

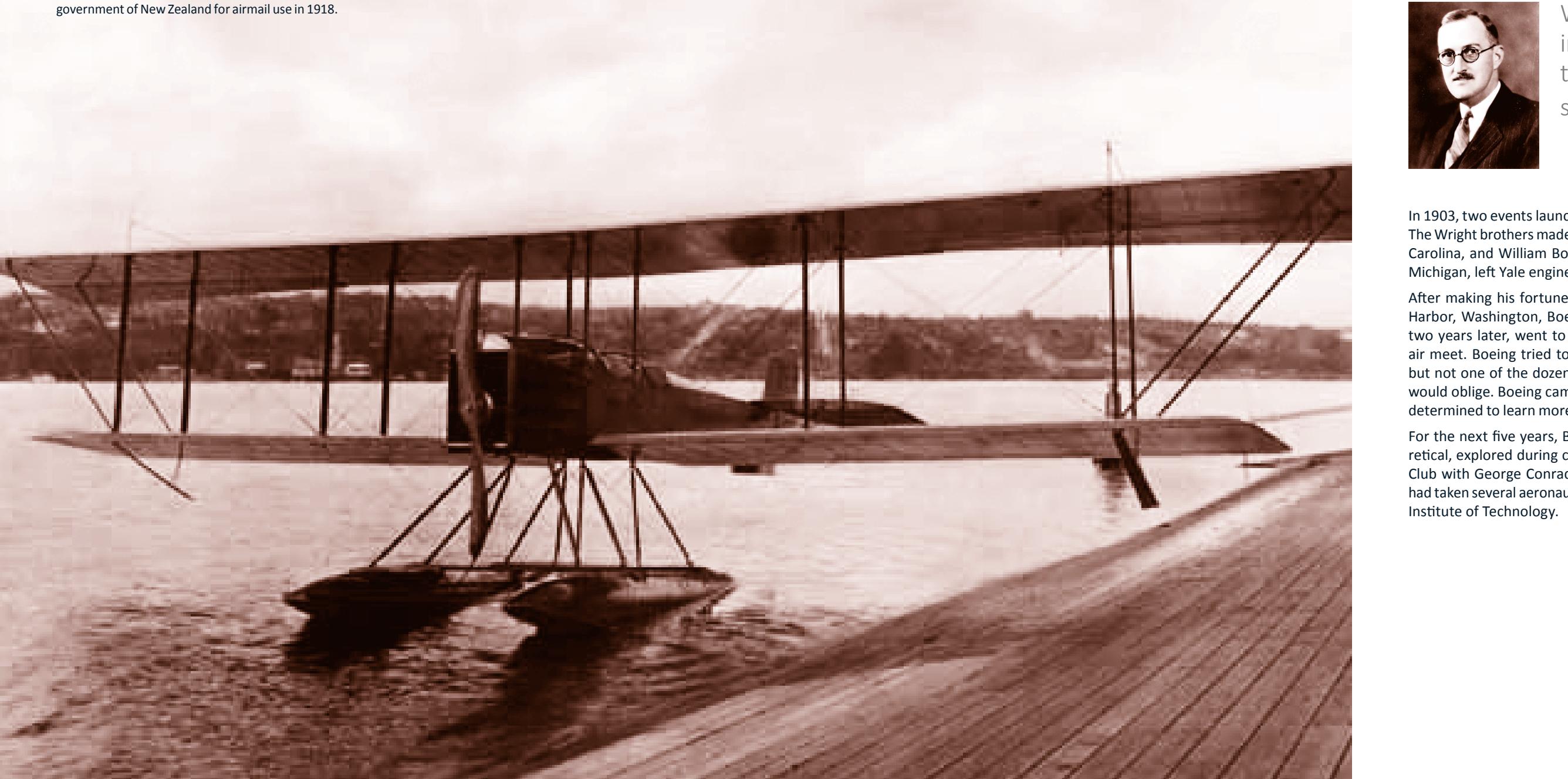


BOEING

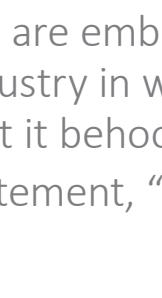
100 YEARS OF FLIGHT

B & W

First in a very long line of Boeing airplanes, the B&W floats on Seattle's Lake Union in 1916. A second B&W was also built and sold with the first to the government of New Zealand for airmail use in 1918.



The Beginnings: 1903-1926



We are embarked as pioneers upon a new science and industry in which our problems are so new and unusual that it behooves no one to dismiss any novel idea with the statement, "It can't be done."

—William Boeing, *Scientific American Magazine*, 1910

In 1903, two events launched the history of modern aviation. The Wright brothers made their first flight at Kitty Hawk, North Carolina, and William Boeing, born Oct. 1, 1881, in Detroit, Michigan, left Yale engineering college for the West Coast.

After making his fortune trading forest lands around Grays Harbor, Washington, Boeing moved to Seattle in 1908 and,

two years later, went to Los Angeles for the first American air meet. Boeing tried to get a ride in one of the airplanes, but not one of the dozen aviators participating in the event would oblige. Boeing came back to Seattle disappointed, but determined to learn more about this new science of aviation.

