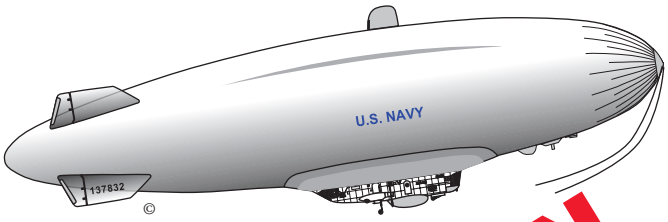
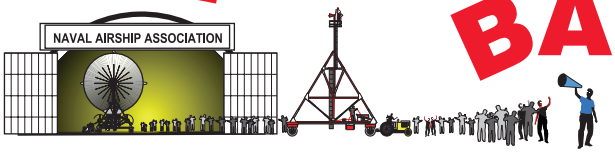
THE NOON BALLOON





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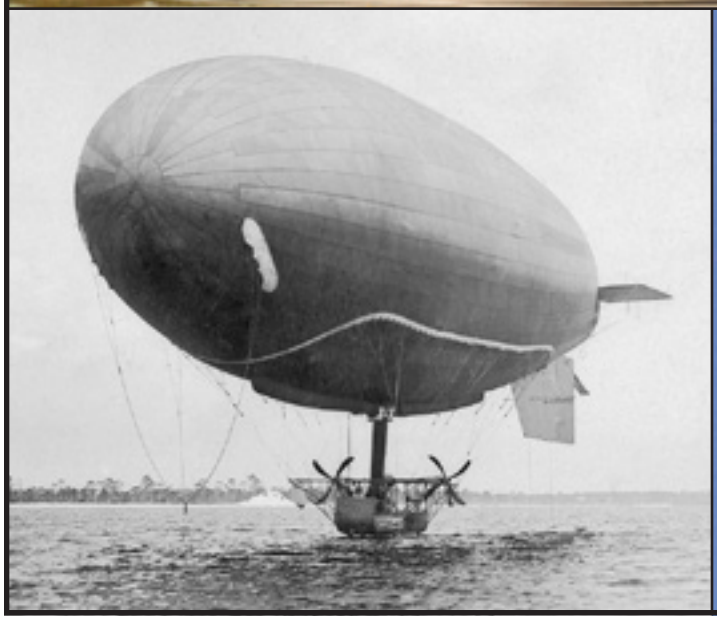

1917-2017: 100 YEARS USN LTA

Above: Ross Wood sent this link which contains nice slide prints of mid to later 1950s airshow aircraft from Bob Garrad: **https://www.flickr.com/photos/23032926@N05/albums/72157628027548881/page1**
It includes this gold-wing emblazoned ZP2K-72 - in other shots you can see the bright red "stick" mast erected there for it.

Below: NADU Goodyear ZPG-2 *Seafarer* blimp moored on NAS South Weymouth's East Mat with LTA Hangar One in the background sometime during the late 1950s. This photograph, which is actually a frame from an 8mm motion picture, was taken looking westward from Union Street while the eastern end of Runway 08/26 was being lengthened. The runway was extended across Union Street, eventually causing this road to be turned from a busy thoroughfare that connected Rockland and Weymouth to a pair of dead-ends. See "Project Meteor" inside on page 28. Photo from Marc Frattasio collection.

THE NOON BALLOON

Official Publication of the Naval Airship Association, Inc.

ISSUE #113 SPRING 2017

Life is like a jar of jalapeno peppers. What you do today may be a burning issue tomorrow. ☺

On the Cover: A bell curve of history: The pinnacle of non-rigids (ZPG-3W) atop the *Alpha* (DN-1) and *Omega* (MZ-3A) as we celebrate 100 years of USN LTA.

THE NOON BALLOON
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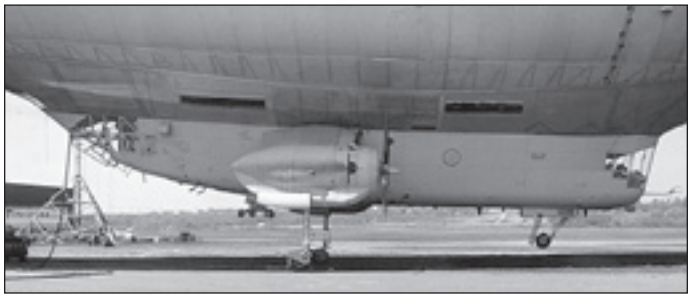


