Visions of Aircraft

by Theodore Zacharia

Acknowledgments:

- All photographic material and computer generated images (CGI) are the work of the author
- Photographs were taken of real aircraft, then worked on and merged to create final composites using Photoshop Elements 2 and/or GIMP 2.2
- All CGI images were created with Vue d'Esprit versions 2 or 5, or captured from Microsoft Flight Simulator
- The Royal Air Force Museum, RAF Hendon, was a major resource where most of the photographs of combat aircraft were taken
- The DeHaviland Heritage Centre http://www.dehavillandmuseum.co.uk/ is a great resource for related aircraft and is where photographed the Heron
- Over the years, numerous flights abroad, both for work and pleasure have afforded me the opportunity to collect a large resource of aerial photographs, these have been used for most of the backgrounds in the composite images
- All historical and technical information has been collected from various sources, but mostly through the highly informative pages of the free online encyclopedia, Wikipedia which can be found at http://en.wikipedia.org/. Although the authors of this information are too numerous to mention I thank them for sharing their detailed knowledge, which made compilation of this book a much simpler and pleasant task

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Sopwith Camel

The Sopwith Camel Scout was a British World War I single-seat fighter aircraft that was famous for its maneuverability and was armed with two .303 in (7.7 mm) Vickers machine guns mounted in the cowl, firing forward through the propeller disc. The type entered squadron service in June 1917 with No. 4 Squadron of the Royal Naval Air Service, near Dunkirk. The following month, it became operational with No. 70 Squadron of the Royal Flying Corps. By February 1918, 13 squadrons were fully equipped with the Camel. Approximately 5,500 were ultimately produced. Unlike the preceding Pup and Triplane, the Camel was not considered pleasant to fly. The Camel owes its difficult handling characteristics to the grouping of the engine, pilot, guns, and fuel tank into first seven feet of the aircraft, coupled with the strong gyroscopic effect of the rotary engine.

The Camel soon gained an unfortunate reputation with student pilots. The Clerget engine was particularly sensitive to fuel mixture control, and incorrect settings often caused the engine to choke and cut out during takeoff. Many crashed due to mishandling on takeoff when a full fuel tank affected the center of gravity. In level flight, the Camel was markedly tail-heavy. Unlike the preceding Triplane, the Camel lacked a variable incidence tailplane. The pilot was therefore required to apply constant forward pressure on the control stick to maintain a level attitude. A stall immediately resulted in a spin and the Camel was particularly noted for its vicious spinning characteristics.

The Camel was nevertheless successful in combat. It offered heavier armament and better performance than the preceding Pup and Triplane. Its controls were light and sensitive. The Camel turned slowly to the left with a nose-up attitude, but turned very sharply to the right with a nose-down attitude. Because it was tail heavy, the plane also looped quickly.

This image is a composite of two different shots of the same a Camel taken at the RAF Museum Hendon and an aerial photograph I took on take off from Heathrow while heading off on vacation.

Fokker Dr.I

The Fokker Dr. I Dreidecker (triplane) was a World War I fighter aircraft designed by Reinhold Platz and built by Fokker-Flugzeugwerke. It became most famous as the plane flown by the Red Baron, Manfred von Richthofen.

Two pre-production triplanes, designated F.I, were delivered to Jastas 10 and 11 for combat evaluation. These aircraft, serials 102/17 and 103/17, were the only machines to receive the F.I designation. They arrived at Markebeeke, Belgium on 28 August 1917. Richthofen first flew 102/17 on 1 September 1917 and shot down two enemy aircraft in the next two days. He reported to the Kogenluft (Kommandierenden General der Luftstreitkräfte) that the F.I was highly satisfactory. The combat debut of the triplane was short-lived, however. Kurt Wolff, Staffelführer of Jasta 11, was shot down in 102/17 on 15 September, and Werner Voss, Staffelführer of Jasta 10, was killed in 103/17 on 23 September.

Delivery of production machines, designated Dr.I, commenced in October. These aircraft were identical to the F.I except for the addition of wingtip skids. All aircraft were delivered to squadrons within Richthofen's Jagdgeschwader 1. Compared to the Albatros and Pfalz fighters it replaced, the Dr.I offered remarkable maneuverability and initial rate of climb rate. The ailerons were light but not very effective. The rudder and elevator controls were light and powerful. Rapid turns, especially to the right, were facilitated by the triplane's marked directional instability.

The Dr.I also demonstrated significant drawbacks. The triplane's instability made it a poor gun platform. More importantly, it was considerably slower than contemporary Allied fighters in level flight and in a dive. Due to the low-compression Oberursel UR.II, a clone of the Le Rhône 9J rotary engine, performance fell off dramatically at high altitudes. As the war continued, the lack of castor oil made rotary operation more difficult. The poor quality of German ersatz lubricant, known as "Voltol," resulted in many engine failures, particularly during the summer of 1918.

Furthermore, the Dr.I proved tricky to land and prone to ground looping, as evidenced by the wooden skids mounted on the lower wingtips. The cockpit was cramped, and the proximity of the gun butts to the cockpit, combined with poor crash padding, left the pilot vulnerable to serious head injury in the event of a crash landing.

Bristol Bulldog

The Bristol Bulldog was a Royal Air Force (RAF) single-seat biplane fighter designed during the 1920s by the Bristol Aeroplane Company, with over three hundred Bulldogs produced, that arguably became the most famous aircraft during the RAF's inter-war period.

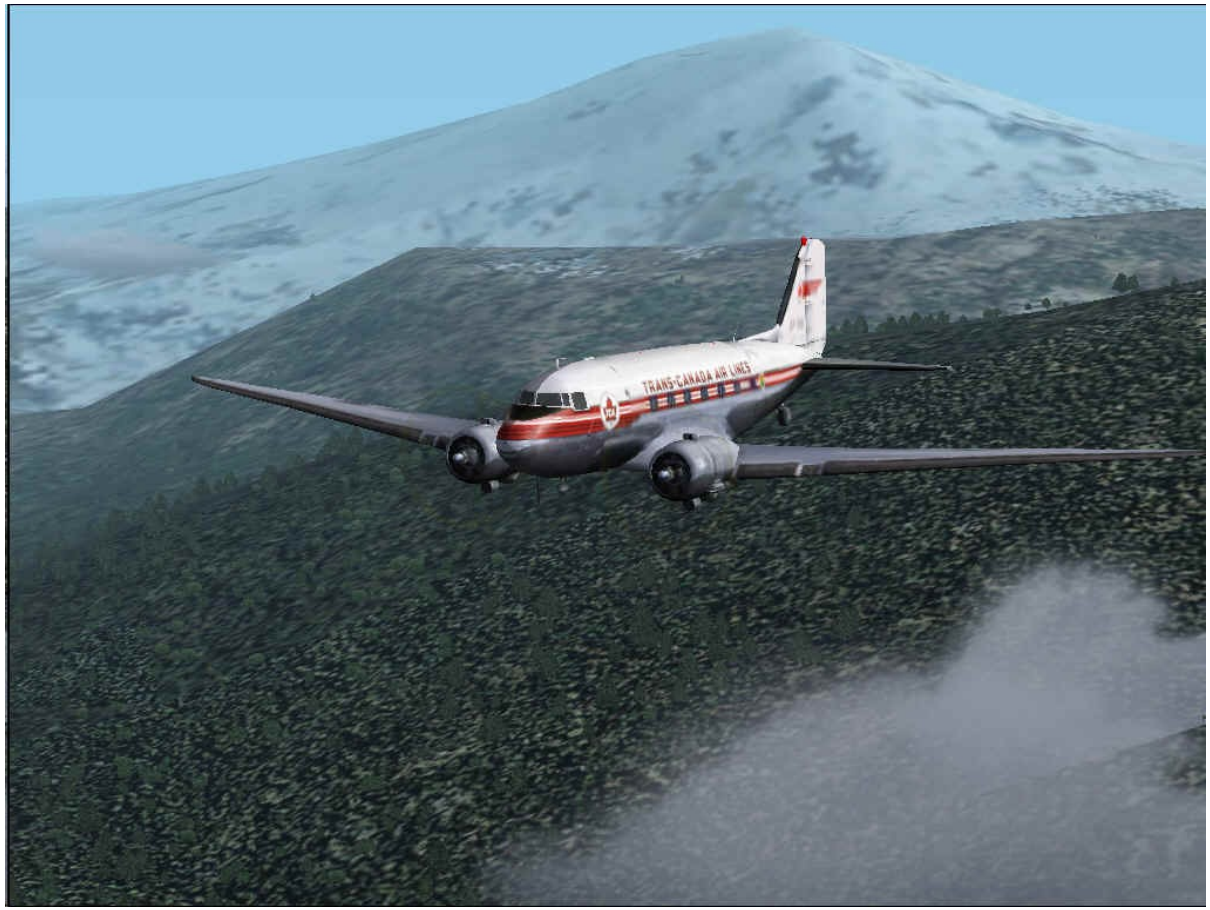
The Bulldog proved to be quite a successful export to foreign air forces, seeing service with Australia, Denmark, Estonia, Finland, Japan, Latvia, Siam, Spain and Sweden. The Bulldog was withdrawn from RAF service in 1937, being replaced by the Hawker Hurricane and Supermarine Spitfire, both of which would become legends of the RAF for their contribution during the Second World War. The Bristol Bulldog's career was not over though, for the type continued to serve with other air forces.

