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**Shield and
Sword:
Fighter Aircraft
Development
in the 1950s**



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Introduction

The 1950s was one of the most important decades of the twentieth century, particularly for civilian and military aviation. New and improved fighter aircraft provided dramatic examples of engineers' abilities to expand the boundaries of what seemed possible. The rate of increase in speed and rate of climb surpassed anything seen before or since.

The years that followed the end of the Second World War were a troubled period. Within weeks of Japan's surrender, the United States and the USSR began to argue over the shape of the postwar world. By 1947, they had effectively split Europe into rival spheres of influence, which resulted in a fearful propaganda war and virtually no trade. The world was in the grips of a Cold War. By the end of the 1940s, the two superpowers were engaged in massive nuclear weapons development programs. The Americans' atomic monopoly was breached in September 1949 when the Soviets detonated a nuclear device. By then, the Soviets had also managed to produce a pirated copy of the most advanced heavy bomber of the Second World War, the Boeing B-29 Superfortress. Like its American counterpart, the Tupolev Tu-4 could and did carry an atomic weapon.

As the 1940s drew to a close, most day fighter units worldwide were still flying single-engine piston-powered single-seat aircraft designed during, if not before, the Second World War. In fact, many of these fighters were still being produced after the war had ended, in places like the USSR, and in Great Britain and the United States, where they were primarily used in naval air units. They were the last of their kind and, as such, the ultimate expression of their designers' art. Among them were aircraft like the Lavochkin La-11 and Yakovlev Yak-9P (USSR); the Hawker Sea Fury and the Supermarine Spitfire and Seafire (U.K.); the Grumman F8F Bearcat, the Vought F4U Corsair, and the North American P-51/F-51 Mustang (U.S.A.). Powerful twin-engine fighters, like the de Havilland Hornet (U.K.) and the Grumman F7F Tigercat (U.S.A.), were flown in small numbers.



Royal Canadian Navy Hawker Sea Fury F.B. Mk. 11 (NAM)



A Supermarine Spitfire F. Mk. 22 on display on a Royal Air Force base (NAM)



*U.S. Navy Grumman F8F-2 Bearcat
(NAM)*



*A U.S. Navy Vought F4U-5 Corsair
on the flight deck of an aircraft carrier
(U.S. Navy)*



*Air National Guard North American
P-51H Mustang (NAM)*



U.S. Air Force North American F-82B Twin Mustang (U.S. Air Force)

A limited number of specialized night fighters were also in use. These were mostly twin engine, two-seaters fitted with rather unreliable, short-range radar sets. A well-known wartime design like the de Havilland Mosquito (U.K.) and the brand new North American F-82 Twin Mustang (U.S.A.) were typical of this class of aircraft. Carrier-based night fighters were versions of single-engine, single-seaters like the F8F Bearcat and F4U Corsair (U.S.A.), or of twin-engine, two-seat aircraft like the F7F Tigercat (U.S.A.) and the de Havilland Sea Hornet (U.K.).

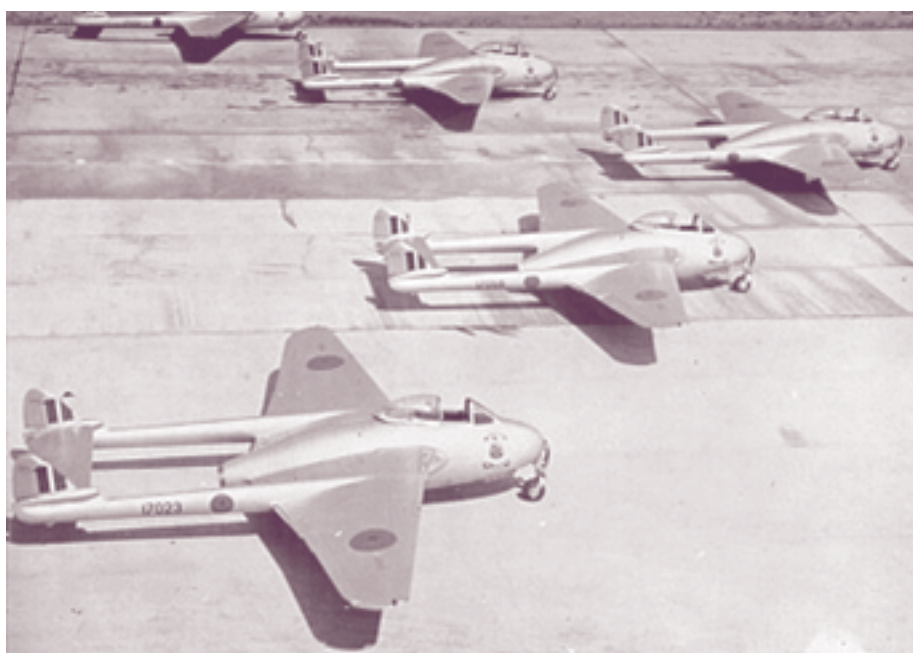


Royal Air Force Gloster Meteor F. Mk.8 (NAM)

Some fighter units were more fortunate and flew the first generation of straight-wing jet fighters developed near the end of the Second World War and after. Great Britain had the Gloster Meteor and de Havilland Vampire, the first jet fighter to serve with the Royal Canadian Air Force (RCAF). Early versions of the Meteor had been used operationally during the war, but had never faced their German counterpart, the Messerschmitt Me 262 Schwalbe, or the rocket-powered Messerschmitt Me 163 Komet. In the early postwar period, the United States could count on the Lockheed F-80 Shooting Star and Republic F-84 Thunderjet. The USSR had the Mikoyan-Gurevich MiG-9 and the Yakovlev Yak-15 and Yak-17, which were loosely based on the well known piston-powered Yakovlev Yak-3 from the Second World War. A conversion similar to the one performed by the Soviet engineers took place later on in Sweden, resulting in the SAAB J 21R, the first jet fighter designed by a middle-ranked power to go into service.



U.S. Air Force Lockheed F-80 Shooting Star (U.S. Air Force)



Five Royal Canadian Air Force de Havilland Vampire F. Mk.3s (NAM)



Two U.S. Air Force Republic
F-84B Thunderjets
(U.S. Air Force)



U.S. Navy Ryan FR-1 Fireball
(U.S. Navy)

Because of the slow acceleration and poor takeoff and landing characteristics of the early jets, naval air arms were slower to adopt the new technology. Still, the U.S. Navy flew some straight-wing jet fighters, like the McDonnell FH Phantom, the North American FJ Fury and the Ryan FR Fireball (a hybrid type with both piston and jet engines). Their British counterpart was the de Havilland Sea Vampire, a navalized version of the Vampire.

In the Beginning Was War

As the 1950s began, the Cold War intensified. On 25 June 1950, North Korea launched a surprise attack on South Korea. Overwhelmed by their enemy's superior firepower, the South Koreans retreated. On 27 June, the United Nations' Security Council approved a resolution asking member nations to help the South Koreans repel their opponents. Within a week, United States Air Force (USAF) units based in Japan gained control of the sky and started to attack the North Korean army. Starting from a small pocket around the southern coastal city of Pusan, United Nations airmen and soldiers moved north all the way to the Chinese border. Faced with the collapse of its neighbouring ally, China entered the conflict late in October, using a new Soviet single-seat jet fighter that would make the United Nations' mission far more difficult, the Mikoyan-Gurevich MiG-15.



A captured North Korean air force Mikoyan-Gurevich MiG-15 (NAM)

Designed for daytime interception of piston-powered bombers, like the American B-29 Superfortress, the new aircraft was an impressive blend of Soviet and foreign know-how. Its swept wings, which produced less drag than straight wings of similar thickness near the speed of sound, were based on German technical information seized after the Second World War. Its Klimov RD-45F engine was a pirated copy of the Rolls-Royce Nenes shipped in 1946 by the new Labour government of Great Britain in a naive gesture of goodwill.

Operating near the Chinese border, the MiG-15 soon proved to be a formidable opponent. The B-29 Superfortress, so modern and powerful in 1945, was all but defenceless. Piston-powered fighters like the F-51 Mustang and F4U Corsair could do little against it. The MiG-15 could outrun, outclimb and outfight the F-80 Shooting Star, which was at the time the only United Nations jet fighter in Korea. These encounters were actually the first ever between jets. To counter the threat of the MiG-15, the USAF called upon its most modern single-seat fighters, the F-84 Thunderjet and the North American F-86 Sabre. The F-84 was first used to escort bombers, but rapidly proved unable to fight the MiG-15 on equal terms, confirming that the heyday of straight-wing jet fighters like the F-84 and the British Meteor was over. Such aircraft were relegated to ground attack missions, but unfortunately, their engines consumed lots of fuel at low level. Ironically, "old-fashioned" aircraft like the F-51 Mustang and the U.S. Navy's F4U Corsair proved to be almost as effective as these straight-wing jets in the ground attack role.