EDITORIAL

R. G. Van Treuren, PO Box 700, Edgewater, Florida 32132-0700, rgvant@juno.com

The 100th anniversary of US Naval Aviation was celebrated back in 2011. (At that time, thanks to one Captain's determined efforts, the MZ-3A got a suitable "uniform.") What about age 100 for USN LTA, we asked? All would agree it predates HTA, not just because of the balloon barge in the Civil War, but because a Navy officer showed interest at the St. Louis Air (dirigible) Races before anyone heard of the Wright Brothers. Others might argue it should be the 1914 NY *Times* notice of the Navy's soliciting bids for airships that "...will not be as large as Zeppelins, nor will they be of the rigid type," or the 1915 acceptance of the lowest bidder. It might have been the 1916 delivery of the boxes to Pensacola, or the first balloon training at Wingfoot Lake. If I may, your Ed. believes the best compromise for observing the 100th anniversary should be the first flight of the Dirigible, Non-Rigid, #1, which took place on April 20, 1917. It's doubtful someone outside our group will bake a cake, so let's give ourselves a great birthday party all year. I'll get the ball rolling with what we know of that DN-1, retroactively relabeled A-1.

This photo, located by our late exhaustive researcher James R. Shock, adds to some of the first ship's mysteries because the original specification called for a mooring facility. Yet that is no mast in the photo, and in fact even Zeppelins did not have mooring masts in those days. (Yes,

this quarter will also see the 100th anniversary of the old Count's death, as well as that of Major Paerseval.)

We have established communication with the Mayor of a French town near where the US Naval Air Station Paimboeuf was created. (Saint-Viaud wants to hold their 100th anniversary party on 25 June 2017.) Officers and air-sailors were sent overseas in 1917 for training and operations since the Americans had no functional ASW airships of their own. So we'll try to next do an article on those hardy souls shipping out to learn to fly in British SS ships, French ATs and evidently some Italian ships as well. Next our team plans to follow with the little-known but incredible story of the "B" ships, which also got going in late 1917. And, how about YOU joining in, coming up with features for the fall and winter issues that highlight the past 100 LTA years?

Sadly, when today's mainstream media struggles with any LTA subject (usually blowing up the *Hindenburg*) we have come to expect them not knowing a ZP2K from a ZPN-1. (Or caring.) Yet it never ceases to amaze me that the much more mainstream HTA history also suffers from errors of commission, some made so long ago and so often replayed they are assumed to be factual. Last quarter saw the 75th Anniversary of the attack on Pearl Harbor. Contractors hoping to cash in produce programs that are often accompanied by the scant actual footage, then a formation of "Japanese dive bombers" attacking battleship row. Except, they aren't: they are actually SBD *Dauntless* planes painted with red spots over their roundels. I believe this was staged for the Frank Capra series *Why We Fight*, but similarly, some SNJs were red-spotted at Lakehurst to play "fighter" roles in Hollywood's only K-ship movie, *This Man's Navy*.

You might notice the magazine you are holding is a bit thinner. As part of our general belt-tightening reflective of the endless listings on the Black Blimp page, we'll try to extend our life a bit longer by lightening ship by a single four-page block. I think we can get along just fine with a bit leaner magazine, still offering what I hope is a pleasing 50-50 mix of current LTA events and our rich history. We reported last issue NAA had been exploring the idea of load-sharing with a sister organization facing similar challenges with the expenses of a print magazine. Sadly, we've not been able to reach an agreement with the two others we've been talking to. We'll keep those lines of communication open, however, so we might both stop wasting resources duplicating each others' efforts.

On a personal note, I am happy to report I have taught myself enough WordPress to get my website, www.zrsthemovie.com, off and running, to finish soon. Our "hook-on fighter," our Silence *Twister* kitplane we've been building for five years and dubbed *AbbacaDebra,* is set to taxi as I write this.

Thanks for your support! – **R. G. Van Treuren**

VIEW FROM THE TOP – PRESIDENT'S MESSAGE

Fred Morin, PO Box 136, Norwell, MA 02061, frmorin@verizon.net

We have begun preliminary planning on our 2018 Reunion/Conference to be held in Akron and are actively pursuing an interesting and full schedule of activities. Tentatively we are looking at late September 2018 for the event. We hope to get some good cooperation from our friends at The Lighter-than-Air Society, including some interesting and relevant visits and possibly a joint banquet at the close of the Reunion. Venues being discussed include the airdock in Akron, the airship facility at Wingfoot Lake (possibly a new Goodyear NT blimp depending on its availability and schedule), visit to the MAPS Museum at the Canton-Akron Airport (a really nice museum including a fully restored Goodyear blimp car and a large collection of other aircraft), and some free time for personal side trips. We would also like to have a time where we can either visit the crash sites in Ava, Ohio, or have the excellent mobile museum created and maintained by the late Brian Rayner and his family commemorating the loss of the USS *Shenandoah* on display for visiting at our Reunion. This requires quite a bit of logistics, but we will try. Please recall that the NAA worked closely with the LTAS to create new signage marking the sites in and around Ava last year.

