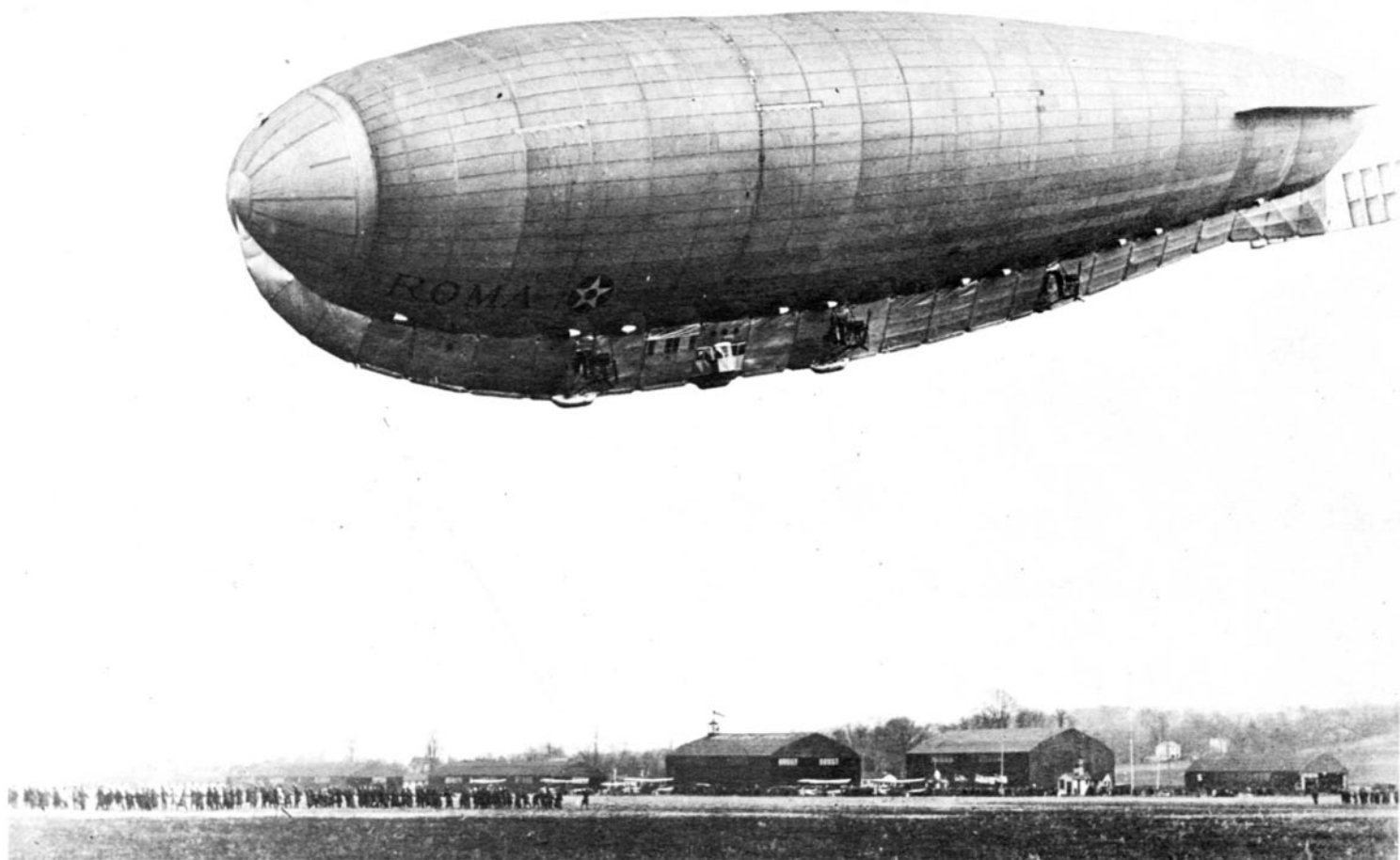


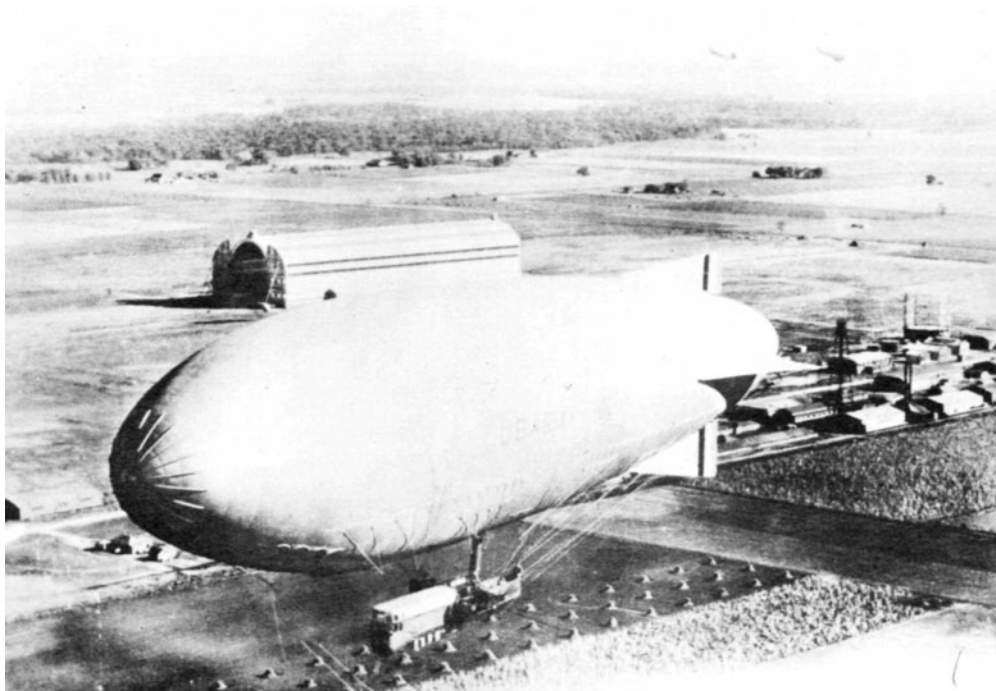


The U.S. Army Airship ROMA being hauled down at Langley Field, Va. (Photo-Nat'l Archives 80-G-4S9293)