*U.S. Navy Grumman F9F-2 Panther
(NAM)*



*U.S. Navy McDonnell F2H-2 Banshee
(NAM)*

When the Korean War began, the U.S. Navy had no swept-wing jet fighter in service. Its most modern aircraft were the McDonnell F2H Banshee and the Grumman F9F Panther. The Panther, arguably the best single-seat naval fighter in the world at the time, was also the very first to fire its guns in anger, in Korea, in July 1950. A tough and reliable performer, the F9F was first powered by a Pratt & Whitney J42 engine, a licence-built version of the Rolls-Royce Nene turbojet. Later aircraft had the J48 engine, an Americanized Rolls-Royce Tay. Although as powerful, the American aircraft had straight wings and was no match for the MiG-15. Neither was the twin-engine F2H, a docile and surprisingly adaptable machine given McDonnell Aircraft's youth and lack of production experience. As a result, the F9F and F2H fought in Korea mainly as fighter-bombers.

The F-86 Sabre, first flown in combat in December 1950, was not as easily dismissed as these straight-wing aircraft. Designed to counter jet-powered fighters and fighter-bombers operating by day, it would have been fitted with straight wings had the results of wartime German research on swept wings not become available early in its development. As a result of this new information, the F-86 was redesigned with swept wings in order to maximize performance. In the latter half of the 1940s, the F-86 and the MiG-15 were considered cutting-edge engineering. Although somewhat more powerful and reliable than the MiG-15, the F-86 was approximately one third heavier. It could not turn as well, climb as fast or fly as high as its Soviet rival. Above 6000 metres the F-86 became increasingly slower. However, it was more stable and easier to handle at high speed and was a better gun platform. In fact, armament was the single greatest difference between the two aircraft.



*U.S. Air Force North American
F-86A Sabre (NAM)*

Faced with the task of destroying large bombers, the MiG-15 was fitted with relatively slow-firing large-calibre weapons: namely two 23-mm Nudelman-Suranov NS-23 and one 37-mm Nudelman N-37 cannons. Weighing 735 grams, a 37-mm explosive shell could readily blow a rugged machine like the F-86 Sabre out of the sky. In comparison, the F-86 had six fast-firing 12.7-mm Browning AN-M3 machine guns, an improved version of a weapon designed near the end of the First World War. With its high-quality gun sight and well trained pilots, many of whom were veterans of the Second World War, the F-86 was far more likely than the MiG-15 to score hits. Unfortunately, the MiG-15 was a solid aircraft capable of taking a great deal of punishment.

The MiG-15 and the F-86 Sabre met in combat for the first time on 17 December 1950 and fierce battles continued to take place above Korea until the armistice on 27 July 1953. The early F-86A was superseded by the F-86E and F-86F, which were each fitted with a more powerful engine. The North Koreans may have operated the MiG-15bis, an improved version fitted with the more potent Klimov VK-1 engine. Until recently, Western sources commonly stated that ten to fourteen MiG-15s were lost for each F-86 and concluded that the American aircraft and pilots were greatly superior to the MiG-15 and their North Korean, Chinese and, in some cases, Soviet pilots. Although air combat tallies have proved to be one of the most contentious topics in the history of aerial warfare, and even though many of the MiG-15s that American airmen honestly claimed, and believed, were destroyed were probably only damaged, the F-86 did win far more often than it lost. The quality of its pilots may have had a lot to do with the success and reverence in which the F-86, unquestionably one of the great fighter aircraft of all times, is held, even to this day. Pilot ability has been paramount since the First World War and will remain so for years to come.

Regardless of the way statistics have turned into accepted truths, there are still some conclusions that can be extracted from the conflict in Korea, and one of them may come as a surprise. Rather than representing the dawn of a new age in air combat, the Korean War marked the end of an era that had begun in the First World War with the knights of the air. Although fought mainly by day with ever larger numbers of jet fighters, the Korean War was one in which pilots jockeyed in order to get close enough to shoot down one another with cannons and machine guns in much the same way their Second World War predecessors had done. Their weapons, however, proved inadequate against other jet fighters. Thus, the conflict revealed deficiencies in rates of fire, projectile lethality, and weapons range. Furthermore, most pilots were still fighting without the benefit of an on-board radar set, sighting by naked eye only.

The Korean War also signalled the end of an era as far as heavy bombers were concerned. Piston-powered aircraft like the B-29 Superfortress and its closely related derivative, the Boeing B-50 Superfortress, their successor, the gigantic Convair B-36, and the Soviet Tu-4, were very much obsolescent; but not all manned bombers in service at the time had to be scrapped. Although aircraft like the MiG-15 and the F-86 Sabre were more deadly than their Second World War counterparts, they would have been ineffective in bad weather or at night, even with the help of advanced radar networks. They already had to contend with medium sized aircraft like the North American B-45 Tornado. Deliveries of this aircraft began in November 1948. The Royal Air Force (RAF) introduced the English Electric Canberra in May 1951. Their Soviet counterpart, the Ilyushin Il-28, went into service in September 1950. Nuclear-armed heavy bombers powered by jet engines would soon make the fighters' job even more difficult. All these aircraft caused a great deal of concern among air defence analysts – the only way to escape nuclear obliteration was to destroy every attacking bomber, an impossible task at the best of times.

Air Defence and Deterrence

Faced with the awesome responsibility of defending their countries against nuclear-armed opponents, major air forces gradually adopted a policy of deterrence, akin to Newton's Third Law of Motion – for every action there would always be an equal and opposite reaction. Both sides in a nuclear war would suffer horribly from such massive retaliation. The amount of damage would, however, vary according to the size and quality, in other words, the credibility, of both the attacking bomber force and the defending fighter force.



*U.S. Air Force Lockheed F-94B Starfire
(U.S. Air Force)*



*U.S. Air Force Northrop F-89D
Scorpion (NAM)*



*U.S. Navy Douglas F3D-1 Skyknight
(NAM)*

To be credible and effective, defensive fighters had to be present in sufficient numbers and able to intercept incoming bombers regardless of the weather or time of day. Aircraft capable of doing this had been known as night fighters, but increasingly they would be referred to as all-weather fighters, even though they were quite incapable of fighting in all kinds of weather. This change in terminology was yet another example of the optimism and faith in technology one encounters so frequently throughout the history of military aviation. Even so, the change was significant because it was in the 1950s that air forces acknowledged that the word "fighter" had become a catch-all term that meant anything anyone wanted it to mean; there was no longer such a thing as "a fighter." While it is true that during both the First and Second World Wars many fighters carried small bombs and, in some cases, big ones, this was primarily the result of war-driven modifications to aircraft already in service. As well, early night fighters tended to be versions of aircraft designed for other purposes. The 1950s changed all that. Larger air forces required, and engineers developed, a multitude of aircraft, each designed to perform a specific task within increasingly integrated national defence structures.

The post-Korean period was undoubtedly the Golden Age of the large, long-range, subsonic and, to a large extent, purpose-built twin-engine, two-seat night/all-weather fighters. Such aircraft were in combat before the end of the Korean War, in July 1953. Indeed, the USAF had been first off the mark with the Lockheed F-94 Starfire, a double exception to the rule in that it had been derived from one of the true classics of aviation, the T-33 "T-Bird" Silver Star, the trainer version of the single-engine F-80 Shooting Star. Delivery of the Starfire to squadrons began in May 1950, barely a year after the first flight of this stopgap design. The following year, the F-94 made its debut in Korea. The purpose-built Northrop F-89 Scorpion faced serious delays, however, which explains why the Lockheed design was rushed into production, and the F-89 only entered service in mid-1951. None were sent overseas. Its naval counterpart and the very first carrier-based jet-powered night fighter, the portly Douglas F3D Skyknight, proved remarkably successful in Korea. Operating from land bases from 1952 onward, its Marine pilots shot down more enemy machines than any other naval fighter; an F3D is credited with shooting down the first jet aircraft ever destroyed by another at night.



Royal Air Force Armstrong Whitworth Meteor N.F. Mk.11 (NAM)

It was in 1951 that the RAF received its first jet-powered night fighters. As had been the case with the F-89 Scorpion, the type designed specifically for the air force was not the first to go into service. Known as the Armstrong Whitworth Meteor, this aircraft was a two-seat development of the airplane originally designed by Gloster. The other machine, also based on a single-seat fighter, was developed as a private venture for the export market. Twelve of these de Havilland Vampire night fighters were ordered by the Egyptian air force, but were taken over by the British government when it imposed an embargo on the export of arms to Egypt. Additional aircraft were built for the RAF as a stopgap measure pending the delivery of better machines. Neither of these night fighters ever fired their weapons in anger.