For the next five years, Boeing's air travel was mostly theoretical, explored during conversations at Seattle's University Club with George Conrad Westervelt, a Navy engineer who had taken several aerodynamics courses from the Massachusetts Institute of Technology.

The two checked out biplane construction and were passengers on an early Curtiss Aeroplane and Motor Company-designed biplane that required the pilot and passenger to sit on the wing. Westervelt later wrote that he "could never find any definite answer as to why it held together." Both were convinced they could build a biplane better than any on the market.

In the autumn of 1915, Boeing returned to California to take flying lessons from another aviation pioneer, Glenn Martin. Before leaving, he asked Westervelt to start designing a new, more practical airplane. Construction of the twin-float seaplane began in Boeing's boathouse, and they named it the B & W, after their initials.

B & W

The B & W was the first Boeing product, named after the initials of its designers, William Boeing and Navy Lt. Conrad Westervelt.

The first B & W, completed in June 1916, was made of wood, linen and wire. Similar to the Martin trainer that Boeing owned, the B & W had, among other improvements, better pontoons and a more powerful engine.

The two B & Ws were offered to the U.S. Navy. When the Navy did not buy them, they were sold to the New Zealand Flying School and became the company's first international sale. The B & Ws later were used for New Zealand express and airmail deliveries, set a New Zealand altitude record of 6,500 feet on June 25, 1919, and made that country's first official airmail flight on Dec. 16, 1919.

Specifications

First flight:	June 15, 1916
Model number:	1
Classification:	Utility seaplane
Span:	52 feet
Length:	27 feet 6 inches
Gross weight:	2,800 pounds
Top speed:	75 mph
Cruising speed:	67 mph
Range:	320 miles
Power:	125-horsepower Hall-Scott A-5 engine
Accommodation:	2 crew

Monomail Transport

In 1930, Boeing created the revolutionary Monomail, which made traditional biplane construction a design of the past. The Monomail wing was set lower, was smooth, made entirely of metal and had no struts (cantilevered construction). The retractable landing gear, the streamlined fuselage and the engine covered by an antidrag cowling added up to an advanced, extremely aerodynamic design.

The Monomail Model 200 was a mail plane, and the Model 221 was a six-passenger transport. Both were later revised for transcontinental passenger service as Model 221As.

The major drawback of the Monomail was that its design was too advanced for the engines and propellers of the time. The airplane required a low-pitch propeller for takeoff and climb and a high-pitch propeller to cruise. By the time the variable-pitch propeller and more powerful engines were available, the Monomail was being replaced by newer, multiengine planes it had inspired.

Specifications

First flight:	May 6, 1930
Model numbers:	200, 221
Classification:	Mail and cargo carrier
Span:	59 feet 1 inch
Length:	41 feet 10 inches
Gross weight:	8,000 pounds
Top speed:	158 mph
Cruising speed:	135 mph
Range:	575 miles
Ceiling:	14,700 feet
Power:	575-horsepower P&W Hornet B engine
Accommodation:	Pilot, approximately 1,500 pounds of cargo

The War Years

To an airman the Pacific Northwest is the home of the long-range heavy bomber, which has changed the character of war and the meaning of peace.

—General Carl Spaatz, Commanding General, U.S. Air Force, 1947

Only 16 months after the Stratoliner's introduction, war clouds darkened the European horizon. Phil Johnson returned from Canada and took over as Boeing company president, in charge of wartime production. He died of a stroke Sept. 14, 1944, while overseeing operations at the Boeing Wichita plant.

By the 1940s Boeing workers were building B-17s at a rapidly increasing rate. Burlap houses and chicken-wire lawns camouflaged the rooftops of Boeing Plant 2 in Seattle so that, from the air, the bomber manufacturing center looked like a quiet suburb.