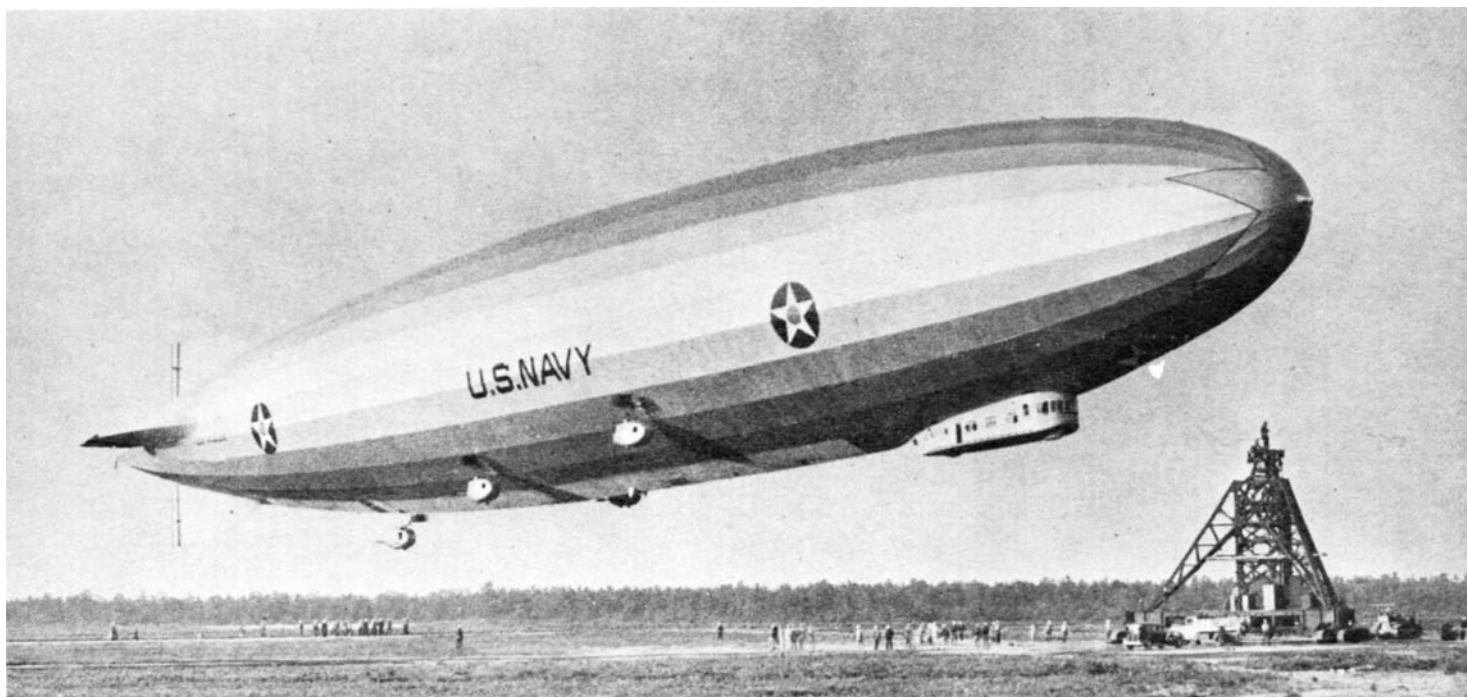
Foreign-Built Airships in U.S. Service

1919 to 1939

By LEON N.WEBB



The U. S. Army Airship, RN-1 (was DZ-1, was DZ-US-1) at Scott Field, Ill. 29 April 1923. The forward section of the car had been enclosed. Scott Fd. was then the Air Service balloon training center. In the rear are two captive balloons of WWI type.



ZR-3, the LOS ANGELES, the Navy's most successful airship, lasted almost fifteen years, both in commission and as a test airship. (Photo - National Archives, No. 80-CF-4149-2)

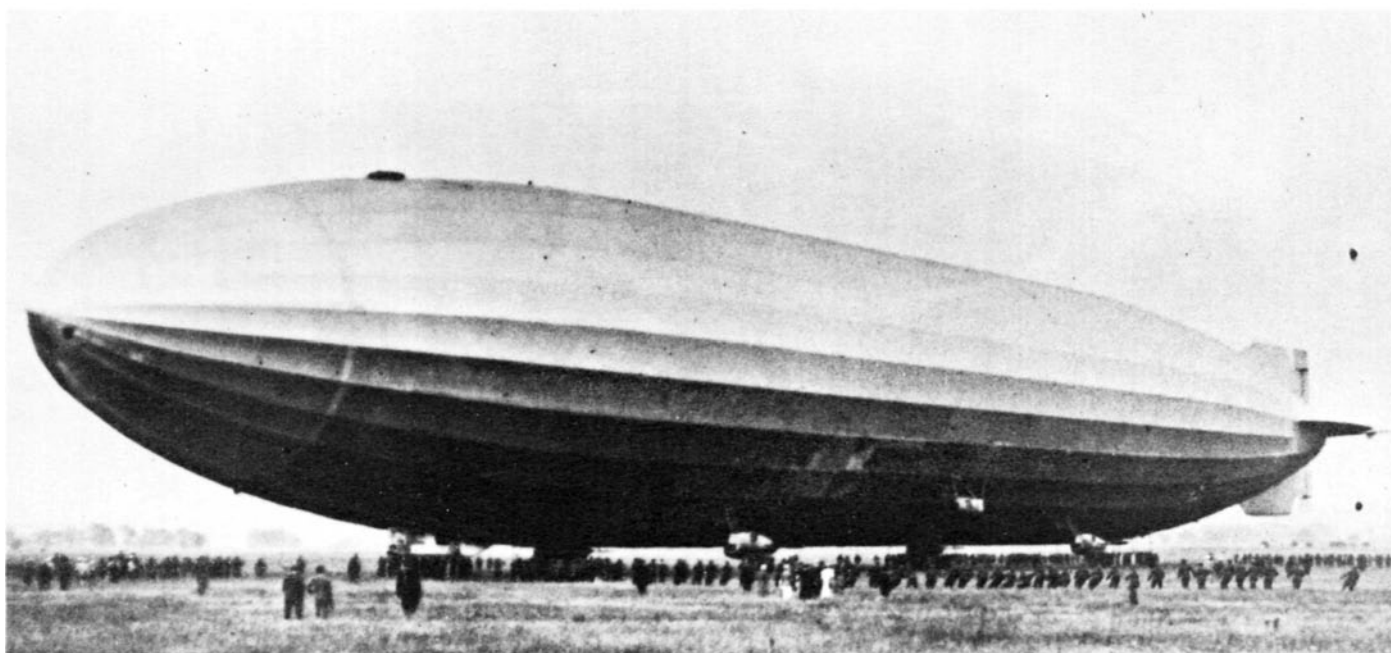
Among the many types of airships which were used by the Armed Forces of the United States, there were several of foreign design and manufacture. The airships chiefly under discussion here are those which were in the commissioned service of the United States during the period from 1919-1939. Although during the First World War some American Naval units stationed in Europe were equipped with airships of French and British manufacture, there is, at present, little reliable information on the operational histories of these airships, and even how many there were.