The Bulldog never saw combat service with the RAF, though during the Abyssinia Crisis of 1935-36, Bristol Bulldogs were sent to the Sudan to reinforce Middle East Command. Douglas Bader, better known for his Second World War actions, lost both of his legs when his Bristol Bulldog crashed while he was performing unauthorised flying acrobatics. A number of Bulldogs, ex-Latvian aircraft, saw service during the Spanish Civil War, as part of the forces fighting the Nationalists. The Bulldogs also saw combat as part of the Finnish Air Force during the Winter War against the Soviet Union, which began in 1939. The Bulldogs fought well against their Soviet opponent, gaining a number of kills, the types being the Polikarpov I-16 and Tupolev SB-2, both of which were quite superior in terms of technology compared to the Bulldog. The Bulldog continued in service during the subsequent Continuation War, again, against the Soviet Union.

This image is a composite of a Bulldog taken at the RAF Museum Hendon and an aerial photograph I took on take off from Heathrow while heading off on vacation (the same flight as the one for the Camel). The introductory image is also the same Bulldog taken at different angles.

Douglas DC-3

The Douglas DC-3 is a fixed-wing, propeller-driven aircraft whose speed and range revolutionized air transport in the 1930s and 1940s. Because of its lasting impact on the airline industry and World War II, it is generally regarded as one of the most significant transport aircraft ever made.



The DC-3 was engineered by a team led by chief engineer Arthur E. Raymond, and first flew on December 17, 1935 (the 32nd anniversary of the Wright Brothers flight at Kitty Hawk). The plane was the result of a marathon phone call from American Airlines CEO Cyrus Smith to Donald Douglas requesting the design of an improved successor to the DC-2. The amenities of the DC-3 (including sleeping berths on early models and an in-flight kitchen) popularized air travel in the United States. With only three refueling stops, eastbound transcontinental flights across America taking approximately 15 hours became possible. Westbound trips took 17 hours 30 minutes - still a significant improvement over the competing Boeing 247. Before the arrival of the DC-3, such a trip would entail short hops in commuter aircraft, during the day, coupled with train travel overnight.

Early U.S. airlines like United, American, TWA and Eastern ordered over 400 DC-3s. These fleets paved the way for the modern American air travel industry, quickly replacing trains as the favored means of long-distance travel across the United States. Piedmont Airlines operated DC-3s from 1948 to 1963. One of Piedmont's DC-3s, operated by the Carolinas Aviation Museum, continues to fly to air shows today and has been used in various movies.

During World War II, many civilian DC-3s were drafted for the war effort and nearly 10,000 military versions of the DC-3 were built, under the designations C-47, C-53, R4D and Dakota. Peak production of the type was reached in 1944 with 4853 being delivered. The armed forces of many countries used the DC-3 and its military variants for the transport of troops, cargo and wounded. Licensed copies were built in Japan as Showa L2D (487 aircraft) and in the USSR as the Lisunov Li-2 (between 2200 and 4900 aircraft, per varying sources).

After the war, thousands of surplus C-47s were converted to civil service and became the standard equipment of almost all the world's airlines, remaining in front-line service for many years. The ready availability of ex-military examples of this cheap, easily-maintained aircraft (it was both large and fast by the standards of the day) jump-started the worldwide, post-war air transport industry.

This image was captured from Microsoft's Flight Simulator FS2002, the location was somewhere to the northeast of Vancouver

Messerschmitt Bf 109

The Messerschmitt Bf 109 was a World War II fighter aircraft designed by Willy Messerschmitt in the early 1930s. It was one of the first true modern fighters of the era, including such features as an all-metal monocoque construction, a closed canopy, and retractable landing gear.

The Bf 109 was the standard fighter of the Luftwaffe for the duration of WWII, although it began to be partially replaced by the Focke-Wulf Fw 190 from 1942. The Bf 109 scored more aircraft kills in World War Two than any other aircraft. At various times it served as an air superiority fighter, an escort fighter, an interceptor, a ground-attack aircraft and a reconnaissance aircraft. The Bf 109 was produced in greater quantities than any other fighter aircraft in history, with over 31,000 units built. Although the Bf 109 had weaknesses, including a short range of early variants around 400 miles (640 km) on internal fuel as drop tanks were not standardized until the E-7 model appearing in mid-1940, and a sometimes difficult to handle narrow, outward-retracting undercarriage, it stayed competitive with Allied fighter aircraft until the end of the war.

The Bf 109 was flown by the three top scoring fighter aces of World War II : Erich Hartmann, the top scoring fighter ace of all time with 352 victories, Gerhard Barkhorn with 301 victories, and Günther Rall with 275 victories. All of them flew with the Jagdgeschwader 52, chiefly on the Eastern front, a unit exclusively flying the Bf 109 models and being credited with over 10,000 victories itself. Hartmann refused to fly any other airplane in combat throughout the war. Hans-Joachim Marseille, “The Star of Africa” also flew the Bf 109, and achieved all of his 158 victories on the Western Front, chiefly against Allied pilots in North Africa, including 17 aircraft shot down in a single day.

This image is a composite of a Bf109 taken at the RAF Museum Hendon and an aerial photograph I took flying over Afganistan while on vacation to Asia.

Supermarine Spitfire

The Supermarine Spitfire was an iconic British single-seat fighter used primarily by the RAF and many Allied countries through the Second World War and into the 1950s. Produced by the Supermarine subsidiary of Vickers-Armstrongs, the Spitfire was designed by the company's Chief Designer R. J. Mitchell, who continued to refine the design until his death from cancer in 1937. Its elliptical wing had a thin cross-section, allowing a higher top speed than the Hawker Hurricane and other contemporary designs; it also resulted in a distinctive appearance, enhancing its overall streamlined features. Much loved by its pilots, the Spitfire saw service during the whole of the Second World War and subsequent years, in all theatres of war, and in many different variants.

More than 20,300 examples of all variants were built, including two-seat trainers, with some Spitfires remaining in service well into the 1950s. Although its great wartime foe, the Messerschmitt Bf 109, in its many variants, rivalled the Spitfire's production statistics, the Spitfire was the only British fighter aircraft to be in continual production before, during and after the Second World War.

The Air Ministry submitted a number of names to Vickers-Armstrongs for the new aircraft, tentatively known as the Type 300, including the improbable Shrew. The name Spitfire was suggested by Sir Robert MacLean, director of Vickers-Armstrongs at the time, who called his daughter Ann, "a little spitfire." The word dates from Elizabethan times and refers to a particularly fiery, ferocious type of person, usually a woman. The name had previously been used unofficially for Mitchell's earlier F.7/30 Type 224 design. Mitchell is reported to have said that it was "just the sort of bloody silly name they would choose", possibly an oblique reference to an earlier, much less successful aircraft of his design that had been given the same name.

The elliptical wing was chosen for superior aerodynamic attributes but it was a complex wing to construct and the Messerschmitt Bf 109's angular and easy-to-construct wing offered similar performance (model per model) to the Spitfire. It has been reported that the Bf 109 took one-third the man hours to construct compared to the Spitfire.

One flaw in the thin-wing design of the Spitfire manifested itself when the plane was brought up to very high speeds. When the pilot attempted to roll the plane at these speeds, the aerodynamic forces subjected upon the ailerons were enough to twist the entire wingtip in the direction opposite of the aileron deflection (much like how an aileron trim tab will deflect the aileron itself). This so-called aileron reversal resulted in the Spitfire rolling in the opposite direction of the

pilot’s intention.