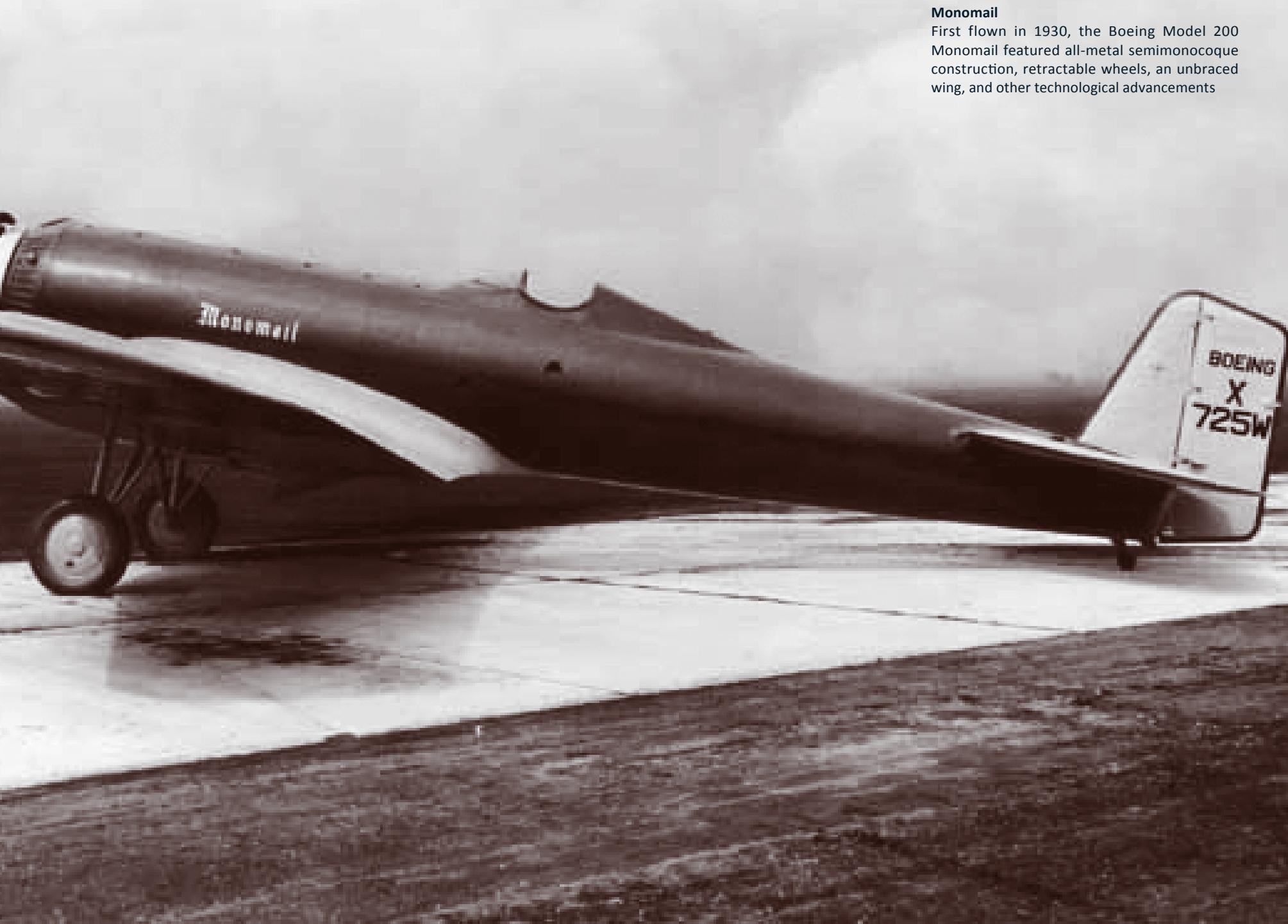
As American men went to war, women built airplanes. Thousands of women, symbolized by "Rosie the Riveter," took up the slack in the workforce and helped boost production from 60 planes per month in 1942 to an astounding 362 planes per month by March 1944 — at one point the Seattle plant rolled out 16 planes in 24 hours.

The Boeing Renton plant near Seattle was built for production of the XPBB-1 long-range patrol bomber for the Navy, but in wartime strategy changed in favor of land-based bombers.

Boeing started producing the B-29 bomber in 1942 at the Renton plant and in Wichita, Kansas. The new "Superfortress" entered combat less than two years after its first flight. In Wichita, farmhands, housewives and shopkeepers built B-29s on 10-hour-shifts, day and night, during what later became known as the "Battle of Kansas."

Companies around the country coordinated their war efforts. B-17s were built at Boeing, Douglas Aircraft Co. and Lockheed Aircraft Corp. factories. B-29s were built at Boeing, Bell Aircraft Co. and Glenn L. Martin Co.

In addition, between 1936 and 1944, Boeing built 240 Douglas DB-7B attack bombers for France, 750 Waco-designed cargo and troop gliders and 8,585 Kaydet trainers, first introduced at the Stearman Aircraft Co. in Wichita in 1933. Boeing Aircraft of Canada built 362 PBY flying boats and amphibians designed by Consolidated Aircraft of San Diego and 16 British-designed Blackburn Shark torpedo aircraft for the Royal Canadian Air Force. Boeing also built three XF8B-1 fighter-bombers.



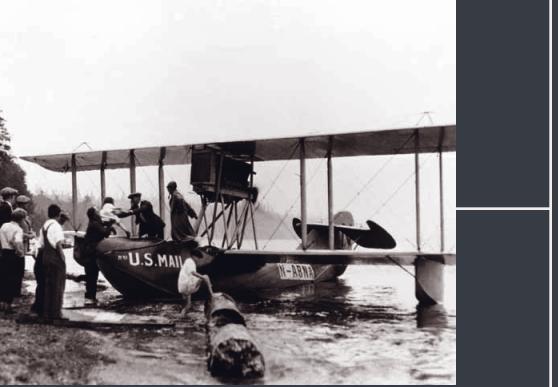
Monomail

First flown in 1930, the Boeing Model 200 Monomail featured all-metal semimonocoque construction, retractable wheels, an unbraced wing, and other technological advancements