The chief factor which led the United States to buy and use these airships was the lack of de-

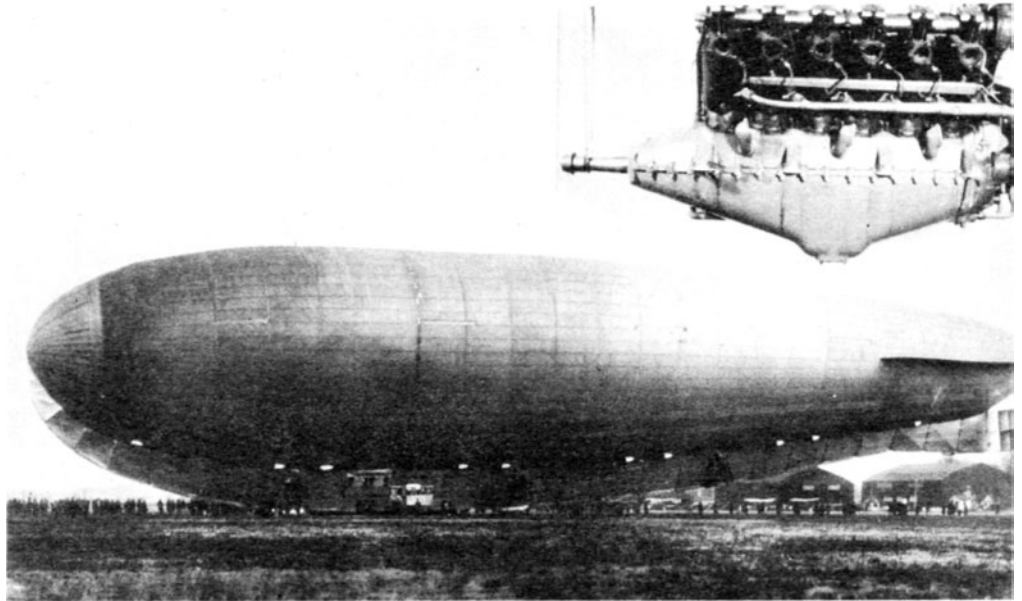
velopment of the science of airship design and fabrication. During the period between World Wars I and II the United States commissioned in its service four airships of foreign design and manufacture. Three of these airships were purchased from the Allies (one from France and two from Italy) and the fourth was a part of war reparations - the famous LOS ANGELES.(1) The two purchased from Italy were semi-rigid.

The other Allied-built airship was the French non-rigid DZ-US-I or DZ-I and eventually designated RN-1. It had about the most successful career of the Allied airships, being in commission for about four years.

R-38, to have been purchased from Britain and designated the ZR-2, ended in a fiery crash at Hull, England just prior to delivery to the U. S. (Photo - National Archives No. 80-CF-4145-1)



The ROMA, 17 December 1921, at Boiling Field for the christening and commissioning. A little over two months later she lay on Langley Field, totally destroyed. Inset is the Italian Ansaldo engine, all of which were replaced by Liberty engines just prior to the fatal 25 min. flight. (Photo-USAF A2T-34/ph/2)



A fifth airship, the British R-38, was built but crashed during its acceptance trials, therefore it was not, technically speaking, in United States service although only one flight away from delivery.

Merle Olmsted covered the flight operations at Langley Field from 1919-22, which included the period of the ZD-US-I and the ROMA, in his article "Army Airship Operations, Langley Field, 1919-22." (2)

WORLD WAR I BACKGROUND.

During the First World War those United States Naval units operating from Royal Navy facilities were equipped with several types of airships such as the NS (North Sea) SST (Sea Scout Twin), and the SSZ (Sea Scout Zero). As far as can be determined there were at least 3 NS-type, three SST-type and two SSZ-type airships operated by (though not necessarily under the command of) American crews, or on order for use by American crews when the Armistice came into effect. (3) Only three of these were assigned serial numbers by the United States Navy, indicating that they were considered a permanent addition to the Fleet. Apparently two of the three craft were shipped to the United States for testing and inspection: the SSZ-23 (ser. No. A-5563) and the NS-16 (Ser. No. A-5580). For technical data see Table III.

The airships used by American units stationed on the European Continent operated from French bases at Paimboeuf, Guipavas, Rochefort, and Gujan, and were of many types. The estimated total of French airships in use by American crews, or on order for their use, ranges from ten to fourteen. Refer to Table IV for their technical data.

The 0-1 was a small airship, and was, as far as can be discerned, the only semi-rigid airship ever operated by the United States Navy. (4) Several interesting features in the design of 0-1, such as an articulated keel made of steel tubing, and nose batens of the same material, are worthy of note. (5)

The control surfaces of the 0-1 were of "box type" structure. They were mounted on the lower stabilizing fin beneath the envelope, and were braced with guy wires attached to patches on the envelope. The control car strongly resembled an open boat, a common feature of non-rigids of that era. It was suspended relatively far beneath the envelope. The

two 125 hp Columbo engines were mounted on outriggers across the stern of the control car, and drove push propellers.

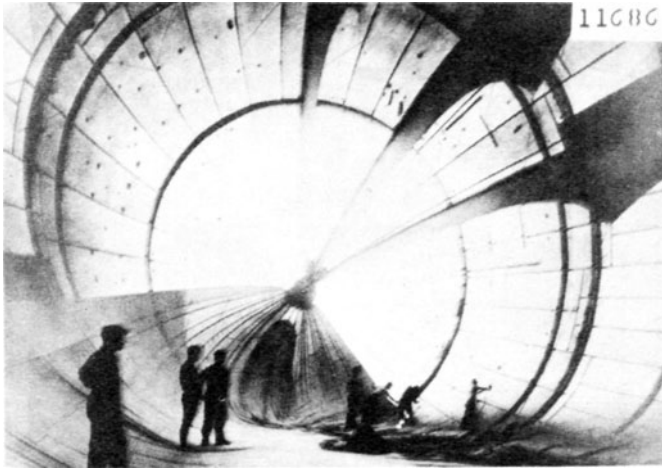
Built by Stabilimento Costruzioni Dirigibili ed Aerostati of Rome, Italy, the 0-1 made its maiden flight on 27 March 1919 at Ciampino, Italy, and following several test flights, was dismantled and shipped to the United States. Leaving Genoa, Italy on May 24, the crates containing 0-1 arrived in Philadelphia in June and were then shipped to Akron, Ohio, for inspection by the engineers of the two largest envelope producers, Goodyear and Goodyrich. The airship then went to Naval Air Station, Cape May, New Jersey, where it arrived in August.

0-1 first flew as a commissioned airship of the Fleet from its operational base at Cape May on 16 September, 1919. During its short operational career the airship gave little difficulty and flew well, but due to the design, it was a craft of rather poor performance. The lack of aerodynamic streamlining did nothing to enhance the speed or endurance of 0-1.

On 31 December 1919, while on the way to Hampton Roads, Virginia, headwinds forced the expenditure of so much fuel, that when the airship was over Wilmington, Delaware the decision was made to turn back to the base at Cape May. Just as the 0-1 was approaching the field, within sight of the landing crew, both engines quit and the airship drifted up river until a point near Pennsville, New Jersey was reached. At the first opportunity a free balloon landing was made among the trees of an orchard, with no damage to the airship, nor injury to the crew.

The commander of 0-1, upon phoning the base at Cape May for instructions, was ordered to dismantle the 0-1 and return it to the base by rail. The railroad, instead of sending a flatcar as requested, had sent a box car, which required that several of the longer keel members be broken in order to fit them into the car. Following an inspection at Cape May, the 0-1 was shipped to the Navy dump at Camden, New Jersey and placed in storage.

Sometime later (probably in early 1921) permission was given for the repair and re-inflation of 0-1. This was done at Hampton Roads, Virginia, and a trial flight was logged.



Air inflation of the envelope of ROMA. The three up-sweeping forms were the catenary curtains which carried the weight of the keel and equipment, and at the same time gave the outer envelope its four-lobed configuration. (Photo-USAF, Wright Fd.#11686)

Some sources state that the 0-1 was never flown after this trial flight; but Captain Ralph S. Barnaby has stated that on July 6-9, 1921, the 0-1 was used near Hampton Roads for dropping target gliders for anti-aircraft gunnery practice. A number of Naval officers flew 0-1 during the period.

