The Aircraft of Jack Northrop

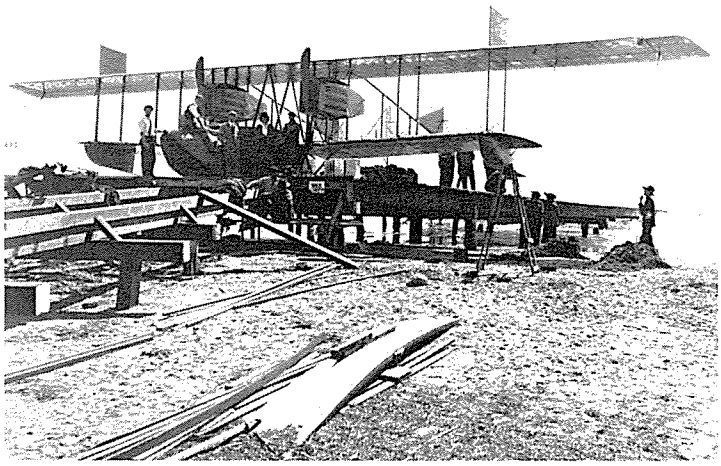
by Gerald Balzer

F-1—The Loughead (Lockheed) F-flying boat introduced John K. "Jack" Northrop to the aircraft industry. While not the largest flying boat in existence, it was a substantial task for the experience level of the fledgling Loughead Aircraft Manufacturing Company. Success of the project in terms of weight and strength was pivotal on the self-taught design and stress analysis of young Jack Northrop.

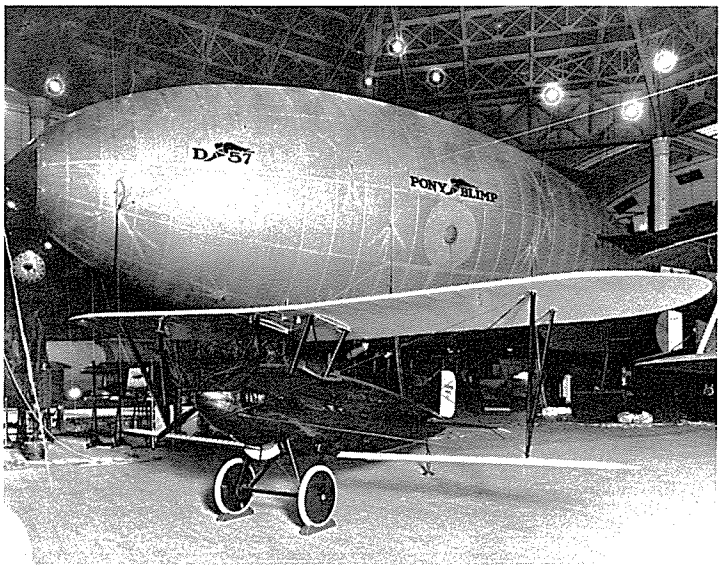
S-1—With the end of World War I, the completion of two HS-2Ls for the Navy and the loss of the F-1A, Loughead Company needed a new project for the postwar market. To quote Jack Northrop, "Even in this early period of my aviation career I had the bug in my bonnet that I wanted to build as clean airplanes as could possibly be done and the little S-1 was an effort in that direction." The wing structure was of contemporary design consistent with available materials and equipment. The molded fuselage was the only unconventional feature which provided a very low drag assembly. Unable to garner production orders due to the flood of Curtiss JN-4s and others, the Loughead Aircraft Manufacturing Company and the S-1 faded into history.

M-1—The airplane that was instrumental in launching Ryan Airlines, the M-1, benefited from the design and stress analysis expertise of Art Mankey and Jack Northrop in 1925. Both were employed by Douglas and with Don Douglas, Sr.'s, concurrence, Art and Jack did a little weekend moonlighting to redesign the wing of the M-1 for significant weight reduction. The design concepts and stress analyses were the basis for the wing on Lindbergh's *Spirit of St. Louis* and the later Ryan Brougham derivatives.

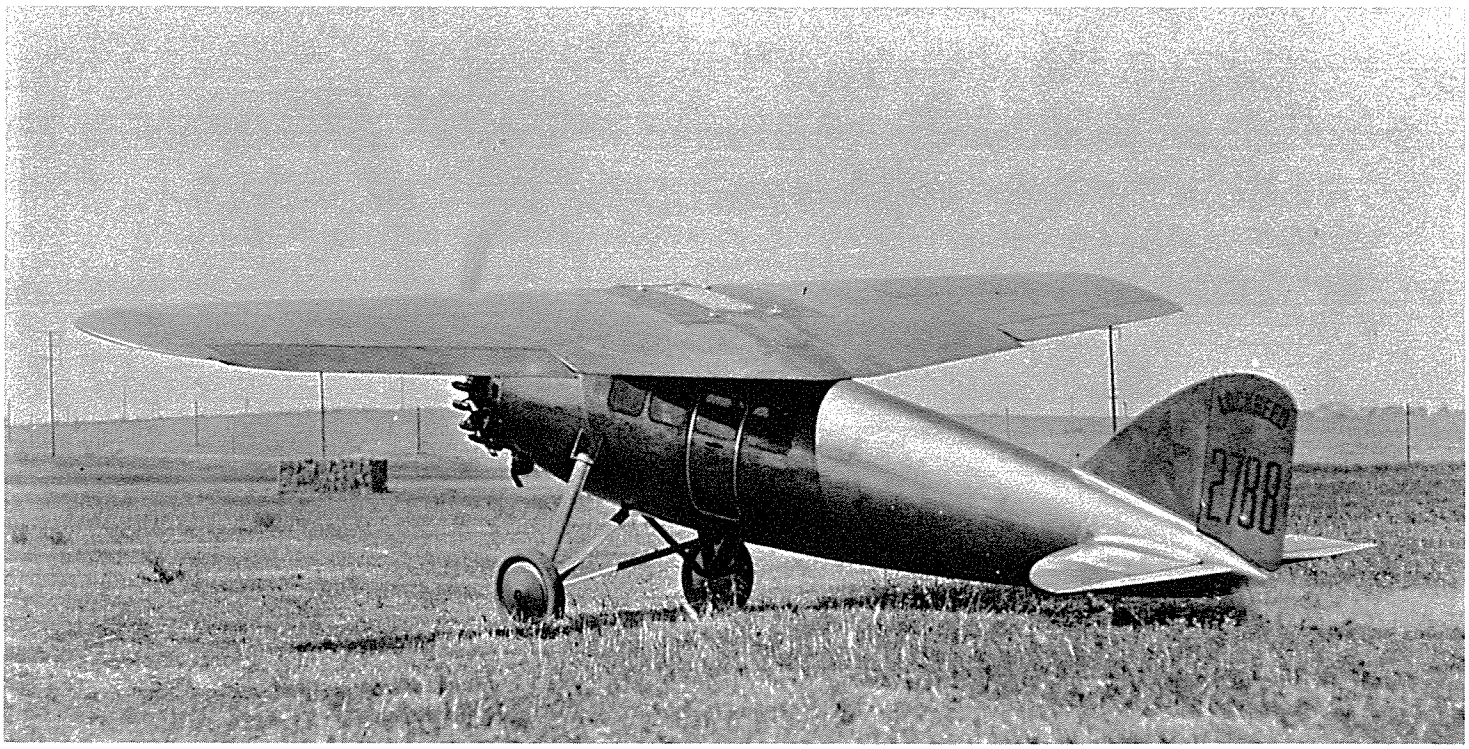
VEGA—Pursuing the "bug in my bonnet," Jack Northrop in late 1926 designed a "clean" airplane consistent with contemporary materials and techniques. The design, born in the privacy of his home in his 'after hours', was later called the *Vega* and became the foundation of the present Lockheed Corporation in early 1927. The *Vega* was an extension of his experience on the earlier S-1. The fuselage was made symmetrical about the vertical and horizontal axes to simplify tooling, while a plywood-covered, cantilever wing was incorporated to greatly reduce drag. The only drag concession made was the retention of a fixed landing gear in the interest of weight and cost.