Please recall that in my last message I reported on discussions we had with the publisher of the Cardington Chronicles to work toward a single, international airship magazine rather than having several, all covering the same news and stories. It's is an interesting concept and could prove economically sound in a number of ways and possibly expose the NAA to a larger audience of potential members. We have since had discussions with another airship organization to join in on the concept. You would still receive all the same material you currently receive in *The Noon Balloon*, but it would also include some new and fascinating international airship history. We do not foresee any increase in our current dues or delivery time to you. We are currently exploring a trial issue or two sometime in the near future. You will receive a note with more details once we finalize the trial period.

Last, but not least, my idea for an LTA Hall of Fame has passed an historic milestone in its passage to fruition. I recently signed a Memo of Understanding with David Wertz, chairman of the Lighter-Than-Air Society to work together on what we will call the National Airship Hall of Fame. David proposed three LTAS members to be on the screening committee along with the three NAA members I appointed earlier. We have some details concerning the screening process and organization of the Hall to resolve, but the future looks very promising. More details and applications will be published soon in a Noon Balloon.

Thank you for your continued support of the Naval Airship Association and hope to see you at the next reunion; date and hotel location to be announced soon thanks to your input. **- Frederick R. Morin**

TREASURER'S STRONGBOX

It is gratifying that we have had such an outpouring of generosity from so many members to ensure that our Association continues to flourish in tough times. We are faced with dwindling memberships due to natural attrition. As of mid-February, we have renewals and new members adding up to 356. Seventy-seven members have not yet renewed. So, for all of you that have sent in your renewals- Thank you! We have had a few lapsed members come back to us, which makes me happy to see. Friendships nurtured over so many years should not be allowed to fade away!

Our treasury shows $8759.27 in checking and $18,839.89 in savings. We will continue to deliver what we think is the best airship newsletter, The Noon Balloon, for as long as we can.

Our Small Stores continue to deliver logo wear products like shirts and hats at good prices and many of you have acquired some of those. If there is something special you want to see us carry, please let your preferences be known! There may be others who are also interested in your choices.

In closing, please do get your membership renewals in, we can't keep up the magazine without your help. Up Ship!

– Deborah Van Treuren

PIGEON COTE

George Mitchell answered the call to i.d. photos, writing, "On page 14 of the Winter Noon Balloon in photo 2016-08-31B the picture of the two enlisted pilots are AMC AP Dick Nye (R) and AMC AP Jim Tucker (L). Both were wonderful gentlemen and very accomplished pilots. I flew with them both hundreds of hours as radioman in my six years in LTA. Chief Tucker was one of the pilots on the record-setting flight in May 1954 of the ZPG-126716 commanded by CDR. M.H. Eppes. I have many pictures of the crew that I took during that flight. I am pleased to help in any way possible with the preservation of LTA history. It was an important time in my life and I am honored to have played a small part. I don't know much about the N-1 except that when I arrived at Lakehurst in November of 1952 I was assigned to Airship Experimental Center, Commanded by LCDR Gordon Burke. I had served with LCDR. Burke in ZX-11 in Key West. I was put with a crew for the N-1 and we were sent to Good Year Akron to learn to operate the aircraft. We came back to Lakehurst after the check out and proceeded to fly the N-1 until we received the ZPG-126716. We spent hundreds of hours flying this airship getting prepared for the record flight of May 1954. I don't remember what was done with N-1. During all this time including the record flight a Good Year Rep was with us, named Ed Moore. In the meantime we received ZPG-135445 and flew and tested the new radar on this airship. Most of the officers and crews of this unit had served together in ZX-11 Key West so we were a tight-knit cohesive group. I have a "Yearbook" "NAS Lakehurst 1953" that has a picture and name of all persons, military and civilian, at Lakehurst at that time. I look forward to working with you and the Association." History Chair Mark Lutz will be traveling to NJ and visiting George this quarter. **Ω**

Tech Comm Chair Juergen Bock wrote CP Hall, "I agree with your doubts about *AirLander* in view of the capacity of a "rebuilt" R-80. It is quite in the line of a borderline between the non-rigid and rigid design which was assumed to be at 30,000 cubic meters by the classical airship experts Eckener, Rosendahl etc. Contrary to the advocates of the inflated designs with their superior textiles, I am convinced that the dynamics of huge inflated membranes is not quite understood as of yet. The failures of the ZPG-3W and many large-size air-inflated structures are realistic proofs. Moreover, all *AirLander*-type "heavy" load carrier conceptions represent a dead-end road for the same reason, whenever payloads of 50-100 tons are required. In the 80s and 90s, the LTA-Committee of the German DGLR advocated a modernized LZ-120 *Bodensee* for research, surveillance and passenger transportation, which is quite in line with your thinking w.r.t. the R-80 as a rigid airship. However, the present Z-NT with its three longerons is a tender step in the right direction but I am afraid, no essential seismic effects [around Wallis' grave] could be registered, either." **Ω**

