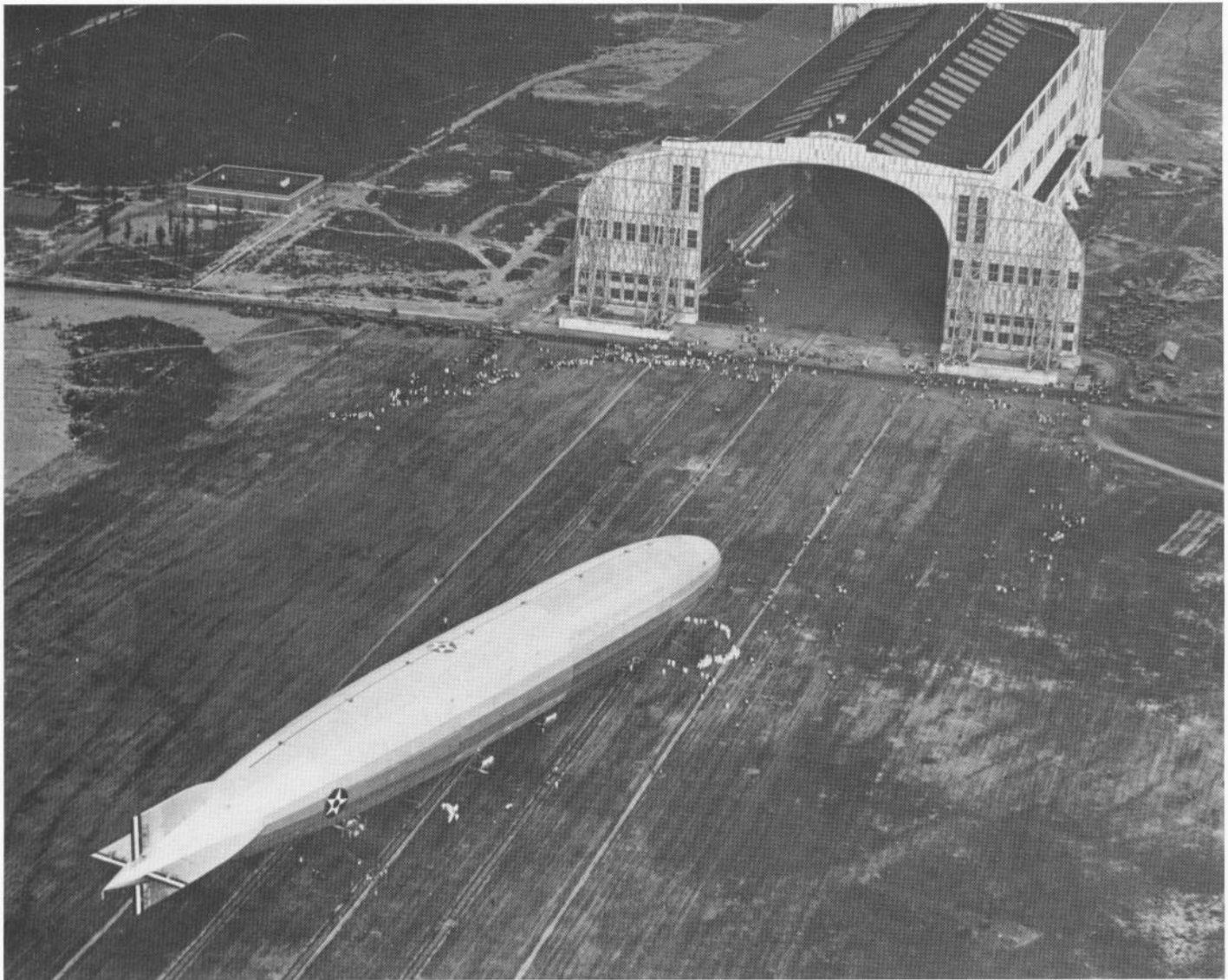




Left, a kite balloon in the "balloon well" of USS Wright (AZ-1) in July 1922. Left below, an artist's rendering of Wright. The ship was designed and built as an LTA tender, with kite balloon operations as her primary mission. Above, USS Shenandoah (ZR-1), the Navy's first rigid airship, at NAS Lakehurst, N.J. Lakehurst was to become synonymous with the operation and development of LTA in the Navy.

of costly helium. Further operations were limited by the need for a gas-cell and structural overhaul of *Los Angeles*, and the lack of non-rigid airships in satisfactory flying condition. When *Shenandoah* was lost, *Los Angeles* was the only airship, rigid or non-rigid, in operational condition in the Navy inventory. This was true until October 1926, when the J-3 non-rigid airship made its first flight.

In the spring of 1927, a commercial company proposed a contract to produce helium from a Kansas field. This offer was accepted by the government and a contract was signed for the delivery of helium. To transport the helium, a tank car was procured, designed for both

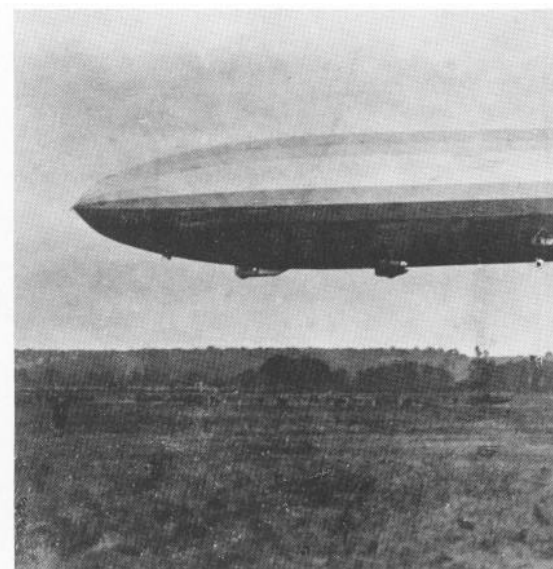
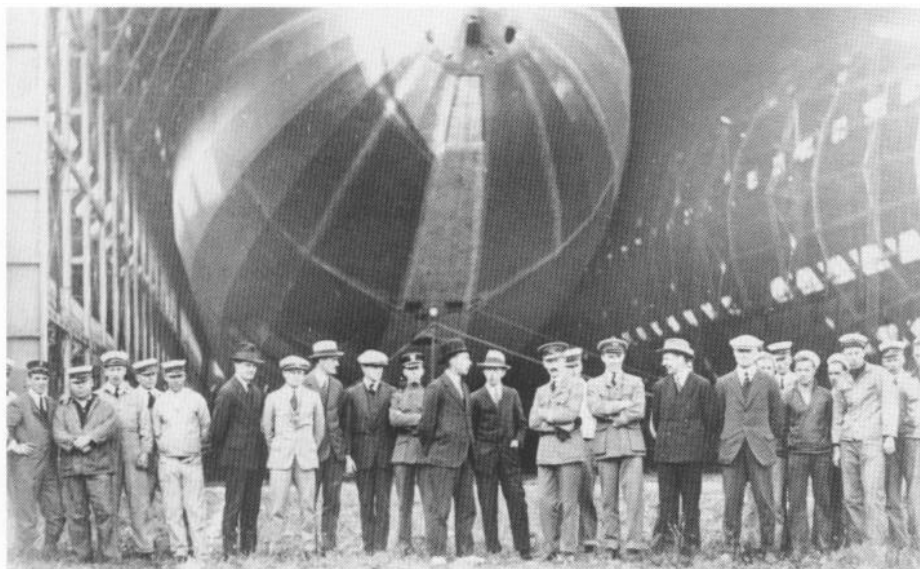
helium transport and storage. Besides a saving in transportation costs, there was less leakage than had been the case when helium was transferred in small cylinders. The tank car also added a great deal of mobility to the helium supply.

The helium supply tended to fluctuate, but by the end of the 1920s it was adequate for airship operations because of increased storage, transportation and additional supplies both from a commercial concern and the government's helium plants. The development and use of helium would not have progressed as rapidly as it did had it not been for the pioneer work begun by the Navy and other government agencies during WW I.

X. The Development of LTA's Home Base and the Rigid Airship Program

A center for LTA operations was established in August 1921 at NAS Lakehurst, which was destined to become the Navy's most important LTA base. Construction work had begun on the LTA hangar there in 1919. It was completed just prior to the establishment of the naval air station in August 1921. Work began immediately on the Navy's first rigid airship.