The exact date of the final dismantlement of 0-1 is not definitely known, but according to several sources the 0-1 was in all probability surveyed sometime in late 1921.

THE FRENCH BUILT NON-RIGID AIRSHIP ZD-US-1.

When the purchase of ZD-US-1 was decided upon in 1918, three airships were ordered from the French firm of Societe des Dirigeable Zodiac, which had been in the field of airship design and construction for several years. June 5 was the date of the signing of the contract. Following the Armistice, the order was reduced to one and ZD-US-1 was completed in early 1919. This dirigible made several flights in France prior to its shipment to the United States, of which one was more than six hours long.(6)

The ex-Navy Blimp, Army's D-3, moved aside in the hangar at Langley Fd. for floor inspection of the ROMA envelope before erection. (Photo-USAF #11692)



The Zodiac-designed non-rigid had originally been intended for the United States Navy, but the decision of the Joint Army-Navy Airship Board had given responsibility for the development of the pressure type (non-rigids and semi-rigid) airships. The Navy was to concentrate on the development of the Rigid Airship

At the time of its construction ZD-US-1 was the largest non-rigid ever built, and in addition to this distinction, the airship had several interesting features, having originally been conceived as a combat craft. Among these was the mounting of a 75mm cannon which fired a projectile weighing thirteen pounds, the most powerful weapon ever mounted on an airship.

Also distinctive, and somewhat unusual at this time, was an enclosed control car,, for the protection of the crew of eight officers and men.

During the first three years of operations, ZD-US-1 was used in an extensive series of tests to determine the military efficiency of this type of aircraft. Among the tests were those which determined the capabilities of the airship in aerial reconnaissance, bombing, and observation in conjunction with radio equipment.

Just before the completion of this series of tests the ZD-US-1 was redesignated DZ-1.

Airships, Incorporated, of Hammondsport, New York, was given the contract for the rebuilding of DZ-1. During the reconstruction several modifications were made. One was the installation of an observation platform atop the envelope, accessible by a vertical tunnel from the control car through the envelope. Mounted on this platform there were two machine guns, for defensive armament. At this time, the original Renault powerplants were replaced with Liberty aircraft engines rated at 400 h.p. each, and another change was made at this time to its final designation, RN-1.

It was considered to have had a successful career, since it was in service for some four years, being decommissioned and dismantled in 1924 after further use and modification at Scott Field, Illinois.

THE ITALIAN-BUILT SEMI-RIGID AIRSHIP ROMA (T-34).

ROMA, designed by a group of engineers at S.C.A. (Stabilimento de Construzione Aeronautiche) of Rome, was a one-of-a-kind prototype, and the largest semi-rigid airship ever built at that time. Among those actively engaged in the design of the ROMA was Umberto Nobile, later to gain world-wide fame for his Arctic adventures.

T-34, as ROMA was designated because of its volume (34,000 cubic meters), was the first semi-rigid to use a rigid nosecap made of steel tubing connected to a hub which formed the forward end of the keel.

Since the designing of ROMA did not begin until after the Armistice (January 1919), primary consideration was given to possible commercial applications, rather than the military needs of such an airship.

In late 1920 the ROMA was purchased by the U. S. Army from the Italian Government. The contract price of \$475,000 was reduced to approximately \$185,000. actually paid by the rate of exchange, at the time of delivery.

On 9 February 1921 Major John G. Thornell, with two officers and five non-commissioned officers of the U. S. Army, sailed for Italy. The mission had to gather data, receive flight instructions, supervise the deflation and packing of ROMA, escort the ship back to the United States, re-erect it, and fly it.

Back in the United States the envelope was laid

out for inspection on August 15 and was inflated with air on September 2 for internal inspection. Upon inspection of the envelope it was found that the upper portions, the sides of the envelope, and the exposed parts of the ballonets were in a state of deterioration. This was the result of storage, actual service, packing, and shipping and the action of the weather. The aluminum coating showed a distinct tendency to dust off, as though an inferior binder was used. It appeared that the coating had been dusted on; portions were completely worn off the top of the envelope. The surfaces discussed here constitute the most important parts of the envelope since they must retain the gas, and carry the weight of the keel and attached equipment. The expected life of this fabric was estimated to be about five months of normal (bi-weekly) operations in the cool season; with the warm weather, the life expectancy would be reduced to three months. The remainder of the fabric of the ROMA, judged to be in serviceable condition, was estimated to have a service life of about eight months.

The envelope was constructed of silk with a weight of 2.2 ounce/yd. The ballonet fabric was two-ply cotton weighing 1.8 oz/yd. Both the envelope and the ballonet fabric were impregnated with a gas film which increased the finished weight of each by 3.0 to 3.1 oz/yd. Contained in the envelope were eleven gas cells and six ballonets. Each gas cell was equipped with a rip panel but these were never hooked up.

14 September 1921 saw the inflation of the envelope of the ROMA with 1,012,000 cu.ft. of hydrogen (made by the iron contact process to a purity of 95%) and the first keel section was assembled three days later.

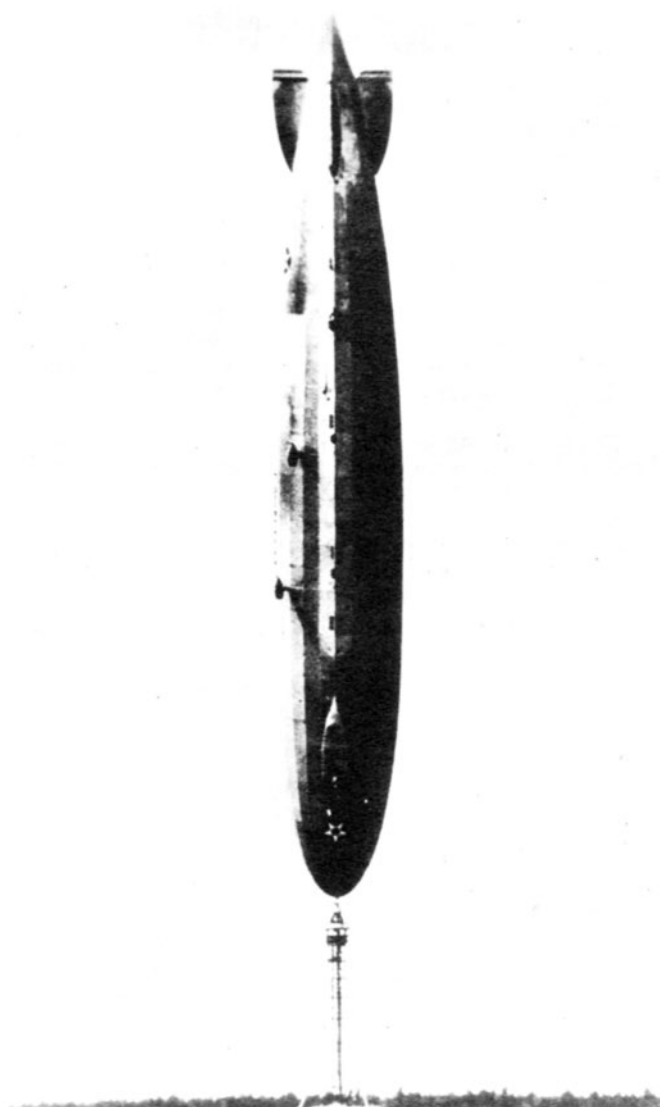
The transverse profile of the envelope of the ROMA was given a four-lobed configuration by three catenary curtains from which cables supported the keel and equipment.