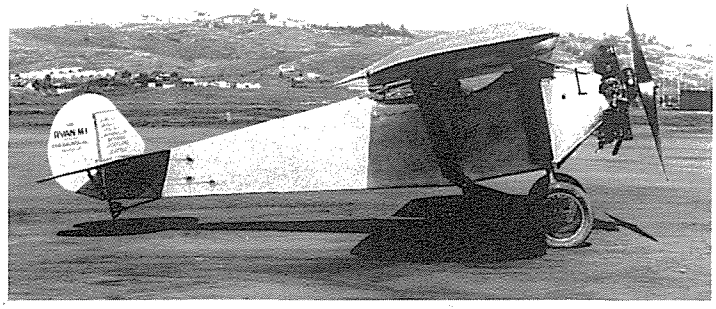
F-1



S-1



Vega



M-1

1929 WING—The 1929 Flying Wing was the first hardware evidence of Jack Northrop's true line of thinking in response to his clean airplane bug-in-the-bonnet. This line of reasoning ultimately became the XB-35 Flying Wing bomber some 17 years later. The gestation of the all-wing concept began in the back of Jack's mind during his time with Douglas and the Lockheed brothers.

The idea was a bit extreme for serious consideration from his peers but the flying wing idea was "sold" as one of the primary objectives to the people who financed the Avion Corporation. The first structural element of the 1929 wing to be built was the horizontal stabilizer (included as a safety feature), because it was the simplest and quickest thing to be built. In the beginning Jack had no specific idea as to how he would do it; the easiest thing seemed to be nested channels and so it was. Testing the structure indicated strength several times greater than thought possible. This idea was then extended to the wing structure, thus the origin of the now universally used multicellular structural techniques.

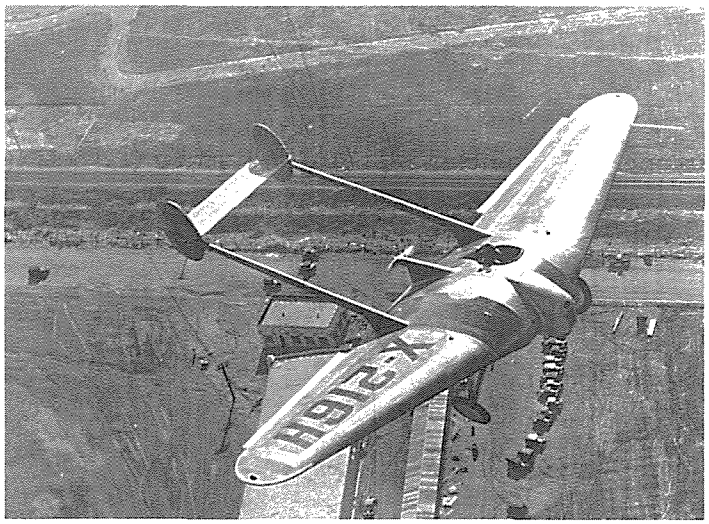
ALPHA—The incorporation objectives of the Avion Corporation were to: 1) explore the flying wing concept, and 2) arrive at a salable article and go into the airplane business. With objective 1) embodied in the 1929 wing, objective 2) was begun in 1929 with the intent of providing an economic return to the stockholders. There was an interest among some airlines for a 6- to 8-passenger airplane of improved performance and operational durability. This need and the newly discovered multicellular structure gave birth to the *Alpha.* The aft-seated pilot and low wing were considerations for the safety of pilot and passengers. The structure inherited from the Avion wing gave it strength and durability. About this time (1928-1929) the concept of fillets was being talked about worldwide. The *Alpha* was the first commercial airplane known to use a wing fillet to reduce turbulent airflow over the tail assembly thereby improving stability and control as well as reducing drag.

BETA—Built as a stablemate to the *Alpha,* the *Beta* was designed for the private market (*Alpha* was commercial) for use simply in enjoying flying. During this period the Avion Corporation was bought out by the United Aircraft and Transport Corporation with this new operating unit identified as Northrop Aircraft Corporation. Initially the *Beta* was powered with a Menasco B6, 160-hp engine and built as a two-seater, a later version powered by a Pratt & Whitney 300-hp *Wasp* was flown as a single-seater. The time-frame was 1930-1931 and the downward trend of the economy of those times stopped any thoughts of production. The *Beta* design along with the *Alpha* were transferred to Stearman at Wichita, Kansas, as part of the economic retrenchment of the United Aircraft and Transport Corporation at which time all operations on the Northrop *Alpha* and *Beta* designs virtually ceased.

DELTA—One of the initial concepts worked on by the new Northrop Corporation (formed with Douglas financing as a research and development source for Douglas, Santa Monica) was the Delta Transport. The *Delta* (Model 1) was an enlargement of the aerodynamic and structural experience gained on the *Alpha* and essentially aimed at the same airline market as the *Alpha.* Untimely intervention by the CAA with their requirements for two pilots and two engines effectively terminated the market for this class of commercial aircraft. A few of the *Deltas* were sold to individuals and companies and also a version (the RT-1) for the Coast Guard.

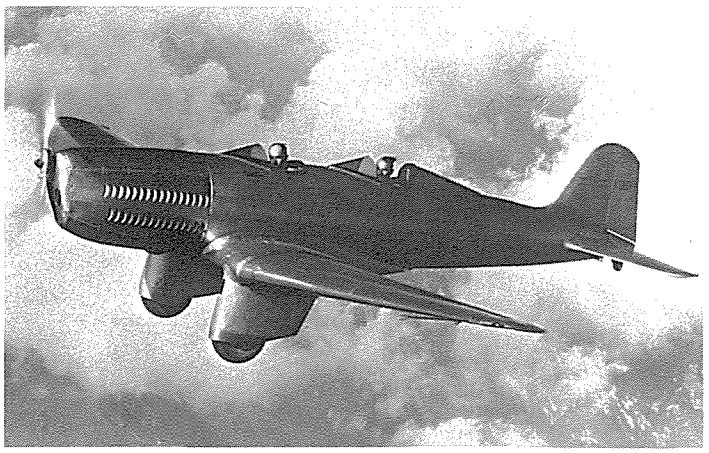
GAMMA; YA-13; XA-16—The *Gamma* (Model 2) began as a series of custom-built, high-performance aircraft for whatever purpose the customer had in mind. Aerodynamic and structural characteristics of the *Gamma* series were extensions and evolutions of those established in the earlier *Alphas* and *Betas* as were those of the *Delta* series. The *Gamma* series ran the gamut from the Model 2A for Frank Hawks/Texaco to the Model 2L sent to England as an engine testbed for the Bristol *Hercules* sleeve-valve engine.