In the late 1920s and early 1930s, NAS



Lakehurst became the primary base for operating airships and training LTA personnel. When the Navy's last rigid airship was transferred to NAS Sunnyvale, Calif., in late 1933, Lakehurst was placed in a reduced operating status. The air station was still maintained for the training of personnel and for limited operations with the ZMC-2 and the non-rigid K-1. Lakehurst gained recognition in the mid-1930s as the terminal for commercial operation of the German rigid airships *Graf Zeppelin* and *Hindenburg*.

In the latter part of the 1930s, LTA operations were again centered at Lakehurst. As the only LTA station, Lakehurst was involved in training, experimentation and ASW exercises. Training included airship operations and extensive tests in the mooring and ground handling of airships. LTA activity continued at Lakehurst and it was not until the advent of a war that additional LTA shore facilities were developed and placed in operation.

The rise of NAS Lakehurst as an LTA center is mirrored by the development of the Navy's rigid airship program. The Naval Appropriations Act passed by Congress on July 11, 1919, provided for construction of a rigid airship and the purchase of another. Facilities in the U.S. did not have the capability to construct a large rigid airship, so the Navy decided to buy one built in Europe, who was ahead of the U.S. in rigid airship construction and design. Such a purchase would give the Navy immediate possession of a state-of-the-art vehicle and provide invaluable training for Navy crews in operating and handling rigid

airships. Thus, the Secretary of the Navy approved the purchase of a British rigid airship on August 9, 1919, and also the construction of a second one in the U.S.

A contract with the British for the purchase of the R-38 (ZR-2) was approved by the Secretary of the Navy on December 5, 1919. In 1920, the Navy sent personnel to England under the command of Lt.Cdr. Lewis Maxfield for training at the British airship bases of Pulham and Howden. Several British airships were used, particularly the R-33 and R-80. The R-38 made her maiden flight June 23-24, 1921 (the flight began the night of the 23rd and ended the morning of the 24th). Three other flights followed and on August 23, 1921, during the fourth trial flight, the R-38 broke in two during maneuvers, igniting the fuel and hydrogen. The airship crashed into the Humber River, near the city of Hull. Seventeen of the 44 personnel killed in the crash were Americans. Two of the Navy's most prominent LTA officers, Lt.Cdrs. Maxfield and Coil, were among those lost. The loss of the American personnel and the R-38 was a serious blow to the Navy's rigid airship program, as well as a portent of things to come.

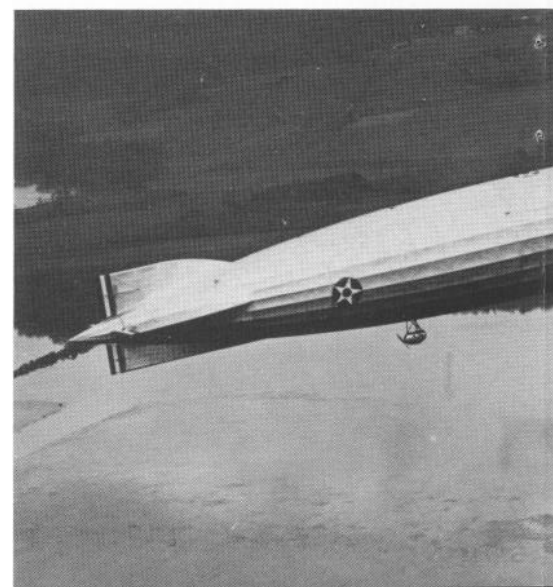
Plans for the construction of *Shenandoah*, the first rigid airship to be built in the United States, were begun in September 1919, and the first materials were delivered to the Naval Aircraft Factory at Philadelphia early in 1920. Her parts were manufactured at the Naval Aircraft Factory and then shipped to NAS Lakehurst for final assembly. When the ZR-2 crashed, the Navy immediately focused its attention on *Shenandoah* (ZR-1). Numerous investigations, design

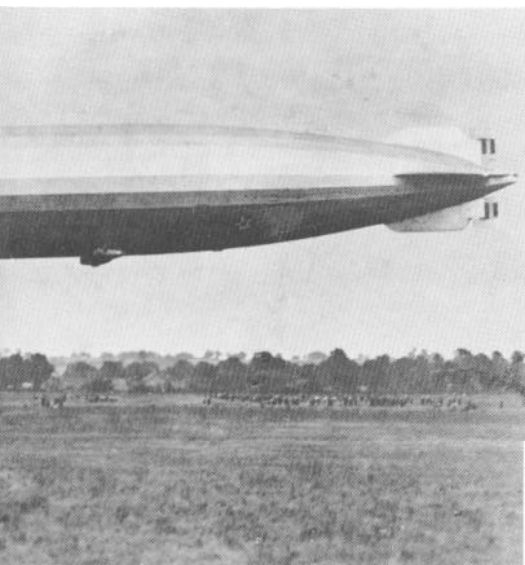
reviews and further testing and experimentation were conducted to ensure that the structural integrity and design of the ZR-1 were adequate to fulfill all required missions.

Shenandoah achieved many firsts during her short career. She was the first rigid airship to be inflated with helium; the first to use water recovery apparatus for the continuous recovery of ballast from the exhaust gas of the fuel burned; and she was the first to fly across the United States. During her relatively short life of two years, she made 57 flights, logging 740 hours in the air, which covered about 28,000 miles on flights designed to train men in the science of handling large airships in naval missions.

The following is a chronological sketch of USS *Shenandoah*'s career:

1922: 11 Feb — Completion of the first cradle for building the ZR-1 at NAS Lakehurst marked the initial step in her assembly.





Far left, the British-built R-39 (ZR-2) in an English hangar. Note a second British rigid airship under construction. Personnel in the foreground include members of the American crew sent to England for training and acceptance of the R-38. Many of them were killed when the R-39 crashed in August 1921. Left, the R-39 at Bedford, England, in July 1921.

visit the International Air Races at St. Louis.

10 Oct — Christened USS *Shenandoah* (an Indian name meaning daughter of the stars) by Mrs. Edwin Denby, wife of the Secretary of the Navy. Commissioned as a U.S. Navy ship at NAS Lakehurst.

16 Nov — First tests of the mooring mast at Lakehurst.

3 Dec — President Coolidge approved the plan to send *Shenandoah* on a flight over the North Pole in 1924.

1924: 16 Jan — In the early evening, was torn from her mooring mast at Lakehurst by a 70-knot gale which drove her northward toward Newark and Staten Island. The crew of 22 on board, under command of the navigator Lieutenant Commander M. R. Pierce,

brought her under control and returned her to Lakehurst in spite of considerable damage to the outer cover and nose cap and a partially damaged vertical fin. This damage caused cancellation of the planned polar flight.

22 May — First flight on 16 January after repair of damage was from Lakehurst toward Toms River and return, with the new commanding officer, Lieutenant Commander Zachary Lansdowne.

8 Aug — Secured to the mooring mast on USS *Patoka* while underway in Narragansett Bay and remained there for almost 24 hours while the ship moved to her anchorage off Jamestown, R.I. This was the first use of the shipboard mooring mast designed to facilitate airship operations with the fleet. She was moored to *Patoka* seven times during her career.

16-17 Aug — Participated in a scouting problem with the Scouting Fleet involving a continuous cruise of 40 hours, 300 miles at sea.

1 Sep — Began a one-month overhaul at NAS Lakehurst.

1923: 13 Aug — Inflation with helium began.