The keel of the ROMA, constructed of 5-meter sections, was of steel tubing carefully tinned on the exterior, and coated with grease on the interior. It was an inverted triangle in cross-section. Connected to the forward end of the keel was the nose-cap, which had a diameter of 45.9 feet. The framework which held the control surfaces was suspended on the stern of the keel.

This framework, again of steel tubing, was 65.5 feet in span, 16.5 feet high, and had a chord of 8.8 feet. In this frame there were three horizontal surfaces with an elevator for each surface at the rear. Placed in the vertical dimension of the frame were eight rudders, reaching the entire height of the framework. This "box" control surface was stabilized and braced by shock absorber cord, and wires attached to the keel and the envelope.

On the envelope proper there were three stabilizing fins, two on the horizontal plane and one vertical atop the envelope, braced with many wires to patches on the envelope. The construction of the fins and of the control surfaces was of fabric covered wood.

The powerplant of ROMA was originally composed of 6 Ansaldo V-12 engines rated at 450 h.p. (@ 1650 r.p.m.) which drove pusher propellers. Mounted in pairs, the forward engines were set at an angle of 12°, the center engines at 10° and the rear pair at 0° to the axis of the airship. This arrangement minimized slipstream interference and stabilized the lines of thrust. Separated by the keel, the



The LOS ANGELES on her nose in an unusual photo, explained in the text. (Photo-Courtesy L. N. Webb).

distance between the propellers of adjacent engines of the same pair was 24 feet, 11-1/4 inches.

Each pair of engines had a fuel supply of 704.5 gallons, in two tanks (one of 500 gallons, the other of 204.5 gallons), in addition to a gravity tank of 38.6 gallons. An oil reserve tank of sixty-one gallons for each engine and water reserve tank of 4.34 gallons for each engine cooling system was provided. There was no provision for transfer of fuel between each pair of engines, thus each was limited to the fuel in its own system.

The total fuel capacity would have been 4,766.1 gallons had the plan to add extra tanks and to use gasoline as ballast for longer flights been carried out. It was calculated that with the substitution of Liberty aircraft engines for the heavier Ansaldo, a weight saving of about 1200 pounds would be realized. This would have permitted even longer flights with the additional 1200 pounds of fuel carried.

Since the engines were not reversible, the propellers on the center pair of engines were removed and tractor type propellers substituted just before a landing was made. This aided the ground crew in stopping the forward momentum of the dirigible.

Following the erection of the keel, a radio room was installed inside the keel, forward of the foremost pair of engines. Constructed of plywood,, it was also used for the storage of spare parts. Along the keel there was a plywood catwalk, which led to a series of steps and a ladder in the nose which gave access to the top of the airship by means of a trap door, on the upper side of the nosecap.

Located at three strategic positions along the catwalk there were three hand-operated blowers for emergency inflation of the ballonets. Placed under the keel at three positions along the lowest portion were three pneumatic pontoons which acted as landing shock absorbers. These pontoons were equipped with 4-inch valves to regulate the degree of inflation.

The number of persons in the crew was determined by the intended duration of the flight. For flights of less than twelve hours, this included the Commanding Officer, Chief Pilot, Supply Officer, Chief Engineer, Radio Officer, Chief Rigger, four Enlisted Riggers, two Radio Operators and six Motor Mechanics. The additional men for a flight exceeding twelve hours were a Navigation Officer and six additional Motor Mechanics.

If the advantage of the photography room (located directly beneath the passenger cabin) was to be exploited to the fullest, the presence of a photographer would be necessary. Also, the carrying of a Master Mechanic would have been advisable. This would have raised the grand total for the crew to twenty-seven men. The officers and the Chief Rigger were expected to double as pilots.

Prior to its shipment to America, ROMA had completed twenty-two test flights without any unusual difficulty, and following its re-erection at Langley Field, three additional flights were made. The Ansaldo engines were then replaced with Liberty engines of less horsepower but lighter in weight. The next flight, following this modification was only twenty-five minutes in duration and had a tragic ending.

The final flight of ROMA was terminated by a spectacular crash into the electrical high tension lines which ran across the landing field atop poles. The disaster resulted in the loss of thirty-three lives of the forty-five persons aboard in the hydrogen and oil-gasoline fed fire which followed.

Following this second disaster to the Army Air Service Lighter-Than-Air-Branch (the first had taken the life of pilot of a non-rigid airship and destroyed the craft by the accidental detonation of a bomb), the investigating board brought forth several factors which they believed contributed to the disaster.

A. The primary cause of the crash was probably due to the development in the forward ballonet and part of the envelope of a "Negative superpressure" by the stoppage of an air duct to the ballonet from the surrounding air. This resulted in the collapse of the nosecap, which in turn buckled the keel, thereby causing the airship to dive into the field. (What caused the stoppage of the airduct was not stated, but I feel that it may have been related to the deteriorated condition of the fabric.) (7)

B. The lack of centralized control for both rapid release of large quantities of ballast in the event of an emergency, and the shutting off of electrical power, especially ignition systems of the power plant.

C. The altitude of the airship at the time of the primary cause was insufficient to permit the crew to regain control of the airship before it crashed into the ground.

D. An finally, the use of hydrogen as the inflation gas was a distinct hazard.

As a result of ROMA's crash on 21 February 1922, many improvements were incorporated in the design and operational policy of United States airships. Probably the most important was the adoption of the famous "helium only" policy for all future operations of airships in the United States.(8)

Thus, by ordinary standards the ROMA cannot be said to have had a successful career. However, in an indirect manner, ROMA contributed to the future success of American airships through its own failure.

GERMAN-BUILT RIGID AIRSHIP USS LOS ANGELES (LZ-126)

Without a doubt the most famous, and most successful rigid airship ever to be in American service was the German-built ZR-3, USS LOS ANGELES. This airship, factory number LZ-126, as the LOS ANGELES was known by its builders, Luftschiffbau-Zeppelin of Friedrichshafen, Germany, was regarded as the airship which saved that nation's airship industry from extinction following the Allies' seizure of BODENSEE and NORDSTERN, two post-war commercial zeppelins.

With the signing of the Armistice all airships of the Imperial German Navy and Army were confiscated by the Allies and divided among the member nations. As its share of the spoils of war, the United States was to have received two of the latest type zeppelins. The crews of the airships, fearing that the socialist-communist elements in Germany at that time would gain control of their craft, took a page from the crews of the surface elements of the Imperial German Navy (then interned at Scapa Flow) and destroyed their airships.

The Allies had set America's compensation for the loss of these zeppelins at \$800,000. Dr. Hugo Eckener, Count Zeppelin's successor, now saw a chance to save his company from complete financial failure, and proposed to pay the compensation, not in cash, but with a new airship, placing Luftschiffbau-Zeppelin as security with the Finance Ministry.