Other notables in the Model 2 series were the 2B for Lincoln Ellsworth's Antarctic expedition; the 2C, the first military adaptation of the series



1929 Wing

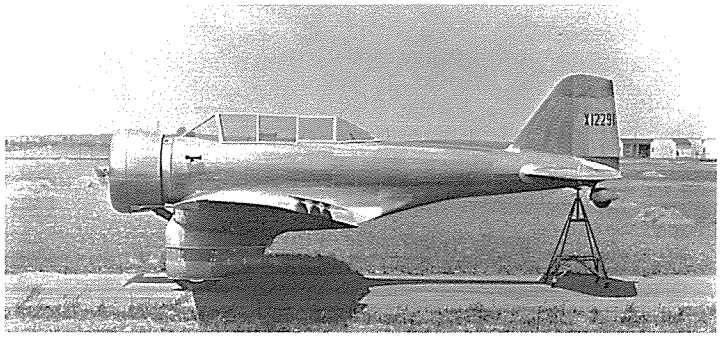
Alpha



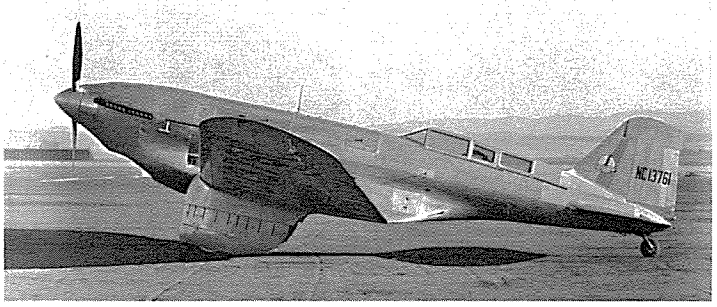
Beta

Delta

which was later modified successively into the YA-13 and the XA-16; the 2D, a mail/cargo plane for TWA; the 2E, the first military production (49 units to China); the 2F; the 2G, Jackie Cochran's racer for the 1935 MacRobertson's London-to-Melbourne race; and of lesser renown, the 2H and 2J.