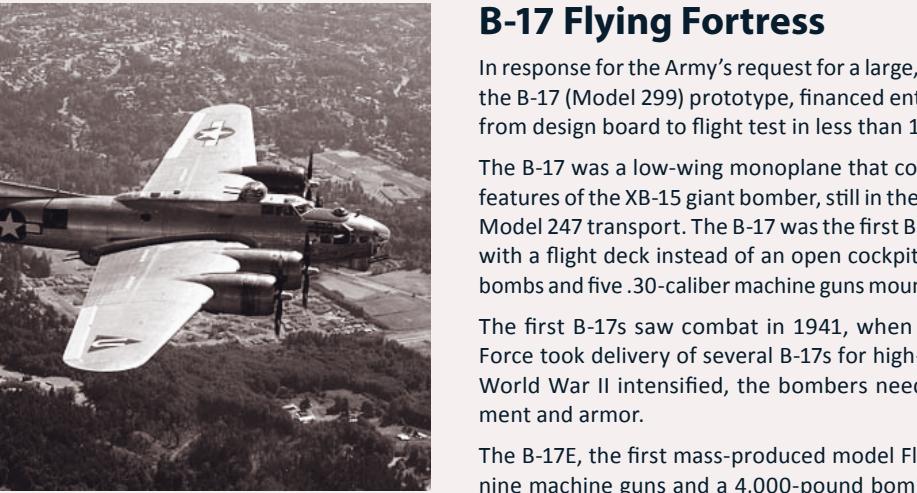
Model C

On March 3, 1919, William Boeing (right) and pilot Eddie Hubbard performed the first U.S. international airmail flight in this Boeing Model C, a modified World War I trainer they flew from Vancouver, British Columbia, Canada, to Seattle.



B-1

This flying boat of 1919 was the first Boeing airplane designed from the outset for commercial use. Unable to compete in price with surplus World War I airplanes, the B-1 was not a commercial success.



B-17 Flying Fortress

In response for the Army's request for a large, multiengine bomber, the B-17 (Model 299) prototype, financed entirely by Boeing, went from design board to flight test in less than 12 months.

The B-17 was a low-wing monoplane that combined aerodynamic features of the XB-15 giant bomber, still in the design stage, and the Model 247 transport. The B-17 was the first Boeing military aircraft with a flight deck instead of an open cockpit and was armed with bombs and five .30-caliber machine guns mounted in clear "blisters."

The first B-17s saw combat in 1941, when the British Royal Air Force took delivery of several B-17s for high-altitude missions. As World War II intensified, the bombers needed additional armament and armor.

The B-17E, the first mass-produced model Flying Fortress, carried nine machine guns and a 4,000-pound bomb load. It was several tons heavier than the prototypes and bristled with armament. It was the first Boeing airplane with the distinctive — and enormous — tail for improved control and stability during high-altitude bombing. Each version was more heavily armed.

In the Pacific, the planes earned a deadly reputation with the Japanese, who dubbed them "four-engine fighters." The Fortresses were also legendary for their ability to stay in the air after taking brutal poundings. They sometimes limped back to their bases with large chunks of the fuselage shot off.

Boeing plants built a total of 6,981 B-17s in various models, and another 5,745 were built under a nationwide collaborative effort by Douglas and Lockheed (Vega). Only a few B-17s survive today; most were scrapped at the end of the war. Some of the last Flying Fortresses met their end as target drones in the 1960s — destroyed by Boeing Bomarc missiles.

Specifications

First flight:	July 28, 1935 (prototype)
Model number:	299
Classification:	Bomber
Span:	103 feet 9 inches
Length:	74 feet 9 inches
Gross weight:	65,000 pounds
Top speed:	287 mph
Cruising speed:	150 mph
Range (max.):	3,750 miles
Ceiling:	35,600 feet
Power:	Four 1,200-horsepower Wright R-1820-97 engines
Accommodation:	2 pilots, bombardier, radio-operator, 5 gunners
Armament:	11 to 13 machine guns, 9,600-pound bomb load

Red Barn

This former shipyard was the first home of The Boeing Company, which was founded in 1916. Affectionately called the Red Barn, it is shown under guard during World War I. The Red Barn is now part of the Museum of Flight in Seattle.





Post-War Developments

Paths open for the future are paths of opportunity for the aggressive, capable company in the aerospace field, offering multiple choices of endeavor... The years ahead promise to be at least as challenging and revolutionary as those through which we have come.

—William Allen

History

The years immediately following the end of World War II rocked with change. The military canceled its bomber orders; Boeing factories shut down and 70,000 people lost their jobs. The same day the plants closed, attorney William M. Allen, somewhat hesitantly, took over as company president.

Allen promised to start hiring people back as soon as airlines ordered the Stratocruiser, a luxurious commercial airliner version of the company's four-engine troop C-97 transport first flown in 1944.

Work still continued on the B-50 bomber, although the Army had cut its initial order of 200 down to 60. Boeing Wichita produced the L-15 Scout liaison-observation aircraft, which first flew in 1947.

Meanwhile, wind-tunnel data discovered in Germany as the war ended helped Boeing engineers design the country's first multiengine, swept-wing jet bomber, the XB-47.

Unfortunately, the elegant Stratocruiser was not the hoped-for financial breakthrough. What contributed most to the company coffers was adapting the C-97 air freighter as a propeller-powered troop carrier and as the KC-97, an aerial tanker.

Boeing

Model 314 Clipper Flying Boat

As airplane travel became popular during the mid-1930s, passengers wanted to fly across the ocean, so Pan American Airlines asked for a long-range, four-engine flying boat. In response, Boeing developed the Model 314, nicknamed the "Clipper" after the great ocean-going sailing ships.

The Clipper used the wings and engine nacelles of the giant Boeing XB-15 bomber on the flying boat's towering, whale-shaped body. The installation of new Wright 1,500 horsepower Double Cyclone engines eliminated the lack of power that handicapped the XB-15. With a nose similar to that of the modern 747, the Clipper was the "jumbo" airplane of its time.

