The legendary designer was obsessed with "the perfect airplane," but fate intervened.

The Low-Drag Worl

IN the course of a long and illustrious career, the legendary Jack Northrop created a series of outstanding aircraft that ranged from a tiny wooden biplane to gigantic flying wings which were, in some ways, 40 years ahead of their time.

Friendly and self-effacing, but possessed of an iron will when it came to engineering, Northrop always attributed his many achievements to the talent and drive of his co-workers. For all that, Northrop was personally at the leading edge of three distinct revolutions in aviation technology.

The first was brought about by his series of sleek wooden monoplanes that became the chosen mounts for famous explorers and record-setters such as Amelia Earhart, Wiley Post, Charles Lindbergh, and Roscoe Turner, to name a few.

Next, Northrop roiled the aviation industry with a succession of swift silver aircraft featuring his innovative all-metal stressed skin construction techniques. Using a low wing, huge bell cowling, and tightly streamlined "trousered" landing gear, the "civil Northrops" outperformed most of the first-line military fighters of the day. They were quickly adopted by aerial adventurers and widely used by airlines around the world.

There followed a host of military variants, one of which—the Douglas SBD Dauntless—proved to be a decisive weapon in the Battle of Midway. The hand of Northrop could be seen in even more-advanced designs such as the famed P-61 Black Widow, the trimotor C-125 Raider, and the F-89 Scorpion interceptor.

His turbojet-powered SM-62 Snark of 1953 was one of the first intercontinental missiles ever seen. It featured inertial navigation moderated by stellar navigation.

Perfect

Jack Northrop's third revolution stemmed from his virtual obsession with creating a "perfect airplane," a flying wing that would eliminate the weight and drag of a conventional fuselage and empennage. After 20 years of effort, Northrop seemed to have reached his goal with the huge XB-35 bomber and its jet variants. Then fate stepped in, either in the form of technology or, as some say, government subversion, and Northrop saw his flying wing dreams collapse in a heap of canceled contracts.

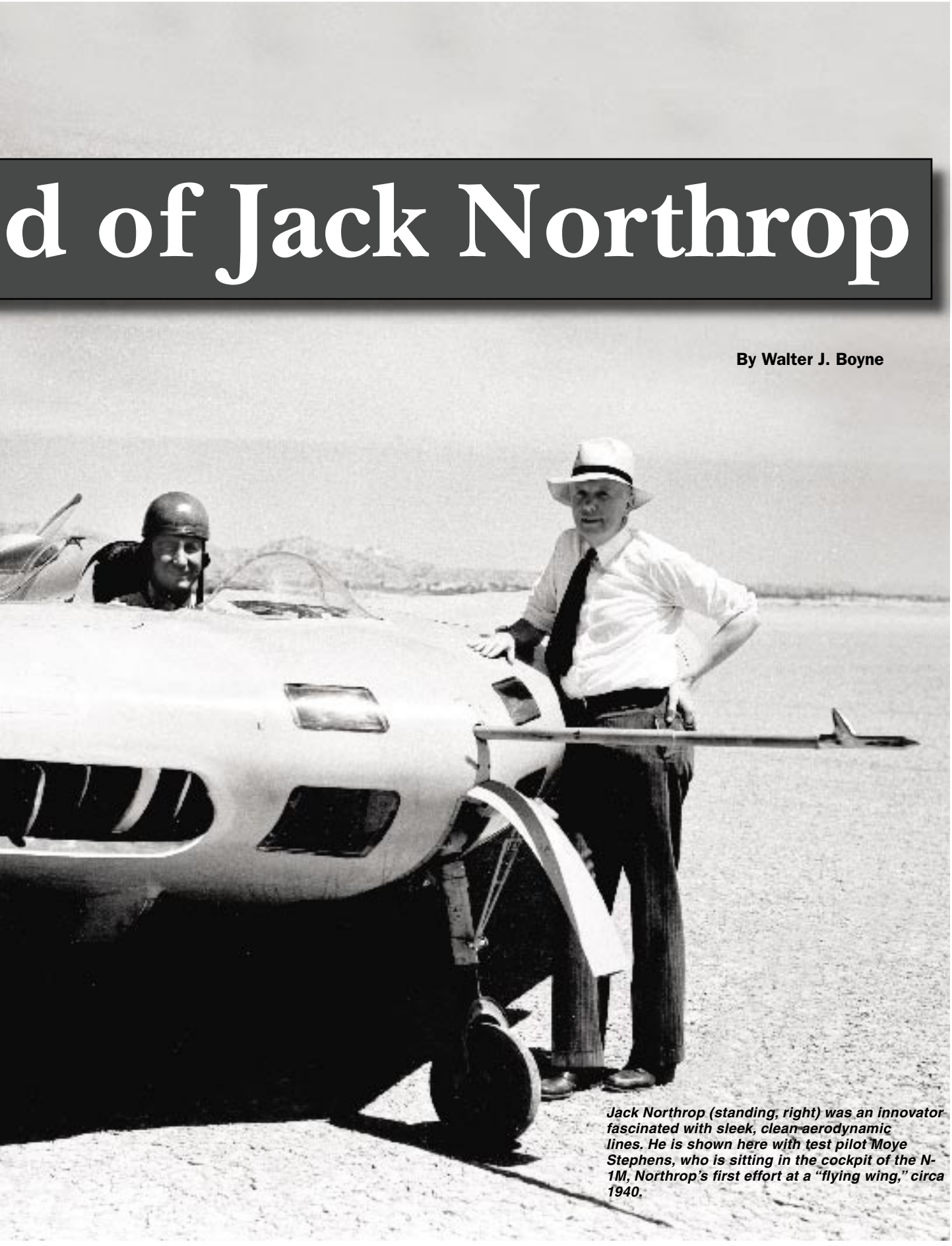
John Knudsen Northrop was born in Newark, N.J., on Nov. 10, 1895. Charles and Helen, his parents, moved the family west in stages, ultimately settling in Santa Barbara, Calif. From 1906 through 1923, Charles Northrop operated a small construction business, building and remodeling homes.