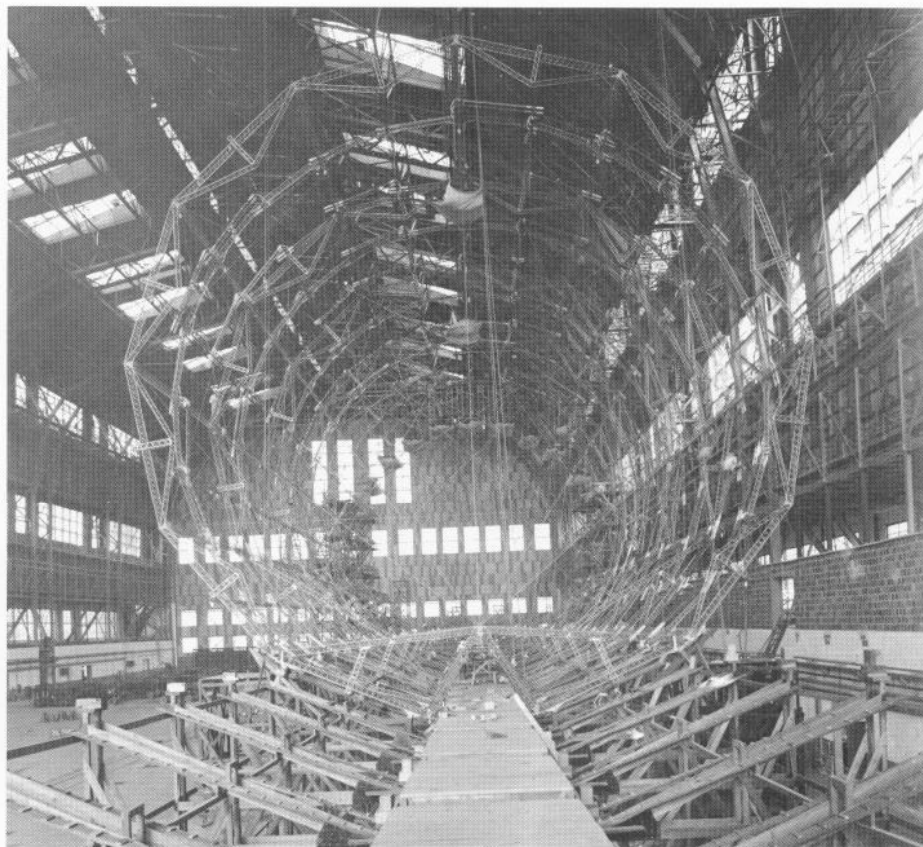
20 Aug — Became airborne for first time as construction scaffolding was removed and she was floated to a new position in the hangar.

4 Sep — First flight from the hangar at Lakehurst. The flight was about one hour in duration and reached a point about 20 miles from the station. Among those on board were: Commander F.R. McCrary, first commanding officer of the ZR-1, R.D. Weyerbacher, Manager of Construction, who was responsible for the assembly of the ship at Lakehurst; and Captain Anton Heinen, test pilot, a former German zeppelin test pilot employed by the Navy Department.

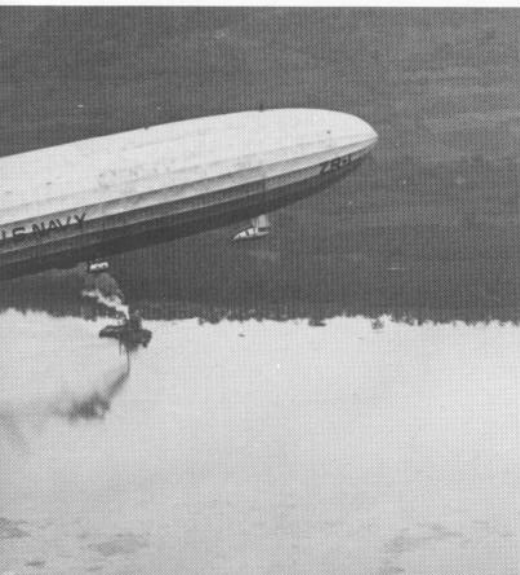
11 Sep — First flight over Philadelphia and New York City.

22 Sep — First flight over Washington, D.C.

2 Oct — Flew cross country to



Above, the frame of USS *Shenandoah* (ZR-1) under construction at Lakehurst. Left, *Shenandoah* in flight.



7 Oct — Left NAS Lakehurst at 1002 for an extended flight to Tacoma, Wash., and return, via Fort Worth, Texas, and San Diego, Calif.

25 Oct — Landed at NAS Lakehurst completing the most extended operation accomplished by an airship up to that time. In crossing the U.S. from the Atlantic to the Pacific and from Canada to Mexico, total time away from the shed at Lakehurst was 19 days, 19 hours, and distance covered was 9,317 statute miles. A great variety of weather, wind and climate was experienced, much of which was adverse. Mooring masts were the only facilities available throughout the trip for fueling, gassing, provisioning and repair.

1925: 3 Jul — Departed Lakehurst for operations with USS *Patoka* in the Bar Harbor, Maine area.

23-24 Jul — Operations with USS *Texas*. Left Lakehurst at 0800 for the Southern Drill Grounds, arrived at and 1240 proceeded with the exercises. After completion, moored to *Patoka* near Cape Charles at 1928. At 0925, July 24, left *Patoka* to continue operations with *Texas*. The return flight to Lakehurst began about 1600; the airship arrived at 2250, and was docked in the hangar at 2130.

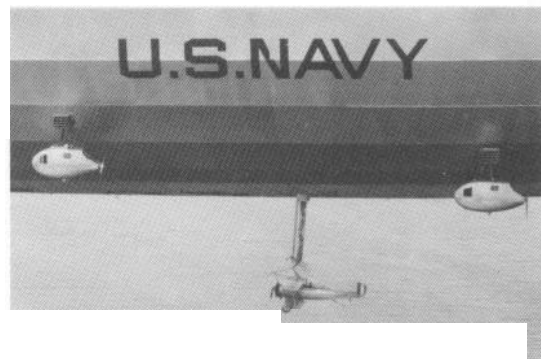
3 Sep — *Shenandoah* disaster. Left the mooring mast at NAS Lakehurst at 1500, September 2, for a flight over the midwest. The airship proceeded westerly over Philadelphia and Wheeling, W. Va., headed for Columbus, Ohio. While over

eastern Ohio, before dawn on the morning of September 3, the airship encountered a severe storm at 0548. EST. She broke in two, ahead of the forward engines over Ava about 25 miles east of Zanesville. The control car separated and fell to the ground while the forward section of the ship rose to a great height and remained in the air for the greater part of an hour, before making a free balloon landing at Sharon, Ohio. The after section descended almost immediately, breaking into two parts when it struck the ground. Twenty-nine of those on board survived the crash, but the commanding officer, Lt. Cdr. Lansdowne and the following men of his crew were lost: Lieutenant Commander Lewis Hancock, Lieutenants John Bullard Lawrence, Arthur Reginald Houghton, and Lieutenant Junior Grade Edgar William Sheppard; enlisted crewmen: Everett Price Allen, Charles Harrison Broom, James William Cullinan, Ralph Thomas Jeffray, Celestino P. Mazzuco, James Albert Moore, Bartholomew B. O'Sullivan, George Conrad Schnitzer, William Howard Spratley.