The Model 314 had a 3,500-mile range and made the first scheduled trans-Atlantic flight June 28, 1939. By the year's end, Clippers were routinely flying across the Pacific. Clipper passengers looked down at the sea from large windows and enjoyed the comforts of dressing rooms, a dining salon that could be turned into a lounge and a bridal suite. The Clipper's 74 seats converted into 40 bunks for overnight travelers. Four-star hotels catered gourmet meals served from its galley.

Boeing built 12 Model 314s between 1938 and 1941. At the outbreak of World War II, the Clipper was drafted into service to ferry materials and personnel. Few other aircraft of the day could meet the wartime distance and load requirements. President Franklin D. Roosevelt traveled by Boeing Clipper to meet with Winston Churchill at the Casablanca conference in 1943. On the way home, President Roosevelt celebrated his birthday in the flying boat's dining room.



Specifications

First flight:	June 7, 1938
Model number:	314A
Classification:	Commercial transport
Span:	152 feet
Length:	106 feet
Gross weight:	84,000 pounds
Top speed:	199 mph
Cruising speed:	184 mph
Range:	5,200 miles
Ceiling:	19,600 feet
Power:	Four 1,600-horsepower Wright Twin Cyclone engines
Accommodation:	10 crew, 74 passengers

Early Manufacture

Boeing female employees stitch fabric onto the top wing of a Boeing-built Thomas-Morse MB-3A Army pursuit plane, circa 1922.



Propeller Construction

Being built in the Red Barn in the early 1920's, these Boeing-designed wooden propellers are for MB-3A Army pursuit biplanes.



Jets and Rockets Take Off: 1957-1970

We have brought back rocks, and I think it's a fair trade... these rocks may unlock the mystery of the origin of the Moon, and indeed even of our Earth and Solar System.

—Michael Collins, Command Module pilot, Apollo 11

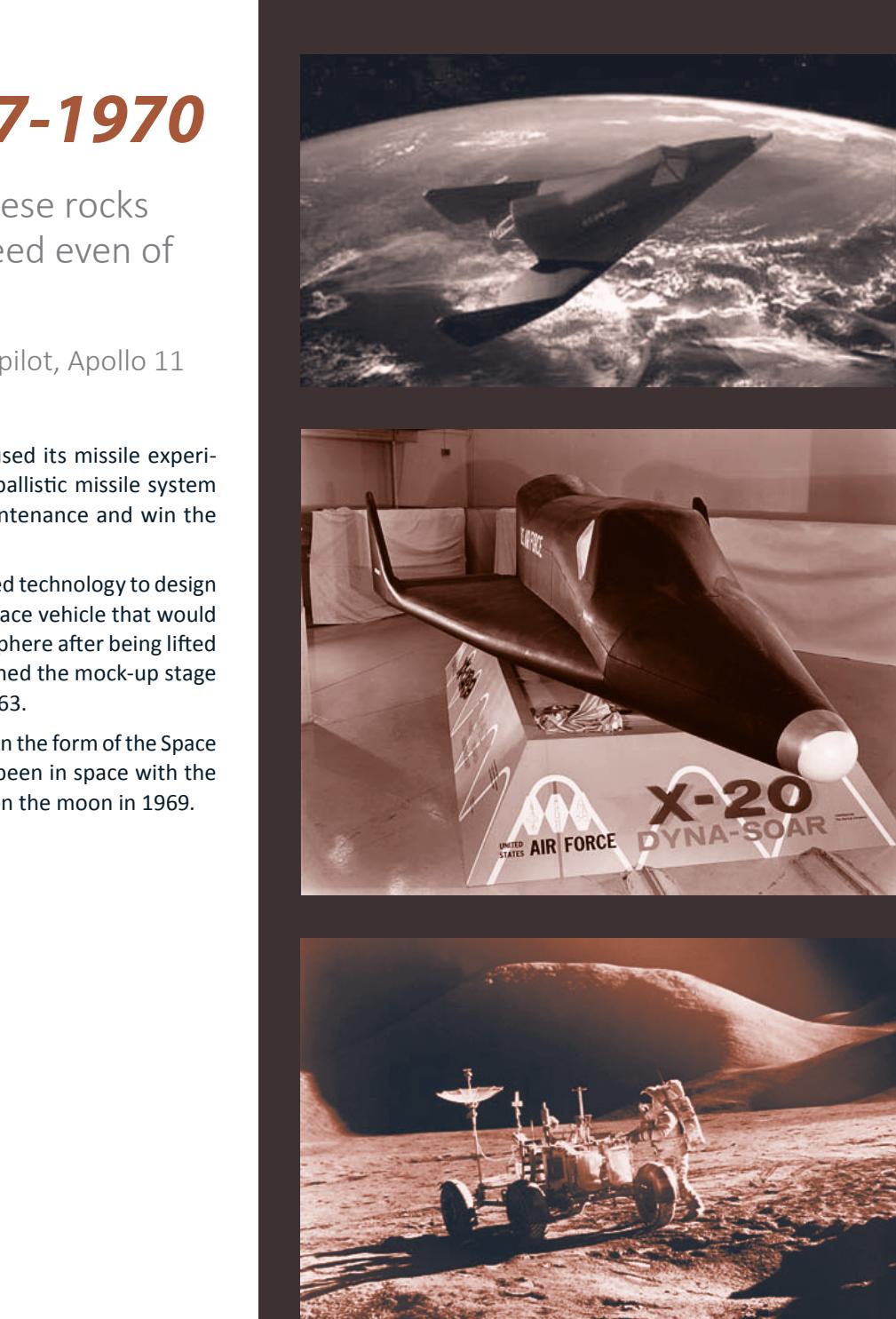
By the late 1950s, the technologies forged in the fires of World War II had impacted every aspect of business and manufacturing, and in less than a dozen years, brought the civilized world into the modern era. Boeing President Allen knew that the company had the scientists, the experience and the facilities to lead the country into uncharted territories — across barriers of sound, time and space.

