A 21-year-old RAF pilot and a German graduate student got the whole thing going 70 years ago.

The Jet Generations

By Bruce D. Callander

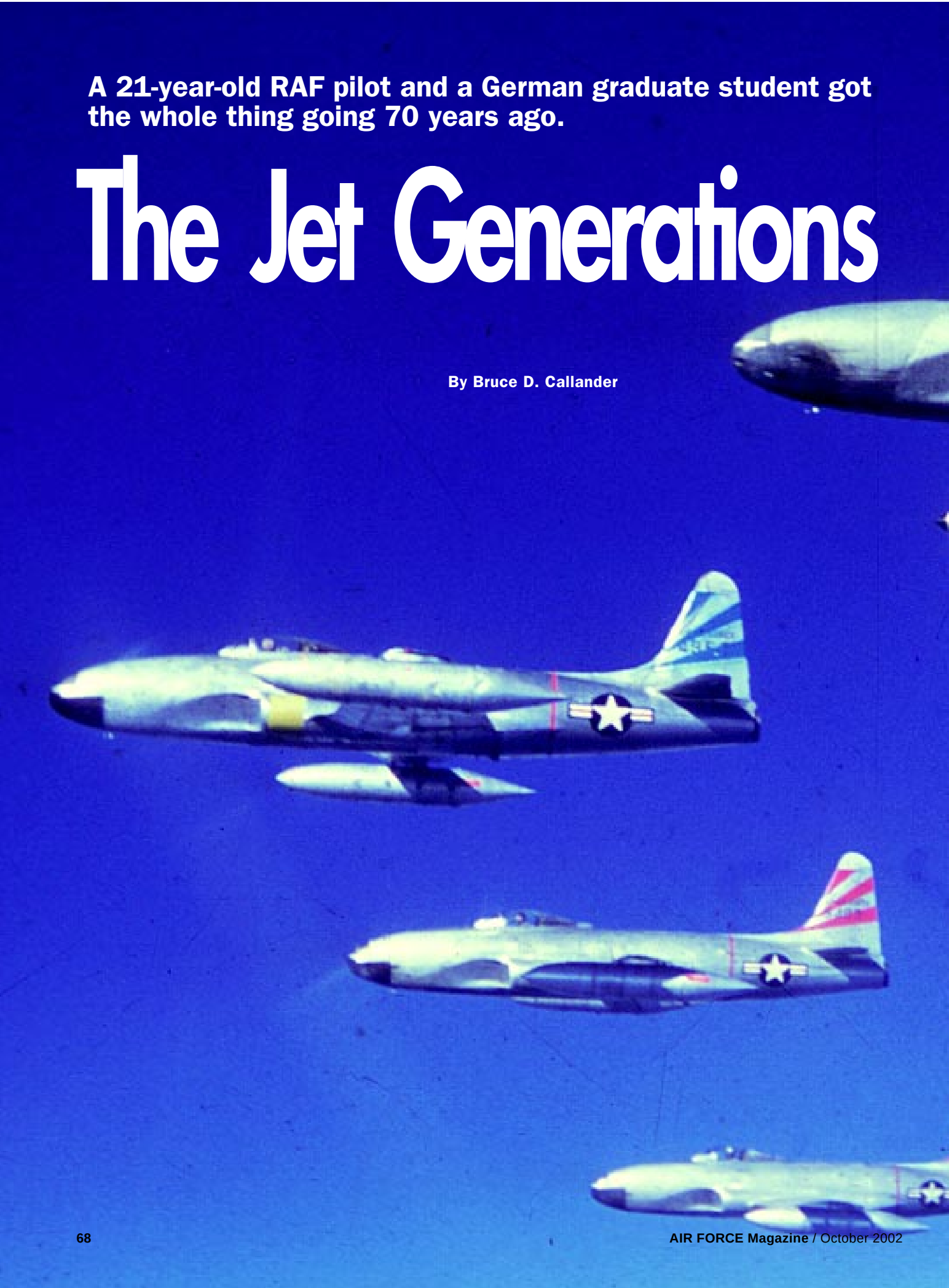


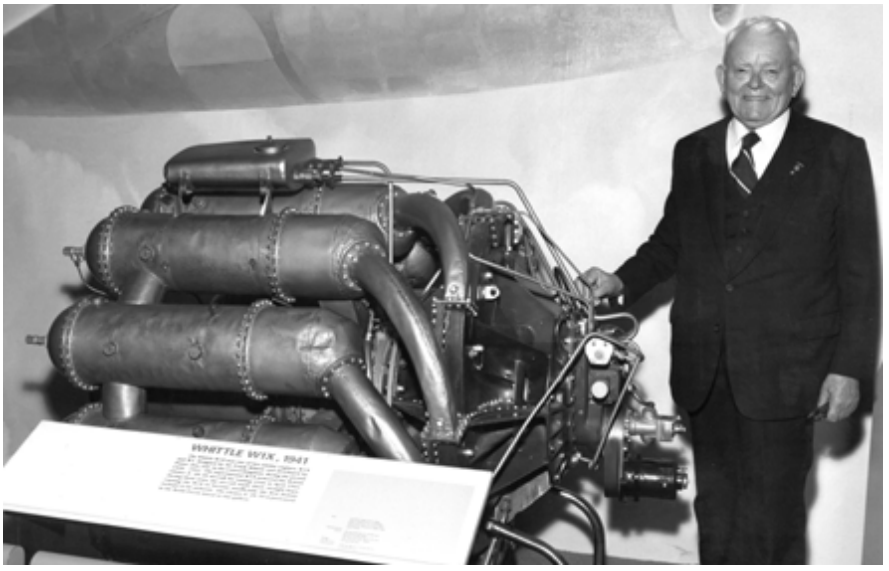
Photo by Russ Rogers via Warren Thompson

IN the last months of World War II, Allied bombers were jumped by German interceptors that had no propellers but could outrun any conventional fighter. In the Pacific, the Japanese sent piloted glide bombs against ships and aircraft, their suicide dives boosted by rocket or turbojet engines. The Axis was losing the war but was still able to inflict damage.

These desperation weapons arrived too late to have any substantial impact on the outcome of the war, but they foreshadowed a postwar transformation in military technology as dramatic in its way as the invention of the flying machine itself. Within a decade, the propeller-driven fighters of the major powers would become virtually obsolete, their successors powered by "reaction engines."

At the time of the Wright brothers' first flight in 1903, a relatively light internal combustion engine was available. For the next three decades, pis-

A four-ship of F-80 fighters. The Shooting Star was the nation's first combat jet fighter.



Frank Whittle stands next to the engine he designed, designated Whittle W1X, on display in the jet gallery at the National Air and Space Museum in Washington, D.C.

ton engines turned propellers that pushed or pulled aircraft through the sky, and the search for other power sources was largely forgotten.