Young Jack Northrop became interested in aviation in his early teens when he witnessed Didier Masson, who modestly termed himself "the world's greatest aviator," flying over Los Angeles.

Northrop inherited his father's mechanical skills. After graduation from high school, he put them to use, working on automobiles in a garage owned by a local named William Rust. He next accepted a position in an architect's office, where he performed minor designing and learned the fundamentals

d of Jack Northrop

By Walter J. Boyne



Photos via Walter J. Boyne

Jack Northrop (standing, right) was an innovator fascinated with sleek, clean aerodynamic lines. He is shown here with test pilot Moye Stephens, who is sitting in the cockpit of the N-1M, Northrop's first effort at a "flying wing," circa 1940.

Northrop was a seminal figure in aviation, pioneering advancements at both Lockheed and Douglas before striking out with his own company, which today is among the top three defense contractors.

of stress analysis. This was an unusual accomplishment for the time, one that would soon prove to be invaluable.

In 1916, two brothers, Allan and Malcolm Loughead, came to Santa Barbara and set up shop in a part of Rust's garage. The two brothers—who later changed the spelling of their surname to Lockheed—soon encountered the 20-year-old Northrop and hired him as an engineer and draftsman. He was put to work on a new biplane called the F-1.

The F-1 was a twin-engine, 10-passenger flying boat. Northrop designed its 74-foot-wide wings and aided in the design of its hull and empennage. Then he did all the three-view and detail drawings and took part in construction.

Not long afterward, however, Northrop was drafted into the Army as an infantryman. Someone noted his aviation experience and transferred him to the Signal Corps, which was the focus of Army aviation at the time. The Loughead brothers, however, made a plea for his return; after six months, the request was honored. Jack Northrop returned to Santa Barbara to conduct an analysis of Curtiss flying boats. In moving from the Army to the aviation industry, his annual pay jumped sevenfold, from $252 to $1,800.

After World War I ended in 1918, the firm turned to the civilian market, and Northrop designed the Loughead S-1, a tiny sports biplane featuring a strong streamlined fuselage of molded plywood. Northrop, factory manager Anthony Stadlman, and Loughead jointly patented a new method of fuselage construction. Three layers of casein-soaked plywood strips were placed in a concrete mold of the fuselage's desired size and shape. The glue's grip was strengthened by a custom-shaped inflatable rubber bag that pressed the layered strips against the mold, eliminating air bubbles and creating a light, strong structure when cured.

The S-1 was a delight to fly, but could not compete in a market saturated with dirt-cheap war-surplus Curtiss Jennys. The Lougheads closed their factory in 1920. Malcolm went to Detroit, where he founded the Lockheed Hydraulic Brake Co. and soon became a millionaire. Allan acted as his West Coast agent and sold real estate.