A formation of Royal Canadian Air Force Avro Canada CF-100 Mk.4Bs (NAM)

Aircraft that came later included one of the best all-weather fighters of the 1950s and the one machine designed by Avro Canada to go into service, the CF-100 Canuck, better known as the "Clunk." Like most of its contemporaries, this aircraft, the first of its type to be produced by a middle-size power, emphasized range over agility and sheer performance. To be able to patrol the night skies, all-weather fighters had to carry plenty of fuel. To find their targets, they needed a radar set and a dedicated radar operator. A fairly large and heavy airframe was needed to house all this and extra power was required to get these aircraft off the ground. Given the technology of the time and the need for safety, engineers usually chose to use two engines. In the case of the CF-100, these powerplants were Orenda engines designed and built by Avro Canada's Gas Turbine division. An RCAF squadron received its first CF-100 in May 1953.

To keep up with their quarry, all-weather fighters were improved over time as more powerful engines, radar sets and weapons were developed. USAF and RCAF machines initially had to make do with 12.7-mm Browning AN-M3 machine guns or 20-mm Colt M24 cannons, while early versions of the F-89 Scorpion, for example, had six Colt cannons and packed a potent punch. The single-engine F-94A Starfire, on the other hand, lacked power and had to make do with a pitiful quartet of 12.7-mm machine guns. By comparison, the CF-100 Mk 3 had eight 12.7-mm machine guns housed in an easily removable pack underneath the fuselage. The night-fighting Meteor and Vampire were both fitted with the four Hispano Mk 5 20-mm cannons used on most British fighters of that period. Because they were built to defend the British Isles, these carried less fuel than their North American contemporaries.

Realizing that the interception of nuclear-armed bombers required increasingly efficient weapons and aiming systems, the USAF developed an interesting solution. Starting in 1953, the F-94C and F-89D were armed with 69.9-mm supersonic folding-fin rockets. The CF-100 Mk 5 was similarly equipped; the Mk 4 version of this airplane carried both rockets and machine guns. The U.S. Navy Bureau of Ordnance developed this 8.2-kg unguided air-to-air rocket, better known as "Mighty Mouse" (a well-known cartoon character of the time and known as a little guy with a mighty punch). It was distantly related to the 55-mm R4M Orkan rocket, a German weapon developed at the end of the Second World War. Used on a few occasions by Me 262 Schwalbe jet fighters operating by day against Allied bombers, the R4M proved deadly.

The F-94C carried forty-eight rockets while the RCAF's CF-100 Mk 4 and 5 could launch fifty-eight. Still, neither could match the awesome power of the F-89D's 104 rockets. These were launched in a single, massive salvo, just like the shot from a shotgun. Blanketing an area of sky the size of a football field, the rockets had a very good chance of hitting a target the size of a Soviet heavy bomber. Since each warhead had a destructive effect comparable to that of a 75-mm explosive shell, a single hit could easily destroy an enemy.

To take the guesswork out of aiming these formidable weapons while providing a safe, efficient and (it was hoped) unobserved attack trajectory for North American fighters, a new player, the Aircraft Division of Hughes Tool (owned by the famous Howard Hughes) developed a series of highly advanced interception and fire-control systems. Early models told the crew when to fire. Later, semi-automatic models actually fired the weapons. Ground based radar networks were used to guide each fighter toward a target. As it got within range, an on-board radar set, far more powerful than anything used before, acquired the enemy aircraft and locked on to it. From then on, the crew only had to arm the weapons and keep the target within a steering circle on their radar screen. Flown on autopilot and guided by the on-board computer, the fighter came into range from the side. When it reached the ideal position relative to the target, the aircraft's computer fired the rockets toward the point in the sky where the target would be a few seconds later. Attacking a bomber from the side rather than the rear greatly increased its apparent size and the probability of scoring at least one hit, provided of course that the enemy pilot did not take evasive action and that the rockets did not go awry (as happened on a number of occasions). Understandably, this approach became known as collision course interception.

The interception and fire-control systems developed in the 1950s, although far superior to what was available in earlier years, were still horrendously heavy and bulky. Moreover, the thinking power of these early "black boxes" was severely limited. The cheap pocket calculators now given to young children are probably smarter. Worse still, they required great numbers of vacuum tubes similar to those found in radio and television sets of the period, and such tubes consumed huge amounts of electricity, generated large amounts of heat and broke down often. The average number of hours between failure was ridiculously low and the slightest problem could take hours to solve. Any repair work involved plenty of handiwork with screwdrivers and, often, soldering irons.

The all-weather jet fighters mentioned thus far were fitted with relatively thin straight wings rather than the swept wings that were becoming more and more popular with their daytime counterparts. Such wings had more forgiving low-speed flying characteristics, an important feature for airplanes that usually had to take off and land at night or in bad weather. Besides providing optimum flying characteristics at high altitude, they also allowed designers to hang heavy fuel tanks or multi-tube rocket launchers on the wing tips.



*Royal Air Force Gloster Javelin
F.(AW) Mk.8 (NAM)*

To keep up with their intended targets, all-weather fighters eventually had to leave these straight wings behind. One of these aircraft was the Yakovlev Yak-25, the first machine of this type to be produced for the Soviet military. Fitted with a bicycle-type undercarriage comparable to that of the Boeing B-47 Stratojet medium range bomber, this solid machine may have been the first swept-wing all-weather fighter to go into service, in 1955. In Great Britain, engineers developed the Gloster Javelin, the world's first twin-engine two-seat, delta wing aircraft and one of the most distinctive fighters of the 1950s. The design of its triangular wing was based on German research seized after the Second World War. With its large area and internal volume, this huge wing provided plenty of space for the landing gear, as well as fuel and weaponry. The first production aircraft were issued to a squadron in February 1956. Although pleasant to fly, the Javelin was slow and the multitude of versions did not facilitate the work of maintenance crews.



*Armée de l'Air SNCASO S.O.4050
Vautour II B (NAM)*

Around 1956, the French started to field a rather more impressive and versatile airplane. The twin-engine SNCASO S.O.4050 Vautour II was one of the first successful aircraft to be produced in postwar France. The configuration of its landing gear and swept wing were loosely inspired by those of the B-47 Stratojet. The Vautour's SNECMA Atar 101 engines were based on a design developed by a small team of German jet engine specialists from BMW who had fled to Switzerland at the end of the Second World War. In mid-1958, a similarly elegant and long lasting machine entered service with the Swedish air force. This was the single-engine SAAB J 32B Lansén, a greatly improved version of the earlier A 32A all-weather attack aircraft. Solid and comfortable, this swept-wing design provided a superb gun platform.

The Yak-25 was armed with a pair of slow-firing 37-mm Nudelman N-37 cannons. The three Western aircraft – the Javelin, the S.O.4050 Vautour II and the J 32B Lansen – on the other hand, were fitted with four fast-firing 30-mm weapons. The Javelin and Lansen had the British ADEN while the Vautour flew with the home-grown DEFA. The two weapons were very similar, which is not surprising given that they were both simply improved copies of the Mauser MG213C 30-mm revolver cannon. Developed in Germany during the Second World War, this revolutionary weapon had come too late to see any action, but its descendants have remained in service to this day. As their name implies, these weapons are built around a five-chamber cylinder comparable in form, if not in size, to that of a revolver. The rotating cylinder made it easier to load the heavy shells, thus increasing the cannon's rate of fire. In fact, the MG213C had to be slowed down during trials because its barrel wore down too fast.

As the 1950s wore on, the world's largest air forces gradually realized that their subsonic all-weather fighters with their large-calibre cannons and unguided rockets were at best an interim solution to the deadly threat posed by the newest types of nuclear-armed bombers. As with fighters, strategic bombers were increasingly fitted with swept wings developed from captured German documents. The USAF set the trend yet again with the radical-looking B-47 Stratojet, first delivered in mid 1951. It was followed four years later by the larger and far longer-range Boeing B-52 Stratofortress. In Great Britain, government efforts to keep manufacturers busy led to orders for three medium-range strategic bombers: an interim design, the Vickers Valiant, introduced in January 1955, and two more sophisticated aircraft, the Avro Vulcan and the Handley Page Victor, which entered service in July 1957 and April 1958 respectively. Soviet designers were also busy at the time. Deliveries of a medium-range aircraft, the Tupolev Tu-16, began in 1954. That same year, a much larger machine thought to be the Soviet equivalent of the B-52, the Myasishchyevev M-4, caused a shock among Western experts when it was flown in public for the first time. An equally remarkable design was unveiled in 1955. This was the Tupolev Tu-95, a long-range swept-wing bomber fitted with the most powerful turboprop engines in the world.