Improved designs and more powerful engines increased performance, but it was apparent as early as the 1920s that propeller-driven aircraft would be limited, particularly in the speeds they could attain.

The solution, many designers agreed, was some form of reaction engine. There were several possibilities but all had limitations. Rocket power, already effective in unmanned weapons, burned fuel quickly and promised only limited range. The "ram" principle was almost as simple, relying on air rushing into the engine, where it would mix with fuel and be ignited to produce a rush of hot gases. However, before the ramjet would kick in, the airplane had to be in motion.

Dawn of the Turbojet

The third, and most promising, option was the turbojet, able to draw air in, compress it, mix it with fuel, and ignite it in one continuous operation. The expelled gases would both propel the aircraft and run a turbine, which turned the compressor blades. Steam turbines already were used in ships and had been tried in early automobiles. The problem was to make one strong enough to stand up to the heat and vibration they would encounter in a fuel-burning engine.

In the 1930s, two men in different countries tackled the problem.

Frank Whittle, in pilot training at the Royal Air Force College from 1926 through 1928, wrote his final thesis on the principle of jet propulsion. Two years later, in 1930, he applied for a patent on a reaction engine for aircraft. The Air Ministry showed little interest, but in 1934, the RAF sent Whittle to Cambridge University for an engineering degree. There, he was encouraged to continue his work, and before he graduated in June 1936, Whittle and some friends formed a company to produce a test model.