Analog computers used to guide the flight of guided missiles in the 1940s, including the Boeing Ground-to-Air Pilotless Aircraft (GAPA), had evolved into much more recognizable predecessors of today's computers. GAPA, a 16-foot needle-nose, solid-fuel supersonic rocket developed in response to German buzz bombs, laid the groundwork for mass production of the 45-foot Bomarc missiles in 1957, intended to intercept invading enemy aircraft.

As the Cold War continued, Boeing used its missile experience to develop an intercontinental ballistic missile system including bases, installation and maintenance and win the Minuteman missile program.

Boeing engineers used this rocket-based technology to design the Dyna-Soar, a manned, reusable space vehicle that would glide through the Earth's upper atmosphere after being lifted into orbit by a rocket. Dyna-Soar reached the mock-up stage before the project was canceled in 1963.

The concept reappeared 20 years later in the form of the Space Shuttle. By then, Boeing had already been in space with the Apollo program that landed humans on the moon in 1969.

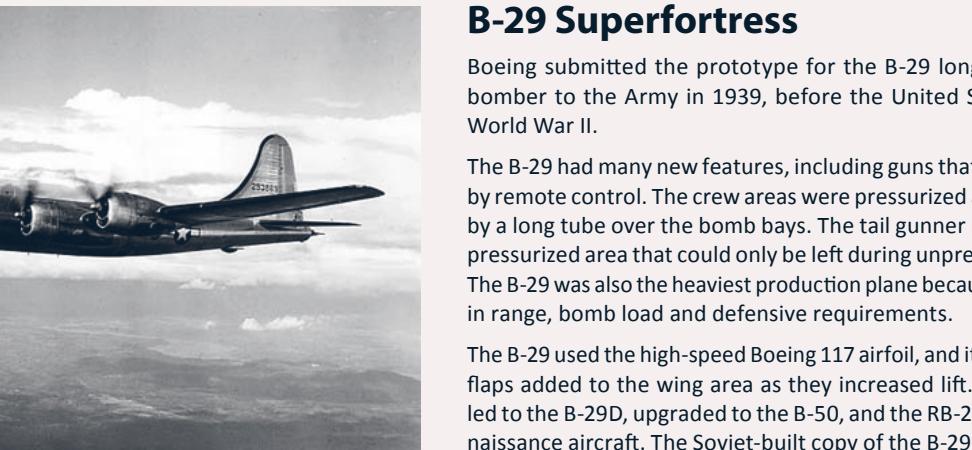


**40A**

This fabric-covered mail plane was the first Boeing commercial success. Built in 1927 (the year Charles Lindbergh crossed the Atlantic), it carried mailbags and load permitting two passengers.

**80A**

With seating for 18 passengers, this fabric-covered transport of 1929 was an enlarged version of the Model 80 - the first true Boeing passenger airliner - of the year before.

**B-29 Superfortress**

Boeing submitted the prototype for the B-29 long-range heavy bomber to the Army in 1939, before the United States entered World War II.

The B-29 had many new features, including guns that could be fired by remote control. The crew areas were pressurized and connected by a long tube over the bomb bays. The tail gunner had a separate pressurized area that could only be left during unpressurized flight. The B-29 was also the heaviest production plane because of increases in range, bomb load and defensive requirements.

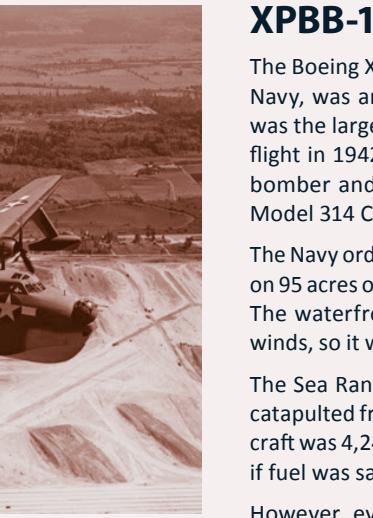
The B-29 used the high-speed Boeing 117 airfoil, and its larger Fowler flaps added to the wing area as they increased lift. Modifications led to the B-29D, upgraded to the B-50, and the RB-29 photo reconnaissance aircraft. The Soviet-built copy of the B-29 was called the Tupolev Tu-4.

The earliest B-29s were built before testing was finished, so the Army established modification centers where last-minute changes could be made without slowing expanding assembly lines.