His Honor Roch Cheraud wrote NAA (in French), "Hello, I am the mayor of the commune of Saint-Viaud where was mainly the NAS Paimboeuf 1917 - 1919 (cf PJ). We are looking for documents concerning this database and especially personal documents of sailors and American aviators who came there, as if there were descendants still alive. This year is the hundredth anniversary of the arrival of the Americans at home and we are commemorating June 25, 2017. Several of your posts Noon Balloon (for example no. 83 and no. 79) have published documents on the subject with photos TRs interesting of James F. Griffin in the no. 79) do you know if we could use them? Would it be possible to send them to us and could we have contact with the people who provided them to you?" Roch Cheraud attached several images of WWI USN LTA aviators. President Morin established communication with him and History Comm Chair Mark Lutz and Ed. put some effort into answering his request. All exchanged information will be offered in our continuing observation of the 100th Anniversary of USN LTA. **Ω**

Ed. wrote Mr. Ben Iannotta, Editor of AIAA's AEROSPACE AMERICA: "I'm sure members of our tech committees are sometimes discouraged when their efforts only wow colleagues, certainly true in our small AIAA LTA Tech Com. Happily there are occasional exceptions – such as Amazon's holiday announcement of a plan for airships to host drone deliveries. DARPA's 2015 RFI had a short deadline and I barely managed to get a proposal in, but at AIAA AVIATION 2015 our LTA Tech Com Chair Ron Hochstetler presented his paper on the modern flying carrier… which was picked up by AVIATION WEEK and was likely the inspiration for Amazon going to work on its patent. Of

course you can access Ron's paper, and if you have any use for it here is the link for my DARPA proposal.
http://zrsthemovie.com/?page_id=2225
Keep up the great work in 2017. **Ω**

Due to an egregious editing error, an entire paragraph of Marc Frattasio's NADU article was omitted. It should have read thusly: "The first blimp assigned to NADU was a Second World War vintage Goodyear ZPM type, M-2 Bureau Number 48240. This type of blimp was sometimes referred to as an "M-Ship". The M-2 was only intended to serve with NADU until the then-new ZPG-2-type blimps became available. The M-2 appears to have been assigned to Project Lincoln during the last week of August 1953, a few days before NADU was officially established at NAS Quonset Point. The blimp was fitted with a whip antenna and other equipment in an effort to investigate the feasibility of using Zenneck surface waves for long-range radar propagation. Several flights in support of this effort were accomplished over the ocean in an area south of Cape Cod between August 26th and October 30th 1953." **Ω**

We've long suspected a great deal of classified R & D went on with the four M-ships that remained secret long after anyone cared or could hope to even know what to ask for. In the Rosendahl collection at UTD there are motion pictures of a technician making adjustments to some sort of open framework as well as what looks like a fuzzy beachball - all while standing on a stepped ladder-like extension jutting out from the open clamshell doors of an M-ship! Shown at a reunion more than a decade ago, no one could offer an explanation of the images. Meanwhile, our hardworking NMNA Library liaison Steve Kozlovski, in his tireless quest to verify/i.d. captions for their images, sent along this brain-twister. An M-ship... with ZPG-2-like radome(s)... and a designation of ZP2W-3!? Obviously classified so never mentioned in the literature, is there anyone left who remembers what was going on here? **Ω**

Tech Com Chair Juergen Bock wrote Barry Prentice concerning the paper in the winter issue of Noon Balloon by Darah Hansen "Why Airships Should Replace Jets for Moving Freight:" "We fully

agree with the ecological aspect of shifting air cargo to the airships, propelled with carbon-free and/or low carbonous fuel. However in the attached paper "Categorization of Airships According to the Need for Industrial Production", we have added more stringent requirements, such as operation in inaccessible areas and independence from standard airfields (deep breath of relief by the airport managers) and Flying Crane capability substituting heavy cargo helicopters.

Strictly according to slogan "requirements first!", we have conducted a systems analysis on the optimum practical configuration of specific airships. Unfortunately the overwhelming majority of airship promoters and enthusiasts are adhered to the classical cigar-shaped or elongated body since the early days of Meusnier until Zeppelin. Unfortunately there is a psychological barrier or an Ã priori rejection of anything else than a zeppelin-type configuration. This explains also that Hokan Colting's proposal of a spherical airships at the earlier Isopolar conferences did not find the acceptance it deserved. Of course, he could not present a larger and structurally reinforced ship with an optimized system of thrusters for drag reduction etc. etc., but the principle he could demonstrate in his manned balloons. The critique about his test ships was generally superficial and prejudiced because "an airship does not look that!"

