeeded in severely disrupting their enemy's production capabilities.

The table below lists the important bomber types used in the war. It is sorted by the size of the bomb load.

Airplane	Country	Bomb Load (kg)	Bomb Load (lb)	No. of Engines
BE2c	Britain	102	224	1
Sopwith 1½ Strutter	Britain	118	260	1
Voisin III	France	150	330	1
DH4	Britain	210	460	1
Breguet 14	France	260	570	1
Caproni CA32	Italy	450	1,000	3
Gotha	Germany	500	1,100	2
Ilya Murometz	Russia	800	1,760	4
O/400	Britain	910	2,000	2

Caproni CA42	Italy	1,450	3,197	3
Giant	Germany	2,000	4,400	4

The War in the Air - Ground Attack
Updated - Saturday, 9 August, 2003

Ground attack is a close relative to tactical bombing. It is aimed at disrupting enemy forces at or near the front and during the course of the battle itself. While strategic and tactical bombing raids are planned and directed at specific targets, ground-attack is often carried out against targets of opportunity, as they appear on a changing battle-field. It is carried out by strafing and by dropping small munitions such as hand grenades. Ground attack is carried out from very low altitudes and is thus both extremely accurate and extremely hazardous.

During the Battle of Messines, in June of 1917, British air force commander Hugh Trenchard ordered the British pilots to fly low over the lines and strafe whatever targets presented themselves. This was in order to harass the troops and break their morale. During the Third Battle of Ypres which followed, this tactic was further pursued and developed with Sopwith Camels armed with four 9kg (20 lb) bombs raiding enemy trenches and approaches. While effective, the loss rate of the attacking planes was very high.

At about the same time the Germans took delivery of the Halberstadt CL II. This was a two seater tractor aircraft intended originally as an escort fighter for observer planes. Realizing the effectiveness of direct ground attacks, flights of Halberstadt CL IIs were reorganized into attack flights (*Schlachtstaffeln*).

These planes were better equipped for ground-attack duties than the single-seater Allied fighters, which were particularly vulnerable to attack from above and behind, while the pilot was preoccupied with aiming and strafing. In the Halberstadt the observer provided both warning and some level of protection from such attacks, and could assist by dropping bombs or grenades.

The colossal, costly, and failed engagements of 1916 had led the military on both sides to seek out new weapons and tactics to change the way in which they waged the war.

The Germans developed a new tactic of "infiltration" – the use of lightly armed, mobile elite troops (*Sturmtruppen*) to break through the defensive lines and fight in the rear of the front line. Ludendorff thought that the use of the *Schlachtstaffeln* would both aid the initial breakthrough, and help them consolidate those initial gains.

On the allied side of the front there was a willingness to rethink the use of the tank. There had been much disappointment with its performance, but by mid 1917 the British command was open to the claims of Brigadier General H. Elles, the commander of the Tank Corps, that the tank had not been used on suitable terrain.

The British launched the Battle of Cambrai on the 20th of November 1917, attacking across dry and chalky ground, and using tactics developed by Lieutenant Colonel J. F. C. Fuller, the Tank Corps Staff Officer.

Fuller had coordinated three elements into his battle plan: an improved artillery system, massed tanks (over 320), and coordinated ground attack by 300 aircraft from fourteen RFC squadrons. The planes attacked trenches, supply convoys, artillery emplacements and other front line installations.

They were highly effective, at times even saving the tanks from being pinned down. But the cost to the airmen was high. The German infantry had learned how to fight back against low flying aircraft, and once air reinforcements arrived the loss rate of ground attack aircraft was as high as 30 percent of aircraft deployed. Entire squadrons were wiped out in less than a week.

On the ground, the initial success of the attack was so great that victory bells were rung in Britain for the first time since the beginning of the war. But the celebration was premature. The attack became bogged down, and the German's counter-attacked.

It was during this counter-attack that Ludendorff used his new infiltration tactics, and to great effect. The spearheads of the *Sturmtruppen* were accompanied by carefully coordinated ground attacks, the pilot strafing and the observer dropping grenades. They were so effective that a British Court of Inquiry found that the *Schlachtstaffeln* were one of the major causes of the success of the German counter-attack.

The RFC learned a number of important lessons at Cambrai. British pilots, taking a leaf from the French, improvised better camouflage so as not to be so visible to defending fighters: in particular the twin bright roundels on the upper wing provided an easily visible and effective aiming point. (One simply had to aim between them to target the pilot.)

Sopwith began developing an aircraft specially designed for the needs of ground attack warfare – its most significant feature being armour plating to protect the pilot. This became known as the Sopwith Salamander.