Meanwhile, Hans von Ohain was working on his Ph.D. in physics and aerodynamics in Germany when he conceived a similar engine. He developed his idea, built a working model, and in 1934, applied for his patent.

Two years later von Ohain was working for the Heinkel Works, where he developed a turbojet that the firm installed in a specially designed He-178. It flew for the first time in August 1939, five days before Germany invaded Poland and touched off World War II.

That same year, the British Air Ministry gave Whittle's company a contract to develop a flight engine and picked the Gloster Aircraft Co. to build an airplane to use it.

However, Britain was straining to produce conventional defense aircraft, so it was slow to exploit the new technology. It was March 1943 before the prototype Gloster Meteor made its first flight. Sixteen of the fighters eventually were delivered to the RAF. The first saw combat in August 1944, when their pilots downed two V-1 rockets over southern England.

By then, Germany already was fielding its jet fighters in numbers. In early 1940, the German Air Ministry had given two aircraft companies—Heinkel and Messerschmitt—contracts to produce test aircraft. Heinkel took an early lead; unfortunately its airplane was plagued by engine failures. Although Messerschmitt got a slow start, the Me-262 made its first flight in July 1942 and won the competition.

Development problems and the demands of the war delayed the project, but in late 1943, Germany approved the 262 for mass production. More than 1,400 were built; however, fewer than one-fourth reached combat. Many were grounded for lack of fuel and qualified pilots or were destroyed by Allied bombs.

Bizarre Proposals

Late in the war, the Germans became more desperate and the proposals more bizarre. Several manned rocket projects were launched, including one for a fighter able to take off vertically. Another designer suggested a manned flying bomb. It was an outgrowth of the V-2 rocket program and was to be designed to reach the US, where the pilot would eject and, with luck, become a prisoner of war. Most such ideas never got beyond the thinking stages.

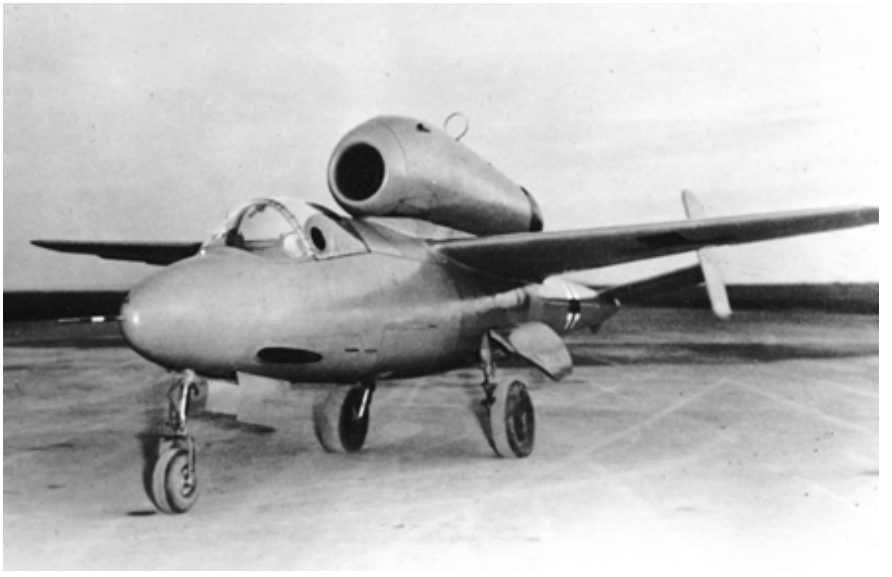
One that did progress was the "Volksjaeger" (People's Fighter). The Reich War Ministry invited bids on a cheap, stripped-down jet that could be built with noncritical materials and by unskilled labor. Heinkel won the job and by January 1945 was producing the He-162.