A novel feature in the final Spitfire design was its wing washout. The trailing edge of the wing twists slightly upward along its length, from -1/2 degree at its root to +2 degrees at its tip. This causes the wing roots to stall before the tips, reducing the potentially dangerous rolling moment in the stall known as a wing drop, that may result in spin. When the root stalls, the turbulent separated slipstream, departing from the wing top side, shakes the elevator and thusly the aircraft’s control column in a characteristic “shudder”, warning the pilot that he is about to reach the limit of the aircraft’s performance, while full control is retained at the wingtips and ailerons. This allowed even average pilots to hold the Spitfire in a steep turn right at the point of stall, hoping that the pursuing enemy would have to fall out of his own steep turn first or would have to follow in a more gradual turn, eventually appearing in the Spitfire’s gunsight.

To build the Spitfires in the numbers needed, a whole new factory was built at Castle Bromwich, near Birmingham as a “shadow” to Supermarine’s Southampton factory. Although the project was ultimately led by Lord Nuffield who was an expert in mass construction, the Spitfire’s stressed-skin construction was a bit too complex and Supermarine and Vickers-Armstrongs engineers were needed. The site was set up quickly from July 1938 - machinery being installed two months after work started on the site.

There were 24 marks of Spitfire and many sub-variants. These covered the Spitfire in development from the Merlin to Griffon engines, the high speed photo-reconnaissance variants and the different wing configurations. The Spitfire Mk V was the most common type, with 6,479 built, followed by the 5,665 Mk IX airframes produced. Different wings, featuring a variety of weapons, were fitted to most marks; the A wing used eight .303 machine guns, the B with four .303 machine guns and two 20 mm Hispano cannon, and the C or Universal Wing which could mount either four 20 mm cannon or two 20 mm and four .303 machine guns. As the war progressed, the C wing became more common.

The first Spitfire to enter service with the RAF arrived at 19 Squadron, Duxford, on 4 August 1938, and over the next few weeks, aircraft were delivered at the rate of one a week to both 19 and 66 Squadrons (also based at Duxford). The next to be equipped with Spitfires was 41 Squadron at Catterick, followed by a succession of squadrons stationed at Hornchurch in Essex. The public’s first sight of the Spitfire in RAF colours was on Empire Air Day, 20 May 1939 during a display at Duxford in which the pilot “belly-landed” his aircraft having forgotten to lower his undercarriage and was consequently fined £5 by the Air Ministry. By the outbreak of the Second World War, there were around 400 Spitfires in service with the RAF, and a further 2,000 on order.

The Spitfire was one of the finest fighters of the war; aviation historians and laymen alike often claim it to be the most aesthetically appealing. It is, however, frequently compared to the Hawker Hurricane, which was used in greater numbers during the critical stages of 1940. Although early Spitfires and Hurricanes carried identical armament (eight .303 inch / 7.696 mm machine guns), the placement of the Hurricane’s guns was better, yielding a closer pattern of fire. A slower top speed, however, made the Hurricane more vulnerable against the German fighter escorts. Wherever possible, the RAF tactic during the Battle of Britain was to use the Hurricane squadrons to attack the bombers, holding the Spitfires back to counter the German escort fighters. In total numbers, the Hurricane shot down more Luftwaffe aircraft, both fighters and bombers, than the Spitfire, mainly due to the higher proportion of Hurricanes in the air. Seven of every ten German planes destroyed during the Battle of Britain were shot down by Hurricane pilots. Losses were also higher among the more numerous Hurricanes.

Junkers Ju 87 - Stuka

The Junkers Ju 87 or Stuka was the best known Sturzkampfflugzeug (German: dive bomber, literally plunging combat aircraft) in World War II, instantly recognisable by its inverted gull wings, fixed undercarriage and infamous wailing siren, though these were only fitted to a few aircraft, the extra drag being unwelcome on an already sluggish aircraft.

The Stuka's design featured some innovative features, including automatic pull-up dive brakes under both wings to ensure that the plane recovered from its attack dive even if the pilot blacked out from the high acceleration, and wind-powered sirens on the wheel covers that wailed during dives to frighten its victims. These were named "Trumpets of Jericho" by Junkers and were a form of psychological warfare. Its rugged fixed undercarriage allowed it to land and take-off from improvised airstrips close to the battlefront, giving close support to the advancing German forces. In all, over 6,000 Ju 87 were built between 1936 and August 1944.

It was a Ju 87 that achieved the first Axis air victory during World War II, on 1st September 1939, when a Luftwaffe Ju 87 pilot shot down a Polish PZL P.11c fighter aircraft piloted by Capt. Mieczyslaw Medwecki.

Although sturdy, accurate, and very effective, the Stuka suffered from low speed and maneuverability, with little defensive armament, making it highly vulnerable to enemy fighters. The Germans learned during the Battle of Britain that air superiority must be obtained before ground attack aircraft could be effectively used. After the Battle of Britain, the Stuka was little used in western Europe, but it remained effective further south where Allied fighters were in short supply, most notably in the Battles of Crete and Malta. Perhaps the prime example of its vulnerability to fighters was the shooting down of five Stukas in the space of a few minutes, by the Australian ace Clive Caldwell in a P-40 Tomahawk on December 5, 1941, over Libya. Stukas were used in vast numbers on the Eastern Front, although the steady rise in Soviet airpower as the war progressed meant that Stuka squadrons suffered very heavy losses by the final stages of the war.

Hans-Ulrich Rudel was the most notable Stuka ace, and the most highly decorated German soldier of World War II. (Hermann Goering was awarded the Großkreuz des eisernen Kreuzes, but not for achievements in battle.)

Flying at 4,600 meters (15,000 ft), the pilot located his target through a bombsight window in the cockpit floor. After opening the dive brakes and slowing his throttle, he then rolled the aircraft 180°, automatically nosing the aircraft into a dive. Red tabs protruded from the upper surfaces of the wing as a visual indicator to the pilot that in case of a g induced black-out, the automatic dive recovery system would be activated. The Stuka dived at a 60 - 90 degree angle,

accelerating to 600 km/h (350 mph).

When the aircraft was reasonably close to the target, a light on the contact altimeter came on to indicate the bomb-release point, usually at a minimum height of 450 m (1,500 ft). The pilot released the bomb by depressing a knob on the control column to release weapons and to initiate the automatic pull-out mechanism. A clutch located under the fuselage would swing the bomb out of the way of the propeller, and the aircraft would automatically begin a 6 g pullout.

Once the nose was above the horizon, dive brakes were retracted, the throttle was opened, and the propeller was set to climb. The pilot regained control and resumed normal flight. The remaining bombs under the wings were used for other targets.

With the G variant, the aging airframe of the Ju 87 found new life as a tank destroyer. Equipped with two 37 mm cannons mounted on underwing gondolas, each loaded with a 6-round magazine of high-explosive tungsten ammunition, the Kanonenvogel (or “cannon-bird” as it was nicknamed) proved spectacularly successful at the hands of the Luftwaffe ace Hans-Ulrich Rudel. The Ju 87G is rumored to have influenced the development of the A-10 Thunderbolt II.

de Havilland Mosquito

The de Havilland Mosquito was a British combat aircraft that excelled in a number of roles during the Second World War. It served with the RAF and many other air forces both in the Second World War and postwar.

The Mosquito was a twin-engine aircraft, powered by a pair of Rolls-Royce Merlins with the pilot and navigator sitting side by side. Unorthodox in design, it used a plywood structure of spruce and balsa in a time when wooden construction was considered outmoded. In the conceptual design stage, de Havilland designers found that adding any defensive armament would significantly reduce the aircraft's maximum speed. Realising that the loss in performance was not worth the benefit of the defensive armament, the initial bomber version was designed without any guns. The Mosquito was a very versatile aircraft; originally conceived as a fast day bomber, the various roles of the Mosquito included: tactical bomber, pathfinder, day or night fighter, fighter-bomber, intruder, maritime strike and photo reconnaissance aircraft.

The Mosquito is often described as having been faster than enemy fighters. On its introduction to service, the aircraft was about as fast as the front-line German fighters that opposed it, the BF 109F and Fw 190A. Advancements in those aircraft would eventually outpace performance improvements in the Mosquito. Nonetheless their speed margin was slim enough that, by the time those aircraft could reach interception altitude, the Mosquito would have completed its bombing run and would be racing for home. Furthermore, the Mosquito could sustain its dash over a greater distance than the opposing fighter aircraft. With the introduction of the nitrous oxide boosted Bf 109s and the jet-powered Me 262 late in the war, the Luftwaffe had interceptors with a clear speed advantage over the Mosquito. The PR Mk 32 photo reconnaissance version of the Mosquito attempted to counter this with long-span wings, special high-altitude superchargers and the elimination of as much weight as possible, raising its cruising altitude to 42,000 feet (12,800 metres). Even with these changes, the Mosquito was not totally immune – in December 1944, one was intercepted at maximum altitude.