Talking about hybrids, we squeezed the sphere to a lenticular disk and gained a stall-free circular wing area which offered a wide spectrum of interesting operational modes, especially w.r.t. the consumption of gaseous hydrogen as a fuel gas and the consequential increased pressure height. This for today; we hope for a profitable debate." **Ω**

Marc Frattasio e-mailed of his work with History Chair Mark Lutz, "I'm cautiously optimistic regarding RADM Jerry MacKay and PROJECT CLINKER. Hopefully he'll follow through and provide some useful information. I've got a guy who works with me who I guess you could call an expert on nuclear submarine propulsion. He was an MM and stood reactor watches on nuclear subs in the Navy. We've had some discussions about thermal detection of submerged nuclear submarines. I've consistently heard two possible reasons for PROJECT CLINKER, one being that it was supposed to detect water heated minutely by friction from contact with the submarine's hull and the other being that it was intended to detect the heat scar from the reactor cooling system. My colleague thinks the first explanation is nonsense, although perhaps in the 1950s nobody knew better and they tried to see if they could detect the difference between water that had been minutely frictionally heated by contact with the sub's hull and ambient ocean water. He thinks that its more likely that they were trying to detect the heat plume or "scar" caused by the cooling water that was discharged from the submarine itself. He's not sure if this would be effective either since he indicated that there really wasn't that much of a difference in temperature between the water when it was taken into the sub for cooling purposes and after it was discharged. I find this hard to believe, but that's what he said. I work with a lot of people who had been reactor operators at commercial nuclear power plants and they all agree. They say that the cooling water that's returned back into the ocean isn't all that much warmer than the ambient sea water and that it cools off pretty quickly once its been discharged. Perhaps this is why PROJECT CLINKER does not appear to have evolved into an operational airborne anti-submarine sensor? I myself never used anything like PROJECT CLINKER and am unfamiliar with anything like it used by any modern ASW aircraft. We used the Texas Instruments AAS-36 thermal imaging system, which was called "IRDS" and "FLIR", in the P-3Bs and P-3Cs that I flew during the 1980s and 1990s. This device was always used as a night-vision system to provide a picture under low light conditions or to detect the smoke from snorkeling diesel submarines. We never used it to detect the heat trail from a submerged nuclear submarine. I don't recall ever seeing such a thing or even having it mentioned in the tactical manuals as a possibility." **Ω**

Just days before he passed (see Black Blimp) former Tech Comm Chair Al Robbins had e-mailed, "ref.: http://www.wired.com/dangerroom/2012/03/giant-spy-blimp/?pid=1122&pageid=74467&vie wall=true

Interesting article, and some great photos. I fear the article may be right. It's always been a political, rather than an engineering program. The Blue Devil II was a low risk platform, high risk sensor suite, and impossible schedule even before the FAA stuck it's oar in. The primary purpose of creating a manned configuration was to gain FAA permission to fly the ship in U.S. airspace. Barnes Wallace introduced radio-controlled models because he was tired of killing test pilots while developing new aircraft. Now we're

bastardizing unmanned aircraft, having to make space (and controls) for a safety test pilot. (Since it's to meet FAA criteria, I assume they'll also have to demonstrate emergency egress and survival equipment as well.)

Unfortunately, neither the Air Force acquisition manager nor the integrating contractor appear to have investigated any of the lessons learned in our last decade of Naval Airship operations, or any Quick Requirement Capability program during and since the Vietnamese War. The Army's LEMV, on the other hand was a high-risk platform, with an impossible mission definition, and equally ridiculous schedule. It was also missing all milestones and no longer permitting press releases. Can't imagine how DoD expected to establish and maintain a 20- to 40-kilometer fire-free landing zone; assuming of course, that they could get the ship in-country in the first place. Almost makes the WALRUS sound reasonable.

Much as I disliked the erratic requirements levied by COMOPTEVFOR there's much to be gained by the extensive CONUS Test, Analyze, and Fix process. When Congress ordered the Navy to investigate airships as a fleet defense against cruise missiles, NavAir developed a set of draft requirements which no reasonable contractor should have bid against. They were astonished to have so many responses. I volunteered to be the Assistant Program Manager for Logistics. My boss turned me down, because OPNAV didn't want anyone involved who might be prejudiced. However, they selected a former E-2C Squadron Commanding Officer as Prospective Program Manager, although program success almost certainly would have meant the end of Carrier Airborne Early Warning. **Ω**

Past Pres. Ross Wood e-mailed more photo i.d. details, "The mechanical mules were made by the Euclid Division of General Motors. They were the only ones we had at ZW-1 when I was there. Re: Chief Nye, I'm pretty sure he was at ZW-1 when I got there in Jan. of 1958. He was an enlisted pilot. Interestingly, we had another Chief Pilot at ZW-1 - Lead Chief "Red" Wahl. He was an amazing guy, who I became good friends with. The story I was always told, not by Red, but by his buddies, was that he was flying an R5D - (DC-4) - in the Korean war. There was a detachment of Army or Marines about 40 or 50 men who were trapped by several hundred North Koreans in a remote area. Red, with a couple of volunteers, landed the R5D on a dirt road, slightly wider than the landing gear, and while under fire rescued the entire detachment. I understood he was awarded the Navy Cross. Another Ltjg, Roland (Rolly) Hassel - no longer with us - and I, use to check out an SNB, and take Red Wahl with us down to an unmanned Coast Guard field at Cape May, N.J. The three of us would rotate in and out of the left seat, shooting touch & go's for about an hour. Red could always put it right on the "numbers". **Ω**