Boeing built a total of 2,766 B-29s at plants in Wichita, Kan., (previously the Stearman Aircraft Co., bought by Boeing in 1929) and in Renton, Wash. The Bell Aircraft Co. built 668 of the giant bombers in Georgia, and the Glenn L. Martin Co. built 536 in Nebraska. Production ended in 1946.

B-29s were primarily used in the Pacific theater during World War II. As many as 1,000 Superfortresses at a time bombed Tokyo, destroying large parts of the city. Finally, on Aug. 6, 1945, the B-29 Enola Gay dropped the world's first atomic bomb on Hiroshima, Japan. Three days later a second B-29, Bockscar, dropped another atomic bomb on Nagasaki. Shortly thereafter, Japan surrendered.

After the war, B-29s were adapted for several functions, including in-flight refueling, anti-submarine patrol, weather reconnaissance and rescue duty. The B-29 saw military service again in Korea between 1950 and 1953, battling new adversaries: jet fighters and electronic weapons. The last B-29 in squadron use retired from service in September 1960.

**XPBB-1 Sea Ranger**

The Boeing XPBB-1 Sea Ranger, or the Model 344, built for the U.S. Navy, was an extremely long-range flying boat patrol bomber. It was the largest twin-engine airplane built until the time of its first flight in 1942.

It incorporated aerodynamic features of the Boeing Model 314 Clipper.

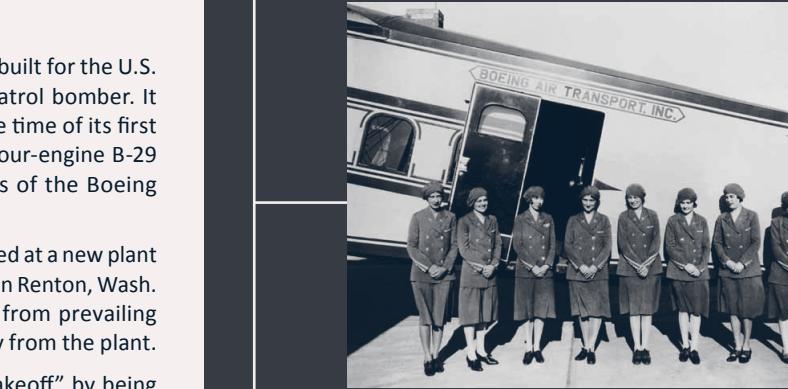
The Navy ordered 57 Sea Rangers to be manufactured at a new plant on 95 acres on the south shore of Lake Washington in Renton, Wash. The waterfront site provided natural protection from prevailing winds, so it was easier to launch seaplanes directly from the plant.

The Sea Rangers were designed for a "boosted takeoff" by being catapulted from huge barges. Although the normal range of the aircraft was 4,245 miles, designers believed this distance could double if fuel was saved by the catapulted takeoff.

However, even before the first Sea Ranger was finished, it was surrounded by rows of B-29 bombers because the U.S. military changed its strategy in favor of land-based bombers after the Battle of Midway, June 4, 1942, when American bombers destroyed four Japanese aircraft carriers.

Only one Sea Ranger was built and nicknamed the "Lone Ranger." The Boeing 25-year tradition of building seaplanes came to an end when the "Lone Ranger" flew out of Renton for the last time on Oct. 25, 1943, heading for the Navy base in San Diego, Calif. The one-of-a-kind seaplane served the Navy in a variety of ways for several years before it was placed in storage at the Norfolk Naval Air Station in Virginia.

The Navy traded the Renton site with the U.S. Army for a plant in Kansas City, Mo., and the Army took over the Renton plant, where Boeing workers subsequently produced 1,119 B-29 bombers. After the war, the plant eventually became a manufacturing facility for Boeing commercial jet transports.

**First Stewardesses**

In 1930, Boeing Air Transport 80As introduced aviation's first stewardesses (one per airplane), who were then required to be registered nurses.

**Boeing 247**

Hailed as the first modern airliner, the Boeing 247 of 1933 marked the emergence of fast, comfortable air travel. This sleek, all-metal monoplane carried 10 passengers at 160 mi/h (260 km/h).



New Markets: 1971-1982

When we're flat on our backs, nobody else looks so bad because we're so big. But when we get moving, watch out. The momentum is tremendous.

—“T” Wilson



As the '70s began, a number of factors came together to push Boeing into a crisis. By the end of the '60s, the big Apollo project wound down and the company hoped to increase sales of commercial aircraft to make up for the decrease of space-related business. Unfortunately, due to the recession in the aviation industry, Boeing went 18 months without a single new domestic order. The huge jumbo jet, the 747, had not yet established itself in the market and had unexpectedly high startup costs and initial delivery problems.

The end of the SST program dealt another blow. Aided by federal funds, Boeing had made major progress, but Congress “pulled the plug” on SST funding in March 1971, forcing Boeing to cancel the program.

In the Seattle area alone, the Boeing workforce was cut from 80,400 to 37,200 between early 1970 and October 1971. Thousands of former Boeing employees, finding little in the local job market, looked for work elsewhere. Things became so bad in Seattle that a billboard on the city's outskirts read, “Will the last person leaving Seattle turn out the lights” (photo courtesy of Seattle Times).

Dealing with the new challenges was “T” Wilson, who became the company president in 1968. When Wilson became chairman of the board in 1972, Malcolm Stamper was named president, holding that position until 1985.