By this time, engineers in the United States and the USSR were already designing bombers capable of defeating one of the great psychological barriers of this century, the sound barrier. The first of these, and one of the most elegant aircraft ever produced, was the highly advanced Convair B-58 Hustler Mach 2 medium range bomber. Deliveries to a USAF squadron began in March 1960. The U.S. Navy's North American A3J Vigilante, a smaller yet equally impressive all-weather attack aircraft, entered service in June 1961. Their Soviet counterpart, the Tupolev Tu-22K, was slower and not as well equipped; it was first seen in public in 1961.

Breaking the Sound Barrier

To call the sound barrier a psychological obstacle may seem exaggerated but, in fact, supersonic devices had been in use for decades – shells and bullets. Even the crack of a whip is a supersonic phenomenon. Creating an aircraft capable of flying faster than the speed of sound (approximately 1060 km/h at high altitude), however, proved very difficult. The newly created USAF won the prize on 14 October 1947 when Captain Charles “Chuck” Yeager exceeded the speed of sound in level flight aboard a specially designed research aircraft, the Bell X-1 rocket airplane. The maximum speed he achieved was Mach 1.015 (1.015 times the speed of sound). This unit of measure was named after Ernst Mach, an Austrian scholar who, around the turn of the twentieth century, published many works on physics and mathematics, as well as psychology and philosophy.

As was to be expected, Yeager’s historic flight resulted in efforts to improve fighter performance. The United States, the most advanced nation in the world at the time technically, had a clear advantage. Thus, the first production airplane designed to operate at speeds greater than Mach 1 was a privately-developed project, the North American F-100 Super Sabre daytime fighter. A USAF squadron took delivery of its first aircraft in November 1953. Its massive Pratt & Whitney J57 was one of the best engines of its day, powering aircraft as diverse as the Douglas DC-8 jetliner and the B-52 Stratofortress. The F-100 carried four 20-mm Pontiac M39 cannons, a weapon loosely based on Mauser’s MG213C 30-mm cannon. Unlike the French or the British, the Americans stuck with 20-mm ammunition, in part because it was readily available. They also believed that cannons were obsolescent and would be replaced by rockets and missiles within a few years.



*U.S. Air Force North American
F-100D Super Sabre (NAM)*

A precedent-setting machine in every sense of the word, the American aircraft was the first of a new generation of fighter airplanes. One could argue that it was the F-100 that started the trend toward ever increasing development and production costs. New materials, techniques and tooling, as well as improved aerodynamics and greater engine power, proved very expensive, and only a few countries would be able to afford them. The F-100's design was so advanced that it actually overstepped the boundaries of aerodynamic knowledge. The loss of several aircraft early on, in unusual circumstances, led to an in-depth study that recommended the wingspan and the vertical tail surface area be increased; this research has influenced the design of most supersonic aircraft ever since. Sadly, the superb F-100 was the last fighter produced in quantity by North American.



Indonesian air force Mikoyan-Gurevich MiG-19 (NAM)

Although originally designed for air combat, this long-lasting aircraft served mainly as a fighter-bomber in the USAF and in numerous North Atlantic Treaty Organization (NATO) air forces. As such, it illustrated a gradual shift in the way jet fighters were used. Originally seen as defensive weapons, they came to be flown more often on offensive missions. One of these fighter-bombers' most effective and powerful weapons was the so-called tactical nuclear bomb. The F-84G Thunderjet was the first fighter aircraft to be so equipped, in the spring of 1952. In order to extend its range, this aircraft was also the first fighter in the world to regularly make use of in-flight refuelling.

The Soviet counterpart of the F-100 Super Sabre appeared soon after. As far as its designers were concerned, and perhaps more so than was true for its American counterpart, the Mikoyan-Gurevich MiG-19 marked a complete break with the past. Two small-diameter engines mounted side by side in the rear fuselage powered this compact design. Its three 30-mm Nudelman-Rikhter NR-30 cannons gave it a firepower unequalled anywhere in the world. The first unit converted to the type in the spring of 1955. Very popular with its pilots, the highly-maneuvrable MiG-19 was a deadly opponent. Forgotten in its homeland (relatively few were built by the Soviet Union), the MiG-19 became the mainstay of the Chinese air force in the 1960s.

Both the MiG-19 and the F-100 Super Sabre owed their supersonic flight capabilities to improved aerodynamics and an idea perfected in the early 1950s, the afterburner. Also known as a reheat, this cylinder-like device was added to the rear section of a jet engine. Fuel was injected into the hot gases that streamed into the afterburner and the mixture ignited, thus increasing the temperature and velocity of the exhaust gases. The result was a significant increase in thrust (and fuel consumption). Afterburners are used mainly under takeoff, climb or combat conditions.



Indonesian air force
Mikoyan-Gurevich MiG-17 (NAM)

The introduction of supersonic fighters did not, however, mean the death of their older and slower cousins. The Soviet Union, for example, had developed the Mikoyan-Gurevich MiG-17 to correct the poor characteristics of the earlier MiG-15 at high speed and in tight turns. Ironically, it was the need to mass produce the MiG-15 for air combat in Korea that led to delays in producing the closely-related MiG-17. It finally went into service in the fall of 1954, but just a few months before the first flight of the greatly improved MiG-19.

In the opposing camp, production of the F-86 Sabre continued. In the United States, a heavier and more powerful fighter-bomber version was developed. In other countries, companies like Commonwealth Aircraft in Australia and especially Canadair in Canada produced airplanes that could outfight their American-built counterparts in air-to-air combat. The Australian aircraft were fitted with a Rolls-Royce Avon engine. Later versions of the Canadair-built Sabres had the Avro Canada Orenda. Earlier versions of this aircraft were transferred to many Allied countries as well as members of NATO. Canadair-built Sabres, for example, became the first swept-wing fighters to be operated by the RAF.



U.S. Air Force North American
F-86D Sabre (NAM)

A more radical redesign led to what was probably the world's first single-seat all-weather fighter, the F-86D, first delivered in 1951. Originally known as the "Dogship" because of its poor reliability, the new airplane was fitted with a compact version of the Hughes interception and fire-control system. The antenna was mounted in a bulbous radome above the chin air intake of the aircraft's engine. The F-86D may also have been one of the first single-seat fighters to be built without guns; instead, it carried a retractable tray or box in the lower fuselage. Extended only when ready to fire, this tray was loaded with twenty-four 69.9-mm "Mighty Mouse" rockets. The F-86K, a simplified version armed with four 20-mm Colt M24 cannons and built without the classified collision-course system, was developed especially for European members of NATO that urgently needed modern all-weather fighters. It went into service in early 1955.

Remarkably enough, North American was able to use the F-86 as a starting point for a series of carrier-based fighters and fighter-bombers for the U.S. Navy. Even though they all bore the same name, the North American FJ-2 Fury had little in common with the FJ-3 or the greatly improved FJ-4. An initial batch of FJ-2s was delivered to a squadron in early 1954. Navy pilots received their first FJ-4s a year later.



U.S. Navy North American FJ-4B Fury
(NAM)



*U.S. Air Force Republic
F-84F Thunderstreak (NAM)*

Other American companies also revamped their fighters. Republic Aviation, for example, produced a swept-wing derivative of its F-84 Thunderjet. Known as the Republic F-84F Thunderstreak, the new machine was powered by a Wright J65, a licensed version of yet another British jet engine, the superb Armstrong Siddeley Sapphire. Although easy to land, the F-84F approached at a very fast speed. Like its predecessor, it was somewhat underpowered and needed long runways to take off, especially during the summer. USAF service began in January 1954. A poor dogfighter, the F-84F was offered free of charge to numerous NATO air forces, where it served many years as a fighter-bomber.

The Grumman F9F Cougar resulted from a similar conversion. This swept wing version of the F9F Panther was developed in record time. A squadron received its first aircraft in November 1952, only fourteen months after the initial flight of the prototype. Although lacking in elegance, the new fighter proved popular with its pilots. Even if the U.S. Navy was quite happy to use relatively low-risk conversions like the swept-wing FJ Fury and the F9F Cougar, it could still be as daring as the USAF. Indeed, naval pilots flew what were arguably two of the most spectacular and radical fighters of the 1950s, the Vought F7U Cutlass and the Douglas F4D Skyray.