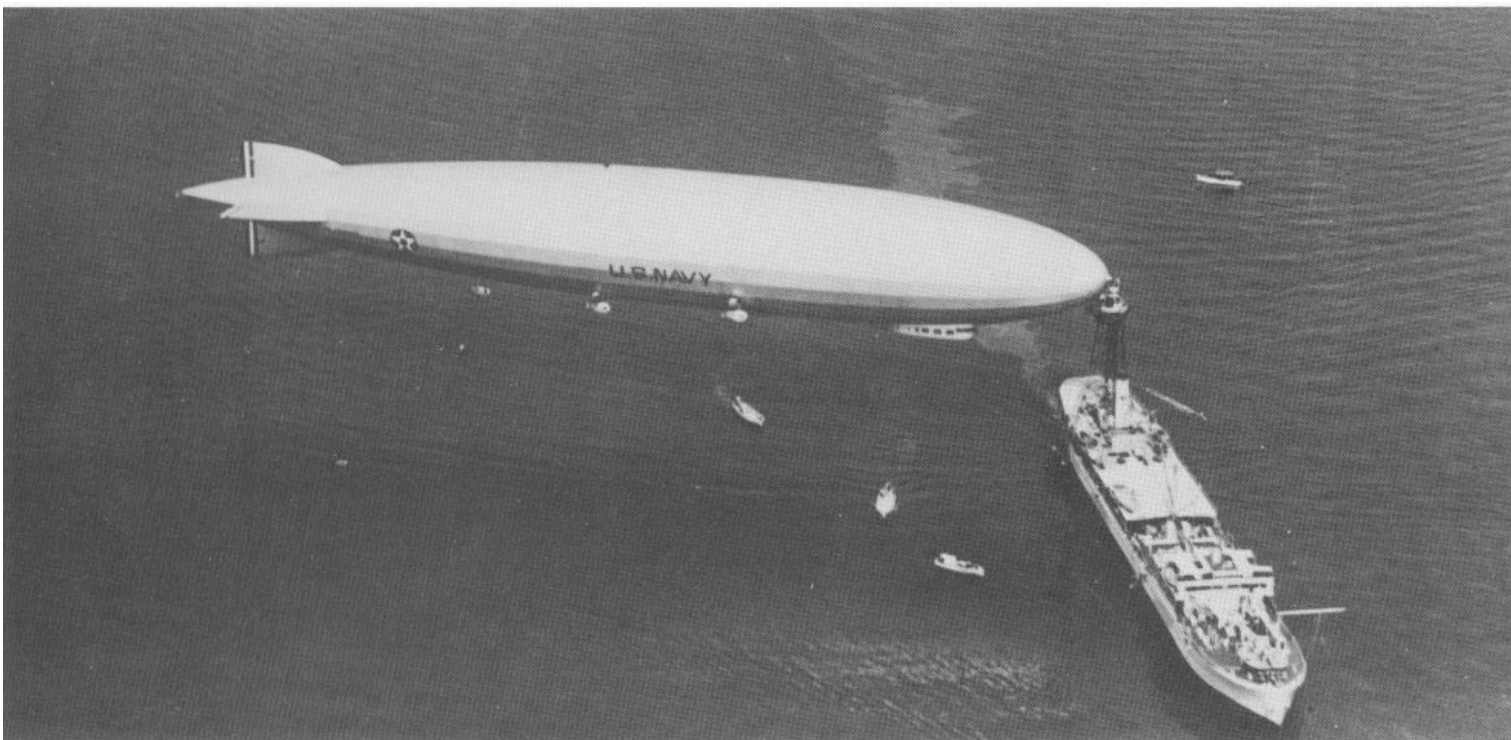
The most successful of all the rigid airships operated by the Navy was USS *Los Angeles* (ZR-3), which was received from Germany after WW I. The two airships originally scheduled for the United States after the war had been destroyed by their German crews. On December 16, 1921, the Council of Ambassadors of the Allied Nations

agreed that Germany should construct one airship for the U.S. as compensation for the loss of the two airships destroyed. This new airship was to be a purely nonmilitary ship, with a gas capacity not to exceed 2,750,000 cubic feet, approximately the size of the largest airship previously built in Germany.

The airship was ordered from the Zeppelin Airship Company on June 26, 1922. Lieutenant Commander Garland Fulton, who had been executive assistant to Commander Jerome C. Hunsaker since the summer of 1918, was sent to Friedrichshafen in early 1922 as Inspector of Naval Aircraft to supervise



USS *Los Angeles* (ZR-3) was built in Germany for the U.S. Navy and was involved in an extensive number of experiments and "firsts." Here, a UO-1 aircraft is hooked onto a trapeze that was specially built for *Los Angeles*. The airship was the first to successfully complete a hook-on and release of an aircraft.



USS *Los Angeles* moored to the tender *Patoka*.

the construction of the ZR-3 by the Luftschiffbau Zeppelin, a.m.b.a. The keel for the airship was laid on November 7, 1922, and she was completed in August 1924. The airship had been designated LZ-126 by her German builders and on August 27, 1924, made her first trial flight from Friedrichshafen. After completing flight trials in Germany, the airship left on October 12, 1924, and was flown to the United States by a German crew. She arrived at NAS Lakehurst on October 15 after an 81-hour, 4229-nautical-mile flight. En route, the airship was under the command of Dr. Hugo Eckener, the lighter-than-air expert who was later well-known for his command of *Graf Zeppelin* and *Hindenburg*. One of the future commanding officers of the ZR-3, Captain G. W. Steele, Jr., was a passenger on the flight. The arrival of the airship at Lakehurst was attended by much fanfare.

At Lakehurst, the hydrogen was released from the gas cells and the airship was reinflated with helium. Water recovery apparatus was installed and on November 10, 1924, the ship was formally accepted by the Secretary of the Navy. On November 25, 1924, she was flown to NAS Anacostia in Washington, D.C., where she was christened USS *Los Angeles* by Mrs. Calvin Coolidge and commissioned as a ship of the U.S. Navy.

Operations were restricted during the first few months since the existing supply of helium was not enough to keep both *Los Angeles* and *Shenandoah* operating at the same time. By transferring the gas from one ship to the other, however, each was available in alternating periods, and the two operated in this fashion until September 3, 1925, when *Shenandoah* was lost. *Los Angeles* proved to be worth her weight in gold as a training airship and a research and development vehicle. She was involved in a variety of scientific and technical experiments. As a flying laboratory, she served to develop many of the improvements and novel devices later used in the designs of Akron and Macon.

Los Angeles continued as the only rigid airship in the Navy for a number of years. She operated from NAS Lakehurst as a training ship and laboratory for many experimental projects, both in the air and on the ground. On January 24, 1925, she took a group of scientists aloft to observe and photograph a total eclipse of the sun, thereby eliminating possible cloud interference. On February 20, 1925, she took off from Lakehurst and made a round trip flight to Bermuda, returning to Lakehurst on February 22. In May 1925, she cruised to Puerto Rico to operate briefly over the Caribbean and while there moored between flights to the special mast built on the tender *Patoka*.

Operations in late 1925 and early 1926 were temporarily suspended as the ship went into overhaul. When her overhaul was completed, operations were further curtailed due to lack of helium. In mid-1926, she began a series of flights along the Atlantic seaboard to calibrate radio direction stations set up as an aid to navigation for vessels approaching the coast and entering port. Flights of this type and training flights in the Lakehurst area, northward to Newport, R.I., southward to Pensacola, Fla., and inland to Detroit, Mich. accounted for most of her flight time in 1927 and made her a familiar sight to persons living in the east.

Los Angeles scored notable firsts. On January 27, 1928, she made a landing on the aircraft carrier USS *Saratoga*, staying long enough to transfer passengers and take on fuel and water. In the next month she made the first nonstop flight from New York to the Panama Canal Zone, returning home after a few days. In October of the same year, she flew to the helium plant near Fort Worth, Texas, and the following February made an extended flight to St. Josephs, Fla., again basing on USS *Patoka*. During 1929, *Los Angeles* was used to test the feasibility of operating aircraft from rigid airships.

Plans for new rigids included use of space within the envelope frame as a hangar for fighter aircraft which could be launched and recovered in air, thereby providing the airship with its own fighter protection. A specially-built trapeze was rigged on *Los Angeles*, tested on the ground and then taken up for practical tests in the air.

On July 3, 1929, while the airship was cruising at an altitude of 2,500 feet at a speed of 48 knots in the vicinity of Lakehurst, a UO-1 airplane piloted by Lieutenant A.W. Gorton successfully hooked onto the trapeze, and then was released. Other successful trials followed. Early the next year, a glider was released from the airship by the same method. These successes demonstrated not only that the operation of airplanes from an airship was feasible, but that it was also possible to deliver passengers and cargo to the ground without the airship landing. Special fighters, Curtiss FSCs, were built as a result of these tests and were ready for service when the new rigids went into operation.

For a brief period in early 1931, by virtue of a special waiver of the proviso prohibiting her use on military missions, *Los Angeles* participated in fleet exercises, as a military aircraft, testing the defenses of the Panama Canal.