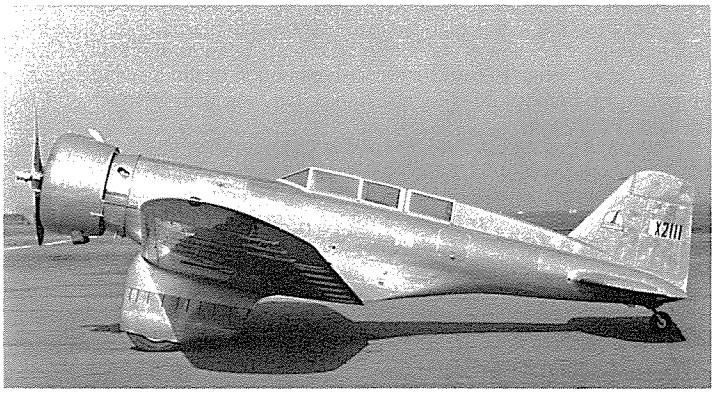


Gamma 2C

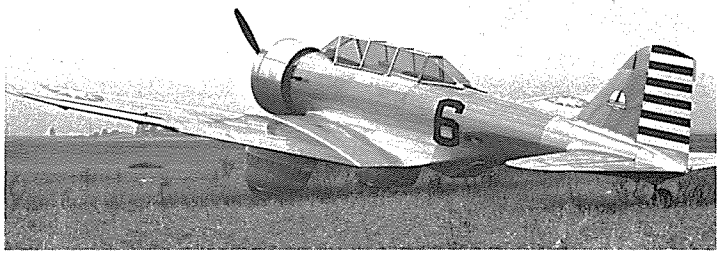


Gamma 2G

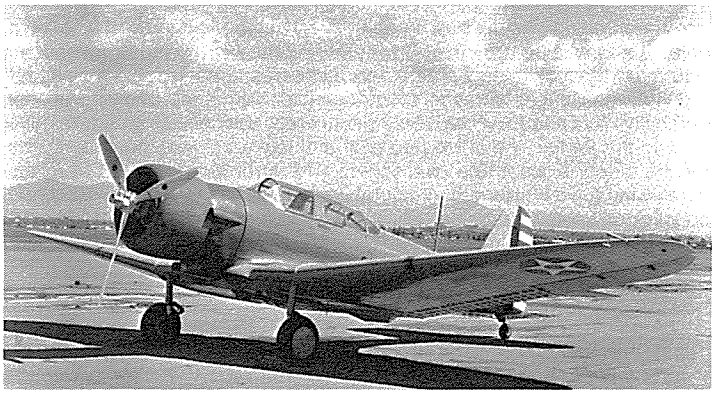
Gamma 2F



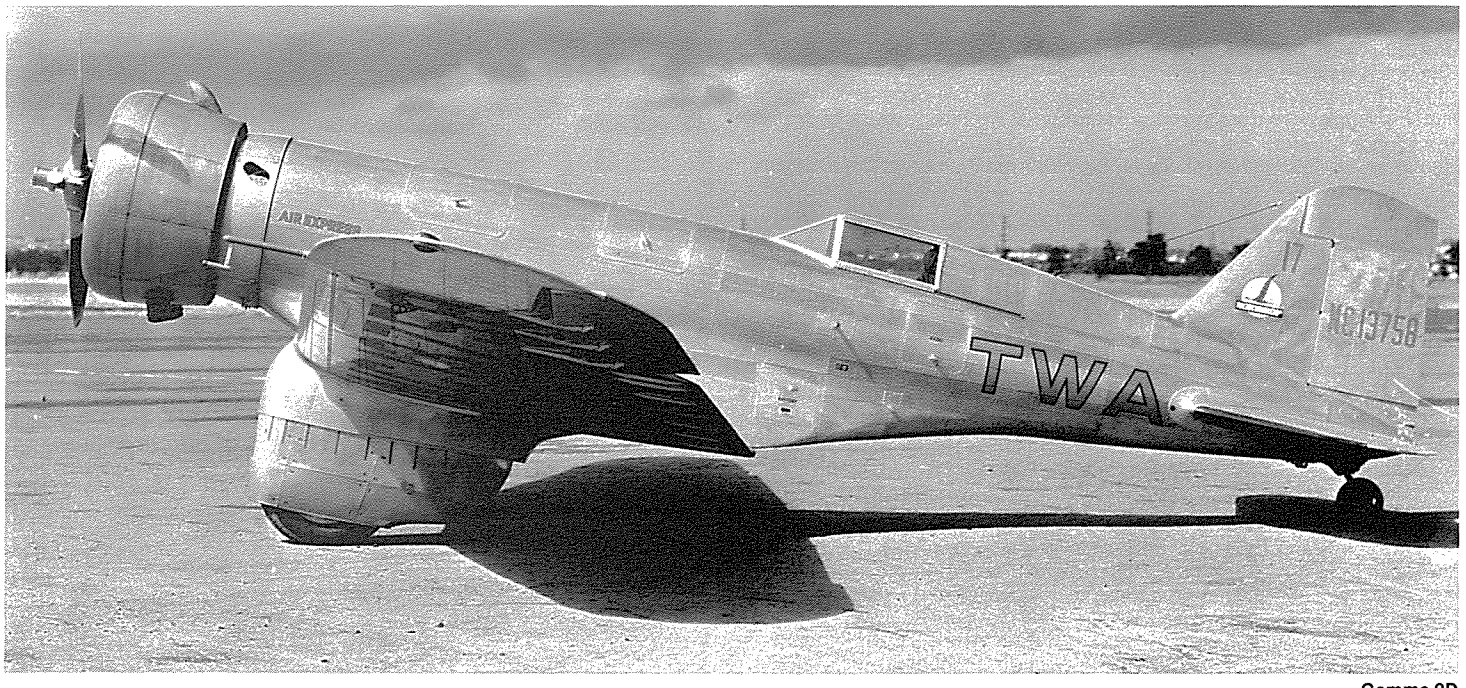
Gamma 2H



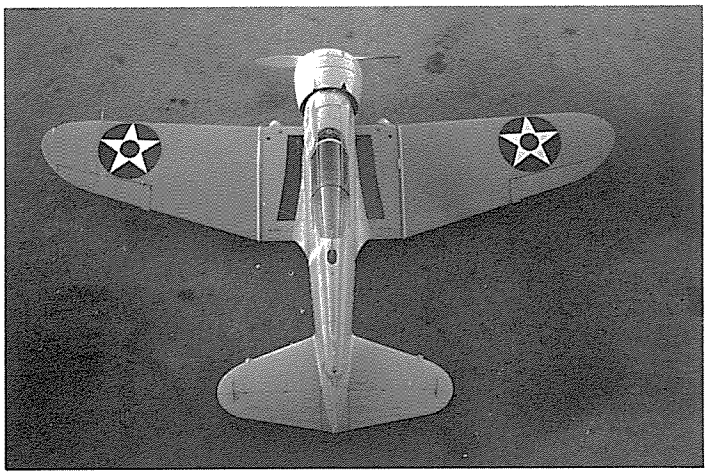
Gamma 2EC



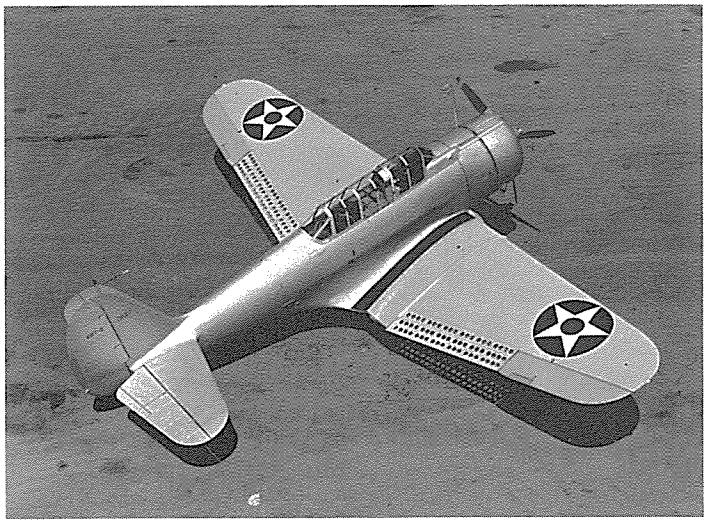
Gamma 2J



Gamma 2D

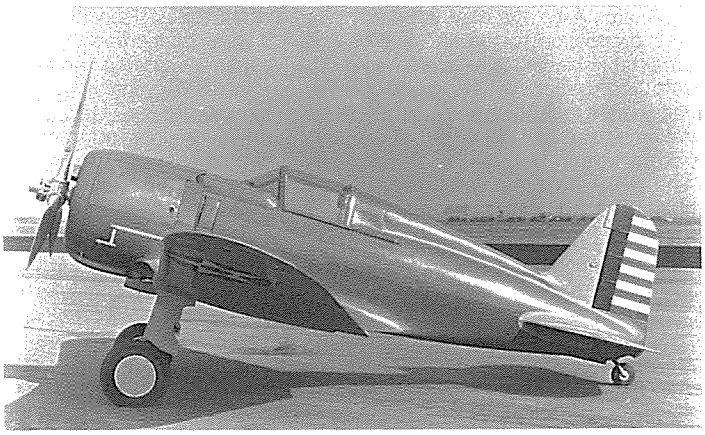


XFT-1



XBT-2

XFT-1—The Navy's competition for fighters in 1933 (BuAer Spec. No. SD-204, 24 January 1933) gave Jack and his engineering team the opportunity to promote all-metal multicellular design and construction in a field still heavily dominated by tube and fabric construction. The XFT-1 was the result of their efforts and reflected their experience on the earlier *Delta* and *Gamma* efforts including the fixed, faired undercarriage. Testing of the aircraft proved it to be the fastest of the offerings but spin prone, a problem that was never satisfactorily resolved. Close study of the configuration dictated by Navy carrier requirements shows a close-coupled wing and tail assembly; this combination readily leads to problems in achieving good airflow over the control surfaces at high angles of attack, such as would precede entry into a spin and the subsequent impaired controllability in a spin. Later, modified by an engine change (650-hp P&W R-1535-72), a new engine cowling and a slightly modified fin and rudder, it reappeared as the XFT-2 for flight testing at NAS Anacostia. Performance was not appreciably improved and the airplane ordered shipped (by land) back to the factory. Test pilot Mosher ignored the shipping instructions and took off for California and lost the aircraft in turbulent air over the Allegheny mountains.

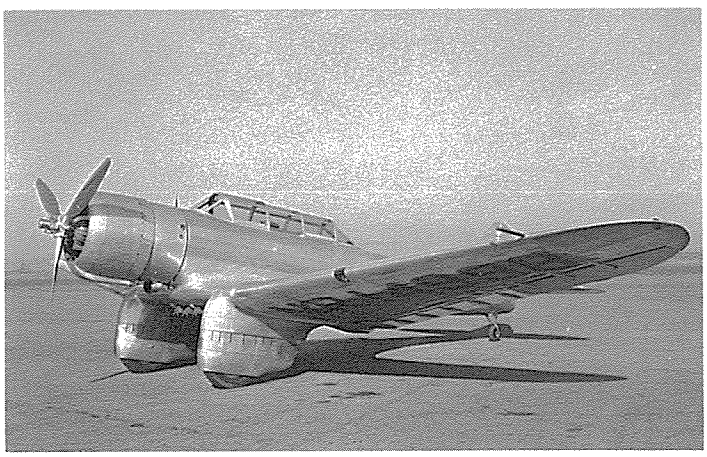


3A

3A—Close on the heels of the XFT-1 competition came an Air Corps design competition in early 1935 with hardware submittals for evaluation by 27 May 1935. Jack and his engineering team headed by Ed Heinemann opted for a cleaned-up version of the XFT under the designation, Model 3A. The primary changes were the 700-hp P&W *Wasp Jr.* and a retractable landing gear. Again the short-coupled airframe proved to be spin prone with some directional instability. The competition was beset with schedule problems as all three competitors (Curtiss, Model 75/P-36 and Seversky, Model SEV-2XP/P-35) had difficulty in submitting their aircraft at the given time and place. Before modifications to overcome spin and stability problems could be made and tested, the 3A was lost on a test flight over the Pacific Ocean with test pilot 1st Lt. Frank Skaer—no trace of either was ever found. This setback removed the 3A from competition, with the design later being sold to Chance Vought Aircraft.

5A

5A; 5B; 5D—In support of the research and development objectives of the Northrop Corporation, Jack Northrop's engineering and sales teams developed the Model 5 variants in parallel with the *Gamma* 2C through *Gamma* 2F/A-17, for the export market which had good sales potential during the middle '30s. While significant production orders did not materialize for the Douglas Company, it is interesting to note that two of the development aircraft (the 5A and 5D) were sold to Japan, while the third airplane (the 5B) was influential in Argentina's purchase of 30 Model 8A-2s in 1938. The 5B later found its way to Mexico and possibly later to Spain.



5B

BT-1; XBT-2—On 1 June 1934, the Northrop Corporation received an invitation from the Navy to bid on an improved carrier-based dive bomber. Northrop's XBT-1 was one of six submittals (the others being Curtiss, XSBC-3; Great Lakes, XB2G-1; Grumman, XSBF-1; Brewster, XSBA-1; and Vought, XSB2U-1) offered and reflected the evolutionary experience begun in the *Alpha* of 1930. Jack Northrop appointed Ed Heinemann as project engineer and between the two of them the XBT-1 took shape. The XBT-1 exhibited two features that were significant departures from the *Delta/Gamma* experience; they were the semi-retractable landing gear and double split flaps. The flap concept could use the lower flap panel as a landing flap or open the upper and lower panels to act as a dive brake—this latter feature being a temporary source of trouble.