*U.S. Navy Grumman F9F-6 Cougar
(U.S. Navy)*



*U.S. Navy Vought F7U-3 Cutlass
(NAM)*



*Two U.S. Navy Douglas
F4D-1 Skyrays (U.S. Navy)*

A thoroughly unconventional airplane, the F7U Cutlass had a broad, swept wing to which were attached a pair of very large vertical tail surfaces. Development proved difficult but its potential was such that the U.S. Navy stuck with the project. The first fully developed version showed that it could outfight any naval fighter then in service. Losses to accidents were heavy, however, and pilots did not really like the F7U. The type entered service in mid-1954 and was retired a few years later. Designed by Ed Heinemann, one of the most gifted aeronautical engineers in history, the F4D Skyray was another highly innovative machine. A formidable dogfighter, this single-seat interceptor had a very high rate of climb. The F4D's all but triangular wing was based on research done during the Second World War in Germany by the creator of the Me 163 Komet rocket-powered interceptor. Its Pratt & Whitney J57 engine could power it to a speed just below Mach 1. The first squadron took delivery in the spring of 1956.



*U.S. Navy McDonnell F3H-2N Demon
(U.S. Navy)*

All aircraft are critically dependent on the performance and quality of their engines. The failure of the F4D Skyray's original engine, the Westinghouse J40, had been an irritant to Douglas engineers. At McDonnell Aircraft, that same failure brought to a virtual standstill the production of the company's first swept-wing design, the F3H Demon. First delivered to a squadron in March 1956, the new airplane was still underpowered and proved disappointing. All three airplanes were fitted with four 20-mm cannons. In addition, the F7U Cutlass could carry a belly tray with thirty-two 69.9-mm "Mighty Mouse" rockets.



*Royal Navy de Havilland
Sea Venom F.A.W. Mk.22 (NAM)*



*Royal Navy Hawker Sea Hawk
F.G.A. Mk.6 (NAM)*



*A Supermarine Attacker F. Mk.1 on
display on a Royal Navy base (NAM)*

These aircraft were far superior to anything the British Fleet Air Arm was flying. The very popular and supremely elegant Hawker Sea Hawk still had a straight wing. Because of this, it could not match the performance of contemporary swept-wing fighters. A product of Sydney Camm's prolific pen, the Sea Hawk went into service in March 1953. A year later, a number of navy crews started to convert to the de Havilland Sea Venom, the Royal Navy's first jet-powered all-weather fighter. As the name implied, it was a navalized version of the de Havilland Venom, a twin-boom design similar in appearance to the earlier Vampire. Little good can be said of the older and slower Supermarine Attacker, which had gone into service in August 1951, other than that it was the first jet fighter designed to operate from British aircraft carriers. It and the Soviet Yak-15 were the only production jet aircraft to be fitted with a tail wheel.



*Two Royal Air Force Hawker Hunter
F. Mk.6s (NAM)*

The RAF was somewhat better off, but its first home-grown swept-wing fighters, the Hawker Hunter and the Supermarine Swift, entered service only in July and August 1954 respectively. The Hunter was by far the better of the two. Another aircraft designed by Sydney Camm, the Hunter was elegant, manoeuvrable and all but unbreakable. This, along with the airplane's four 30-mm ADEN cannons, led to its wide-scale use as a fighter-bomber. A typical British design, it had only a limited range. The Armstrong Siddeley Sapphire powered early versions of the aircraft. Most Hunters, however, had the Rolls-Royce Avon, an engine also used on airliners like the de Havilland Comet and the SNCASE S.E.210 Caravelle, one of the most elegant designs of the age. Both powerplants clearly illustrated the high level of performance achieved by British aircraft engine designers. Widely exported and used for decades after its first flight, the Hunter was undoubtedly one of the greatest fighters of all time.



*Royal Air Force Supermarine Swift
F. Mk.7 (NAM)*

The RAF's second swept-wing fighter, the Supermarine Swift, was a sad example of the muddled thinking, mismanagement and bad luck that plagued the British Air Ministry in the postwar period. Development was overly long and production was launched before the aircraft's many problems had been solved. As a result, early Swifts were virtually useless and many only served for ground instruction. Later versions proved somewhat better but were only produced in small batches. Because the RAF did not really want them, the Air Ministry cancelled the program. By then, however, close to one hundred Swifts were already flying and production was proceeding in two factories, and the program cancellation held unfortunate implications for the aircraft, factories, and employees. The main production version served for some time as a low level reconnaissance aircraft.



Two Armée de l'Air Dassault MD.450
Ouragans (NAM)

The French followed a very different route. Rebuilding the country and the armed forces was a matter of national pride after the humiliating defeat of 1940. France's chosen instrument was a company founded by an aircraft designer who had spent most of the Second World War in a concentration camp. Born Marcel Bloch, he changed his name to Marcel Dassault. His first jet fighter was a simple and well-designed machine with just a hint of a sweep in its wing and tail. The Dassault MD.450 Ouragan was powered by a Rolls-Royce Nene built under licence by a famous French aircraft engine maker, Hispano-Suiza. Unspectacular but easy to maintain, the MD.450 Ouragan went into service in early 1952.



Armée de l'Air Dassault Mystère IIC
(NAM)

The introduction of this aircraft signalled the beginning of the company's conscious policy to take only manageable steps in its quest for progress; there would be no great leaps into the unknown. A swept-wing development of its predecessor, the Dassault Mystère IIC was ordered to keep the production line humming while the much better Mystère IVA was being introduced. Although similar on the outside, the new machine was entirely new under the skin. The SNECMA Atar 101 of the Mystère IIC was replaced by a Rolls-Royce Tay built in France by Hispano-Suiza and, later, by the French-derived Verdon. British and American assistance were also of great help in areas like tooling and accessories. The Mystère IIC and the Mystère IVA were developed concurrently and entered service in 1954. In both cases, the four 20-mm Hispano-Suiza cannons of the MD.450 Ouragan were replaced by two of the greatly superior 30-mm DEFAs.



Armée de l'Air Dassault Mystère IVA
(NAM)

With the success of these fighters, the French company produced the Dassault Super Mystère B2, western Europe's first supersonic aircraft. Sporting an air intake similar to that of the F-86 Sabre, and other less visible borrowings from the F-100 Super Sabre, the new machine was powered by a SNECMA Atar 101 fitted with an afterburner. Entering service in 1957, the Super Mystère B2 enjoyed a long and successful career. It was the final development of Dassault's widely used series of swept-wing daytime fighters.



Armée de l'Air Dassault
Super Mystère B2 (NAM)



Swedish air force SAAB J 29C (NAM)

Surprisingly, the first swept-wing fighter to be produced in Western Europe was not British, or even French. That honour belonged to neutral Sweden and its SAAB J 29, delivery of which had begun in May 1951. Widely known as the "Tunnan" because of its barrel shape, the J 29 was based on German wartime ideas of what a jet fighter could look like. It carried four 20-mm cannons and was powered by a de Havilland Ghost produced under licence in Sweden. The portly J 29 was a surprisingly agile airplane with a high rate of climb. Later versions were fitted with an afterburner developed by Swedish engineers. It was with this fighter that SAAB took its place as one of the main fighter aircraft manufacturing companies in the Western world.



*A Finnish air force Folland
Gnat F. Mk.1 with temporary
Royal Air Force markings (NAM)*

In the 1950s, many European air forces and aircraft manufacturers, worried by the ever increasing weight, complexity and cost of the new jet fighters, devoted more attention to the so-called light fighter concept. Small and relatively cheap aircraft could be produced in greater numbers than big and expensive ones. They would also be easier to maintain in the field. The same idea had occurred to German officials in 1944. The aircraft they had come up with was the Heinkel He 162 Salamander, or Volksjäger, a cheap but by no means easy to fly fighter that did not officially enter service.

The first of only two lightweight fighters produced during the 1950s was a truly small and aptly-named machine, the Folland Gnat. A fairly small company, Folland Aircraft received no help from either the RAF or the British Air Ministry. The ecstatic comments of the pilots who flew the prototype, however, convinced authorities to sign a contract for six trial aircraft. In the end, a number of Folland Gnat Trainers did serve with the RAF. A superb low-level dogfighter with a high rate of climb, the Gnat was barely half the size and weight of its contemporaries. It was powered by a Bristol Orpheus and was fitted with two 30-mm ADEN cannons. A dozen were delivered to Finland in 1958 but it was in India that the Gnat created the greatest interest. It became the first fighter ever to be built under licence in that developing country.