In May of 1918 Fuller began developing plans for the next year of combat. This became known as "Plan 1919." Hailed as the precursor of the "Blitzkrieg," one of the keystones of the plan was integrated ground attack using the Salamanders. Large scale production was underway at the time of the armistice, but in practice the Salamander never saw combat.

When the Germans launched their final great push in March of 1918, they placed such an emphasis on ground attack that it was considered to be the most important task of the German planes. Flying Halberstadt CL.II, the improved Halberstadt CL.IVs, and the specialist all-metal Junkers J1, they initially enjoyed tremendous success.

For their part, the allies found it hard to perform ground attack duties, and indeed found it hard to coordinate their air power at all, because they needed to evacuate seventeen of their forward airfields. But by late March they had reorganized and began to inflict heavy losses on the German airforce.

By the time of the last German offensive, in mid July, shortages of pilots, aircraft and gasoline meant that their was little air support. In a mirror image of the battle of Cambrai, the Allied counter-attack was strongly supported by coordinated ground attack.

Perhaps the most dramatic use of ground-attack occurred in Palestine. By September of 1918 the British had complete control of the air, largely through the efforts of the First Squadron, Australian

Flying Corps, flying the excellent two seat Bristol F2 Fighter and a single Handley-Page O/400. (Ross Smith, who later won the 1919 England-Australia air race, was one of the pilots of this squadron.)

Following the success of Allenby's attack at Megido on the 19th of September, the Turkish divisions were forced to retreat through the narrow defile of Wadi Farra. On the 21st of September the Australians trapped them there, when they bombed the head and the tail of the Turkish column. Together with RAF SE5as and DH9s the Australians mercilessly bombed and strafed the terrified Turks.

In the words of T. E. Lawrence, "When the smoke had cleared it was seen that the organization of the enemy had melted away. They were a dispersed horde of trembling individuals, hiding for their lives in every fold of the vast hills. Nor did their commanders ever rally them again. When our cavalry entered the silent valley the next day they could count ninety guns, fifty lorries, and nearly a thousand carts abandoned with all their belongings. The RAF lost four killed. The Turks lost a corps."

The War in the Air - Naval Warfare
Updated - Saturday, 9 August, 2003

The first time that a plane took off from a ship was on the 10th of November 1910, when Eugene Ely, flying a Curtiss biplane, took off from the American light cruiser *Birmingham*. Two months later he even made the first landing of an aircraft on a ship's deck, albeit a ship at anchor, the *Pennsylvania*.

Between 1910 and 1914 the navies of all the major protagonists showed interest in using aircraft for reconnaissance purposes. The RNAS experimented with ships carrying small platforms from which aircraft could take off, but takeoff weights were limited and no practical solution to landing was found, as Ely's landing on the *Pennsylvania* was deemed a feat not repeatable for a ship at sea.

The RNAS found the concept of "seaplane tenders" more practical. These ships carried a small number of seaplanes that could be lowered by crane over the side. At the end of their flight they would land next to the ship and be raised back on deck.

The first seaplane tender was the short lived H.M.S. *Hermes*, which was torpedoed and sunk in November of 1914. However at the outbreak of the war the Navy requisitioned three cross-channel packet boats and converted them as seaplane tenders. These were the *Engadine*, *Riviera* and *Empress*.

It was from these ships that the raid against the Zeppelin bases at Cuxhaven and Wilhelmshaven was carried out on Christmas Day of 1914. This was the first time ship-borne aircraft were used offensively, and while the raid was not successful in terms of damage inflicted, it proved the practicality of such operations.

The navy acquired more seaplane tenders. In 1915 the British launched the audacious, and ultimately disastrous, campaign against the Turks at Gallipoli. At the opening of the campaign the sea-plane tender *Ark Royal* provided eight Short 184 seaplanes, which provided reconnaissance and aerial spotting.

In June it was joined by the *Ben-My-Chree*. (Erskine Childers, the novelist and Irish revolutionary, served as an observer on the Shorts. He first served on the *Engadine* in 1914 and participated in the bombing raid against Cuxhaven, and later he served on the *Ben-My-Chree* during the Gallipoli campaign.)

During the troop landings at Sulva Bay in August these planes spotted for the Naval guns, and even carried out some bombing sorties, impeding Turkish attempts to reinforce their troops. On the 12th of August 1915 C. H. K. Edmonds, flying from the *Ben-My-Chree* became the first pilot to sink a ship by torpedo when he scored a direct hit on a Turkish merchantman. The Turks later got their revenge on the *Ben-My-Chree* when their shore artillery sank her on the 11th of January 1917.

The Battle of Jutland took place in May of 1916. The *Engadine* was a part of the British battle cruiser squadron. When Admiral David Beatty first received reports of enemy vessels he ordered it to launch a seaplane to investigate. Heavy clouds forced the plane to fly at a mere 900 feet above the waves. It encountered four light cruisers, which opened fire but failed to hit it.