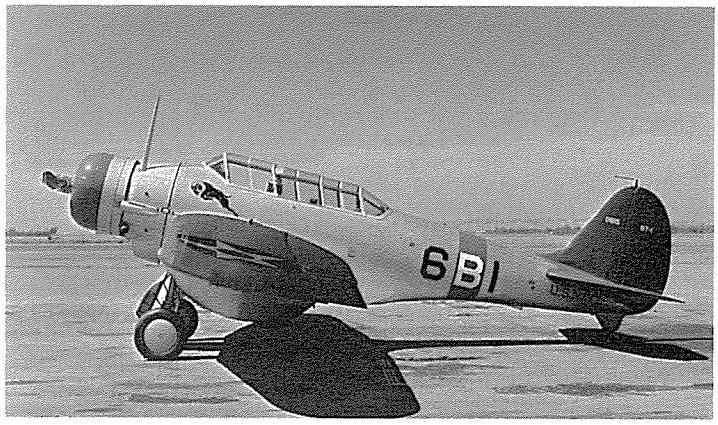
The semi-retractable landing gear was a compromise for Jack and Ed—it supported Jack's bug-in-the-bonnet "clean airplane" and also placated

Jack's stress experience by not having to cut a hole for the landing gear in the wing's primary structure, thus keeping strength up (for the dive bomber mission), weight to a minimum and yet achieve some drag reduction. The split flap/dive brake feature gave considerable trouble in a dive, creating heavy turbulence over the tail and a resulting loss in stability and control. Ed Heinemann approached NACA with the problem, with the perforated split flap evolving as the answer. Basic flight performance went virtually unchanged while dive performance was greatly improved. Fifty-four BT-1s were ordered and issued primarily to Navy VB-5 *(Yorktown)* and VB-6 *(Enterprise)*. The 38th production BT-1 was modified to incorporate a fully retractable main landing gear and redesignated XBT-2. Successive modifications resulting from flight and wind tunnel testing ultimately converted the BT-1 cum XBT-2 into the renowned Douglas SBD-1 *Dauntless.*

A-17—Jack Northrop and his small but enthusiastic company were the recipients of a much anticipated and appreciated Christmas Eve gift in 1934. Official notification for an order for 10 A-17 attack aircraft was received in the mail; this event marked the transition of a research-and-development oriented company to a large-scale (for them) production facility. The A-17 contract resulted from the flight testing of the *Gamma* 2F in late 1934—in fact, the 2F was modified with the substitution of a fixed, faired landing gear for the semi-retractable gear on the 2F, substantial change to the cowling, canopy and tail surfaces and delivered as the first production A-17 of a contract that totaled 110 airplanes. Transition from A-17 production to the A-17A was accomplished by incorporating the retractable landing gear promoted on the *Gamma* 2J entered into an Air Corps competition for basic and advanced trainers. Two special A-17As, designated A-17AS, were built as personal aircraft for Maj. Gen. Oscar Westover and Brig. Gen. Henry H. Arnold. With the management transition from Northrop Corporation to the El Segundo Division of Douglas, the A-17/A-17A was modified in small details and produced as the Douglas Model 8 for the export market.

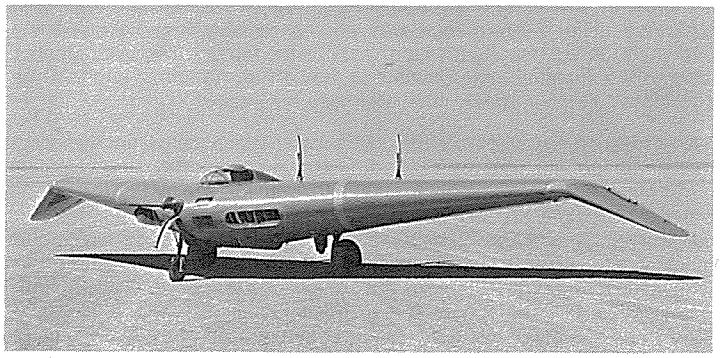
DB-7A/B—Jack Northrop's last new design project in the El Segundo location was the private venture, the Northrop 7A. Designed for observation and attack missions, work was stopped because of changing Air Corps requirements when the engineering work was about 50 per cent complete. Redesigned with a glazed nose for the attack role only, the design reappeared and was built as the Model 7B. In spite of a tragic crash while being demonstrated to members of the French Purchasing Commission, the 7B evolved into the Douglas DB-7 and the A-20 series aircraft whose World War II record is well known.

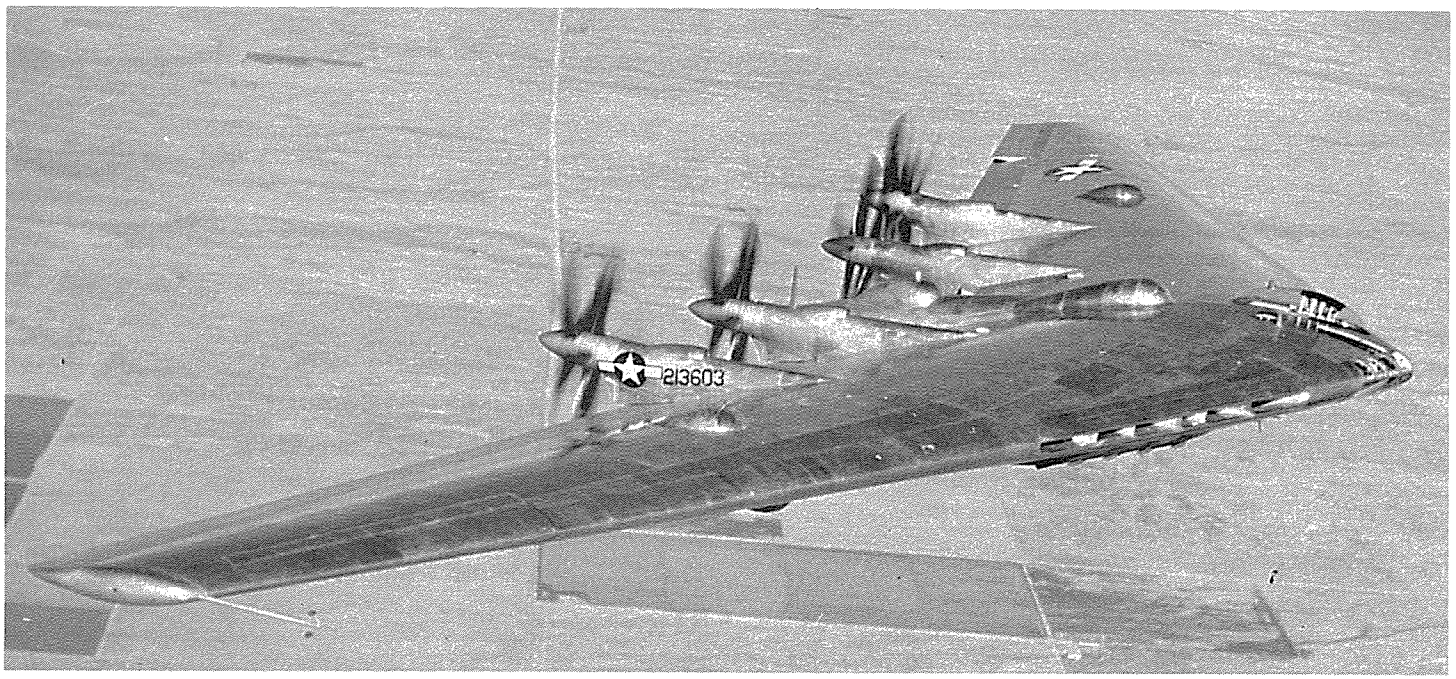
N-1M—The first step in Jack Northrop's final chapter in his quest for the ultimate in clean airplanes was the design and development of the N-1M. Company model numbers for the aircraft designed by Jack's last company to bear his name, Northrop Aircraft, Incorporated, carried an "N" prefix followed by a sequence number which was independent of the type or class of aircraft. The N-1 designator accordingly was the first project of the new company. The N-1M (M, a designator for "flying Mockup") was a true flying wing designed to test wing planform variations for stability and control. Built of easily fabricated wood, the N-1M was configured to