Since Dr. Eckener had made his proposal directly to the American Military Commission and not through official German Government channels and because of the fact that many Germans had strong nationalist feelings regarding the zeppelin concept, this, along with other political issues caused a great deal of trouble on the German political scene. These feelings were brought to a climax on the date of the signing of the contract, 24 June 1922, by the assassination of Finance Minister Rathenau, a supporter of Dr. Eckener's plan.

The American Government was more than willing to accept an airship instead of the cash, and since Dr. Eckener had proven that the cost of such an airship would exceed the reparations by about \$100,000, it was agreed to pay the additional sum to Dr. Eckener upon delivery of the airship to the United States, making the total cost of the "Reparationsschiff" about \$900,000.

Obviously the necessity of delivery to the United States made it essential that the zeppelin have trans-oceanic capability. The technology involved in the construction of such a craft was nothing new to Luftschiffbau-Zeppelin, since in 1917 they had designed and built the German Naval Zeppelin L-59,

which flew over 4,000 miles non-stop on a relief mission from Bulgaria to take supplies to General von Lettow-Warbek in German East Africa. (9) In the last months of the war they (Luftschiffbau-Zeppelin) had designed and built the L-72 with the intention of using it for the aerial bombardment of New York City.

In order for the new airship to have the lift necessary to carry sufficient fuel, provisions, and ballast for a trans-Atlantic voyage, it would have to have a volume of about 2,500,000 cubic feet. The London Protocol, however, had forbidden the Germans to construct any airships with a capacity of more than 30,000 cubic meters (approximately 1,000,000 cubic feet). The Allies considered that any airship over that specified size was a military aircraft, forbidden to the Germans.

By means of a special concession from the Allies, the United States agreeing not to use the aircraft for military operations, permission was granted to build the "Reparationsschiff". The powerplant was composed of five Maybach engines with 1,750 total horsepower mounted in five power cars suspended from the framework of the dirigible. These engines, specifically designed for use in airships, enabled the craft to attain a top speed of 79 knots, and a cruising speed of 50 knots. The low specific fuel consumption gave the airship an operational range of over 4,000 miles.

By the end of September 1924, the LZ-126 had been completed, and after a series of test flights, was prepared for its historic journey, set for the morning of 12 October 1924. On the eve of the scheduled take-off for the first flight from the European continent to the Western Hemisphere (in 1919 the R-34 had flown from England to the United States) all preparations had been completed, even to the weighing off (balancing the lift against the load which could be carried).

Some thirty tons of fuel, two tons of lubricating oil and 3,300 lbs. of water ballast were taken aboard. However, a change in atmospheric conditions caused the airship to become too heavy to fly when the takeoff was attempted the following morning. Despite considerable criticism from the spectators, Dr. Eckener decided to postpone the flight for twenty-four hours, due to the extremely heavy condition of the airship.

The following morning the "Reparationsschiff" with thirty-two persons aboard under the capable command of Dr. Hugo Eckener left its birthplace for its historic voyage from the central part of Europe to the United States. Aside from the pioneering nature of this Atlantic crossing, the flight was about as eventful as crossing the main street of your home town.

The historic trans-oceanic flight was brought to a successful conclusion some seventy-seven hours after take-off with the arrival of the future LOS ANGELES off Sandy Hook, New Jersey. Following a brief aerial display of the airship over New York City, the zeppelin landed at Lakehurst Naval Air Station, New Jersey.

On 25 November 1924, following the valving of all the hydrogen which had carried the airship from Germany, and replacing it with the helium from the gas cells of the SHENANDOAH the LZ-126 was commissioned ZR-3, USS LOS ANGELES, by the U. S. Navy in ceremonies at the Anacostia Naval Air Station, Washington, D. C.

During the following years, the LOS ANGELES performed many missions which made aviation history,

among which were, a landing on the flight deck of the aircraft carrier SARATOGA without any special equipment (later duplicated by post war tests with non-rigid airships of the U. S. Navy), a trip to Panama Canal, several cruises to Bermuda, and operating from the airship tender PATOKA at Guantanamo Bay, Cuba fleet exercises. (10) There were many tests with parasite aircraft, which put the principles into use later with the USS AKRON and USS MACON. (TT)

One instance where the LOS ANGELES made history was not planned by the Navy Department. This took place at Lakehurst on August 25, 1927. While the LOS ANGELES was moored to the 158 foot high mooring mast being readied for a flight, a sudden breeze came up and caught the tail of the airship, causing it to rise (the breeze was cooler, and coming from the opposite direction to the prevailing wind at the time, it increased the effective buoyancy of the stern section over that of the bow) and eventually to assume an angle vertical to the ground. For a moment the dirigible stood poised on its nose atop the mooring mast, while the astounded spectators waited for the airship to impale itself on the mast. Like a ballet dancer, LOS ANGELES turned 180° on her nose and slowly settled back to an even keel with the ground, now facing directly opposite from its original heading. Aside from a few holes in the outer cover, caused by loose equipment and spare parts falling through the cloth, an extensive and rather anxious inspection revealed that the framework and other components of the airship had suffered no damage whatsoever.

During the years the LOS ANGELES was in service, it was surpassed in size by seven other airships, the GRAF ZEPPELIN, the HINDENBURG, GRAF ZEPPELIN II: the British rigid airships, R-101 and R-100; and the American rigids, USS AKRON and USS MACON. It had greater volume than the SHENANDOAH, although twenty-two feet shorter. Its range was 6,000 miles. Some other statistics were:

Ratio Control Surface Area to Fin Area:	0.208*
Total Flight Hours Logged:	5,368 as of 6/30/32
Total Number of Flights:	331 " " 6/30/32
Fuel Capacity:	60,000 lbs. gasoline
Oil Capacity:	4,000 lbs. Lub. Oil
Water Ballast Capacity:	3,300 lbs.

As indicated by the asterisk, the ratio of control surface area to that of the fin area is deserving of further comment. At the time of the construction of the LOS ANGELES, the usual ratio was 0.333 . . . Probably the reason for the extremely low ratio in this case is because, since the LOS ANGELES was one of the fastest airships of its time, it was a successful attempt (as evidenced by subsequent performance) to reduce the dynamic bending forces exerted on the framework while the airship was turned at a high speed.

Primarily due to economic reasons, the LOS ANGELES was decommissioned in June, 1932, though still in good flying condition. For the seven years that followed the airship was kept in condition and used for test purposes until 24 October 1939, when it was dismantled and scrapped. During those seven years a great deal of testing was done to develop mooring masts and the techniques of their use. It is probable that the LOS ANGELES was flown several times for very short periods, as demanded by the tests. Thus came to an end the most widely known airship ever flown, not a military vehicle, but one which provided invaluable training for later works.

THE BRITISH-BUILT RIGID AIRSHIP 4-38.

The first airship of a new class, R-38, was ordered by the Air Ministry from Short Brothers (located at Cardington, Bedfordshire, England) early in September 1918. Cancelled on January 31, 1919, it was re-ordered February 17, 1919.

Due to the austerity program initiated by the government of the United Kingdom following the war, the remainder of the R-38 class of airships were either abandoned or cancelled, thus preventing the airships which were to have had the designations R-39, R-40 and R-41 from ever reaching completion. Some of the structural parts of the R-40 were used in the construction of R-38.