Luther E. Franklin e-mailed Mark Lutz, "Page 9 of the Fall 2016 Issue (No. 111) of The Noon Balloon contained a brief account of a traumatic event that the Professor Layton and his crew of ZP-4 (Weeksville, NAF) experienced. He referenced an earlier article that I had submitted concerning loss of a wheel that resulted in a Blimp crash. I was on the ground as the single landing gear hit the ground and the wheel fell off. The wheel careened down the runway and as the landing strut gouged into the asphalt, the blimp leaned over to the left, the rotating props ripped the bag and were severely bent. The Crew commander was a highly respected Sr. pilot who was wrongfully blamed for the accident. Professor Layton, i.e. the Pilot who was in the right seat of the Airship that hit the sea while towing the whale-shaped sonar unit that was being tested at that time, is a highly respected pilot of what was considered the best crew of ZP-4. That is why they were assigned to test the sonar transmitter. His first-hand account literally Made my Day!" **Ω**

Speaking of "Red" Layton, he e-mailed this photo in full flight gear conning the "Park Lane Blimp" at a Halloween event. Is that a candy sack he's carrying as ballast?

SHORE ESTABLISHMENTS

TUSTIN/SANTA ANA (see back cover)

Goodyear's longstanding desire to have its own hangar for its Carson, California, blimp base is finally coming to fruition, and it will not be re-assembling their in-stock hangar from their deleted Houston, Texas, base.

It will be the world's largest stress skin building and will be manufactured in 10 sections which are to be assembled on the Carson site. It is to be 107 m long, 41 m wide and 26 m high. The press release states "The hangar will be built out of 73 miles of partially translucent polyester fabric and will be almost nine-stories tall and longer than a football field." Manufacturing is already underway and on-site erection target is July. A new masting system, likely mobile, will replace the pole design in place since the base's opening in 1968.

Cleveland.com states "Improvements include an inflatable hangar for the new Goodyear Blimp *Wingfoot Two*, expected to arrive in California by the end of the year." The manufacturer tells Noon Balloon "This hangar is fully transportable and should a Zeppelin go down anywhere in the USA the hangar could be transported there in days." So this major investment has not so much to do with the questionable future of the Tustin (Santa Ana) hangars, the GZ-20's traditional retreat for routine upkeep, but rather another demonstrable commitment to operation of the Zeppelin NT airships in America. **Ω**

MOFFETT

The 2016 Breakthrough Prize ceremony was held November 8, 2015, at NASA's Hangar One. Host Seth MacFarlane was joined by leading figures from the worlds of technology, business, entertainment and academia. The event was produced by Vanity Fair and Don Mischer Productions. The show was broadcast live on National Geographic channel and later on Fox and National Geographic channels worldwide.

MFHS newsletter *Sparrowhawk* summed it up, "In short, a few billionaires in the Silicon Valley started an awards program five years ago with the intent to get the youth of our planet interested in math, science, physics, and the biosciences. They offer a $3 million dollar award. That is over twice as much as a Nobel prize! ... they just might be the most impressive and meaningful awards on the planet and they were at Moffett recently... It took over two weeks to assemble three huge buildings and equipment next to our Museum and inside our Airpark."

Below: Christina Aguilera and Yuri Milner, one of the founders of the Breakthrough Prize, ready to present Svante Paabo (right) with the Breakthrough Prize for his studies of DNA.

Sparrowhawk said of the TV show, "Great shots when they would break for a commercial. Camera on a boom outside would go from looking down into the room and then pan over and up to a lighted Hangar One. Very impressive.... At the end, the credits showed "Thanks to NASA Ames, Planetary Ventures, and the Moffett Field Historical Society". Hey, we all made the credits!" **Ω**

EXPEDITION CLOCKWORK OCEAN

(see inside back cover)

The HZG is utilizing a zeppelin for marine and coastal research. It is equipped with special cameras and will detect small ocean eddies in the Baltic Sea. The scientists can "park" the Zeppelin directly above the eddies, never losing sight of them.

Special cameras are employed for investigating eddies from the air. These cameras can measure temperature variations of approximately 0.03 degrees Celsius and can determine the color spectrum of the seawater. Using these observations, scientists can establish how the cold internal core of the eddy mixes with the warmer outer portion of the water and how algae react to such mixing. The scientists are tracking the eddies with highly sensitive cameras in this hovering laboratory.