Critically short of experienced pilots, Air Minister Hermann Goering proposed to train members of the Hitlerjugend (Hitler Youth) in gliders, transition them to the jet fighters, and send them into combat. Like the airplanes, the young pilots would be expendable.

Fortunately for the Hitler Youth, the war ended before they could take on what would have been suicide missions for most. In Japan, how-

ever, thousands of minimally trained pilots were dispatched with no hope of survival. Most kamikaze pilots flew conventional aircraft loaded with explosives, while some versions of the Yokosuka Cherry Blossom piloted glide bomb had jet engines.

The Axis powers also experimented with rocket-powered aircraft. One of the most promising was the Me-163 interceptor, which actually made it into combat. Called the Komet, it could reach speeds of almost 600 mph; it carried fuel for only about 10 minutes of powered flight and had a tendency to explode. The Japanese copied the airplane for their Mitsubishi Shusui, but its engine failed on its initial flight test and the project was abandoned.



Late in the war, Germany grew desperate to turn the tide against the Allies. One proposal was the He-162 Salamander, a flimsy lightweight jet aircraft built partially out of plywood and intended to be expendable.

A Slow Start in the US

The United States did not field a jet in combat during the war—not for lack of trying. Three months before Pearl Harbor, Lt. Gen. H.H. "Hap" Arnold, Chief of the Army Air Forces, asked Lawrence Bell to work on a fighter using a Whittle–type engine.

By the following spring, Bell Aircraft had designed a single-seat airplane powered by two turbojets built by General Electric under British license. The first XP-59 was shipped to Muroc Army Air Base in California, where it flew on Oct. 1, 1942. Called the Airacomet, it offered little advantage over conventional fighters, and the few that were produced served mainly as test beds or trainers.

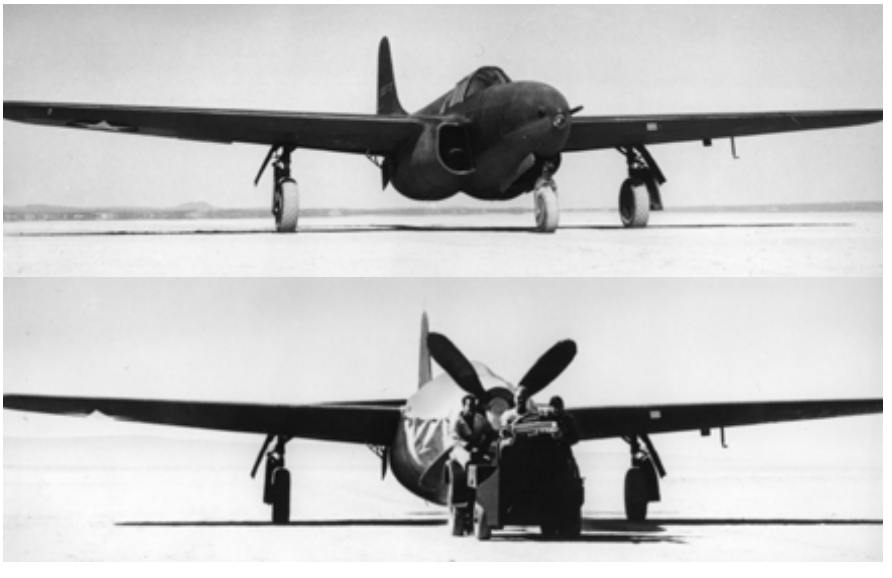
The second US entry, the prototype of Lockheed's P-80, designed around a de Havilland engine, was completed within 143 days and flown at Muroc on Jan. 8, 1944. It went through several evaluations including a change to GE engines, and by 1944, the AAF had ordered several thousand production models. A few P-80s made it to Europe but too late to see combat.

Other companies were also in the running. Republic developed the P-84 Thunderjet, planned as a successor to its P-47. North American was working on the P-86 Sabre, an AAF version of a jet it was developing for the Navy. Neither airplane flew until after the war.

If Germany had been able to send hundreds of Me-262s into combat when it was losing the war and struggling to produce anything, why had the Americans been so far behind?