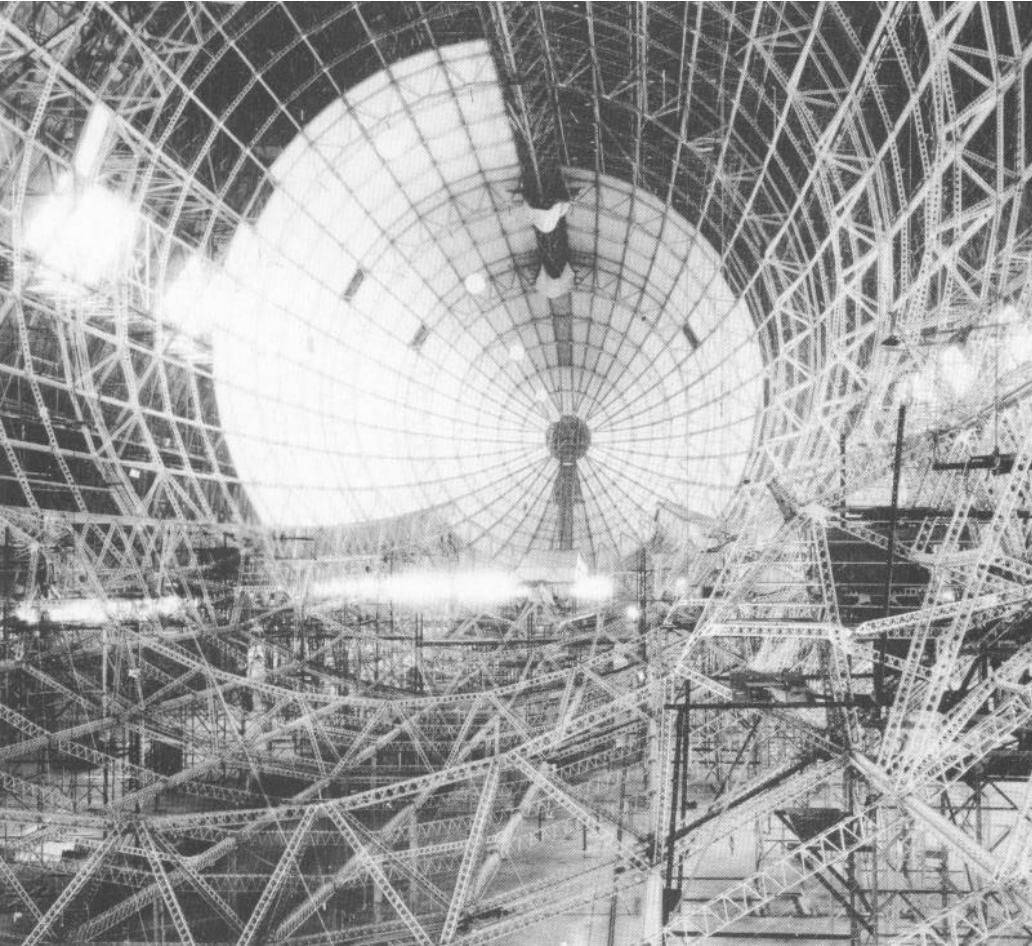
Although attacked and theoretically destroyed by planes from the carrier *Langley*, *Los Angeles* discovered one of the "enemy" convoys before being taken under attack, and otherwise proved her value as a scout on extended patrols.

During these exercises, including the flight from Lakehurst to Panama via Guantanamo, Cuba, and her return to home base, *Los Angeles* set a record for extended operations away from a hangar or base unequaled by any airship up to that time.

On the night of June 24, 1932, *Los Angeles* took off from Lakehurst for a leisurely flight over Philadelphia and New York City. She docked at Lakehurst shortly after five o'clock the next morning and was moved immediately into the hangar. It was her last flight. On June 30, 1932, she was decommissioned. The decision was based on the need for economy. The airship, in spite of her long life, was still airworthy, but a new rigid was already in service, with another under construction, and general economic conditions made it imperative that operating costs be reduced.

In her service career of seven years and eight months, the longest for any of the U.S. Navy rigids, *Los Angeles* made 331 flights, totaling over 4,300 hours, and also logged almost 2,000 hours moored at masts out in the open. Her passenger list included a king and queen, and many distinguished naval personnel and civilians. She had been seen in the air by thousands of Americans and had been a familiar sight at countless fairs and festivals. She had made noteworthy contributions to the Navy, to the country and to the progress of airships and their operation. But her decommissioning was not the end of her career. She was preserved in the hangar at Lakehurst, initially in a condition to permit recommissioning on 30 days' notice. In December 1934, she was reinflated with helium, on the 14th was airborne, and on the 18th she was moved out of the hangar into the open. She became a laboratory once more for experiments and tests and, although at one time she was moored out continuously in all kinds of weather for about five months, she never took to the air again.

On January 6, 1939, the Board of Inspection and Survey recommended that she be made available for additional tests not involving flight and that, upon their completion, she be dismantled and scrapped. But it was clear that her popularity had not waned. In June, part of her outer cover was removed and she



Above, USS Akron (ZRS-4) while under construction, showing the aluminum alloy framework and the outer covering being applied. Above right, an N2Y hooks onto the trapeze of Akron. Note the dark cross on the underside of the airship. The aircraft was hoisted through this opening and placed in the hangar of Akron. Right, Akron over New York City.

was opened to visitors. From June 20 until September 8, when President Roosevelt proclaimed a limited national emergency and all stations were closed to visitors, a total of 44,871 persons signed her visitors' log, an average of 577 per day. On October 24, she was stricken from the Navy list. Dismantling began immediately and was completed on December 15. The commanding officers of USS *Los Angeles* were: Commander J. H. Klein, Jr., November 1924 - April 1925; Captain George W. Steele, April 1925 - June 1926; Lieutenant Commander Charles E. Rosendahl, June 1926 - April 1929; Lieutenant Commander Herbert V. Wiley, April 1929 - April 1930; Commander Alger H. Dresel, June 1931 - March 1932; and Commander Fred T. Berry, March - June 1932.

Perhaps the most romantic period in the Navy's LTA operations was the era of the rigid airships *Akron* and *Macon*. The *Akron* - *Macon* design was conceived in the Bureau of Aeronautics in 1924 as a major improvement over the *Shenandoah* design, based on the experience gained from her operation. The design embodied a series of tentative studies designated BuAer Design No. 60.

These initial designs experienced a wide variety of changes over the years. When *Shenandoah* was lost in 1925 the Navy was left with only one rigid airship, which could not engage in military operations. Admiral Moffett immediately insisted on a replacement for *Shenandoah* and requested two rigid airships to enable the Navy to more effectively evaluate airship operations.

On June 24, 1926, Congress authorized the construction of two more rigid airships of 6,000,000 cubic feet capacity, and the continuing development of the rigid airship program. Appropriations for construction were not approved until March 2, 1928. Goodyear-Zeppelin Corporation was the winner in the design competitions and a contract was signed with the Navy on October 6, 1928, to build two rigid airships.

Fabrication of the subassemblies started in 1929 and construction of the ZRS-4 (*Akron*) began on November 7, 1929, when RAdm. Moffett drove a golden rivet in the ZRS-4's main ring.

One of the unique features in the design of the ZRS-4 and 5 was their capability to house and carry other aircraft. Each ship was designed with a hangar within the hull to house five small aircraft with a trapeze for launching and recovering the planes. The airship's planes were equipped with sky hooks that enabled them to be launched or retrieved aboard the airship by using the trapeze. It was planned that the airships would take off in stable equilibrium without the planes aboard and, when airborne, the planes would be received on board. Once aboard the airship, the planes' landing gear would be removed and belly tanks substituted to augment the fuel supply for operations from the airship.

Line handlers help to secure the tail section of USS Macon (ZRS-5), the Navy's last rigid airship. Comparing the tail section with the line handlers gives an idea of Macon's actual size.