The pilot of this plane was F. J. Rutland, who not surprisingly became known thereafter as "Rutland of Jutland". Although this sighting had no marked effect on the conduct of the battle, Beatty was to write that the sighting did, "indicate that seaplane under such circumstance are of distinct value."

Other navies also used seaplane tenders. Most noticeably were the Russians, whose Black Sea fleet used them quite aggressively in their campaign to blockade the Bosphorus and prevent shipments of coal to Istanbul. Their most successful raid was on the 6th of February 1916, when a flight of eleven M-9 seaplanes from the ships *Emperor Aleksandr I* and *Emperor Nikolai I* attacked the port of Zonguldak. Among other damage they sank the Turkish collier *Jamingard*.

One of the main duties of the RNAS was to aid in the battle against the U-Boat. The RNAS employed both seaplanes and non-rigid airships to carry out reconnaissance missions. The airships were slower, but could carry the bulky wireless transmitters that were too heavy for the seaplanes.

The aim of these missions was two-fold: detection, and to force the U-boats underwater as much as possible, in order to make them more vulnerable to attack when they were forced to the surface to recharge their batteries. As the war progressed the RNAS began to use the seaplanes offensively against the U-Boats as well. On the 20th of May, 1917 the UC36 earned the dubious distinction of being the first submarine ever sunk by an aircraft. The UB20 suffered a similar fate in July and the UB32 in August.

The Royal Navy wanted to equip ships with aircraft that could intercept the Zeppelins, and thus deprive the German Navy of its greatest reconnaissance asset. It was clear that the seaplanes, weighed down and cumbersome because of their floats, could not provide the required performance.

With the Sopwith Pup there was finally available a plane that could climb high enough, and fast enough, to tackle the Zeppelins. In addition it required a very small take off run. In fact, flying into a 20 knot wind the Pup required a meagre six metres (20 feet) to take off.

The navy revived the idea of flying wheeled aircraft off from decks. F. J. Rutland, who had flown the reconnaissance mission at Jutland, flew the first such takeoffs from platforms on the *Manxman* and *Campania*. The navy subsequently fitted light cruisers with such takeoff platforms.

The solution was far from ideal as there was still no way to land, and the planes had to either land on shore, or if this was too far away, to ditch into the sea. The Pups were supplied with special airbags to keep them afloat until the ship's crane could lift them back up on deck.

On the 21st of August, 1917 a Sopwith Pup piloted by Second Lieutenant B. A. Smart, took off from such a ship, the HMS *Yarmouth*, which had been escorting a mine-laying force in the Heligoland Bight. Climbing to 7,000 feet he attacked the Zeppelin L23 from above, and shot it down. He subsequently ditched in the sea and was recovered by HMS *Prince*.

The Royal Navy took an even more advanced approach when it changed the layout of the HMS *Furious*, then under construction as a light cruiser.

They cleared the forward deck of her intended gun turret, and placed instead a takeoff deck 70 metres long and 15 metres wide. (228 feet by 50 feet.) The deck was connected by a hatchway and crane to a hanger which held four seaplanes and six land planes.

The Squadron Commander on the *Furious* was E. H. Dunning, and he thought he had a solution to the problem of landing. He knew that if the ship, with its top speed 21 knots, sailed directly into a 19 knot wind, the combined speed would match the Pup's 40 knot landing speed.

On the 2nd of August 1917 he demonstrated how this could be used to land the craft on the takeoff deck. He flew alongside the *Furious*, and as he lowered his speed he was virtually hovering in relation to the deck. He then side-slipped over the ship. Waiting crewmen grabbed prepared ropes and literally pulled the plane down, while Dunning cut the engine at the same time.

He attempted a second landing five days later, but this time instructed the crew not to grab the ropes until the plane had touched down. Something went wrong (it has been variously reported as the engine stalling, or a tyre bursting) but whatever the cause the plane crashed over the side and into the sea. Dunning was knocked unconscious and drowned before he could be rescued. Further attempts to land using this technique were banned.

As an alternative solution the Navy carried out a further modification to the *Furious*. Her aft gun was removed, and a second 87 metre (285 foot) deck, intending for landing, was located aft of the funnel. Another important change was the installation of lifts to connect between the hanger and the flight decks.

The landing decks were equipped with arrester gear: cables stretched across the deck which were to be snared by horns projecting from the undercarriage. This technique had been successfully tried on shore, but at sea it was a failure. The hot exhaust from the funnel made the air turbulent and the funnel itself blocked the vital headwind.

Rutland was one of the pilots who failed to land in these trials, crashing over the side. He was more fortunate than Dunning and was rescued.