Enter Donald Douglas

Jack Northrop returned to work for his father, but not for long. In 1923, Northrop was picked up and hired by Donald W. Douglas in what would prove to be a complex relationship. His first job was to design the fuel tanks for the Douglas World Cruiser.

Moonlighting for Ryan Airlines in San Diego with Douglas chief draftsman Art Mankey, he redesigned the wing of the Ryan M-1, the direct antecedent of Charles Lindbergh's immortal *Spirit of St. Louis.* With the refinements in design, the engineers shaved 250 pounds off the weight of the wing—weight savings that showed up directly in the Lindbergh airplane.

Despite the excellence of the Douglas and Ryan aircraft, Northrop hated what he saw as excessive drag of their struts and wires. Working at home, he designed a clean commercial monoplane with a cantilever wing, without any struts or wires. During the same period, discussions with Stadlman led to his vision of the ideal airplane, a pure flying wing that would dispense with the weight and drag of the traditional fuselage and empennage.

Stadlman and Northrop would later fall out over the question of who was the true father of the flying wing.

In 1926, Northrop parted amicably with Douglas. Allan Loughead liked Northrop's designs, which used the same type of fuselage construction as that of the S-1. Loughead formed the Lockheed Aircraft Co. with Jack Northrop as chief engineer.

Soon, Northrop was at work on a new aircraft called the Vega. The Vega made its first flight on July 4, 1927, and was an immediate success, quickly producing a large backlog of orders. So many pilots used it to set records that company advertisements boasted, "It Takes a Lockheed to Beat a Lockheed."

Northrop's flexible design enabled him to lay out concepts for follow-on aircraft that repositioned the basic Vega wing and fuselage in new configurations.

Although Northrop was pleased at the worldwide acceptance of the Vega design, he was convinced that new 24ST aluminum alloys made wooden structures obsolete. He resigned from Lockheed on June 28, 1928, to form the Avion Corp. There, he laid plans for an all-metal commercial aircraft. He also developed his concept for a workable flying wing.

Northrop's inaugural product, unveiled in 1929, was the Avion Experimental No. 1. It was a flying wing with no commercial prospects whatsoever. The center section of the Avion's thick 30-foot wingspan enclosed the 90 hp engine and cockpit. The Avion had a distinctive "reverse" tricycle landing

gear, with two wheels forward and one aft. Both fixed and retractable gear were tested. Because a pure flying wing configuration was so radical, Northrop played it safe by adding a twin-boom, twin-tail empennage.

Stressed Skin

But the most revolutionary aspect of the Avion was Northrop's new all-metal stressed skin construction, in which span-wise shear webs replaced the conventional wing spars. William E. Boeing visited the plant, recognized the worth of the all-metal technique, and arranged for his United Aircraft and Transport Corp. to buy Avion Corp., establishing it as the Northrop Aircraft Corp. on Jan. 1, 1930.

The new arrangement permitted the Avion's flight-test program to be continued until September, by which time Northrop had become convinced that his ideas on the flying wing were sound.

At this point, he concentrated his energies on the Alpha, a low wing monoplane using his stressed skin multicellular construction technique, geared to commercial use. Northrop later maintained, "As far as the structure is concerned, that which was developed into the Alpha was really the pioneer for every airplane in the sky today." He always insisted that this structural innovation was his greatest contribution to aviation technology.

The handsome silver Alpha, with seats for six forward and with the cockpit well aft, gained immediate acceptance despite an early crash of the prototype. Transcontinental and Western Air, Inc., used the Alphas as mail airplanes, flying at night in all weather. Seventeen were built, and the last existing example is in the collection of the Smithsonian's National Air and Space Museum.

Northrop pioneered all-metal airframes, streamlined design, cantilevered monoplane wings, and the use of new metal alloys. His P-61 Black Widow (shown here) was the first US night fighter, serving in both theaters of World War II.

In September 1931, the chilling effects of the Great Depression caused United Aircraft to economize by merging the Northrop Aircraft Corp. with Stearman Aircraft in Wichita, Kan.

Northrop refused to leave California, however, and decided to form a new company. His stalwarts, Walter J. Cerny, Kenneth Jay, and Don Berlin, all elected to stay with him.

Northrop turned to his old friend Donald Douglas for help. Douglas' high opinion of Northrop's ability was reinforced by the fact that the new series of DC airliners were scheduled to use Northrop's stressed skin construction. On Jan. 1, 1932, the Northrop Corp. was formed as a Douglas subsidiary.