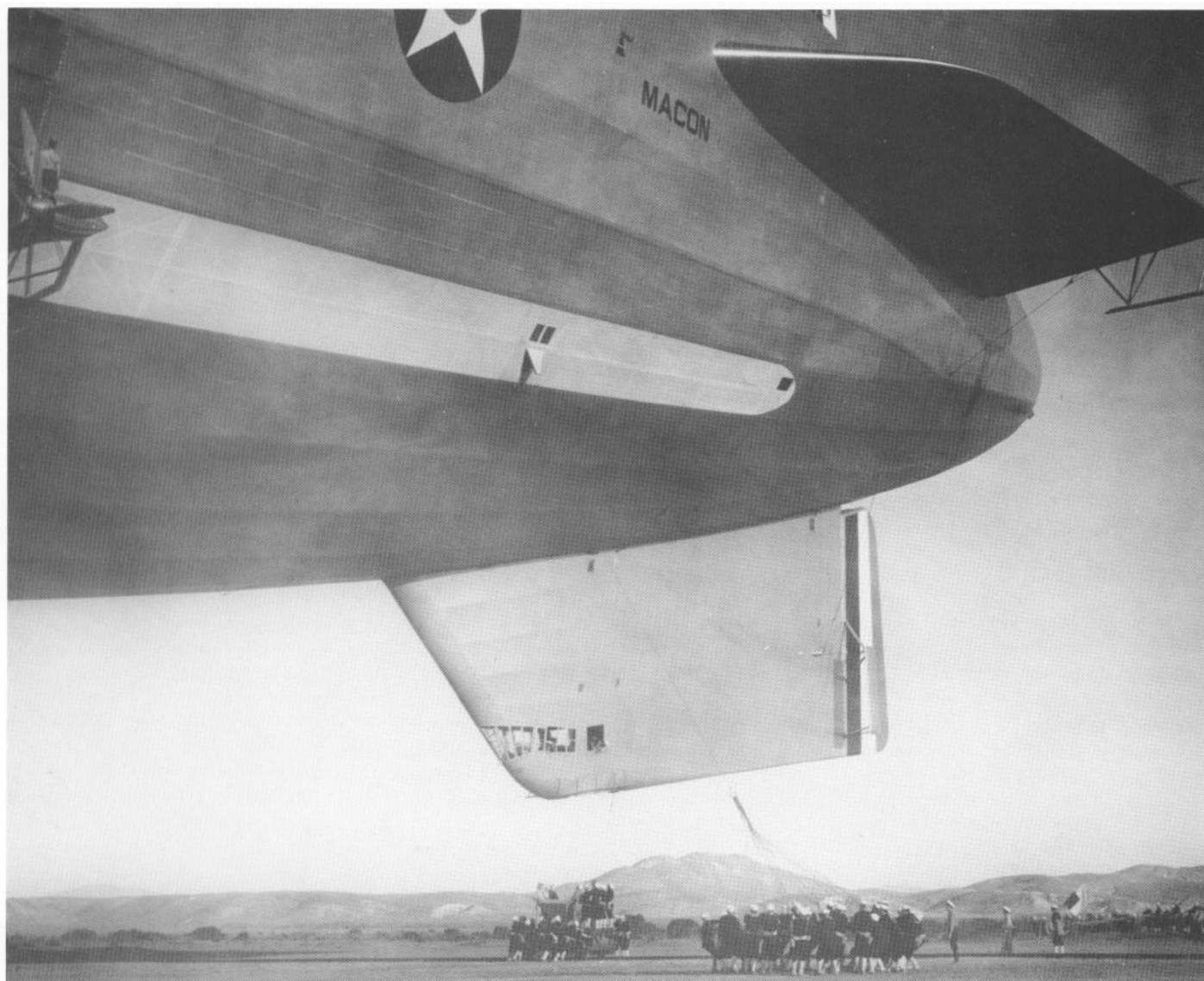
The airplane-carrying capability of the two airships gave great promise for long-range reconnaissance. The airship's phenomenal range and endurance (compared to aircraft of the day) was far greater than anything in existence. Using her own aircraft, the airship could extend her patrol and reconnaissance capabilities far beyond the horizons and triple the width of her patrol. The planes also provided picket and fighter protection for the airship, in essence, making her invisible to enemy forces.

The original mission of the hook-on planes was a dual one to afford fighter protection for the airship and an extended scouting/patrol range. Early emphasis was placed on the fighter mission. Consequently, the Curtiss F9C was a good fighter but a very poor aircraft for reconnaissance. During various fleet exercises, the rigid airships were used for scouting and their aircraft were relegated

strictly to fighter protection for the airship. Only by mid-1934, after many fleet exercises in which the airship was "lost," were the mission requirements changed. The airship became the carrier and communications center for her planes and the hook-on planes operated as her distance eyes and provided fighter protection.

This concept of the airship as a carrier rather than simply an airship which carried airplanes received heavy emphasis and was developed aboard *Macon* in the latter part of 1934.

Beginning in 1935, airship supporters were viewing this concept as an important future military development in which a rigid airship would become a high-speed carrier with dive bombers and be given a designation as an aircraft carrier lighter-than-air (ZRCV). This proposal received a fatal blow with the loss of *Macon*.





The ZRCV concept floated around BuAer between 1935 and 1942 but was never able to gain the support necessary to implement the program. As part of their legacy, *Akron* and *Macon* were the world's first and last flying aircraft carriers. Both airships were much stronger than any previous designs but, unfortunately, inadequate provision was made for the fins. They were unable to handle the large loads which developed on the leading portions of the fins during rough air and rapid maneuvers. The designs also made provision for incorporating eight German Maybach engines inside the hull. The propellers had a bevel connection which made it possible to rotate them for vertical or horizontal thrust. This was a valuable asset in landing and takeoffs as well as providing a rapid vertical ascent capability.

Construction on the ZRS-4 progressed rapidly and on August 8, 1931, Mrs. Herbert Hoover christened the airship at Akron, Ohio. Her first trial flight was on

September 23, 1931, and she was accepted by the Navy on October 21. The airship was flown to NAS Lakehurst and commissioned USS *Akron* (ZRS-4) on October 27, 1931.

A brief chronology of *Akron's* career follows:

1931: 8 Aug — Mrs. Hoover christened ZRS-4 *Akron* at the Goodyear-Zeppelin Corporation dock at Akron, Ohio.

23 Sep — ZRS-4 made her maiden flight around the Cleveland area carrying 112 persons aboard, including Adm. Moffett and Secretary of the Navy Charles F. Adams. Between September 24 and 18 October there were eight different trial flights to test the airship, including an endurance flight from October 16-18.

21 Oct — ZRS-4 was flown from Akron to NAS Lakehurst for delivery to the Navy.

27 Oct — Captain Harry E. Shoemaker commissioned USS *Akron* and Lieutenant Charles E. Rosendahl

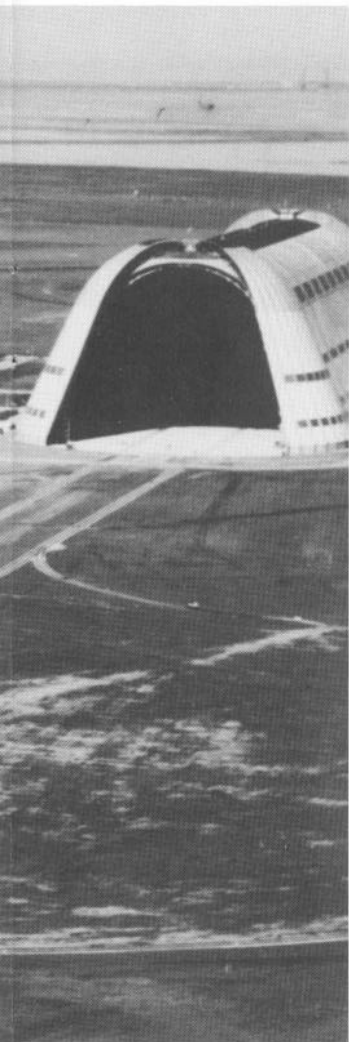
formally accepted command of the airship.

2 Nov — A special press flight for aviation editors and writers, and a remote broadcast by NBC. There were 109 persons aboard during the flight, including Adm. Moffett. Numerous flights were conducted between November 3, 1931, and January 5, 1932, ranging from New England to Alabama and New Orleans.

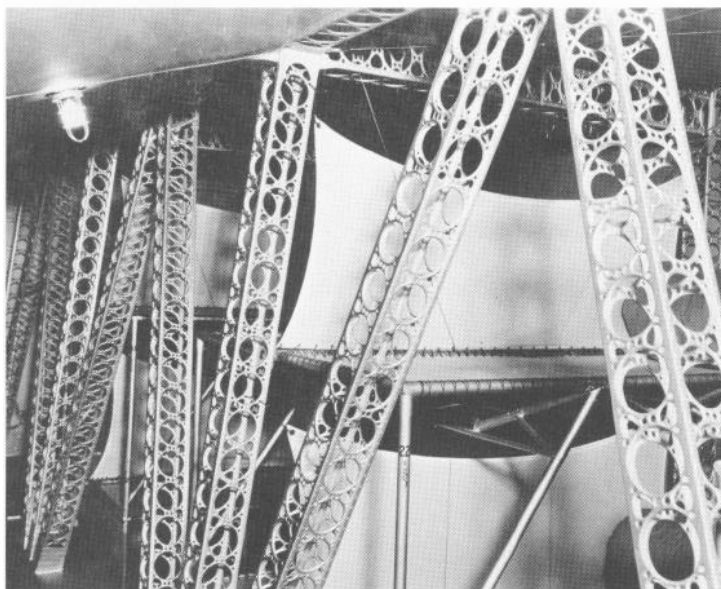
1932: 9 Jan — Operated with the Scouting Fleet off the coast of the Carolinas and northeast of the Bahamas. There were no aircraft aboard during this exercise because the trapeze had not yet been installed and aircraft storage facilities were not completed.