The first bomber squadrons to receive the Mosquito B IV used it for several low-level daylight raids. One was carried out in the morning of 30 January 1943, against a Nazi rally in Berlin, giving the lie to the speaker's (Reichmarschall Hermann Göring's) claim that such a mission was impossible. Not content with this, Mosquitos from RAF No 139 Squadron went to Berlin in the afternoon and tried to interrupt an important speech by Dr. Joseph Goebbels, Germany's Propaganda Minister. Mosquito bomber versions were used as part of Bomber Command; the Pathfinders in 8 Group and the Light Night Striking Force

(LNSF). The LNSF carried out high speed night raids with precision aiming and navigation. Their mission was twofold: first, they would target small but vital installations; and second, they would act as a diversion from the raids of the heavy bombers, simulating large formations through the use of chaff. On nights when no heavy bomber raid was planned, the LNSF would often strike so the German air defences would not get a rest.

The first fighter Mosquito introduced into service was the NF Mk.II in mid 1942, with four 20 mm cannon in the fuselage belly and four 0.303 in. Browning machine-guns mounted in the nose. It carried Aircraft Interception radar (AI) Mk.IV / Mk.V when operating as a defensive night fighter over the UK, although at the time this was omitted from Mk II's operating as night 'Intruders', roaming over Europe at night to cause maximum disruption to lines of communications and flying operations.

Operational experience in its varied roles quickly led to the development of a versatile fighter-bomber version; the FB VI, which first saw service in early 1943. The Mark VI had a strengthened wing for external loads and along with its standard fighter armament could carry two 250 lb. bombs in the rear of the bomb bay and two 250 lb. bombs under the wings, or eight wing-mounted rockets. Later up-engined versions could carry 500 lb bombs. The FB VI became the most numerous version of the Mosquito, (2,292 built) equipping the day bomber 2 Group, the intruder squadrons of Fighter Command and 2 nd TAF, and the strike wings of Coastal Command, who used the variant as a potent anti-shipping aircraft armed with eight 60 lb. rockets.

North American P-51 Mustang

The North American P-51 Mustang was an American long-range single-seat fighter aircraft that entered service with Allied air forces in the middle years of World War II. The P-51 became one of the conflict's most successful and recognizable aircraft.

The P-51 flew most of its wartime missions as a bomber escort in raids over Germany, helping ensure Allied air superiority from early 1944. It also saw service against the Japanese in the Pacific War. The Mustang began the Korean War as the United Nations' main fighter but was supplanted as a fighter by jets early in the conflict, being relegated to a ground attack role. Nevertheless, it remained in service with some air forces until the early 1980s.

Despite being economical to produce, the Mustang was a well-made and rugged aircraft. The definitive version of the single-seat fighter was powered by the Packard V-1650-3, a two-stage two-speed supercharged 12-cylinder Packard-built version of the legendary Rolls-Royce Merlin engine, and armed with six aircraft versions of the .50 caliber (12.7 mm) Browning machine guns. Like most other fighters that used a liquid-cooled engine, its weakness was a coolant system that could be punctured by a single bullet.

After World War II and the Korean conflict, many Mustangs were converted for civilian use, especially air racing.

Messerschmitt Me 262

The Messerschmitt Me 262 Schwalbe (German “Swallow”) was the world’s first operational jet-powered fighter aircraft. It was produced in World War II and saw action starting in 1944 in bomber/reconnaissance and fighter/interceptor roles.

Officially named Schwalbe, because the swallow is one of the fastest birds known when going into a dive to capture and eat an airborne insect, German pilots nicknamed it the Turbo, while the Allies called it the Stormbird. While the Me 262 had a negligible impact on the course of the war, the German pilots claimed (but not verified) the destruction of almost 150 Allied aircraft for the loss of 100 Me 262s in air-to-air combat. Its design was highly influential on postwar aircraft development.

In April 1944, Erprobungskommando 262 was formed at Lechfeld in Bavaria as a test unit to introduce the 262 into service and train a core of pilots to fly it. Major Walter Nowotny was assigned as Commander in July 1944, and the unit redesignated Kommando Nowotny. Kommando Nowotny was essentially a trials and development unit, but it holds the distinction of being the world’s first jet fighter squadron. Trials continued slowly with initial operational missions against the Allies in August 1944, allegedly downing 19 Allied aircraft for six Me 262s lost, although these claims have never been verified by cross-checking with USAAF records. The RAF Museum holds no intelligence reports of RAF aircraft engaging in combat with an Me 262 in August 1944, although there is a report of an unarmed encounter between an Me 262 and a DH98 Mosquito. Nowotny himself was shot down and killed on 8 November 1944 by 1st Lt Edward “Buddy” Haydon of the 357th Fighter Group, USAAF and Capt Ernest “Feeb” Fiebelkorn of the 20th Fighter Group, USAAF. The “Kommando” was then withdrawn for further training and a revision of combat tactics to optimise the 262’s strengths.

By January 1945, Jagdgeschwader 7 (JG7) had been formed as a pure jet fighter unit, although it would be several weeks before it was operational. In the meantime a bomber unit—I Gruppe, Kampfgeschwader 54 (KG54)—had re-equipped with the Me 262 for use in a ground attack and fighter role. However, the unit lost 12 jets in action in two weeks for minimal returns.

Jagdverband 44 (JV44) was another Me 262 fighter unit formed in February, by Lieutenant General Adolf Galland, who had recently been dismissed as Inspector of Day Fighters. Galland was able to draw into the unit many of the most experienced and decorated Luftwaffe fighter pilots from other units grounded by lack of fuel.

During March, Me 262 fighter units were thus able, for the first time, to deliver large scale attacks on Allied bomber formations. On March 18, 1945, 37 Me 262s of JG7 intercepted a force of 1,221 bombers and 632 escorting fighters. They managed to shoot down 12 bombers and one fighter for the loss of three Me 262s. Although a four-to-one ratio was exactly what the Luftwaffe would have needed to make an impact on the war, the absolute scale of their success was minor as it represented only one per cent of the attacking force. In 1943 and early 1944, the USAAF had been able to keep up offensive operations though enduring loss ratios of 5% and more, and the few available Me 262s could not inflict sufficient magnitude of losses.

Several two-seater “B” trainer variants of the Me 262 had been adapted as night fighters, complete with on-board radar and “deerhorn” antennae. Serving with 10 Staffel, Nachtjagdgeschwader 11, Night Fighter Unit, near Berlin, these few aircraft (alongside several single seat examples) accounted for most of the 13 Mosquitoes lost over Berlin in the first three months of 1945. However, actual intercepts were generally or entirely made using Wilde Sau methods, rather than AI radar-controlled interception. As the two-seat trainer was largely unavailable many pilots had to do their first flight in a jet in a single seater without an instructor.

Despite its deficiencies, the Me 262 was clearly signalling the beginning of the end of piston-engined aircraft as efficient fighting machines. Once airborne, it accelerated to speeds well over 800 km/h (500 mph), over 150 km/h (93 mph) faster than any Allied fighter operational in the European Theater of Operations.

Grumman F9F Panther

The Grumman F9F Panther was the manufacturer's first jet fighter and the U.S. Navy's second. The Panther was the most widely used U.S. Navy jet fighter of the Korean War. It flew 78,000 sorties and was responsible for the first air kill in the war—the downing of a North Korean Yakovlev Yak-9 fighter. Total F9F production was 1,382, with several variants being shipped to Argentina for export.

Development studies at the Grumman company began near the end of the World War II as the first jet engines emerged. The prototype Panther, piloted by test pilot Corky Meyer, first flew on 24 November 1947. Propulsion was a Rolls-Royce Nene turbojet built under license by Pratt & Whitney as the J42. Since there was insufficient space within the wings and fuselage for fuel for the thirsty jet, permanently-mounted wingtip fuel tanks were added which incidentally improved the fighter's rate of roll. It was cleared for flight from aircraft carriers in September 1949. During the development phase, Grumman decided to change the Panther's engine, selecting the Pratt & Whitney J48-P-2, a license built version of the Rolls-Royce Tay. The other engine that had been tested was the Allison J33-A-16, a development of the Rolls-Royce Derwent.