BT-1


A-17A

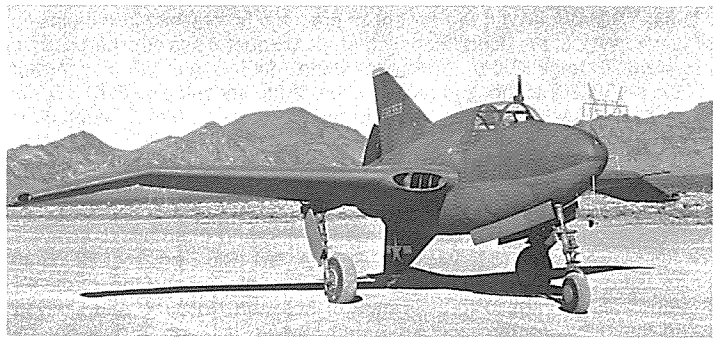

N-1M



XB-35

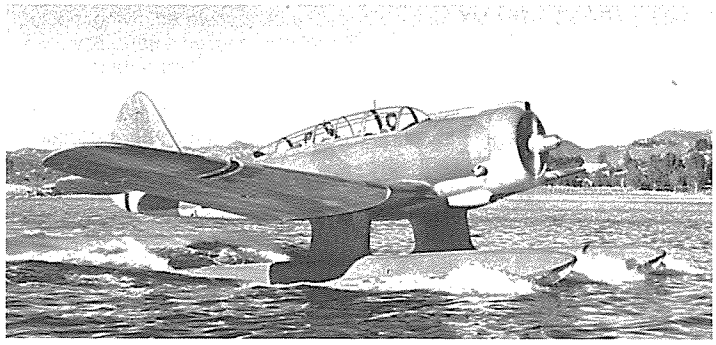
provide test variations in wing sweep and dihedral, as well as wingtip anhedral initially considered necessary for directional stability. Some 200 flight tests refined the configuration to a straight, swept leading edge wing without wingtip anhedral. Successful flight testing of the N-1M aroused Army Air Corps interest even to the extent of supporting some of the flight testing. This in turn provided the basis for the future XB-35.

XP-56—The XP-56, Northrop Model N-2, was the third-place winner in the fighter competition resulting from the Air Corps Request for Data, R 40-C, dated February 20, 1940. Win and place in the competition went to Vultee (XP-54) and Curtiss, St. Louis (XP-55). The XP-56 represented Northrop's concept for a high-speed pursuit featuring unconventional design. For Jack Northrop it was "an unhappy compromise in that it had a substantial fuselage and was a retrograde in the work we were doing" (i.e., N-1M), but such was the nature of the compromise incorporating a P&W R-2800 engine and an erect seated pilot. A unique feature of the XP-56 was the use of all-welded magnesium to achieve lower weight and increased structural stiffness due to the lower density of magnesium and the thicker structural elements made possible by its lower density. A fallout of the use of magnesium, which has been extensively used since then, was the invention and development of heliarc welding. Jack credits the basic concept of the heliarc welding process to H.V. Pavlecka who was a much-valued employee by Mr. Northrop and a key figure in many Northrop development items including the XT-37 Turbodyne engine. The No. 1 XP-56 was destroyed in a high-speed taxi accident seriously injuring John Myers and the No. 2 XP-56 is in the care and custody of the National Air and Space Museum, Smithsonian Institution. While Jack was justifiably pleased with the advent of heliarc welding his "feeling was never really 100 per cent enthusiastic for the '56."



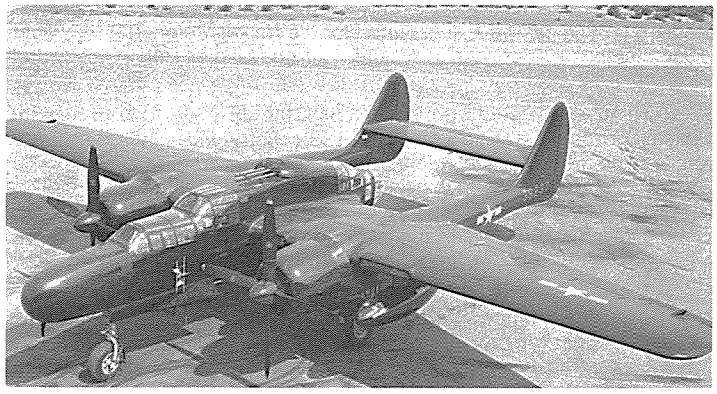
XP-56

N-3PB—The N-3PB (derived from the N-3 attack bomber—the third design project of the fledgling Northrop Aircraft, Inc.) was the first production contract of an indigenous design and was created specifically for the Norwegian government. Utilizing lessons learned, beginning with the *Alpha*, Jack Northrop and his engineering team under Project Engineer Fred Baum created what was one of the cleanest multiplace combat aircraft up to that date. Using the evolved version of Jack's multicellular structure, the N-3PB proved to be a rugged well-streamlined airplane. The principle departures from contemporary American design practices were the use of a smooth contour greenhouse (no steps) and cantilevered pylons for mounting the floats. Twenty-four aircraft were sold to Norway but the N-3PB never flew its design mission of patroling the coastal waters of Norway. Due to the Nazi occupation of Norway, the N-3PB served Norway as an element of the RAF (330 Squadron) in the brutal Arctic environs of the Atlantic Ocean from bases in Iceland. One example remains, reconstructed in 1980 by volunteer help at Northrop Corporation's Aircraft Division in Hawthorne, California, and ultimately destined for permanent display in Norway.



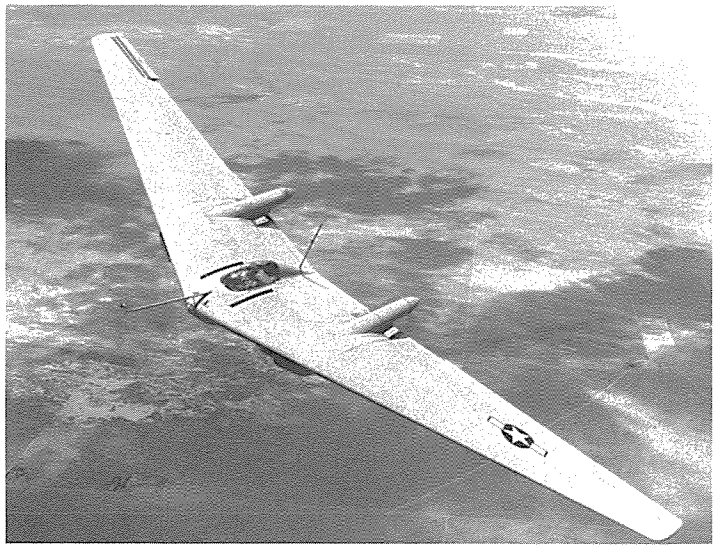
N-3PB

XP-61 — F-15A — Jack Northrop's P-61 is unique in the annals of combat aircraft being the first night fighter aircraft designed as such for that mission from the beginning. The P-61 was a sole source contract and to quote Jack in later years, "It wasn't the result of a design competition—it was simply given to us as a suitable contractor for its development, and possibly because we were known for being perfectly willing to try novel ideas of one sort or another." Production of the P-61 totaled 706 aircraft in five models: XP-61, YP-61, P-61A, P-61B, and P-61C. Other versions existed as modifications of these aircraft namely the XP-61D, XP-61E, P-61G, F2T-1, XF-15A and 36 production F-15As produced from partially completed P-61C airframes available after V-J contract cancellations.