16 Jan — USS *Akron* made her first mooring to USS *Patoka's* mooring mast.

22 Feb — *Akron* was damaged while being towed out of her hangar. The extended repairs caused her to miss the 1932 annual fleet problem held in the Pacific.



USS Macon at NAS Sunnyvale, Calif.



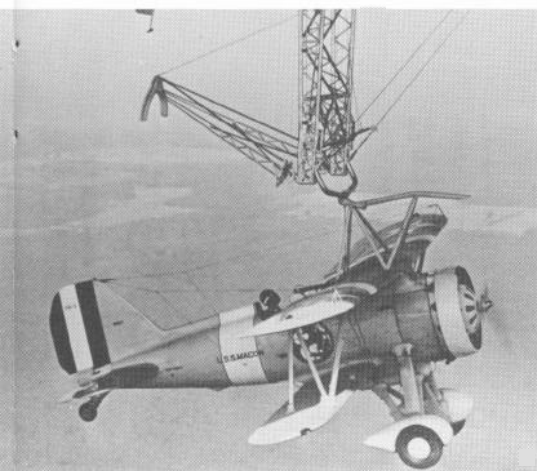
Left, the crew's sleeping quarters aboard Macon.



Below, a close-up of an F9C Sparrowhawk on Macon's trapeze.



Below left, Macon approaching the mooring mast at NAS Sunnyvale. Below, an interior view of the port catwalk on Macon.



3 May — Airship's formal acceptance trials with Navy Department's Board of Inspection and Survey on board. During this flight, Lieutenants D. Howard Harrigan and Howard L. Young flew the N2Y trainer and the XFSC-1 to *Akron's* trapeze for the first time.

8-11 May — Transcontinental flight from NAS Lakehurst to Camp Kearny (San Diego). During the flight, she carried two aircraft aboard, the XFSC-1 and an N2Y-1.

12-13 May — Flew from Camp Kearny to Sunnyvale (later named Moffett Field).

17 May — Moored to USS *Patoka* in San Francisco Bay.

1-4 Jun — USS *Akron* participated in her second (and last) exercise with the Scouting Fleet. Operations were held off the coast of lower California. *Akron* was successful twice in locating and tracking the enemy. However, elements of the cruiser force launched their seaplanes against her and were evaluated as unsuccessful in their attack. *Akron* did not carry any of her planes aboard during the exercise. The Commander Scouting Force, judging from *Akron's* performance in the two exercises with the Scouting Fleet, felt he

could not recommend to the CNO any further expenditures for rigid airships in the immediate future.

11-13 Jun. — Transcontinental flight from Sunnyvale, Calif., to Parris Island, S.C.

22 Jun — Commander Alger H. Dresel became the second commanding officer of the *Akron*, relieving Lt.Cdr. Rosendahl.

29 Jun — Local flight testing of the new three-bladed propeller and exercise of hook-on planes.

17 Nov — Local flight down the coast of New Jersey to test the use of hook-on planes as scouting pickets to extend the airship's field of vision.

1933: 3 Jan — Commander Frank C. McCord relieved Cdr. Dresel as C.O. of *Akron*.

3-4 Mar — *Akron* flew over inauguration ceremonies for Franklin D. Roosevelt.

3-4 Apr — *Akron* left NAS Lakehurst at 1830 on April 3 en route to New England to assist in calibrating radio direction finders. She was caught in a storm off the coast of New Jersey and at 0030 crashed into the sea. Seventy-three people were lost, including RAdm. Moffett, Chief of the Bureau of Aeronautics.

30 Apr — USS *Akron* was formally stricken from the Navy register.

USS *Macon* (ZRS-5) was the last of the great rigid airships constructed for the Navy. Construction began in October 1931, immediately after *Akron* left the hangar at the Goodyear facility and was turned over to the Navy. *Macon* embodied several minor improvements in design

over *Akron*. These modifications shaved four tons off the dead weight of the airship. The three-bladed propellers increased the fuel efficiency of the ship and provided an increased speed of two to three knots.

A detailed chronology of USS *Macon* (ZRS-5) follows:

11 Mar — At the Goodyear-Zeppelin airship dock in Akron, Ohio, Mrs. William A. Moffett christened the ZRS-5.

21 Apr — *Macon* made her first flight, executing preliminary turning and climbing trials, and a speed run in which she made 70 knots. Test flights continued until her commissioning.

12-14 Jun — An endurance flight was made across Michigan, Wisconsin, Illinois and Ohio.

23 Jun — Inside the Goodyear-Zeppelin airship dock, Rear Admiral Ernest J. King, Chief BuAer, placed USS *Macon* in commission with Cdr. Alger H. Dresel assuming command.

23-24 Jun — *Macon's* delivery flight to Lakehurst, N.J. Passengers were Rear Admiral E.J. King; Paul W. Litchfield, president of Goodyear-Zeppelin Corp.; and Dr. Karl Arnstein, the company's chief engineer.

6-7 July — *Macon* made a flight up Long Island Sound and returned to the Lakehurst area where, on July 7 she received her planes aboard for the first time. After Lieutenant D. Ward Harrigan tested the trapeze with an N2Y trainer, he and Lieutenant Junior Grade Frederick N. Kivette tested it with the heavier F9C-2 fighters.

30-31 Aug — On a local flight for Board of Inspection and Survey, the

first hook-plane landing was made on *Macon's* "perch."

31 Aug — On another local flight for Board of Inspection and Survey, hook-on planes exercised, and on speed runs *Macon* reached 75.6 knots, which was 3.2 knots more than the 72.4 required by contract. (*Akron's* best speed was 69 knots.) *Macon's* improved performance was due to a cleanup of her hull protuberances and, even more, to her three-bladed propeller of adjustable pitch. Admiral William V. Standley, CNO, and RADM E.J. King, Chief BuAer, were on board for this flight.

12-15 Oct — *Macon* made a transcontinental flight from Lakehurst to her new home at Moffett Field, Calif., with one N2Y training plane embarked. After she unmoored at Lakehurst, the air station never again serviced a commissioned airship of the Navy.

14-17 Nov. — Participated in fleet exercises. In Exercise D, November 15, she was "shot down" by anti-aircraft fire from enemy cruisers and later was "shot down" by 36 enemy fighters.

1934: 3-6 Jan — Participated in fleet exercises. On the 4th she flew over the enemy fleet at night with all her lights on and was promptly shot down. On the 5th she was hit by enemy fighters and was again ruled shot down.

20 Mar — On a local flight, hook-on planes practiced gunnery drills. The new Waco XJW-1 utility planes were flown to her trapeze for the first time.

Below left, a squadron of F9C Sparrowhawks assigned to *Macon*. Below, *Macon* preparing to take its aircraft aboard.



9-12 Apr — Participated in fleet exercises and was ruled shot down twice by enemy planes.

20-22 April — Made a transcontinental flight from Moffett Field to Opa-Locka, Fla. During the flight, severe turbulence was encountered causing the buckling of diagonal and inter-ring girders. Temporary repairs were made and she continued on to Florida.

5-7 May — Participated in Fleet Problem XIV in the Caribbean. On May 6, she was jumped by six Grumman FF-1 fighters from USS *Lexington* and shot down, but not before she got off an important report of the carrier's position.

11-13 May — Participated in Fleet Problem XIV, off the southern coast of Puerto Rico. She came through unscathed and in these operations tried some novel methods of using her hook-on planes navigating from the airship.

16-18 May — Transcontinental flight from Opa-Locka to Moffett Field. No planes were carried; on both east and west flights the planes were sent cross-country independently.

19-20 Jun — Flight up the coast to Coos Bay, Ore. No planes were carried, but some hook-on tests were conducted with the XJW-1's upon her return to the San Francisco Bay area.