F9F-2s, F9F-3s and F9F-5s served with distinction in the Korean War, downing two Yak-9s and five Mikoyan-Gurevich MiG-15s with a loss of one F9F. On 3 July 1950, LTJG Leonard H. Plog of U.S. Navy's VF-51 flying an F9F-3 scored the first air victory of the war by shooting down a Yak-9. The first MiG-15 downed was on 9 November 1950 by U.S. Navy Lieutenant Commander William (Bill) Amen of VF-111 "Sundowners" Squadron flying an F9F-2B. Two more were downed on 18 November 1950 , and the other two were downed on the 18 November 1952. The type was the primary Navy jet fighter and ground-attack plane in the Korean conflict. Panthers were withdrawn from front-line service in 1956, but remained in training roles and with Reserve units until 1958, some continuing to serve in small numbers into the 1960s.

F-100 Super Sabre

The North American F-100 Super Sabre was a jet fighter aircraft that served with the United States Air Force (USAF) from 1954 to 1971 and with the Air National Guard (ANG) until 1979. It was first US fighter capable of supersonic speed in level flight.

The F-100 also served in several NATO air forces and with other US allies. In its later life, it was often referred to as "the Hun," a shortened version of "one hundred." Considered the successor to the F-86 Sabre, it would be largely replaced by the F-4 Phantom II and later, the F-16 Falcon. The F-100 is noted as the first of the Century Series collection of USAF jet fighters.

The F-100A officially entered USAF service on 27 September 1954 with 479th Fighter Wing at George AFB. By 10 November 1954, the F-100As suffered six major accidents due to flight instability, structural failures, and hydraulic system failures, prompting the Air Force to ground the entire fleet until February 1955. The 479th finally became operational in September 1955. Due to ongoing problems, the Air Force began phasing out the F-100A in 1958, with the last aircraft leaving active duty in 1961. By that time, 47 aircraft were lost in major accidents. Escalating tension due to construction of the Berlin Wall in August 1961 forced the USAF to recall the F-100As into active service in early 1962. The aircraft was finally retired in 1970.

The TAC (Tactical Air Command) request for a fighter-bomber was addressed with the F-100C which flew in March 1954 and entered service on 14 July 1955 with 450th Fighter Wing, Foster AFB. Operational testing in 1955 revealed that the F-100C was at best an interim solution, sharing all the vices of the F-100A. The uprated J57-P-21 engine boosted performance but continued to suffer from compressor stalls. On a positive note, the F-100C was considered an excellent platform for nuclear toss bombing because of its high top speed. The inertia coupling problem was more or less addressed with installation of a yaw damper in the 146th F-100C, later retrofitted to earlier aircraft. A pitch damper was added starting with the 301st F-100C, at a cost of US$10,000 per aircraft.

The addition of "wet" hardpoints meant the F-100C could carry a pair of 275 US gal (1,040 L) and a pair of 200 US gal (770 L) drop tanks. However, the combination caused loss of directional stability at high speeds and the four tanks were soon replaced by a pair of 450 US gal (1,730 L) drop tanks. The 450s proved scarce and expensive and were often replaced by smaller 335 US gal (1,290 L) tanks. Most troubling to TAC was the fact, that, as of 1965, only 125 F-100Cs were capable of utilizing all non-nuclear weapons in the Air Force inventory, particularly cluster bombs and AIM-9 Sidewinder air-to-air missiles. By the time the F-100C was phased out in June 1970, 85 had been lost in major accidents.

The definitive F-100D aimed to address the offensive shortcomings of the F-100C by being primarily a ground attack aircraft with secondary fighter capability.

To this effect, the aircraft was fitted with autopilot, upgraded avionics, and, starting with the 184th production aircraft, the Sidewinder capability. In 1959, 65 aircraft were modified to also fire the AGM-12 Bullpup air-to-ground missile. To further address the dangerous flight characteristics, the wing span was extended by 26 inches (66 cm) and the vertical tail area was increased by 27%.

The F-100D flew on 24 January 1956, entering service on 29 September 1956 with 405th Fighter Wing at Langley AFB. The aircraft suffered from reliability problems with the constant speed drive which provides constant-frequency current to electrical systems. In fact, the drive was so unreliable that USAF required it to have its own oil system to minimize damage in case of failure. Landing gear and brake parachute malfunctions claimed a number of aircraft, and the refueling probes had a tendency to break away during high speed maneuvers. Numerous post-production fixes created such a diversity of capabilities between individual aircraft that by 1965 around 700 F-100Ds underwent High Wire modifications to standardize the weapon systems. High Wire modifications took 60 days per aircraft at a total cost of US$150 million. In 1966, Combat Skyspot program fitted some F-100Ds with an X band radar transmitter to allow for ground-directed bombing in inclement weather or at night.

I took this photograph back in 1993 while visiting a show at the Dallas Naval Air Station, TX, USA.

de Havilland Heron

The de Havilland DH.114 Heron was a small, propeller-driven British airliner that first flew on May 10 1950. It was a development of the de Havilland Dove, with a stretched fuselage and two more engines, for a total of four. The first deliveries were to NAC, (later part of Air New Zealand).

The Heron was of all-metal construction, and was laid out as a conventional, low-wing monoplane with tricycle undercarriage. One hundred fifty were built, exported to around 30 countries. Herons later formed the basis for various conversions, such as the Riley Turbo Skyliner and the Saunders ST-27 and ST-28.

World War II, the aircraft manufacturer De Havilland developed the DH.104 Dove, a small, two-engined passenger aircraft intended as a replacement for the earlier Dragon Rapide, and which soon proved to be successful. As a further development, they basically enlarged the Dove; lengthened the fuselage in order to provide room for more passengers or freight, and increased the wingspan to make room for two additional engines. The resulting aircraft was supposed to be able to use many of the parts originally designed for the Dove, thus simplifying logistics for airlines employing both types.

The first Heron, model 1A suffered from a number of deficencies, as NAC soon discovered. First of all, the aircraft was generally underpowered. It was powered by four quite heavy engines (weighing approximately 400 kg each), providing as little as 250 hp. By comparison, later modifications or rebuilt aircraft (such as the Saunders ST27) had more power in one engine than the Heron had in total! Also, and contrary to the Dove, the Heron came with a fixed undercarriage, and no nosewheel steering, which simplified maintenance, but reduced the top speed.

After 51 aircraft had been built of models 1A-D, production switched to the model 2, featuring retractable landing gear, which reduced drag, and fuel consumption, and increased the top speed somewhat. Model 2A was the equivalent of 1A, the basic passenger aircraft; 1B/2B with higher maximum takeoff weight, 2C featured fully-feathering propellers, Heron 2D had an even higher maximum takeoff weight, while the Heron 2E was a VIP version.

After production ceased in 1963, several companies offered various conversions, with the most extreme being the Saunders ST27/28, that basically changed the look of the whole aircraft; it was reduced to two engines, the easily recognisable ‘hump’ over the cockpit disappeared, the shape of the windows were changed, and the wingtips were squared instead of rounded.

Boeing 707

The Boeing 707 (most commonly spoken as “Seven Oh Seven”) is a four engined commercial passenger jet airliner developed by Boeing in the early 1950s. Boeing delivered a total of 1,010 Boeing 707s, which dominated passenger air transport in the 1960s and remained common through the 1970s. As of October 2006, 68 Boeing 707 aircraft (of any variant) were reported to be remaining in airline service, just one airline flying passengers, Saha Airlines of Iran. Boeing also offered a smaller, faster version of the aircraft that was marketed as the Boeing 720, but sales of this version were few.

Although it was not the first commercial jet in service (that distinction belongs to the De Havilland Comet), the 707 was the first to be commercially successful, and is credited as ushering in the Jet Age. It established Boeing as one of the largest makers of passenger aircraft, and led to later series of aircraft with the “7x7” designation.

At Seafair on August 6, 1955, Boeing test pilot Alvin “Tex” Johnston performed a barrel roll in the Dash-80 (an early 707 demonstrator, specifically a 367-80) at 500 feet. Johnston was summoned to Boeing president, William Allen’s office the next day and after explaining that the maneuver was absolutely non-hazardous was told not to do it again. To date Johnston is the only pilot to have performed a roll in a four engine jet transport. (Other big four engine jet aircraft have done barrel rolls; for instance, the Avro Vulcan XA890 was rolled by Roly Falk on the first day of the 1955 Farnborough Air Show, but it was a bomber). This story appears on a video called ‘Frontiers of Flight - The Jet Airliner’, produced by the National Air and Space Museum in association with the Smithsonian Institution in 1992. The roll can be viewed on video at AviationExplorer.com (see http://www.aviationexplorer.com/707_roll_video.htm).