For one thing, the two countries had different priorities. What the US needed, particularly early in the war, was fighters able to escort bombers on long missions. With drop tanks, some P-51s had a range of up to 2,000 miles, well beyond that of any proposed jet fighter. By the time the Me-262 emerged, however, the Allies had shifted the war to Germany, which then needed to produce last-ditch, home-defense weapons.

The US also was absorbed in quantity production, in improving the aircraft already in hand, and in training skilled aircrews. After the initial shock of meeting the German Me-262 in combat, Allied bomber crews and fighter pilots found they could destroy many of them even with conventional aircraft.



Progress in US jet engine development during the early 1940s was a closely held secret. At Muroc AAB, Calif., Bell Aircraft employees fitted a mock propeller to the XP-59 to confound curiosity seekers.

To the Victors

Germany's highly touted secret weapons did not change the outcome of the war; however, its new technologies helped shape the future forces of the victors.

As the fighting wound down, Allied forces moved in to recover what was left of the enemy hardware and to pick the brains of the men who had designed it. A US technical intelli-

gence team went to southern Germany to an airfield with surviving Me-262s and flew them out for study.

Shortly after the war, von Ohain, who had developed Germany's first turbojet, came to Wright–Patterson AFB, Ohio, eventually becoming chief scientist of the Aero Propulsion Laboratory there.

The Soviets also captured German jet aircraft in various stages of development. Although they had yet to develop an effective engine, they were able to buy a Rolls-Royce Nene from the United Kingdom and copy it.

With these assets in hand, Moscow called for an interceptor able to reach Mach .9 and stay aloft for more than an hour. Veteran designers Artem I. Mikoyan and Mikhail I. Gurevich answered with what became the MiG-15, which entered service in 1949. It had some characteristics of the German jets but was a major improvement over them.

One of the most important lessons the winners learned from the losers, however, did not involve engine expertise but aircraft design. The most successful German airplanes, including the Me-262, had swept wings while all the early Allied designs called for straight wings. When research data showed the speed advantages of the German airplanes, the Allied designers took notice.

North American was among the first to capitalize on the information. They redesigned the P-86 with swept wings—which cost the firm a year's delay—increasing its performance dramatically. Republic later adopted the swept-wing approach for its F-84F. The Soviets already had incorporated it in their MiG-15.

Photo by John Harris via Warren Thompson

The Whittle engine was installed on the Gloster Meteor, the first Royal Air Force jet aircraft. Sixteen Meteors were delivered to RAF late in World War II. The first saw combat in August 1944.

The First Jet Fighter War

No opposing jet forces met during World War II, but five years later, North Korea invaded South Korea and set the stage for the first encounter of unconventional aircraft. USAF units flying with Lockheed Shooting Stars (designated F-80) were the first to engage.

Initially, parts shortages and maintenance problems plagued the F-80s, and some units replaced them with older F-51 Mustangs. The problems were worked out, however, and the Shooting Stars returned in force.

On Nov. 8, 1950, 1st Lt. Russell J. Brown was flying an F-80 when he shot down a MiG-15. Brown's victory was a rare one. The MiG usually won against the straight-wing F-80s.

The arrival of the F-86 Sabre in Korea in late 1950 evened the odds. North American's decision to delay production to accommodate swept wings had paid off. The Sabres went into service almost immediately, and on Dec. 17, pilots of the 4th Fighter–Interceptor Wing destroyed several MiGs in quick succession.

Both airplanes had advantages. The MiG could fly higher and reach higher speeds at those altitudes. The F-86 was faster at lower levels and stood up better to high-speed maneuvers. By the end of the war, the Sabres claimed a 10-to-one kill rate. Since the airplanes were about evenly matched, officials credited the superior training and experience of US pilots for much of their success.

The F-80, in a two-seat trainer version dubbed T-33, became the standard jet trainer for generations of new pilots. Lockheed produced more than 5,600 T-33s.

Photo by Frank Harrison via Warren Thompson

In 1953, a North Korean pilot defected with a swept-wing MiG-15, here seen at Eglin AFB, Fla., where it underwent USAF testing. A USAF pilot flying an F-80 shot down a MiG-15 in 1950 in a rare victory for the straight-wing F-80.