America's desire for a British airship was no doubt influenced by the successful trans-Atlantic flight of R-34 in 1919. The United States Government appropriated \$2,000,000 on 11 July 1919 for the purchase of a rigid airship of British manufacture. The final procurement step came when the War Department gave its approval on August 9, for the purchase of R-38, to be designated ZR-2, as a sister airship to the SHENANDOAH.

The manufacturers were, at that time, engaged in the construction of R-31 and R-32 (wooden-girder hulled airship based on Schutte-Lanz designs) and this delayed the start of the construction of R-38 until 3 September 1919. Some thirteen months after the original order, the first main frames of the R-38 had been erected, and gradually, until November 1920, the remainder of the framework was assembled. This resulted in some parts of the framework being considerably older than other portions when the erection was completed.

Following the appropriation of \$2,000,000 by the United States for the R-38, the British government provided two of its rigid airships for the training of the American crew who were to man the future ZR-2. These airships were the R-32, a wooden girder airship built in Germany, and the metal girder airship R-34. However, on a later flight, the R-34 ran into a hill in a thick fog, and a new streamlined metal-girder airship, R-80 was used as replacement for R-34 in the training program.

Due to the lack of sufficient data concerning stresses developed in the framework in powered flight, the safety factors of the R-38 were insufficient to withstand aerodynamic stresses incurred at low altitudes. The design on which the R-38 was based was that of a high-altitude German wartime zeppelin, and consequently, the strength of the girders of the frame work was necessarily lower due to the reduction of weight necessary to attain the altitudes required. In the hands of relatively inexperienced crews, flying at low altitudes, these lightened girders would not have the required strength. The wartime zeppelins which were known as the "height climbers" customarily operated at altitudes of from 18,000 - 20,000 feet.

Prior to the maiden flight of the R-38 a number of the circumferential wires (cables rigged around the inside circumference of the hull, to transfer the lift from the gas cells to the framework) were broken due to the over inflation of the gas cells and the occurrence of superheating. Since the wiring and the framework was coated with protective varnish only after the erection was completed, and the frames of R-38 had been under fabrication and erection for about two years, the materials used had deteriorated from exposure to the elements.

Thus about one-third of the life expectancy of the materials used in its construction had been expended during the period of erection, one of the many factors which contributed to the loss of the airship.

The first flight of the R-38 took place on June 23-24, 1921 and was about seven hours in duration, during which time problems with the controls developed due to their being over-balanced, and resultant slack in the control cables. The highest speed attained during this flight was 38 knots. Upon its return to base these faults were corrected by reducing the area of the balances, and placement of bungee springs in the control cables.

During the second flight a similar over-balancing of the controls was observed at a speed of 45 knots. The post-flight inspection revealed a weakness in the structural strength of the fins, originally designed as cantilever structures; a weakness which made it necessary to brace them with wires attached to the hull. The area of all the control surfaces was reduced by 10%.

The third flight on July 17-18, took place over the North Sea, during which the speed was increased to 50 knots. A tendency for the airship to "hunt" over a 500 foot range of altitude was discovered. It was then found that the transverse girders opposite the mid-ship engine cars had failed. After the return to Howden, at reduced speed, these members were replaced.

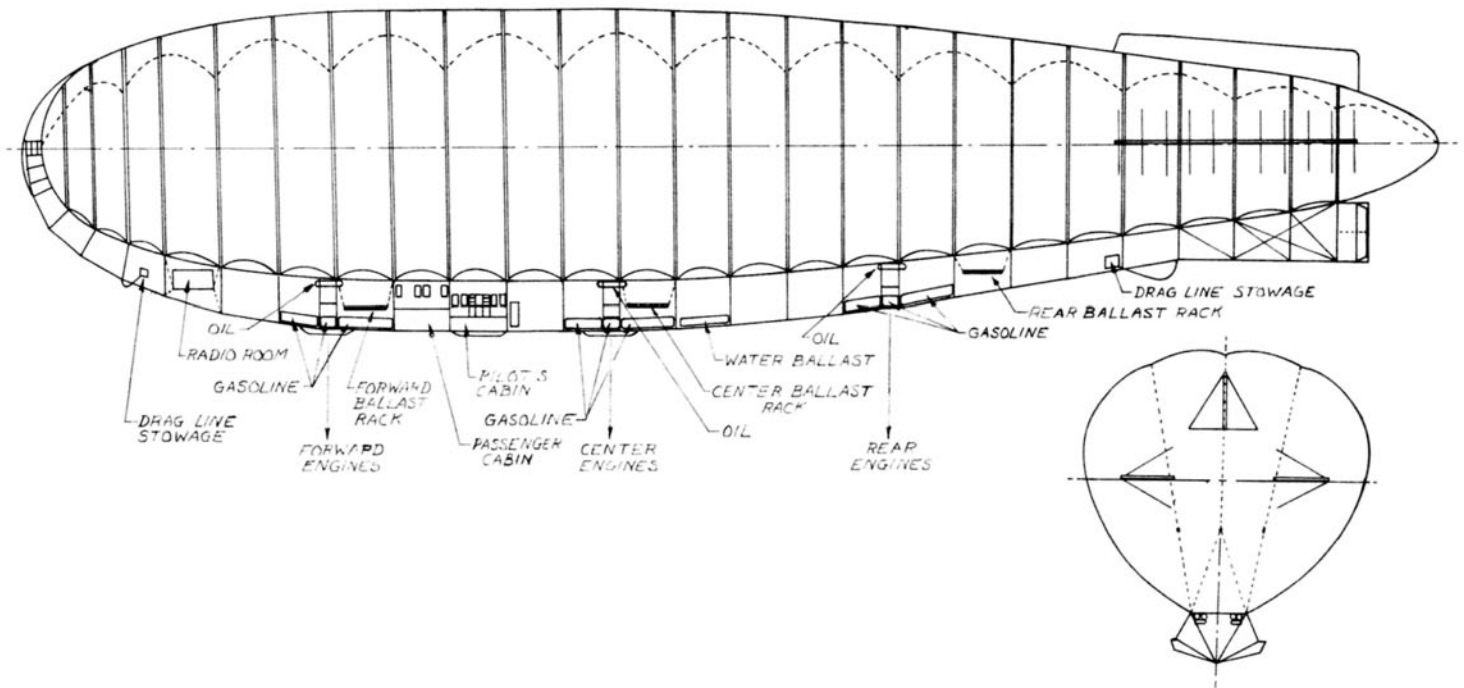
Following the third flight, Flight Lieutenant Pritchard, RAF, pleaded for the adoption of the German testing procedure which called for a minimum altitude of 7,000 feet instead of the 2,000 feet specified in British practice. Since this would make necessary a complete re-evaluation of the airship (costing money, but probably more important, a loss of prestige), nothing was done.

23 August 1921 was the date of the fourth and final flight of the R-38. Turning tests using 5° of rudder (on one occasion 10°) at a speed of 48 knots were conducted. Delays, plus a lack of knowledge of the exact position of the airship over the North Sea due to an overcast sky after sunset, caused the R-38 to remain at sea until the next morning.