The 707’s engines could not supply sufficient bleed air for pressurization without a serious loss of thrust, so the aircraft instead used engine-driven turbocompressors to supply high-pressure air for this purpose. On many commercial 707s the outer port (#1) engine mount is distinctly different from the other three, as this is the only engine not fitted with a turbocompressor. The Boeing 707 was the first commercially successful airplane to use podded engines.

The 707 wings are swept back at 35 degrees and, like all swept-wing aircraft, displayed an undesirable “Dutch roll” flying characteristic which manifested itself as an alternating yawing and rolling motion. Boeing already had considerable experience with this on the B-47 and B-52, and had developed the yaw damper system on the B-47, that lent itself to later swept wing configurations like the 707. However many new 707 pilots had no experience with this phenomenon as they were transitioning from straight-wing propeller driven aircraft such as the Douglas DC-7 and Lockheed Constellation.

On one customer acceptance flight, where the yaw damper was turned off to familiarize the new pilots with flying techniques, a trainee pilot exacerbated the Dutch Roll motion causing a violent roll motion which tore two of the four engines off the wing. The plane, a brand new 707-227 N7071 destined for Braniff, crash landed on a river bed north of Seattle at Arlington, Washington, killing four of the eight occupants.

In his autobiography, Tex Johnston described a Dutch Roll incident he experienced as a passenger on an early commercial 707 flight. As the aircraft's movements gradually became more severe, he went to the cockpit and found the crew frantically attempting to resolve the situation. He introduced himself and relieved the ashen-faced captain who immediately left the cockpit feeling ill. Johnston quickly stabilised the plane and later, even landed it for the crew.

English Electric Lightning

The English Electric Lightning (later the BAC Lightning) was a supersonic British fighter aircraft of the Cold War era, particularly remembered for its great speed and natural metal exterior. The Lightning was used throughout much of its service life by the Royal Air Force and the Royal Saudi Air Force. The aircraft was a stunning performer at airshows; it broke the world air-speed record and was the first aircraft capable of supercruise. The Lightning was one of the highest performance planes in formation aerobatics.

The Lightning's speed and climb performance were excellent not just by 1950s or 1960s standards but even compared with modern operational fighters. Its initial rate of climb was 50,000 ft per minute (15 km/min). The Mirage IIIE climbed initially at 30,000 ft/min (9 km/min), the MiG-21 managed 36,090 ft/min (11 km/min), and the Tornado F-3 43,000 ft/min (13 km/min).

The official ceiling was a secret amongst the general public and low security RAF documents simply stated 60,000+ ft (18 000 m), although it was well known within the RAF to be capable of much greater heights. Recently the actual operating ceiling has been made public by the late Brian Carroll, a former RAF Lightning pilot and ex-Lightning Chief Examiner, who reports taking an F-53 Lightning up to 87,300 feet (26 600 m) at which level "Earth curvature was visible and the sky was quite dark". In 1984, during a major NATO exercise, Flt Lt Mike Hale intercepted an American U-2 at a height which they had previously considered safe from interception. Records show that Hale climbed to 88,000 ft (26 800 m) in his F3 Lightning. Hale also participated in time-to-height and acceleration trials against F-104 Starfighters from Aalborg. He reports that the Lightnings won all races easily, with the exception of the low level supersonic acceleration, which was a dead-heat.

In British Airways trials in April 1985, Concorde was offered as a target to NATO fighters including F-15s, F-16s, F-14s, Mirages, F-104s - but only Lightning XR749, flown by Mike Hale and described by him as " a very hot ship, even for a Lightning", managed to overtake Concorde on a stern conversion intercept. Despite its remarkable performance, the Lightning inevitably found itself outclassed by newer fighters in terms of range, radar, avionics, weapons load and air-to-air capability. The short range of the Lightning - just 900 miles - was particularly crippling.

Aérospatiale-BAC Concorde

The Aérospatiale-BAC Concorde supersonic transport (SST) was the more successful of only two supersonic passenger airliners to have operated commercially (the Tupolev Tu-144 being the other). First flown in 1969, Concorde service commenced in 1976 and continued for 27 years. It regularly flew from London Heathrow (British Airways) and Paris Charles de Gaulle (Air France) to New York JFK. It set many records, including a time of 2 hours, 52 minutes and 59 seconds between New York and London, on 7 February 1996.

The costly development phase represented a substantial economic loss for the French and British governments, although it made large operating profits for British Airways for much of its service life. Commercial flights, by British Airways and Air France, began on 21 January 1976. As a result of its only crash (in 2000), world economic effects arising from the September 11, 2001 attacks, and other factors, operations ceased on 24 October 2003, with the last “retirement” flight on 26 November that year. Even in retirement, Concorde remains an icon of aviation history.

Concorde was an ogival delta-winged aircraft with four powerful Olympus engines based on those originally developed for the Avro Vulcan strategic bomber. The engines were jointly built by Rolls-Royce and SNECMA, the latter gaining its first foothold in civil aviation turbojet engine manufacturing. Concorde was the first civil airliner to have an analogue fly-by-wire flight control system. It also employed a trademark droop snoot lowering nose section for visibility on approach.

These and other features permitted Concorde to have an average cruise speed of Mach 2.02 (about 2,140 km/h or 1,330 mph) with a maximum cruise altitude of 60,000 feet (18,300 metres), rather more than twice the speed of conventional aircraft. The average landing speed was a relatively high 185 mph (160 knots).

Hawker Siddeley Harrier

The Hawker Siddeley Harrier GR.1/GR.3 and the AV-8A Harrier are the first generation of the Harrier series, the first operational close-support and reconnaissance fighter aircraft with V/STOL capabilities. The Harrier was the only truly successful V/STOL design of the many that arose from the 1960s, and the only truly successful V/STOL design period until the development of the F-35 Lightning II in the early 2000s.

The Harrier was extensively redeveloped, leading to the Harrier GR7/GR9 and AV-8B Harrier II, that were built by BAE Systems and Boeing.

The major combat experience for the Harrier in British service was during the Falklands War where both the Sea Harrier and Harrier GR.3 were used. The Sea Harrier, based on the GR3, was important to the naval activities. Twenty Sea Harriers were operated from the carriers HMS Hermes and Invincible mainly for fleet air defence. Although they destroyed 23 Argentine aircraft in air combat (in part due to using the American-supplied latest variant of the Sidewinder missile and the Argentine aircraft operating at extreme range) they couldn't establish complete air superiority and prevent Argentine attacks during day or night nor stop the daily flights of C-130 Hercules transports to the islands. Three Sea Harriers were lost to ground fire and another three due to operational accidents, none to enemy aircraft. The Harrier GR.3 was operated by the RAF from Hermes and provided close support to the ground forces and attacked Argentine positions but were unable to destroy the Port Stanley runway. If the Sea Harriers had been lost they would have replaced them in air patrol duties.

The RAF Harriers would not see further combat, the Hawker Siddeley airframes would be replaced by the larger Harrier II developed by McDonnell Douglas.

The Sea Harrier FRS.1 saw combat during the Bosnia conflict, with one aircraft of 801 NAS flown by Lt Nick Richardson being shot down by Serbian defences in 1994. These missions continued as the Sea Harrier force was updated to the FA2 standard. During the Kosovo War, combat patrols were flown, but no weapons were fired. The Sea Harrier patrolled over Iraq during the 12 years of enforcing no-fly zones.

The Sea Harrier and Harrier GR7 forces were merged to formed Joint Force Harrier in 2000. With the retirement of the Sea Harrier in 2006 the RAF and RN will share the GR9 fleet until the introduction of the F-35 Joint Strike Fighter.

Grumman F-14 Tomcat

The Grumman F-14 Tomcat is a supersonic, twin-engine, two-seat, variable geometry wing aircraft. The F-14 was the United States Navy's primary maritime air superiority fighter and tactical reconnaissance platform from 1972 to 2006. It later performed precision strike missions once it was integrated with LANTIRN. It was developed after the collapse of the F-111B project, and was the first of the American teen-series fighters which were designed incorporating the experience of air combat in Vietnam against MiGs.

It entered service in 1972 with the U.S. Navy, replacing the F-4 Phantom II. It was later exported to the Imperial Iranian Air Force in 1976. It was retired from the U.S. Navy fleet on 22 September 2006, having been replaced by the F/A-18E/F Super Hornet. As of 2007, it remains in service only with the Islamic Republic of Iran Air Force.