Drifters are deployed on the water's surface to determine the current. The current measurements are completed by means of scientific ship radar systems. An Acoustic Doppler Current Profiler (ADCP) is used for currents beneath the sea surface. Similar to how a radar measures a car's velocity, the ADCP measures movement of the water by means of sound.

A towed instrument chain has recently been developed. The researchers can, for the first time, pull up to 20 sensors through the water simultaneously at high speeds with this chain. It reaches a depth of 50 metres below the surface. The towed instrument chain can determine the eddy's energy much more precisely than can conventional measurement methods. The *Ludwig Prandtl*, the *Eddy* and the *Elisabeth Mann Borgese* research vessels also help provide more precise insight into the eddy. The ships are supported by drifters, gliders and mini-robots that independently measure the eddies.

The goal of the scientists to track down and measure the small vortexes in the sea requires optimal measuring conditions. The previously used aircraft, which could make a series of "snapshots" using thermal imaging cameras, were now replaced by a Zeppelin. The Zeppelin can "park" during the measurements above the vortex and does not leave it from the focus of its special cameras.

Map of the expedition area between the islands of Bornholm and Usedom. The water depth measures 50 to 70 meters around Bornholm. The scientists will scan the area, measuring approximately 150 square kilometers in size, for ocean eddies and fronts.

The Zeppelin's airport base was located on Usedom, an island approximately 50 kilometers east of Greifswald. From the tranquil airfield, the eddy hunters set out over the Baltic Sea in the impressive research Zeppelin, heading in the direction of the Bornholm Basin. **Ω**

HYBRIDS UPDATE - HAV

The *AirLander* team are pleased to announce that the structural damage sustained to the Flight Deck during its second Test Flight last August has now been repaired. Following on from the successful repair and restoration of the Mission Module structure in December, the first key objective achieved was to migrate the flight deck instrument panels, overhead console and all associated wiring from the temporary rig and reinstall in position in the mission module. The move was achieved in only a number of days, thereby minimizing the down-time of power-off on the aircraft. With the equipment installed, power on was achieved and aircraft testing continues.

The second key objective was to reattach the mission module to the hull. With this now in place we have full access to the lower surface of the aircraft to continue work, and suspension ropes are ready to be tensioned to the correct levels needed for flight. The aircraft is entering the final stages of repair and is ready for advanced testing.

A comprehensive investigation has taken place since *AirLander 's* heavy landing in August, the root causes of which are now fully understood and a number of changes in procedures and training have been implemented. We are pleased to report that our insurers, led by Allianz, have helped us significantly in the phase after our heavy landing - reflecting their confidence in the *AirLander's* upcoming test flight program. Following this successful repair of the Flight Deck structure, *AirLander* is now structurally complete ahead of Hangar Exit and resuming the Flight Test Program. A rigorous testing and training program has now commenced to prepare for *AirLander* taking to the skies again. The aerospace community has been incredibly supportive of the *AirLander* and what the team continue to achieve. The *AirLander* team have embarked on an extensive testing and training schedule prior to resuming the Flight Test Program soon. **Ω**

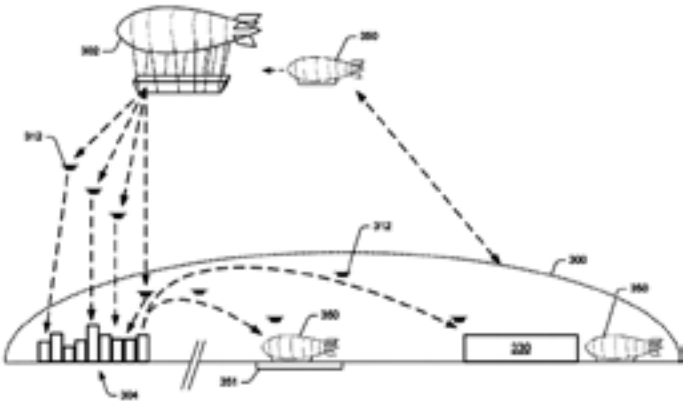
LOCKHEED

Canadian Mining Company to Lease Lockheed Airships Reuters (11/16) reports that Canadian mining company Quest Rare Minerals plans to lease seven Lockheed Martin heavy-lift airships from operator Straightline Aviation, "in the first commercial use deal for the airships." Under the $850 million deal, the airships would "provide dedicated air services between the company's Strange Lake complex mine site in Northern Quebec and Schefferville, which has a rail link to the Port of Sept-Iles." According to Lockheed, the airships are able to move 20 tons of cargo, and can land on sand, snow, and water. **Ω**

How The Use Of Airships Would Help The Trucking Industry (Excerpt) By Derek Clouthier