11 Jul — Lieutenant Commander Herbert V. Wiley relieved Cdr. Dresel as commanding officer of *Macon*.

18-21 July — Training flight to intercept the cruisers *Houston* and *New Orleans*, which were en route from Panama to Hawaii via Clipperton Island, with the vacationing President Roosevelt embarked in *Houston*. On the 19th her planes made contact with the CAs; later Lieutenant Harold B. Miller and Ltjg. Kivette flew down in their F9Cs and dropped bags of the latest newspapers and magazines for the President.

26-27 Jul — On a local flight on July 21, the F9Cs had been flown from the trapeze without their wheel landing gear for the first time. The maneuver was repeated during this flight, and thereafter became standard procedure. Upon return to the Bay area on the 27th, *Macon* made the first test of the airship's rescue gear for retrieving a pilot downed at sea; it was simply a raft and bosun's chair at the end of a wire winched out from her hangar.

8 Aug — Local flight operations, Camp Kearny to Moffett Field; hook-on planes exercised and, upon return to the Bay area, the airship's spy-basket was

streamed for the first time since the initial abortive test aboard the *Akron* in 1932. No one was aboard the basket which was fortunate since it was still unstable and performed badly.

26-28 Sep — Extended flight operations at sea, including training for the F9Cs in navigation problems, battle lookout and night hook-on. On the 27th, the spy-basket, modified with a ventral stabilizer, had a 17-minute "flight" with Lieutenant Commander Jesse Kenworthy, its first "pilot."

1934: 7-9 Nov — Flight from Camp Kearny to Moffett Field while participating in a fleet exercise. In this operation, the airship acted as a carrier for her planes and let the latter do most of the searching. Her planes located the "enemy" carrier *Saratoga* and managed to keep her under constant surveillance for several hours.

5-8 Dec — Camp Kearny to Moffett Field, participated in minor tactical exercises with the fleet. On the 7th, while her planes were tracking the *Lexington*, the carrier's dive bombers found her and "shot her down." On the 8th, the day's exercise was suspended when two planes from *Cincinnati* became lost and went down at sea. *Macon* found them and hovered over them until surface vessels arrived to rescue the pilots.

1935: 2-3 Jan — Visibility tests were conducted with *Lexington* in order to determine how easily the airship was sighted, and who saw whom first, airship or surface ship. It was a draw.

11-12 Feb — Participated in a minor fleet tactical exercise off the Santa Barbara Islands, in which *Macon* made imaginative use of her four planes, to the extent of sending them on sorties 225 miles distant. But at 1705, while returning to base, her upper fin was carried away (reinforcements not yet installed). The damage worsened and loss of gas from the after gas cells placed her at an extreme angle of trim, bow up. Too much ballast was dropped and she shot over pressure height where her automatic gas valves opened, blowing away the small margin of lift which remained. Twenty-four minutes after the casualty, *Macon* was brought to a forced landing in the Pacific, and sank within 30 minutes of hitting the water. Eighty-one of the 83 persons on board were saved. When she sank to the bottom of the Pacific, she took with her two of her personnel, four of her hook-on airplanes, and the best hopes of the flying aircraft

carrier.

26 Feb — SecNav informed all bureaus and divisions of CNO that USS *Macon* was formally stricken from the Navy register.

During the period of rigid airship operations, non-rigid development took a backseat to the giant airships. Experimentation continued in the non-rigid field but on a very limited basis. Most of the non-rigids in the mid-1920s to mid-1930s were used as training vehicles or for limited experiments. The crews necessary to operate the giant rigids were trained in the non-rigids. In 1922, Mr. Upson, the Goodyear engineer who flew the first successful B-class airship, formed his own corporation to promote development of a new airship design. The design had an outer covering that was metal vice the traditional fabric covering on the rigid and non-rigid airships. This metal-clad airship operated on the same principle as the non-rigid, whereby the internal gas pressure kept the sides of the airship rigid. The use of the pressure principle led the Navy to classify the metal-clad as a non-rigid airship.

This practical development of a metal-clad airship became a reality when an automatic riveter was perfected that could make strong gas-tight joints between thin aluminum alloy sheets, and when a special type of seam sealing compound was invented. Mr. Upson's company, the Aircraft Development Corporation, submitted a proposal to the Bureau of Aeronautics for construction of an experimental 200,000-cubic-foot, metal-clad airship in September 1925.

Congress authorized money for the metal clad airship in 1926. Contract number 447 was signed on August 18, 1926 for the airship which was designated ZMC-2, and assigned bureau number A-8282 after she was accepted by the Navy. The ZMC-2 made her first flight at Detroit's Grosse Ile airport on August 19, 1929. She was delivered to the Navy on September 12, 1929, at NAS Lakehurst which was to be her home base for operations. The ZMC-2 was used mainly for experimental work, however, it also provided support for various humanitarian missions, rescue/disaster work and training. Her main mission was pointed out by Adm. Moffett in his 1926 annual report, "purely an experimental craft, intended to test the practicability of the novel type of construction used in it."

The ZMC-2 was unsatisfactory in

directional control during rough air conditions and at low speeds. However, it was felt this was because of its small size and not due to the design of the airship. On the sixth anniversary of the ZMC-2's first flight, she had flown more than 57,000 miles and had been in the air over 1,400 hours. The ZMC-2 remained in service for 12 years until she was scrapped in 1941. When she was stricken, her total time in the air exceeded 2,200 hours, a testimony to the experimental/operational capabilities and durability of this prototype airship. A contract was awarded by the Bureau of Aeronautics in 1932 to the Metalclad Airships Corporation (successor to the Aircraft Development Corp.) for a design and engineering analysis of metal-clad airships. However, none were built for the Navy.

XI. Pre-WW II Blimps and the Evolution of the K-class

With the economic depression in 1929, plans for the development of an experimental non-rigid airship were scaled back. Congress would not authorize specific funds for the new airship, but the Navy was able to appropriate funds from several different sources for construction of the airship.

The envelope was built by Goodyear and the control car by the Naval Aircraft Factory. The airship was the first in a series of K-types, the K-1, and its design had several new features. The engines burned a fuel gas (similar to propane) instead of the traditional liquid fuel. This gas could be contained in cells within the airship envelope and, since it was of approximately the same density as air, its consumption did not change the buoyancy of the airship. In addition, the gas proved to be a more efficient fuel than liquid gasoline, and eliminated the necessity of valving lifting gas or condensing water from the exhaust to compensate for the weight of fuel burned in flight. The K-1 had a special ballonnet of 51,700 cubic feet for carrying the fuel gas. She was also the first Navy non-rigid to employ an internally-suspended control car.

The components of the K-1 were mated in 1931 and the airship was delivered to NAS Lakehurst by Lieutenant Commander T. G. W. Settle on August 10, 1931. Evaluation of the experimental K-1 began on October 7, 1931. She was the largest non-rigid airship the Navy had operated up to that time. The K-1 was reasonably successful, although at that time it was believed she was too large for a non-rigid (less than three-quarters of the size of K-types used during WW II).

The K-1 made her last flight in September 1940. She was dismantled and surveyed in the fall of 1941 to make space for new airships in the defense buildup. The K-1 was an experimental prototype and no other airships of this type were built.

After the acquisition of the experimental K-1, the Navy changed its approach and procured its next non-rigid off the shelf. Under contract 44308 of September 23, 1935, the Navy purchased Goodyear's airship *Defender*, the largest of the Goodyear fleet of advertising and passenger airships. She was delivered to NAS Lakehurst on October 5, 1935, and put into service as a training and general utility ship with the designation G-1. The G-1 was lost in a midair collision with another airship on June 8, 1942. The two airships were on a night flight, conducting visual and photographic observations of an experimental nature. Twelve people were killed in the crash, including five civilian scientists. The G-1 prototype had demonstrated her capabilities as a training and utility airship.

The Navy's need for training and utility airships in WW II led to the acquisition of seven more G-type airships. Under contract number 151 of December 24, 1942, seven more G-type airships were ordered, with a 13,700-cubic-foot increase in volume over the G-1. They were used for advanced training and utility purposes. The first group of G-types (G-2 through 5) was received in the latter part of 1943 and the next group (G-6 through 8) was received in mid to late 1944. During WW II, the G-type airships operated primarily at NAS Moffett Field and Lakehurst for training and with Airship Utility Squadron One and its detachments on the East Coast.

In 1937, the Navy contracted for two different types of airships on the same contract, the L-1 and K-2. The L-1 design

The ZMC-2, shown here on a flight over Washington, D.C., was the only metal-clad airship.