Italian air force Fiat G.91R.1 (NAM)



U.S. Navy Grumman F11F-1 Tiger (NAM)

The other light fighter design produced in the 1950s was built to meet NATO's first-ever operational requirement. Issued in 1954, this specification was for a rugged and easily maintained light attack fighter that could operate from short runways and prepared grass strips. The new machine was to become standard equipment in NATO air forces. The winning entry was the Fiat G.91, the first Italian-designed jet aircraft to be produced in quantity. It bore a marked resemblance to the F-86K Sabre, hardly surprising given that the American fighter had been built under licence by Fiat. Although heavier and larger than the Gnat, the Italian aircraft was also fitted with a Bristol Orpheus engine. Internal armament consisted of four 12.7-mm Colt-Browning machine guns or two 30-mm DEFA cannons. A delightfully agile aircraft, the G.91 was an early victim of NATO's perennial problem with weapon standardization. Every NATO member agreed with the basic idea. Those with an aircraft industry, however, wanted their own aircraft to be accepted by everybody else. As a result, the G.91 served with the air forces of only three of the fifteen NATO countries. Deliveries to an Italian squadron began in the spring of 1959.

The U.S. Navy was of course highly interested in obtaining a supersonic fighter of its own. The very special requirements of carrier operations, however, made it more difficult for designers to come up with satisfactory designs. In the end, two very different aircraft were adopted for service. Remarkably enough, deliveries to operational units began almost at the same time – March 1957. The first one, the Grumman F11F Tiger, proved relatively short-lived. A nice if somewhat slow and underpowered airplane, it was one of the clearest examples of a then recent development in aerodynamics known as area rule. One of the great engineering achievements in aviation history, area rule was the brainchild of a young American researcher, R. T. Whitcomb. It illustrates the importance of an aircraft's overall shape in minimizing drag in the vicinity of Mach 1. The section of the fuselage where the wing was attached, for example, should be made slimmer, cinched much like an old-fashioned soft drink bottle. In the case of the F11F, the very first fighter to make use of this concept from the outset, the application of area rule resulted in a distinctly wasp-waisted fuselage.



*A U.S. Navy Vought F8U-1 Crusader
(U.S. Army)*

The U.S. Navy's second supersonic gunfighter was the more formidable Vought F8U Crusader. Powered by a Pratt & Whitney J57, which produced fifty percent more thrust than the F11F's Wright J65, the new fighter was a highly innovative design. Its most radical feature was its wing, mounted on pivots in such a way that its leading edge could be raised for takeoff and landing. Even though lift was increased to some degree, the F8U remained a difficult aircraft to land. In the air, however, pilots had nothing but praise for it. Few land-based fighters could win a dogfight against the F8U. Regard for this airplane was such that most of them were rebuilt to prolong their life, even into the 1980s. Both the F11F and the F8U carried four 20-mm Pontiac M39 cannons.



*Royal Navy Supermarine Scimitar
F. Mk.1 (NAM)*

By comparison, the Royal Navy had to make do with the Supermarine Scimitar and the de Havilland Sea Vixen, two thoroughly subsonic designs. The Scimitar was introduced in June 1958. Powerful, tough and popular with its pilots, the Scimitar was the first swept-wing aircraft to serve on a British aircraft carrier and, sadly, the last product of the Supermarine design team. It was armed with four 30-mm ADEN cannons. The Sea Vixen, a swept-wing all-weather fighter, was put in service in July 1959 to complement this day fighter and attack aircraft. Originally developed for a competition won by the Gloster Javelin, the Sea Vixen was the ultimate development of the twin-boom design inaugurated by the Vampire. Fitted with two Rolls-Royce Avon engines comparable to those of the Scimitar, this large two-seater was built without any guns, a first for a British fighter. Instead, its internal armament consisted of two retractable boxes or trays below the fuselage that housed a total of twenty-eight 50.8-mm unguided folding-fin rockets, too small a number to be fully effective. It could also carry far deadlier air-to-air missiles.



*Royal Navy de Havilland
Sea Vixen F.A.W. Mk.1 (NAM)*

The Birth of a New Breed

The story of the air-to-air missile started earlier than one might think. Germany yet again played a vital role in the development of this weapon. The Ruhrstahl X-4 was actually used during the Second World War, against a small number of Allied bombers that accidentally crossed the path of German crews performing test firings. Interestingly, the United States and the USSR showed little interest in pursuing this particular line of research. The American military were nonetheless very interested in air-to-air missiles. They knew that the 69.9-mm “Mighty Mouse” rocket was at best an interim solution to the problem of defending the United States against Soviet nuclear-armed jet bombers.

The country’s main producer of semi-automatic interception and fire-control systems – the Aircraft Division of Hughes Tool – was also deeply involved in this story. It designed the very first air-to-air missile to enter full combat service anywhere in the world. A remarkably small weapon made up largely of glass-reinforced plastic (the first structural use for this then recently-developed material), the Hughes GAR-1 Falcon was carried by older USAF all-weather fighters like the F-89 Scorpion from May 1956 on. Given the level of technology of the time, it was not particularly manoeuvrable, reliable or easy to operate. Two types of guidance systems could be used on this short-range weapon, both of which made use of the energy emanating from their intended target.

In the case of the GAR-1, the first to enter service, the fighter had to keep its radar set locked on the target throughout the attack. The missile then homed on radar waves reflected from the target. This approach was known as semi-active radar homing. The second method, used on the Hughes GAR-2 Falcon, did not require that the fighter remain flying toward the enemy aircraft until the missile hit. It relied entirely on the heat, or infra-red radiation, produced by the engine(s) of the target to guide the missile toward it. This second approach was known as infra-red homing. Weapons of this type tended to detonate very close to the target aircraft’s hot exhaust nozzles, meaning that a warhead lighter than that of a radar-guided missile could be just as effective. As a result, infra-red missiles could be smaller and cheaper. Because they made little demand on the launch aircraft, these weapons could be fitted to a great variety of fighters. Unfortunately, infrared radiation does not travel very far and cannot penetrate rain, cloud or fog. Because of this, and the fact that a potential target could only be attacked from behind, where the engines were, infrared missiles were of little use to all-weather fighters operating in Europe.

The GAR-2 Falcon was not the first infrared missile to go into service, however. This honour belonged to a most remarkable example of American ingenuity, the NOTS AAM-N-7/GAR 8 Sidewinder. This incredibly simple and cheap weapon was created by a small team of U.S. Navy engineers who, because they did not have any real funding, used parts and materials they found, literally, in trash heaps, to complete their testing equipment. The main structure of this missile consisted of little more than an aluminum tube with four fins. Its potential was such that the U.S. Navy had no choice but to order the weapon. Even USAF generals had to admit that the new missile was more reliable than their vaunted radar-guided GAR-1 Falcon. They too ordered it. This version, the Philco-built GAR-8, reached service in 1956, as did the U.S. Navy's AAM-N-7. Both of them could be fitted to virtually any type of jet fighter. Improvements were made over time, and this formidable weapon remained in production right into the 1990s.

The GAR-8 Sidewinder was the first air-to-air missile to be officially used in combat, in the fall of 1958, when F-86 Sabres flown by Nationalist Chinese pilots engaged Communist Chinese MiG-15s and MiG-17s over a period of six weeks and allegedly destroyed twenty seven of them without any losses. This resounding victory would prove costly to the Western alliance, however. As incredible as it may seem, a MiG-17 that had taken part in one of these engagements apparently flew to its base with an unexploded GAR-8 imbedded in its rear fuselage. Soviet engineers could not have been happier. Their copy of the American missile, the K-13, was first seen in public in 1961.

Nineteen fifty six was a particularly auspicious year for missile development. It was in July of that year that the U.S. Navy introduced another trend-setting weapon, the Sperry AAM-N-2 Sparrow I. Considerably larger than the GAR-1 Falcon, this weapon was known as a beam rider because it flew within the radar beam its carrier plane directed at the intended target. To ensure success, the fighter had to keep its radar equipment locked on the enemy aircraft until impact. The missile's size was a result of the rather poor accuracy of its guidance system – a large airframe was needed to carry the heavy warhead deemed necessary to ensure destruction of a target. Specialized all-weather versions of carrier-based fighters like the F3D Skyknight and the F7U Cutlass flew with AAM-N-2s but never fired any in combat. Another development, the Raytheon AAM-N-6 Sparrow III, was a semi-active radar homing missile introduced in 1958. Specifically designed for use against targets that were too far to be seen by the naked eye, it was the most expensive air-to-air missile of its time. The AAM-N-6 Sparrow III proved superior to its predecessor. The F3H Demon was the first airplane fitted with this weapon. All three carrier-based fighters carried up to four Sparrow missiles each. Greatly improved versions of the Sparrow III medium range missile were still being produced almost four decades after the initial delivery.