Experimental Days

It was Northrop's intent that his firm would serve as an experimental and research tool for Douglas, but when the parent firm's production capacity was filled, the Northrop Corp. began to take on production contracts. The new plant was located in Inglewood, Calif.

Northrop worked closely with prominent pilots to make sure his next design would meet high-performance needs. The result was the Gamma, essentially a scaled up Alpha mated to a 700 hp engine. Civil and military orders followed for variants of the adaptable Gamma and its parallel development, the Delta.

Airlines wanted the Gamma as a fast mail airplane. The Gamma also was used for extensive experimental research in instrument flying and in the development of anti-icing techniques. The famed aviatrix Jacqueline Cochran bought a Gamma and later leased it to Howard Hughes for his 1936 record-breaking transcontinental effort.

In 1934, the Army Air Corps award-

Unconventional designs were Northrop's trademark. The F-89 Scorpion was one of the first fighter "systems," integrating the aircraft, radar, and weapon. It was the first nuclear-armed interceptor and served in air defense for 17 years.

ed Northrop a $2 million contract to build 110 A-17 attack bombers. This was followed by orders for 129 A-17As with retractable landing gear. He was equally successful with the Navy, which came to Northrop for development of its BT-1, a dive-bomber that was subsequently transformed into the Douglas Dauntless.

Donald Douglas now pressured Northrop to merge the two firms, but Northrop wished to keep his independence. A friendly separation took place on April 5, 1937. What had been the Northrop Corp. became Douglas' El Segundo division. It was not until August 1939 that the new Northrop Aircraft, Inc., opened for business. War seemed inevitable, and Northrop planned a large 122,000-square-foot factory on 72 acres in Hawthorne, Calif.

Northrop started out subcontracting tail sections and later produced the Vultee V-72 Vengeance bomber. Norway purchased 24 Northrop N-3PB patrol bombers, which were twin-float developments of the Gamma design. Within months of the plant's opening, Northrop had a huge backlog of orders that permitted him to fulfill his dream of almost 20 years, the creation of a true flying wing.

The first of these, the N-1M, flew July 3, 1940. The N-1M's 38-foot wingspan contained two 65 hp engines driving pusher propellers through a faired extension shaft. The N-1M was very underpowered, and later two 117 hp engines were substituted.

While the N-1M looked simple, it was in fact a complex aircraft with unusual controls. The flying wing's relatively brief test program was hampered by inadequate engine cooling and stability problems. It nonetheless demonstrated to Northrop that his vision was correct.

Northrop's first big flying wing was the XB-35, anticipated to be USAF's first postwar bomber (shown at top with a P-61 flying chase), but it couldn't handle the giant atomic bombs of the time. The YB-49 (above) was a jet-powered advancement of the design, comparable in shape and size to today's B-2 stealth bomber.

As it happened, the Chief of the Army Air Forces, Maj. Gen. Henry H. "Hap" Arnold, was an old friend of Northrop's, and the designer made contact. He submitted preliminary designs for what would become the XB-35 in September 1941. The Army contracted for two of the giant bombers, with the implicit understanding that they would probably not be required during World War II.

This was more than acceptable to Northrop, whose plant was busy producing the P-61. This large, twin-engine aircraft was the first specifically designed American night fighter. Nearly 700 were delivered, and they operated in both the European and Pacific Theaters.

Meanwhile, Northrop built four N-9M flying wings as engineering development vehicles to gather data for the XB-35. The N-9Ms had 60-foot wingspans and were powered by two 260 hp engines. The first N-9M flew Dec. 27, 1942. This aircraft crashed five months later, killing test pilot Max Constant.

Northrop was tasked to create some other flying wings to meet specific, if often bizarre, wartime requirements. The XP-56 Black Bullet was a flying wing fighter with disappointing performance. The MX-324 and MX-334 were engineering development vehicles for the XP-79B, a twin-jet interceptor designed to ram enemy bombers. And the JB-1 Power Bomb, a ground-launched missile, was Northrop's equivalent of the German V-1.