377 Stratocruiser

The Boeing 377 Stratocruiser of 1947 provided seating for 55 passengers, or 100 passengers with its sleeping deleted. Stratocruisers were the last piston-powered airliners built by Boeing.

Model 377 Stratocruiser Commercial Transport

After World War II was over, Boeing re-entered the commercial market with a new long-range airliner, the Stratocruiser (Model 377). It was the first Boeing commercial transport since the Stratoliner and, like its military counterpart, the C-97, was based on the B-29 bomber. It possessed all the speed and technical improvements available to bombers at the end of the war.

The Stratocruiser set a new standard for luxurious air travel with its tastefully decorated extra-wide passenger cabin and gold-appointed dressing rooms. A circular staircase led to a lower-deck beverage lounge, and flight attendants prepared hot meals for 50 to 100 people in a state-of-the-art galley. As a sleeper, the Stratocruiser was equipped with 28 upper-and-lower bunk units.

Pan American placed the first order for 20 Stratocruisers, worth \$24 million, and they began service between San Francisco, Calif., and Honolulu, Hawaii, in 1949. Boeing built 56 Stratocruisers between 1947 and 1950, and they marked the company's first significant success selling passenger planes to airlines in other countries.

During the early 1960s, Aero Space Lines ballooned the Stratocruiser's fuselage into a whale-like shape to carry spacecraft sections. Nine of the variants were assembled. The first was called the “Pregnant Guppy,” followed by five larger “Superguppies” and three smaller “Miniguppies.” In the process, one of the most elegant airplanes in the sky became one of the ugliest.



307 Stratoliner

The Boeing 307 Stratoliner — the world's first pressurized airliner — carried passengers in unprecedented comfort high above the weather. World War II preempted this promising airliner's career and just nine were delivered.



Stratoliner Cockpit

The 307's crew included a flight engineer (seated behind the copilot) whose job it was to manage the airplane's piston engines, pressurization, and other systems.



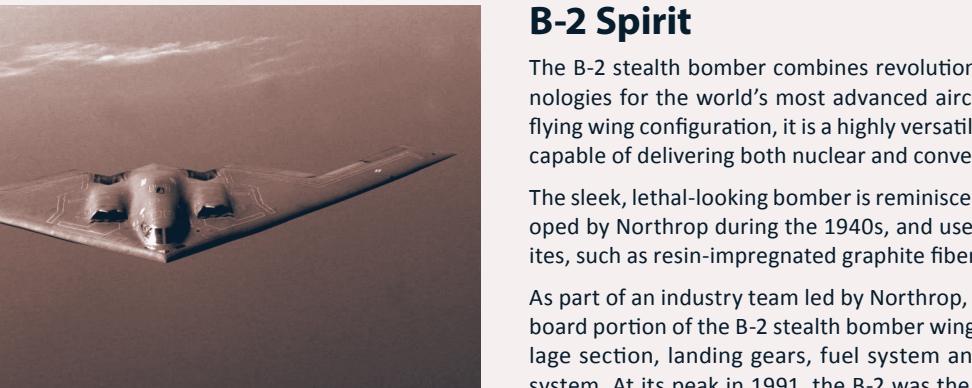
Sleeping Berths

In the days before jet speeds, the Boeing 377 Stratocruiser provided passengers with sleeping berths for intercontinental nonstop flights extending more than 4,000 miles.



Lower-deck Salon

Another popular Stratocruiser feature was this lower-deck cocktail lounge with available seating for 14 passengers, who reached it via a spiral staircase.



B-2 Spirit

The B-2 stealth bomber combines revolutionary aerospace technologies for the world's most advanced aircraft. With its unique flying wing configuration, it is a highly versatile multi-role bomber, capable of delivering both nuclear and conventional munitions.

The sleek, lethal-looking bomber is reminiscent of the B-35, developed by Northrop during the 1940s, and uses advanced composites, such as resin-impregnated graphite fiber, rather than metal.

As part of an industry team led by Northrop, Boeing built the outboard portion of the B-2 stealth bomber wing, the aft center fuselage section, landing gears, fuel system and weapons delivery system. At its peak in 1991, the B-2 was the largest military program at Boeing, employing about 10,000 people. The same year, the National Aeronautic Association of the U.S.A. awarded the B-2 design team the Collier Trophy for the greatest achievement in aeronautics or astronautics in America, demonstrated in actual use.

The first B-2 rolled out of the bomber's final assembly facility in Palmdale, Calif., in November 1988 and it flew for the first time on July 17, 1989.

The first B-2 entered the Air Force's operational fleet at Whiteman Air Force Base, Mo., on Dec. 17, 1993. On Oct. 29, 1994, the Air Force's fourth operational B-2 was named "Spirit of Washington" in Seattle, Wash., to honor the people of the state who helped make the B-2 a reality. During 2001, the B-2 flew missions to Afghanistan nonstop from Whiteman Air Force Base. In 2004, there were 21 B-2s assigned to the U.S. Air Force 509th Bomb Wing. As part of the Air Force B-2 industry team, Boeing built primary structural components; supplied the bomber's fuel systems, weapons-delivery system and landing gear; worked on the B-2's smart bomb racks; and upgraded the SATCOM radios.