(During the 1930s Rutland became an advisor on aircraft carriers to the Japanese, who later set him up as a spy in Hawaii and California. In 1941 he returned to England where he was interned without trial until 1944.)

After these initial experiments the idea of landing on the *Furious* was abandoned, and only her flying off deck was used. On the 19th of July 1918 operation "F7" was launched from her decks. Of the seven Sopwith Camels that took off one turned back with engine trouble, but the other six attacked the Zeppelin base at Tondern, destroying two airships and disabling the base for the rest of the war.

One of the pilots of this mission was B. A. Smart, who had shot down the L23. As on that previous occasion he successfully ditched beside the fleet and was picked up, as was one other pilot. Three others landed in Denmark, and one failed to find the fleet on return. His body was washed up a month later, and it is assumed he drowned after ditching alone at sea.

The experience gained with the *Furious* paid off. In the autumn of 1918 the navy launched the first true aircraft carrier, the HMS *Argus*. Exhaust from her engines was channelled aft through ducts and discharged over the stern. The small chart-house on deck could be lowered, leaving the *Argus* with a clear 168 by 21 metre (550 by 68 foot) flight deck for taking off and landing.

The first deck landings took place in October of 1918. Admiral Beatty put forward a plan to use the *Argus*, carrying the new Sopwith Cuckoo torpedo bomber, to attack the harbour-bound German High Seas Fleet. The admiralty rejected this plan, but the concept was sound, and was first used to great effect by the British 23 years later against the Italian fleet at Taranto in 1940. This raid greatly influenced the Japanese thinking prior to Pearl Harbour.

The *Argus* made the concept of the seaplane tender obsolete, and post war developments made the *Argus* itself obsolete within a few years. Nevertheless, she was used throughout World War II. She served most of the war as a transport for aircraft, but she was also successfully used as a carrier during Operation Harpoon – the supply of Malta - in 1942.

The War in the Air - Air Aces of World War One
Updated - Saturday, 1 November, 2003

The First World War introduced a new form of battleground: to ground and sea warfare could now be added aerial conflict. Nascent aircraft technology was quickly and relentlessly developed to produce machines capable of serving each country initially in reconnaissance missions (ideal in conditions of trench warfare) and later in fighter and bombing raids.

The air war threw up a new breed of fighter, and in general the Allied and Central Powers' governments proved quick in exploiting the successes of their airmen for propaganda purposes (although the British were less inclined to trumpet the Royal Flying Corps' achievements, with one or two notable exceptions).

The French government was the first to award the distinction of 'ace' to those of their fighters who had demonstrably downed five enemy aircraft. Independent confirmation was a strict requirement however, which often posed a practical difficulty in crowded dogfight circumstances.

The German government quickly followed, specifying however that eight (later sixteen) 'kills' were required for a pilot to be considered an ace and eligible for the prestigious Pour le Merite award.

Britain - and later the U.S. - followed the French example, although both were more lenient in allowing 'probable' victories to count. The British Distinguished Flying Cross was available to those pilots who had scored at least eight victories.

Most victories were scored in the crowded skies above the Western Front. Even then reliable statistics are not easy to come by: figures for the other fronts (e.g. the war in the East) are even more unreliable.

It was routine for pilots to claim 'kill' figures notably higher than their official figures. Some units also instated regimes whereby 'easy' targets were to be left to the leading aces, thus further boosting their totals (much to the resentment of junior pilots).

The table below lists the top twenty airmen of the war. The 'Red Baron', Manfred von Richthofen, scored the highest number of victories of the war, although Frenchman Rene Fonck was the highest scorer to survive the war.

Links are provided to pages containing biographical sketches of individual pilots. Click here for a full listing of those available on this site. Click here to view this site's section specific to the air war.

Top 20 Fighter Pilots

Manfred von Richthofen	80
Rene Fonck	75
William Bishop	72
Ernst Udet	62
Edward Mannock	61
Raymond Collishaw	60
James McCudden	57
Andrew Beauchamp-Proctor	54
Georges Guynemer	54
Erich Lowenhardt	54
Donald MacLaren	54
William Barker	52
Josef Jacobs	48
Werner Voss	48
George McElroy	47
Robert Little	47
Charles Nungesser	45
Fritz Rumey	45
Rudolf Berthold	44
Albert Ball	44-47

Top Aces by Nation

Germany	Manfred von Richthofen	80
France	Rene Fonck	75
Canada	William Bishop	72
UK	Edward Mannock	61
South Africa	A. Beauchamp-Proctor	47
Australia	Robert Little	47
Ireland	George McElroy	47
Belgium	Willy Coppens	37
Austria-Hungary	Godwin Brumowski	35
Italy	Francesco Baracca	34
USA	Eddie Rickenbacker	26
Russia	Alexei Kazakov	17

http://www.firstworldwar.com/features/aces.htm