U.S. Navy McDonnell F3H-2M Demon
(NAM)

Another weapon, far more destructive than any of its contemporaries, should be included in this tally even though it was not really a missile. The Douglas MB-1 Genie was a massive looking unguided rocket fitted with a nuclear warhead. This anti-bomber weapon entered service around 1958. It was detonated by a radio signal emitted by the fire-control system of the carrier plane and its warhead could destroy any aircraft within a radius of more than 300 metres. Given the questionable reliability of most air-to-air missiles of the time and the deadly cargo carried by Soviet jet bombers, the basic concept behind the MB-1 made a great deal of sense, at least as far as the USAF was concerned. Its 1.5 kiloton warhead was later fitted to the Hughes GAR-11 Nuclear Falcon, a still larger version of the original GAR-1 Falcon missile. Unlike the MB-1, the GAR-11 was fitted with a guidance system – in this case a semi active radar seeker.



Royal Air Force Gloster Javelin F.(AW)
Mk.8 (NAM)

Other missile pioneers of the 1950s included France's SNCAN Nord 5103 beam-riding missile as well as the Matra R.511 semi-active radar-homing missile. The Mystère IV, the Super Mystère B2 and the S.O. 4050 Vautour IIN could all be equipped with Nord 5103s. In Great Britain, de Havilland Propellers was the main player in this new field. Its first successful product, the Firestreak, was an interesting weapon. In spite of its complexity, the Firestreak was said to be both more reliable and deadlier than the far better known GAR-8/AAM-N-7 Sidewinder. It entered service in 1958 and was fitted to aircraft like the Royal Navy's Sea Vixen and the RAF's Javelin. Both could carry four missiles.



U.S. Air Force Convair F-102A Delta
Dagger (NAM)

The F-100 Super Sabre was not the only supersonic fighter under development for the USAF in the early 1950s. Preoccupied as they were by the size and power of the Soviet bomber fleet, USAF generals wanted to field a high-performance all-weather fighter as soon as possible. The airplane they received in mid-1956, the Convair F-102 Delta Dagger, was the most advanced aircraft of its type in the world. Few of its contemporaries recorded as many "firsts:" the first supersonic all-weather fighter; the first supersonic delta-wing aircraft to go into production; the first fighter capable of carrying missiles internally; and the first aircraft to be developed as part of an overall weapon system. This new approach was revolutionary indeed. From then on, American combat aircraft would no longer be thought of as mere flying machines filled with equipment bought off the shelf. Weapons systems would include everything that had to do with the aircraft and its mission: airframe and engine, fire-control system and weapons, testing gear and simulators, manuals and teaching aids, even the tools.

Another revolutionary approach pioneered by the F-102 Delta Dagger was the so-called Cook-Craigie plan. Named after its architects, this production method took as a given that an aircraft under development would be made as perfect as possible, which allowed the manufacturer to bypass the prototype stage and use production tooling from the very beginning. Production would start with a small batch of aircraft. When corrections were deemed necessary, the tooling itself would be modified. As the entire factory gradually came on line, production rates would rapidly increase until they reached their peak. This was the theory, but an obvious drawback was that any serious oversight in the design process would result in delays and additional spending as production came to a halt in order to modify the tooling, and the aircraft already built. The Cook-Craigie plan was not for the faint of heart, and engineers at Convair learned this the hard way when they could not get early F-102s to go supersonic in level flight. The program was saved by the first practical application of area rule – engineers modified the shape of its fuselage and greatly reduced overall drag.

Standard armament consisted of six Falcon missiles of various types mounted on swinging arms, each in its individual compartment. Immediately before a missile was to be fired, the doors of its compartment were opened and the arms swung down, moving the missile away from the fuselage. The missile was released, the arms came up and the doors shut tight. The entire process lasted two seconds. Like all other delta wings, that of the F-102 Delta Dagger was based on German technical data seized after the Second World War. A large and somewhat inelegant fighter, it proved surprisingly manoeuvrable and easy to fly in operation. Pilot workload was high but they still liked the airplane and its Pratt & Whitney J57 engine.



Royal Canadian Air Force McDonnell
CF-101B Voodoo (NAM)

Deliveries of a still heavier and bigger fighter began in May 1957. This was the McDonnell F-101 Voodoo, the first USAF production order to be won by the company. Arguably the most powerful fighter in the world at the time, the F-101 was also one of the safest, reliable and long-lasting. Although early aircraft served as single-seat fighter-bombers, the most important version was the two-seat F-101B all-weather fighter, introduced in 1959. Aircraft of this type defended Canada's skies for two decades, starting in late 1961. They carried no internal guns, only missiles. Three Falcons of various types were carried on the inner side of a rotary door below the fuselage. A pair of MB-1 Genies could be mounted on the outside. Like most USAF fighters of the period, the early fighter-bomber versions were armed with four 20-mm Pontiac M39 cannons. Every version of the F-101 was powered by two Pratt & Whitney J57 engines.



*U.S. Air Force Lockheed
F-104C Starfighter (U.S. Air Force)*

Toward the end of the decade, a new breed of fighter plane appeared on the world scene, introducing a whole new level of performance. They were the so-called Mach 2 fighters. The first off the mark was the Lockheed F-104 Starfighter, one of the most radical and spectacular fighter planes ever developed. It was created by Kelly Johnson in response to complaints by Korean War pilots that the aircraft they used in combat could not climb fast enough or high enough and were too slow. Lockheed's answer was a pure interceptor with minimal electronics and tremendous acceleration, speed and rate of climb. From the beginning, however, it was an airplane that was not easy to fly. The F-104 was the first production aircraft to be powered by one of the most widely used jet engines in history, the highly-reliable General Electric J79 turbojet. A squadron received its first machine in January 1958.

The F-104 would be known by many names besides Starfighter. The "missile with a man in it" was one of the most dramatic, and it gave a good indication of the aircraft's appearance – a beautifully streamlined fuselage sporting a pair of absurdly small wings. As designed, the F-104 carried two GAR-8 Sidewinders on the wingtips. It was also the first aircraft to be armed with a revolutionary weapon – General Electric's recently-perfected multi-barrel cannon, the 20-mm M61 Vulcan. Frequently described as being a distant relative of the hand crank operated machine gun patented in 1862 by R. J. Gatling, the M61 had six barrels that rotated as a unit. Using many barrels made it possible to break the weapon's firing cycle into separate phases, significantly accelerating the rate of fire. Whereas the Pontiac M39 could fire 1600 rounds per minute, the M61's standard rate of fire was a dazzling 100 rounds per second (or 6000 rounds per minute). It remains the standard aircraft cannon for both USAF and U.S. Navy fighters.

Of limited value as an interceptor because of its limited electronics, the F-104 Starfighter would have been abandoned had Lockheed not re-engineered the aircraft as a fighter-bomber. The new F-104G "Super Starfighter" was a resounding export success. Germany was the launch customer. An initial batch of F-104Gs was declared operational in June 1962. Canadair produced almost four hundred CF-104s and F-104Gs for both the RCAF and NATO countries. A much heavier machine, the F-104G was flown fast at low level to provide its pilots with realistic training. It was very stable, responsive and safe when flown strictly by the book. The F-104G was one of the mainstays of NATO air forces throughout the 1960s and 1970s.



*U.S. Air Force Republic
F-105D Thunderchief (NAM)*

It was in May 1958 that a USAF squadron took delivery of its first Republic F-105 Thunderchief. Although designated as a fighter, it had not been designed for air combat. Immensely popular with its pilots because of its toughness, the F-105 was supremely fast at low level. It could carry bomb loads equivalent, if not superior, to those of a Second World War heavy bomber. A few bombs could be carried internally, and it also had an M61 Vulcan cannon. The F-105 was originally developed as a private venture, and was fitted with the powerful and highly successful Pratt & Whitney J75 turbojet, civilian models of which flew in long-range versions of the Boeing 707 and Douglas DC-8 airliners. This formidable fighter bomber, the heaviest single-seat aircraft of its era, was rightly nicknamed the "one man air force." It served with great distinction during the Vietnam War.