P-61B

N-9M—Northrop design project, N-9 was the basis for the B-35 Flying Wing bomber contract. The "M" designator in N-9M is for a flying mockup (as in the N-1M) and in this case the N-9M was an approximate one-third scale model for the XB-35. Four models/versions of the N-9M were built (N-9M1, N-9M2, N-9MA and N-9MB) and were used to evaluate aerodynamic characteristics of the big wing; evaluate a variety of control surface and controls configurations; and provide a level of flight training for company and military test pilots. Like the N-1M, the N-9Ms were essentially wooden aircraft which could readily be modified for testing and at the same time did not use strategic aluminum or encroach on metal fabricating facilities sorely needed to support the war effort. N-9M1 was destroyed on a flight test early in the program killing test pilot Max Constant. The remaining three aircraft completed the test and training programs with the N-9MB surviving (somewhat poorly because of the wooden construction) in Ed Maloney's "Planes of Fame" museum.



N-9M

XB-35—The XB-35 was the threshold of Jack Northrop's longtime dream of a "clean" airplane. Designed to the same criteria of 10,000 pounds and 10,000 miles as its competitor, the Consolidated B-36, the XB-35 was a considerably smaller aircraft than the B-36. In fact, the XB-35 could utilize existing hangar space for B-29 class aircraft and only one-third the ramp area of its larger competitor. Development of the XB-35 lagged much to the distress of Jack Northrop and his entire work force. The lag was caused by the inability to acquire satisfactory engine-gearbox-propeller combinations. Malfunctioning propellers are credited by many as causing the cancellation of the B-35 production contract then in the early definition process with the Glenn L. Martin Company. A total of 15 XB-35, YB-35 and YB-35A aircraft were either complete or under construction when the program was canceled.

YB-49; YRB-49A—With the advent of practical jet engines in the closing stages of WW II, the need to apply them to bomber-class aircraft became apparent. Change Order II, dated 1 June 1945 to the YB-35 contract (W535-ac-33920) authorized modification of the second and third YB-35s to 8-jet (J-35-A-15) YB-49s. This fortunate step, in effect, kept Jack Northrop's dream alive when the chronic failures of the XB-35's propeller governors and gearboxes caused cancellation of the B-35 program. The future of the flying wing seemed well established early in 1948 with positive progress in flight testing the YB-49s, the initiating of a contract for 30 FB-49A aircraft,(later redesignated RB-49A) and the modification of a YB-49 (later YB-35A) to a prototype RB-49A. The tragic crash of #2 YB-49 on 15 March 1950 and the political involvement of the Secretary of the Air Force in an attempt to force a merger between Northrop and Convair killed the B-49 program and frustrated forever Jack Northrop's dream, then on the threshold of reality.

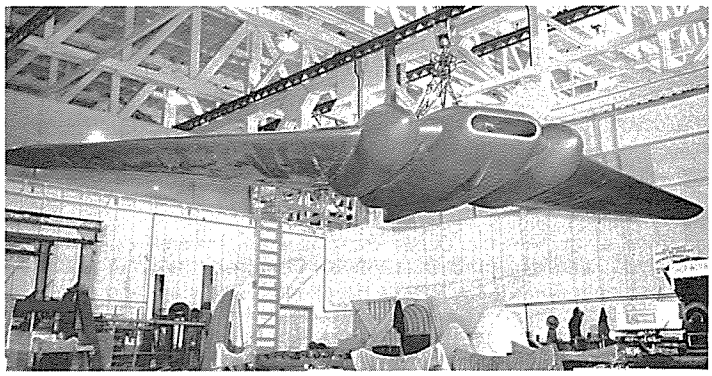
MX-324; XP-79B—The MX-324, a wooden, rocket-powered, flying mockup (a la N-1M and N-9M) for the XP-79 rocket-propelled interceptor, was destined to become the first successful rocket-propelled airplane in the United States. Due to tight security on the program, the MX-324 saw the first light as an unpowered glider designated MX-334 (the MX-324 became an instant glider when the fuel burned out). Flight testing of the MX-334 as well as the MX-324 was conducted by towing them aloft behind a P-38, although initially several unsuccessful attempts were made to launch an MX-334 by towing behind a specially modified 16-cylinder Cadillac. The origin of the XP-79 began in September 1942 when Jack Northrop made a proposal to the Air Technical Service Command for a flying wing, prone pilot interceptor with a 2000-pound thrust engine. As an intermediate step, the MX-324/MX-334 were built to flight test the configuration to verify flying qualities before completion of the XP-79. The XP-79 failed to materialize because of the inability of the Aerojet Corporation to produce a workable rocket motor. In a last effort to salvage the program two Westinghouse Model B jet engines were substituted for the rocket motor. The first flight (12 September 1945) ended in a tragedy killing test pilot Harry Crosby and destroying the aircraft.

JB-1; JB-10—Initiated as project MX-543, the JB-1 was one of several pilotless or robot bombs developed in this country under the pressure of war and the advent of the German V-I buzz bomb. Northrop's flying wing version was created on an expedited basis by photo reducing the tooling templates for the MX-324/MX-334. The JB-1 was powered by two General Electric, Type B1 jet engines. Eleven of the 13 JB-1 airframes ordered were modified to accept the PJ-31-1 pulse jet engine built by the Ford Motor Company and redesignated JB-10.

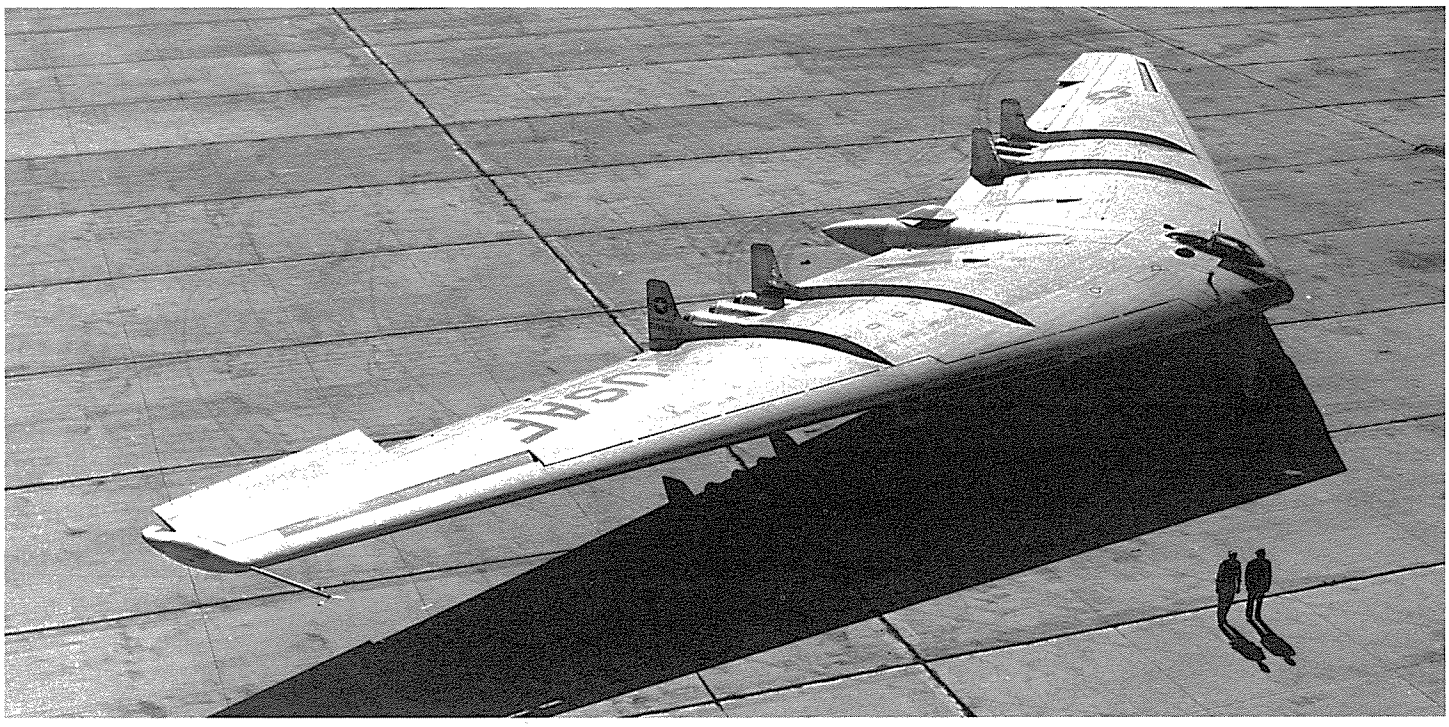
N-23—Northrop's postwar offering to the civilian/commercial market was the N-23 *Pioneer* trimotor. It was built in response to a perceived need for profitable air transportation in the underdeveloped parts of the world that lacked modern airport facilities. The N-23 possessed excellent low-speed flight characteristics as the result of a wing planform, control system and flap arrangement similar to that of the P-61. A production status was never