Early Jet Bombers

The evolution of jet bombers—slower than that of the fighters—also began early in World War II.

Work on the most successful one, the German Arado 234, began in 1940. As with the Me-262, development was slowed by want of a suitable engine. The first version had twin turbojets and was used largely for reconnaissance. A later C model had four engines and was intended as a high-speed bomber. It flew in September 1944 but only a few entered service before the war ended.

Germany had a more radical bomber in the works that never got beyond the test stage. The first prototype of the Junkers Ju-287, which used the fuselage of an He-177 and parts from other airplanes, had forward-swept wings. This V-1 model flew several times in 1944. It had four turbojet engines and, like the Arado, used rockets to assist takeoff.

A second version was nearly ready when the Allies overran the construction site. That German bomber was completed by the Soviets and tested in 1947. A third model with six engines never got beyond the design stage. It was intended to fly at more than 500 mph and carry some 8,800 pounds of bombs.

American wartime efforts in the jet bomber field were more limited. By the time reaction-engine technology reached the practical stage, the US already was producing conventional bombers able to reach any point in Europe, and the B-29 was putting Pacific targets within range.

However, US manufacturers were looking for ways to introduce the new technology into existing designs. In 1943, Douglas had proposed a radical light bomber with twin engines powering contrarotating propellers in the tail. Dubbed the "Mixmaster," it flew with conventional engines the next year. The war ended before the airplane could go into production. By then, Douglas was working on another version—the XB-43 with turbojets for power. It flew in May 1946; however, the Air Force decided to go instead for a four-engine bomber.

Northrop's plan for a flying wing followed a similar route. Proposed in 1941 as a long-range, propeller-driven heavy bomber, the XB-35 suffered many development problems and was reduced to a test program. After the war, however, the firm fitted the wing with jets. This project also fizzled out, although the concept reappeared eventually in the development of USAF's B-2 stealth bomber.

The medium-range B-47—the world's first swept-wing bomber—was developed about the same time as the long-range B-52. The design of the six-engine B-47 was so advanced that some called it futuristic.

North America's B-45 Tornado, the US's first operational jet bomber, was more successful. Its conventional fuselage and wings were like those of the firm's durable B-25, but wing-mounted engines gave it almost twice the speed. Three prototypes were ordered in 1945 and the first flew in 1947. Production models deployed overseas suffered a variety of mechanical problems and had a short career.

By the Korean War, the Air Force still was looking for an effective medium jet bomber to replace its aging B-26s. The B-45 lacked maneuverability at low altitudes. When other US contenders also fell short, USAF turned to the British Canberra, a twin-engine airplane conceived by English Electric in the last months of World War II and which was then in production. The British firm couldn't supply both the RAF and USAF, so it licensed the Martin Co. in the US to build it as the B-57.

Martin made a number of changes, including substituting US–built engines and adding rotating bomb bay doors. The B-57 went into service in 1954. Too late for the Korean War, it flew long enough to see action in Vietnam. (Britain also sold the Canberra to other countries, including Argentina, which used them against RAF aircraft during the 1982 Falklands War.)

America's first heavy jet bomber evolved more slowly. In 1943, Army Air Forces asked builders to think about a long-range bomber using the new turbojet technology. Boeing proposed a straight-wing model similar to the B-29 but, after studying German research, opted for a swept-wing airplane with six engines.

When AAF called for an even bigger long-range jet, Boeing again entered the race with an eight-engine giant in the same general configuration. In parallel developments, the firm developed the medium-range B-47, which first flew in 1947, and the long-range B-52, first flown in 1952.

Later generations of bombers and fighters followed. Today's warplanes can outrace the speed of sound, skim the treetops, reach altitudes undreamed of in World War II, and make themselves virtually invisible to enemy defenses. Still, even these owe their existence in large part to technology conceived more than half a century ago by a 21-year-old RAF pilot and a slightly older German graduate student. ■

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