*U.S. Air Force Convair
F-106A Delta Dart (U.S. Air Force)*

A lesser known yet more long lasting machine entered service in the USAF in mid-1959. Known as the Convair F-106 Delta Dart, it was designed to intercept high performance Soviet bombers and as such represented the ultimate expression of the engineers' art in the specialized field of bomber interception. Sadly enough, the F-106 came into the world at the worst possible time. On 4 October 1957, the Soviet Union launched Sputnik, the world's first artificial satellite. In doing so, the Soviets proved that they had a rocket powerful enough to lob nuclear warheads across thousands of kilometres. The world was shocked. North American cities could be destroyed almost without warning. A new weapon had made its appearance, the intercontinental ballistic missile or ICBM. The American military, although deeply concerned, was not exactly caught unprepared. Indeed, its first ICBM, the USAF's Convair SM-65 Atlas, went into service in September 1959. Nonetheless, Soviet declarations and detailed estimates prepared by the Central Intelligence Agency (CIA) as well as the USAF seemed to indicate that the United States could soon be confronted by a massive Soviet missile force that could not be intercepted by any available weapon. American missile production plans might not be sufficient. A new expression was coined to reflect this – the missile gap. Money would have to be found, or reallocated, to build up the country's missile force.

In addition, American defence analysts had gradually come to the conclusion that the Soviet Union did not have as many long-range bombers as was believed only a few years before. An advanced reconnaissance airplane, the Lockheed U-2, had begun to fly over Soviet territory in July 1956 at extremely high altitude, beyond the reach of all interceptors. The photos it took were incredibly valuable to American intelligence officers – they could literally count the number of bombers on the taxiways. Earlier in the decade, USAF and CIA estimates had shown that the United States needed to keep on building increasingly faster and more expensive all-weather fighters to counter an ever-growing Soviet bomber fleet. There was a “bomber gap,” or so it was thought. The photos taken by the U-2 changed all that. Analysed in conjunction with the new information on Soviet missile production, they suggested that money spent on all-weather fighters designed to protect North America could be safely diverted toward missile production.

This, of course, was bad news for the F-106 Delta Dart. Back in 1957, the USAF had planned to order a thousand of these fighters. By September 1958, two thirds of these orders had been cancelled and an improved version was never built. The aircraft that were delivered proved surprisingly agile given their size. Their single Pratt & Whitney J75 turbojet gave them plenty of power and they were well armed with missiles mounted in an internal bay. A typical load consisted of a single MB-1 Genie and four Hughes GAR-3 or GAR-4 Super Falcons, improved versions of the original weapon respectively fitted with a semi-active radar or infra-red guidance system. Its Hughes MA-1 automatic interception and fire-control system was capable of flying an entire mission, from takeoff to landing, without any pilot intervention. In more ways than one, the F-106 was the best of its kind to see service anywhere in the world. It was also the last American all-weather fighter specifically designed to intercept Soviet bombers. Although refurbished over the years, its complex avionics gave its pilots the heaviest workload in the USAF. Their feelings toward the aircraft were in no way diminished. The F-106 remained in service until the late 1980s.

The F-106 Delta Dart was not the only all-weather fighter under development in 1957–1958 for the USAF. It had already flown, however, and delivery was expected to begin fairly quickly. Its more advanced successors were not so lucky. The Republic F-103, for example, was undoubtedly the most exotic-looking fighter plane of the 1950s. This huge airplane built of heat-resistant titanium and stainless steel was designed to reach Mach 4, an incredible 70 kilometres per minute, at very high altitude. However, it was cancelled in August 1957, before construction of a prototype had actually started. The North American F-108 Rapier suffered a similar fate in September 1959. This Mach 3 aircraft was both larger and heavier than any other fighter plane of that era. It incorporated many ideas developed for an equally fast and advanced aircraft, the North American B-70 Valkyrie long-range bomber, which also fell victim to the changing times. Changing requirements played as great a role in the cancellation, in December 1958, of the most spectacular carrier-based fighter of the 1950s. The Vought F8U-3 Crusader III had little in common with its predecessor. More powerful and armed only with missiles, it was a formidable dog-fighter. Unfortunately, it came into being as the U.S. Navy set out to obtain larger and more versatile fighter planes.



*The first Avro CF-105 Arrow Mk. 1
(NAM)*

These circumstances also had a major impact in Canada. Earlier in the decade, the RCAF had issued a very demanding specification for a two-seat supersonic all-weather fighter capable of intercepting Soviet supersonic bombers coming over the North Pole. Avro Canada submitted a number of proposals, one of which was accepted. It led to the most advanced aircraft ever developed in Canada, the Avro CF-105 Arrow. A massive delta-winged aircraft, the production version, or Arrow Mk 2, was to be powered by a pair of engines developed by an Avro Canada subsidiary. This turbojet, the Orenda Iroquois, was one of the most powerful and advanced in the world. Intent on obtaining the best performance possible, the RCAF also financed the development of an extremely advanced interception and fire control system, the RCA-Victor Astra. The same need explained the military's choice of primary weapon. The Douglas AAM-N-3 Sparrow II was probably the world's first active radar homing air-to-air missile. Equipped with its own miniature radar set, which in itself was quite an achievement given the level of technology at the time, the AAM-N-3 homed in on the radar waves reflected by its intended target. Even though it worked reasonably well, this advanced weapon was cancelled in 1956 by the U.S. Navy, without any prior warning. Understandably concerned, the RCAF decided to pursue development of the weapon.

Thus, Canada found itself responsible for the financing of the Arrow's airframe, engines, avionics and weaponry. This was a far cry from the original idea, which was to put foreign-designed yet licence-made components in an airframe designed in Canada. Not surprisingly, overall costs of the program soared. The first Arrow was unveiled on 4 October 1957, during a grandiose ceremony. Fate, unfortunately, chose that moment to intervene. Sputnik, which had been launched that same day, grabbed the headlines. The Arrow eventually flew on 25 March 1958. By September of that year, a newly-elected Progressive Conservative government cancelled the Sparrow II missile and the Astra interception and fire control system. These were to be replaced by Falcon missiles and the MA-1 system, which were used on the F-106 Delta Dart. Both were produced in the United States by the Aircraft Division of Hughes Tool. At the same time, the government announced it would review the entire project. A decision was to be made public in March 1959.

On 20 February 1959, the Prime Minister announced the cancellation of the Arrow program. In shock, and proclaiming that it had no other work to offer to its employees, the management of Avro Canada fired approximately 14 000 people within hours of the announcement. The government found itself in the middle of a political hurricane. The Liberal opposition did not attack the cancellation itself, but it did criticize the manner in which the Arrow program had been cancelled. The five aircraft that were flying were destroyed later that year. The sixth airframe, fitted with the Canadian-designed Iroquois engines, was about to fly, and it too was reduced to scrap. More than forty years after the fact, many Canadians still lament the passing of the Arrow. Even though it did not kill the Canadian aircraft industry, the cancellation of the Arrow certainly led to a massive refocussing of its activities. No longer striving for independence, Canada signed the Defence Production Sharing Arrangements and formed a partnership with the American defence industry.

As the 1950s drew to a close, a number of fighters were about to enter service. Unlike many of their predecessors, the new aircraft each had an on-board radar set. Indeed, fighter aircraft limited to daytime operations were on their way to extinction, or would survive mainly as light fighters. Even though the service history of the new single-seat Mach 2 fighters actually belongs with the 1960s, they deserve mention. After all, these aircraft resulted from the technology of the 1950s, when top fighter speed more than doubled and individual engine power was multiplied by a factor of three.

The Soviet Union had its Sukhoi Su-9 and Mikoyan-Gurevich MiG-21 delta-wing fighters. Deliveries began in early 1959 and in 1960. The Su-9 rapidly passed into obscurity, but the MiG-21 turned out to be one of the greatest successes of the Soviet aircraft industry. A small and relatively simple aircraft, it was very agile if somewhat short-ranged. The Swedes came in second. The first SAAB J 35 Draken was delivered to a squadron in March 1960. Although early aircraft only attained Mach 1.5, later versions could easily reach Mach 2. Fitted with a so-called double-delta wing, the J 35 was a true pilot's airplane and a formidable opponent. The awkward-looking English Electric Lightning entered service in July 1960. It was the first combat aircraft capable of exceeding the speed of sound without afterburners, and incorporated a number of unusual features. The Lightning had a superb rate of climb. The French entry was more conventional and elegant, although slightly underpowered. The delta winged Dassault Mirage III, introduced in July 1961, was probably France's greatest single export success of the postwar era. An even more famous warplane went into service in December 1960 – the U.S. Navy's McDonnell F4H Phantom II. Unattractive and angular, this twin-engine two-seater is undoubtedly one of the greatest combat aircraft of all time. It was also big, powerful, adaptable, reliable and tough.

The 1950s saw tremendous improvements in fighter aircraft performances. Many ideas developed during these years were put to the test in the 1960s in places like the Indian subcontinent, the Middle East and, especially, Vietnam.