The F-14 began replacing the F-4 Phantom II in USN service starting in September 1974 with squadrons VF-1 Wolfpack and VF-2 Bounty Hunters aboard USS Enterprise and participated in the American withdrawal of Saigon. The F-14 had its first kills on August 19, 1981 over the Gulf of Sidra in what is known as the Gulf of Sidra incident after two F-14s from VF-41 Black Aces were engaged by two Libyan Su-22 'Fitters'. The F-14s evaded the short range heat seeking AA-2 'Atoll' missile and returned fire, downing both Libyan aircraft. U.S. Navy F-14s once again were pitted against Libyan aircraft on January 4, 1989, when two F-14s from VF-32 shot down two Libyan MiG-23 'Floggers' over the Gulf of Sidra in a second Gulf of Sidra incident.

Despite the attention given to the Tomcat over aerial encounters in the Gulf of Sidra, its first sustained combat baptism of fire was as a Photo Reconnaissance platform. The Tomcat was selected to inherit the Reconnaissance mission upon departure of the dedicated RA-5C Vigilante and RF-8G Crusaders from the fleet. A large pod called the Tactical Airborne Reconnaissance Pod System or TARPS was developed to house three sensors: a two position 6" KS-87 frame camera in the forward bay capable of forward oblique or vertical shots selectable by the RIO, a 9" KA-99 panoramic camera capable of narrow or wide field of view in the center bay and an AAD-5 InfraRed line scanner in the aft bay. All camera settings were selected by the RIO although the pilot could initiate camera operation if set up to do so in proper position by the RIO. TARPS entered fleet service by 1979 with VF-84 and was intended to be an interim system until a dedicated F/A-18R variant was fully developed. One of each two Tomcat squadrons per airwing was designated as a TARPS unit and received 3 TARPS capable aircraft and training for 4 TARPS aircrews. The TARPS pod was carried on the starboard aft side of the belly stations with ballast (AIM-54 Phoenix pallets or inert Sparrow missiles) in the forward missile stations.

Panavia Tornado

The Panavia Tornado is a family of twin-engine fighters, which was jointly developed by the United Kingdom, Germany and Italy. There are three primary versions of the Tornado, the fighter-bomber Tornado IDS (Interdictor/Strike), the interceptor Tornado ADV (Air Defence Variant), and the suppression of enemy air defences Tornado ECR (Electronic Combat/Reconnaissance).

Developed and built by Panavia, a trination consortium consisting of British Aerospace (then the British Aircraft Corporation), MBB of Germany, and Alenia Aeronautica of Italy, the Tornado first flew on August 14, 1974, and saw action with the RAF and AMI (Italian Air Force) in Operation Granby / Gulf War. International co-operation continued after its entry into service within the Tri-National Tornado Training Establishment, a tri-nation training and evaluation unit operating from RAF Cottesmore in Rutland in the English Midlands. Including all variants, 992 aircraft were built for the three partner nations and Saudi Arabia. Though still in service, plans are currently underway to replace the aircraft.

The Tornado was originally designed as a low-level supersonic ground attack bomber, capable of taking off and landing in short distances. This requires good high-speed and low-speed flying characteristics. In general, an aircraft which is designed to fly at high speeds usually has poor low-speed characteristics. In order to achieve the desired high-speed performance, an aircraft has a highly swept or ‘delta’ wing platform. However, these wing designs are very inefficient at low speeds where unswept wing planforms are required. In order for an aircraft to be operated efficiently at both high and low speeds, variable wing sweep is a desirable feature; this was incorporated into the Tornado design.

When the wings are swept back, the Tornado GR4 increases its high-speed low-level capability by reducing drag. When sweeping, the wings partially slide into the fuselage, reducing the exposed wing area. This gives the aircraft a low gust response in turbulent low-level winds. This not only makes flight much more comfortable for the aircrew but makes the aircraft a more stable platform from which to aim and deliver unguided weapons at low level.

The aircraft was designed to be land-based and operate from large airfields that were considered to be vulnerable to aerial attack. Therefore, during the development of the aircraft, short field landing capability was considered essential in order to enable the aircraft to operate from short strips on potentially

damaged runways and taxiways. With the wings swept fully forwards the Tornado GR4 generates greater lift because of the increased exposed wing area and the utility of full-span flaps and slats. This gives greater lift at lower speeds, reducing the minimum landing speed required and therefore giving shorter landing distances.

In general, when the pilot wants to fly at low speed, they sweep the wings forward (through a selection lever in the cockpit) to maximise lift, and when flying faster they sweep the wings further back. The Tornado GR4 flies at one of 3 levels of wing sweep: 25, 45 and 67 degrees of sweep. There is a corresponding speed range that is appropriate for each level of wing sweep; these change with the configuration of stores on the aircraft, as they directly affect the lift and drag characteristics.

F/A-18 Hornet

The Boeing (formerly McDonnell Douglas) F/A-18 Hornet is a modern all-weather carrier-capable strike fighter jet, designed to attack both ground and aerial targets. Designed in the 1970s for service with the U.S. Navy and U.S. Marine Corps, the Hornet is also used by the air forces of several other nations. It has been the aerial demonstration aircraft for the Blue Angels since 1986. Its primary missions are fighter escort, fleet air defense, suppression of enemy air defenses (SEAD), interdiction, close air support and reconnaissance. Its versatility and reliability have proven it to be a valuable carrier asset, though it has been criticized for its lack of range and payload compared to its contemporaries. A version exported to Finland and Switzerland without ground attack capabilities is called the F-18 Hornet.

The F/A-18E/F Super Hornet is a distinct, evolutionary upgrade to the F/A-18 designed to serve a complementary role with Hornets in the U.S. Navy.

McDonnell Douglas rolled out the first F/A-18A on 13 September 1978, in blue-on-white colors marked with “Navy” on the left and “Marines” on the right. It took its first flight on 18 November. In a break with tradition, the Navy pioneered the “principal site concept” with the F/A-18, where almost all testing was done at NAS Pax River, instead of near the site of manufacture, and involving Navy test pilots instead of contractor pilots much earlier in the process.

In March 1979, Lt Cdr John Padgett became the first Navy pilot to fly the F/A-18. In all, nine F/A-18As and two F/A-18Bs were assigned to flight systems development. During this period, the snag on the leading edge of the stabilators was filled in, and the gap between the leading edge root extendors (LERX) and the fuselage mostly filled in. The gap, called the boundary layer air discharge (BLAD) slots, controlled the vortices generated by the LERX and presented clean air to the vertical stabilizers at high angles of attack. However, they also generated a great deal of parasitic drag, worsening the problem of the F/A-18’s inadequate range. McDonnell filled in 80% of the gap, leaving a small slot to bleed air from the engine intake. This may have contributed to early problems with fatigue cracks appearing on the vertical stabilizers due to extreme aerodynamic loads, resulting in a momentary grounding in 1984 until the stabilizers were strengthened. Starting in May 1988, a small vertical fence was added to the top of each LEX to broaden the vortices and direct them away from the vertical stabilizers. This also provided a minor increase in controllability as a side effect.

The first production F/A-18A flew on April 12, 1980, and following trials by VX-4 and VX-5, began to fill the Fleet Readiness Squadrons (FRS) VFA-125, VFA-106, and VMFAT-101, where pilots are introduced to the F/A-18. the Hornet entered operational service with Marine Corps squadron VMFA-314 at MCAS El Toro on January 7, 1983, and with Navy squadron VFA-113 in March 1983, replacing F-4s and A-7Es, respectively. The initial fleet reports were

complimentary, indicating that the Hornet was extraordinarily reliable, a major change from its predecessor, the F-4J.

After a production run of 371 F/A-18As, manufacture shifted to the F/A-18C in September 1987. As the A-6 Intruder was retired in the 1990s, its role was filled by the F/A-18. The F/A-18 demonstrated its versatility and reliability during Operation Desert Storm, shooting down enemy fighters and subsequently bombing enemy targets with the same aircraft on the same mission, and breaking all records for tactical aircraft in availability, reliability, and maintainability. The aircraft's survivability was proven by Hornets taking direct hits from surface-to-air missiles, recovering successfully, being repaired quickly, and flying again the next day.

In the 1990s the US Navy faced the retirement of its aging F-14 Tomcat, A-6 Intruder, EA-6 Prowler airframes without proper replacements even in development. To answer this deficiency, the Navy developed the F/A-18E/F Super Hornet. Despite its designation, it is not an upgrade of the F/A-18 Hornet, but rather, a new, larger airframe utilizing the design concepts of the Hornet. Until the deployment of the F-35C Lightning II, Hornets and Super Hornets will serve complementary roles in the US Navy carrier arsenal.