Following a high-speed run, turning maneuvers at a speed of 54.5 knots and at an altitude of 2,500 feet were attempted. At one period the airship attained a speed of 62 knots. Apparently during the turning maneuvers, a number of "hard over to hard over" turns were ordered. At the same time the R-38 was also hunting over a range of altitude. The accumulated stresses soon exceeded the strength of the framework which failed amidships, causing the dirigible to break into two parts. The hydrogen inflated dirigible fell in flames into the number River at Hull, England. It was a failure not due to any one cause, but as a cumulative result of many events.

Since the fifth flight was to have been to deliver the airship to the United States, part of the American crew was aboard for training purposes and the American insignia had been painted on the hull in anticipation of that flight.

Richard K. Smith has reported that "Among the 44 killed were Lieutenant Commander Lewis H. Maxfield and 15 other U. S. Navy personnel. In view of what subsequently became known of the R-38, she was no loss; but the deaths of Maxfield and his crew deprived the Navy's tiny airship organization of one of its few senior officers with wartime airship experience, and a trained crew.



The load distribution diagram of the Airship ROMA, from an official USAF document, Report M-2760 dated at Langley Field, Virginia, 3 November 1921.

TABLE I

AIRSHIPS OF AMERICAN FORCES IN EUROPE, 1917-1918

AIRSHIP	Vol. x 1000 cu.ft.	Length	Diameter	Ratio L/D	Lift (Gross, w/Hydrogen)
ASTRA-TORRES					
*AT-1	222.3	224'	44.5'	5.0	14316 lbs.
AT-13	292.9	247'	48.6'	5.1	18863
AT-17	292.9	247'	48.6'	5.1	18863
AT-18	338.8	264'	52.8'	5.0	21819 (9967 Net)
VEDETTE-ZODIAC					
VZ-3	97	156'	35.6'	4.4	6247 lbs.
VZ-7	97	156'	35.6'	4.4	6247
*VZ-8	97	156'	35.6'	4.4	6247
*VZ-13	97	156'	35.6'	4.4	6247
CRAAIS-MEUDON					
CM-5	320.5b	262.5'	45.7'	5.7	20643 lbs.(4903 Net)
CM-6	321.2	287'	46.0'	6.2	20685 (4945 Net)
** T-2	321.9	273'	46.2'	5.9	20730 (11098 Net)
ZODIAC					
ZD-1	218	237'	42.9'	5.5	14091 lbs.
(8) ZD-2 & ZD-3	218	237'	42.9'	5.5	14091

*These airships were: AT-1 - #A-5472; VZ-8 - #A-5592; VZ-13 #A-5593.

**Also known as the CAPTAIN CAUSSIN

SPRING - 1968

TABLE II

BRITISH AIRSHIPS USED BY AMERICAN FORCES IN WW I			
TYPE	NS-CLASS	SST-CLASS	SSZ-CLASS
Numbers used	3	3	2
Length	262	196	143
Diameter	56.75	49	32
Vol. x 1000	360	100	70
Gr.Lift (H ₂)	10.85 tons	32.1 tons	2.25 tons
Net Lift (R ₂)	3.8	0.8	0.15
Coefficient of Utility	35%	2.1%	6.6%
Fineness of Ratio	4.6	4.0	4.5
Engine Type	Fiat	Hawk*	Hawk
No. of Engines	2	2	1
Total H.P.	520	150	75
Speed (Max)	48 knots		
Crew	10	4-5	3

Certain inaccuracies may exist in the above table. At best the actual number of aircraft (both French and British) can only be estimated at present.

* Rolls-Royce "Hawk".

REFERENCES

(T) There are some references to a fifth foreign-built airship which was in United States service in the continental United States; the SSZ-23 (Wingfoot L.T.A. Society Bulletin, Volume 12, Nos. 3-7) or as it was reputedly known as Z-2 or Z23, operated from Cape May Naval Air Station during the winter of 1919-1920, about the same time that O-1 operated from that base. This airship was given the aircraft serial number A-5563.

Q) JAAHS, Vol. 5, No. 4 (Winter 1960), pp.293-305.

(T) These figures were derived from "Pressure Airships", Blakemore \$ Pagon, and "The British Rigid Airship, 1908-1931", Hingham.

(?) O-1 was given the aircraft serial number A-5587,

(S) Battens are structural members sewn into the nose of a non-rigid or semi-rigid airship, to prevent the nose from buckling under the dynamic flight pressures developed while the airship is in powered flight.

(§) The ZD-2 and ZD-3 are described in Table I. Possibly ZD-2 was also shipped to the United States and placed in storage (due to the confusion surrounding these foreign airships, and the multiplicity of designations placed on ZD-US-1). Query: Could the components of ZD-2 have been used in the reconstruction and maintenance of the RN-1?

(7) In *Mitchell-Pioneer of Air Power*, Chapter 10, "The Way of an Eagle", Section III, Page 275, re the ROMA Disaster: "... At that time a letter from General Patrick, dated February 2, was awaiting Mitchell. Written nineteen days before the tragedy, and preserved by Mitchell in his files, it threw some light on the mysterious explosion: 'The ROMA is being equipped with Liberty motors, but her envelope is getting pretty rotten' Patrick reported. 'We have ordered a new one from Italy, but it will

TABLE III

FOREIGN BUILT AIRSHIPS IN AMERICAN SERVICE

CHARACTERISTIC	DZ-US-1/ DZ-L/RN-1		ZR-3 LOS ANGELES	
	0-1	ROMA		
Length (ft)	177.8	264	410.1	656.2
Diameter (ft)	35.4	49.5	74.6	90.5
Vol. x 1000 (design)*	123.7	326.0	1,204	2,472
Vol. x 1000 (actual)	127.0	338.3	1,240	2,542.3
Gross Lift (Ho)	9,120	21,027	89,000	167,080 0
Dead weight	5,850		47,200	78,000
Useful Lift	3,290		41,950	85,528
Fuel weight allowance	540			
Coefficient of utility	36.0%		47.0%	51.25%
Fineness ratio	5.0	5.3	5.5	7.25
Total H. P.	250		2100	1750
Speed (max)	56.6		68.3	68.0
Crew	3	8-10	18-25*	25*

0 Gross lift with Helium - 153,200 lbs.

* Crew varied with mission and duration of flight.

be some months before it comes through."

(W) Olmsted gave slightly different views, citing Lieutenant Orvil Anderson, USAS, (Later Major General, USAF) and was less emphatic about the end of the hydrogen era. (Editor's note)

QF) Dr. Douglas H. Robinson, "Flight to Africa of the German Naval Airship L.59," JAAHS, Vol. 4, No.2 (Summer 1959) pp. 110-116.

(TTT) The USS PATOKA was a fleet oil tanker which had been modified for this purpose by the addition of a mooring mast on the stern of the ship, and the installation of other supporting equipment not so noticeable.

FTTL Richard K. Smith, "The Navy's First Sky Hook" JAAHS, Volume 6, No. 2 (Summer, 1961). Smith described many of the tests performed with the Los Angeles.

(IT) "The Airships AKRON and MACON". Annapolis: United States Naval Institute, 1965, 228 pp, indexed, illus.

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A 50th ANNIVERSARY See Page78

A significant anniversary in the history of foreign-built airships in U.S. service is found in *United States Naval Aviation, 1910-1960*. March 1-3, 1918 mark the dates of commissioning of the U. S. dirigible station at Paimboeuf, France and the first flight of the Asta-Torres I under American control.