MX-324

XP-79B



JB-1



YB-49

SM-62

achieved due to the flood of C-46 and C-47 aircraft available to the civil market after WW II. Tragedy ended the N-23's flight test program after nearly one year when it crashed during the yaw testing a modified vertical fin, taking the life of test pilot L.A. "Slim" Perrett.

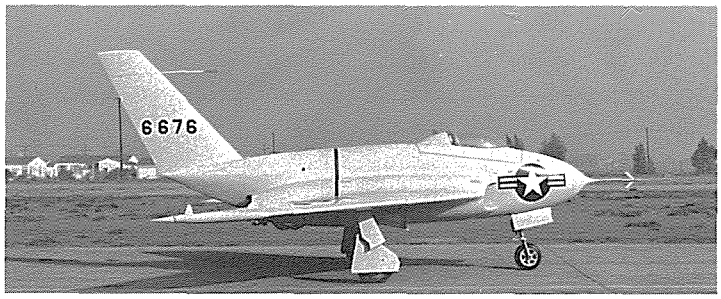
X-4—The critical need for transonic and supersonic aerodynamic data after WW II led to a joint NACA/Air Force/Navy research airplane program covering research models X-1 through X-5 and the Douglas D558-1 and D558-2. In response to this effort Jack Northrop proposed a semi-tailess aircraft for testing swept wing characteristics in the high transonic speed regime. A contract for the airplane, designated X-4, was awarded on 5 April 1946. Two aircraft, each powered by two Westinghouse J-30-WE-7-9 engines were built. The X-4 served its purpose quite well as degraded stability characteristics appearing at Mach 76 through Mach 90 identified the need for continued testing of airfoils and control surface configurations.

N-25; SM-62—As the result of a letter from General L.C. Craigie, dated 31 October 1945, to various airplane manufacturing companies, outlining a proposal for a Guided Missile Research Program, Jack Northrop and his engineering team responded with a proposal that was to become the MX-775 Snark missile program by a letter contract dated 28 March 1946. Under company designation N-25 the missile evolved as a swept wing, semi-tailess cruise missile with 1,500 to 5,000 statute-mile range and a 5,000-pound warhead flying at a speed in excess of 600 mph. During 1951, specification changes increasing the range to 5,500 nautical miles and a warhead increase to 7,000 pounds forced a redesign which was designated N-69. The N-69 series test vehicles became the physical and functional prototypes to the SM-62 Intercontinental Missile. The SM-62 *Snark* became operational at the SAC base at Presque Isle, Maine. The name *Snark* was suggested by Mr. Northrop, the origin of which was a poem by Lewis Carroll describing a mythical creature—part snake, part shark.

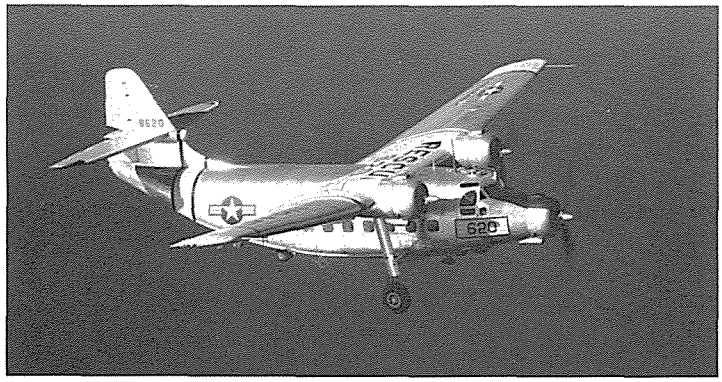
YC-125—The trimotor YC-125A/B was essentially the military evolution of the N-23 *Pioneer*. The wing of the YC-125 possessed a high degree of aerodynamic similarity to the N-23, the major, obvious variation being an increase in dihedral and trailing edge flap design. Built in two versions, the YC-125A Assault Transport and the YC-125B Arctic Rescue, the aircraft were externally identical—the variations being internal equipment. First flown on 1 August 1949, by Max Stanley, the YC-125 seemed to be a step back in time. It was, however, ahead of its time in accessibility for maintenance which would have been critical for mission performance. Performance characteristics, however, were marginal causing the airplane to lose the competition to the Chase C-123. Twenty-three aircraft were produced, the majority of which went on to civilian careers in Latin America.

XF-89; F-89D—Jack Northrop's last major design and ultimately the beginning of his most productive effort, the XF-89 began as his entry for an all-weather fighter in late 1945. By March 1946, the proposals submitted were evaluated and on 13 June 1946 a letter contract was executed for two XP-89 aircraft. Originally conceived to destroy enemy air force and tactical targets under all-weather, day and night conditions, the XP-89 was initially configured to carry a 4-gun turret in the nose of the aircraft. This was soon replaced by a fixed, six 20mm gun installation on the YF-89A, F-89A, F-89B and F-89C. In April 1949, Brig. Gen. W.L. Richardson recommended that the F-89 be used for air-to-air guided missiles because the plane's large size would permit great variations in armament installations. From this, the missile carrying F-89D, F-89H and F-89J (F-89D modifications) were developed. The F-89J fired the first air-to-air atomic missile.

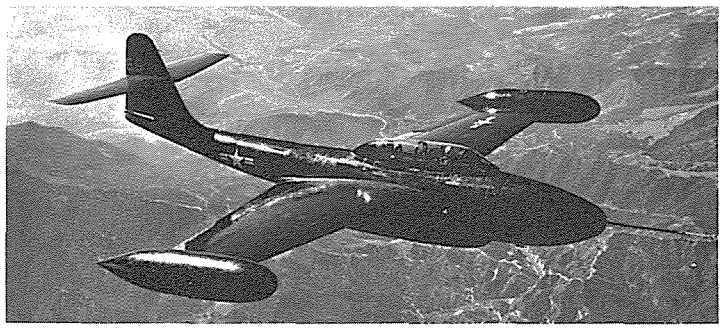
N-23



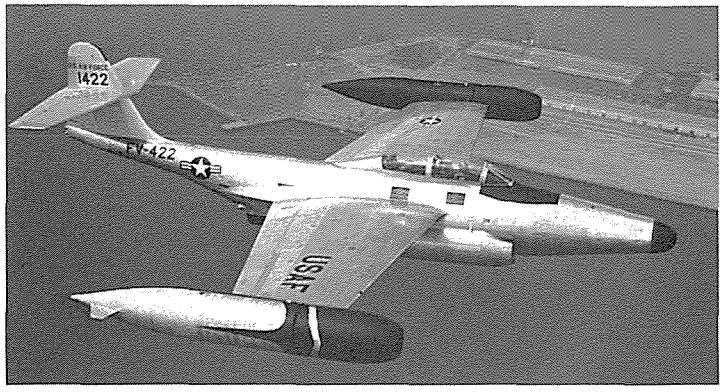
X-4



YC-125



XF-89



F-89D