This photograph was also taken back in 1993 while visiting a show at the Dallas Naval Air Station, TX, USA. The Blue Angels, the U.S. Naval Flight Demonstration Squadron (USNFDS) were there but I did not own a long enough lens to get very good shots of their F-18 Hornet aircaft, this composite is of two of the shots I captured on that day

Eurofighter Typhoon

The Eurofighter Typhoon is a twin-engine multi-role canard-delta strike fighter aircraft, designed and built by a consortium of European aerospace manufacturers through Eurofighter GmbH which was formed in 1986. However studies began as early as 1979 into what would become the Eurofighter Typhoon.

The series production of the Eurofighter Typhoon is now underway and the aircraft has formally entered service with the Italian Air Force and with the Spanish Air Force. 'Initial Operational Capability' is expected to be declared by Germany and the United Kingdom in 2006. Austria has purchased 18 Typhoons, while Saudi Arabia signed a contract on 18 August 2006 for 72 to be built by BAE Systems.

The Eurofighter Typhoon is unique in modern combat aircraft in that there are four separate assembly lines. Each partner company assembles its own national aircraft, but builds the same parts of all 620 aircraft.

- Alenia – Left wing, outboard flaperons, rear fuselage sections
- BAE Systems – Front fuselage (including canards), canopy, dorsal spine, tail fin, inboard flaperons, rear fuselage section
- EADS
    - German division– Main centre fuselage
    - Spanish division– Right wing, leading edge slats

Production is divided into three "tranches" with an incremental increase in capability with each tranche. Tranches are further divided up into batches and blocks, eg the RAF's Tranche one twin seaters are batch 1 T1s and batch 2 T1As.

F-22 Raptor

The F-22 Raptor is a stealth fighter aircraft. It was originally envisioned as an air superiority fighter for use against the Soviet Air Force, but is equipped for ground attack, electronic warfare and signals intelligence roles as well. Faced with a protracted development period, the prototype aircraft was designated YF-22 and, as F/A-22 during the three years before formally entering United States Air Force service in December 2005 as the F-22A. Lockheed Martin Aeronautics is the prime contractor and is responsible for the majority of the airframe, weapon systems and final assembly of the F-22. Along with Lockheed Martin, partner Boeing Integrated Defense Systems provides the wings, aft fuselage, avionics integration, and 100% of the pilot and maintenance training systems.

Intended to be the leading American advanced tactical fighter in the early part of the 21st century, the Raptor is the world's most expensive fighter to date with a cost of about US$120 million per unit, or US$361 million per unit when development costs are added. As of April 2005 the total development and production cost of the program is at least US$70 billion, and the number of planes to be built has dropped to 438, then 381, and now to 180, down from the initial requirement of 750. Part of the reason for the decrease in the requirement is that the F-35 Lightning II uses much of the technology used on the F-22, but at a much more affordable price. To a large extent the cost of these technologies is only lower for the F-35 because they have already been developed for the F-22. Had the F-22 not been developed, the costs of these technologies for the F-35 would have been significantly higher.

While attempting its first overseas deployment to the Kadena Air Base in Okinawa, Japan, on February 11, 2007, a group of six Raptors flying from Hickam AFB experienced multiple computer crashes coincident with their crossing of the 180th meridian of longitude (the International Date Line). The computer failures included at least navigation (completely lost) and communication. The planes were able to return to Hawaii by following their tankers in good weather. The error was fixed within 48 hours and the F-22s continued their journey to Kadena.

F-35 Lightning II

The F-35 Lightning II, descended from the X-35 of the Joint Strike Fighter (JSF) program, is a single-seat, single-engined military strike fighter, a multi-role aircraft that can perform close air support, tactical bombing, and air-to-air combat. Its development is being funded by the United States, the United Kingdom, and other partner governments. It is being designed and built by an aerospace industry team led by Lockheed Martin and major partners BAE Systems and Northrop Grumman. Demonstrator aircraft flew in 2000; a production model first took flight on 15 December 2006.

The JSF program was created to replace various aircraft while keeping development, production, and operating costs down. This was pursued by building three variants of one aircraft, sharing 80% of their parts:

- F-35A, a conventional takeoff and landing (CTOL) variant slated to replace U.S. Air Force (USAF) F-16 Fighting Falcons, beginning in 2011.
- F-35B, a short-takeoff and vertical-landing (STOVL) variant slated to replace the U.S. Marine Corps (USMC) AV-8 Harrier IIs and F/A-18 Hornets, and Royal Air Force (RAF)/Royal Navy (RN) Harrier GR7/GR9s beginning in 2012.
- F-35C, a carrier-based variant (CATOBAR) slated to replace U.S. Navy (USN) F/A-18 Hornets (A/B/C/D variants only) beginning in 2012.

Reference and Bibliography

The following sites have been used to provide the text and reference for the information in this book:

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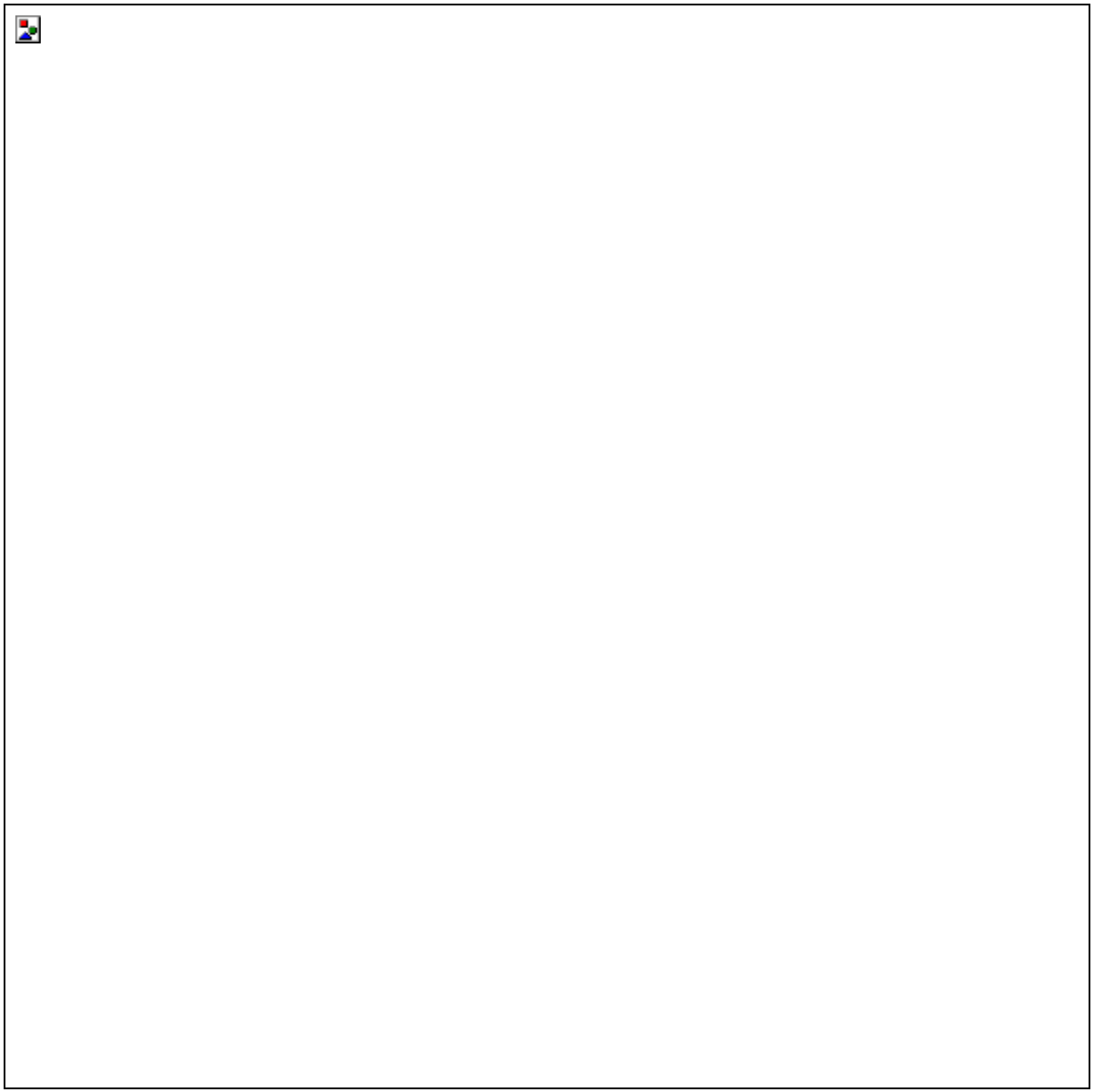
Title



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