Gaining Momentum

Even as other flying wing programs faltered, the XB-35 gathered momentum. A large aircraft that was roughly three times the size of a B-24, the XB-35 had controls as distinctive as its outline. Both the elevons and the rudders were power operated, with artificial feel provided to the pilot. The trailing edge of the wing had trim flaps, elevons, and landing

Shown here are XB-35s lined up on the ramp. Northrop modified the XB-35 to handle new requirements, but USAF in January 1949 terminated the program and scrapped all the existing aircraft. The decision sparked a decades-long controversy.

flaps. The rudders were split flaps built into the trim flaps and operated differentially for turns and together as a speed brake. At high angles of attack, the automatically controlled wingtip slots opened.

The XB-35 had eight bomb bays that could carry a combined total of 10,000 pounds of bombs, but they were not large enough for nuclear weapons. Heavy defensive armament consisted of machine guns in seven remotely controlled turrets.

Power was supplied by four Pratt & Whitney engines, each rated at 3,000 hp and driving complex counter-rotating propellers.

Northrop's dream finally came true June 25, 1946, when the XB-35 made its first flight. Management had requested that workers not go out and line the runway to watch the first flight, and, characteristically, Northrop obeyed the edict, staying at his desk while his pride and joy took off.

The Army let a contract for 13 test YB-35s, but the airplane soon was plagued by problems in its propeller gearboxes. Single rotation gearboxes were installed, solving the problem. Of much greater importance, the jet age had arrived and the prospect of in-flight refueling as a regular tactic was already anticipated. Northrop attempted to adjust to new circumstances by modifying two YB-35s with eight 4,000-pound-thrust J35 jet engines, creating the YB-49. The new flying wing jet was taken aloft on Oct. 21, 1947.

Jet engines vastly improved the aircraft's performance, though fins had to be added on either side of the two bays of jet engines to compensate for a loss in stability that had been provided by the propellers. Yet the YB-49's airframe was of the piston engine era, and the wing was too thick, factors limiting its top speed. Consequently it was not really competitive with the faster Boeing B-47 or B-52 bombers.

The Fatal Blow

Tragedy struck on June 5, 1948, when the second test YB-49 crashed, killing its crew, including Capt. Glen W. Edwards, the namesake of today's Edwards Air Force Base in California.

Despite this, the flying wing program seemed to gather new life when the Air Force ordered 30 RB-49s as reconnaissance aircraft. Then began a flying wing controversy that continues to this day.

On Jan. 11, 1949, the Air Force told Northrop to terminate work on the RB-49 program. Northrop was allowed to keep working on one aircraft, the YRB-49A, but only as a test bed for reconnaissance equipment. In November 1949, the government decided that it would not convert the existing YB-35 aircraft to the jet-powered YB-49 version. Instead, all of these aircraft simply would be scrapped.

The Northrop Flying Wing was dead, but the arguments over its merits never would be. There are many facets to the long argument. Fans of the flying wing claim that the YB-49 produced performance superior to that of the B-36. The question is, what happened?

In the wake of the decision, Northrop testified before Congress that he was under no pressure at the time of the YB-49 cancellation. Many years later, however, he withdrew the statement, claiming in 1980 that the flying wing was canceled because he had refused to merge his firm with Convair. He said the Air Force's reaction to his refusal was to cancel his contracts and to order the existing flying wing aircraft destroyed.

Not so, the Air Force insisted. USAF maintained that, while the YB-49 design had many problems in its fuel system, landing gear, and cockpit layout, its principle drawback was that it was not a good bombing platform. The aircraft also may have needed some form of stability augmentation. Unfortunately for the flying wing, the computers necessary to provide such stability simply did not exist at the time.

The cancellation of the flying wing program and the destruction of all remaining examples deeply wounded Northrop. He decided to retire in 1952 and was bitter about what he believed was a cruel and unnecessary end to his flying wing dreams.

Toward the end of his life, however, Jack Northrop managed to salvage a bit of satisfaction. The Northrop Corp. in April 1980, after obtaining the required security clearances, showed the legendary Northrop a model of a beautiful flying wing. It was Northrop's B-2 stealth bomber. Eyes welling with tears, Northrop reportedly said, "Now I know why God has kept me alive for the last 25 years."

He died Feb. 18, 1981, content at last in the knowledge that his concept of a pure flying wing had been made real. ■

Walter J. Boyne, former director of the National Air and Space Museum in Washington, is a retired Air Force colonel and author. He has written more than 600 articles about aviation topics and 40 books, the most recent of which is Today's Best Military Writing: The Finest Articles on the Past, Present, and Future of the US Military. *His most recent article for* Air Force *Magazine, "The Lord of the Skunk Works," appeared in the June issue.*