Look up and someday soon you could see a zeppelin-like airship floating across the Canadian skyline, transporting goods to remote northern communities. California-based hybrid aircraft operator Straightline Aviation has a contract for the first 12 airships from Lockheed Martin, and the company has indicated that Canada would be an ideal testing ground. Production of the airships is set to begin in 2018. If the idea of moving cargo into northern Canadian communities comes to fruition, it would certainly alter the landscape of the trucking industry, which is the primary mode of transportation of goods in Canada's north with the use of ice roads. "As the current case, all freight will begin or end on a truck because it is hard to envision door-to-door airship delivery," said Dr. Barry Prentice. Prentice said airships would never compete head-to-head with trucks where roads already exist, as the cost to move freight would be significantly higher for an airship. He estimated that an airship moving 20 tons could cost around $25 million versus a tractor-trailer being around $250,000 or less. But in areas where there are no roads, and the price tag to build such infrastructure for truck use being approximately $3 million per kilometer, Prentice said airships would be beneficial to both the communities served and the trucking industry. "Around the year 2000, news was emerging that climate change was happening and we could see it in the reducing length of the ice road seasons in the north," Dr. Barry Prentice said. "It occurred to me that cargo airships would provide an ideal solution." Prentice attended a conference on airships but was disappointed that there was no focus on the a business case for implementing such a mode of transportation to Canada's north, so he organized his own business conference – Airships to the Arctic – bringing together potential user and providers of airships to discuss whether the idea was a viable solution to Northern Canada's supply chain woes. "The problem in every case is the lack of funding," Prentice said. "The two airships that are closest to development are the *AirLander* in the U.K and the *SkyTug* by Lockheed Martin in the US. "It is worth noting that unlike the 1980s, the collapse of oil prices has not dampened interest in cargo airships. The difference in 2016 is the concern about climate change. International agreements to curb carbon emissions have been signed and carbon taxes (and) cap and trade programs have been created." **Ω**

AMAZON Patents Airship-Drone Delivery Carrier



Amazon has been awarded a patent for a giant flying warehouse that acts as a launchpad for drones to deliver items within minutes. The e-commerce giant was approved for a patent in April for "airborne fulfillment centers" that use drones to make speedy deliveries. The patent describes that Amazon blimps would circle over cites at 45,000 feet and launch drones carrying orders. The drones would initially fall to earth relying largely on gravity, and their motors would fire up for the final stretch. After completing a delivery, a nearby shuttle would fly them back to the blimp. CNN reported that is because the drones, which can run for about 30 minutes, might not have enough power to fly back on their own.

US 9,305,280 Patent claim #1: A computer-implemented method of order fulfillment, having inventory stored airborne at altitude, using unmanned vehicles (UAVs/drones) to make deliveries to customers (paraphrased). The idea that the inventory, stored airborne at altitude, is in an airship, is one of the additional claims. The full patent for Amazon's "airship warehouse with delivery drones" is available here: https://patents.google.com/patent/US9305280B1/en

Mark Lutz notes, "It is clear from the drawings that no effort on airship design is part of the patent - airship design is not part of any of the claims." **Ω**

Global Airships Market: Move Toward Cost-effective Advertising to Bring Positive Outlook, Predicts TMR

Transparency Market Research observes that there are several emerging players in the global airships market as the market is a nascent one. This is also the primary reason why the market is quite fragmented. Some of the dominant players such as Aeroscraft, American Blimp Corporation, and Northrop Grumman are placed in North America. As a majority of airships are still under production or construction, the market is yet to realize its full-blown potential.

Presence of Strong Players Ensures Continued Growth of Airships Market in North America

According to the research report, the global airships market is expected to be worth US$273.2 mn by the end of 2024 from US$152.8 mn in 2015. Analysts predict that between the forecast years of 2016 and 2024, the global market is expected to progress at a CAGR of 6.5%. In terms of regions, North America is projected to lead the global market as the U.S. will boast a strong presence of key manufacturers. By the end of 2024, the North America airships market will be worth US$90.3 mn. Out of the various types of airships, the non-rigid airships will steal the show due to their low operating cost and light weight. The non-rigid airship segment is expected to account for a share of 43.5% in the global market by 2024.

Safety Concerns Lend Impetus to Global Airship Market

The global airships market is primarily being driven by increasing uptake of airships in the field of advertising. "Several advertising agencies are opting for airships are they are exceptionally cost-effective solutions and thus have the chance to yield higher returns of investments," states the lead author of this research report. Airships can be raised up to cover a large view area at a minimal cost. Thus, they offer excellent visibility and remain stable until taken down. The demand for airships is also soaring as safety concerns continue to pressure several governments across the globe. Militaries across the globe are using airships for observing, temperature broadcasting, and geo-spatial mapping. They have not only made air surveillance cheaper but also eliminated the risk of humans handling these tasks.

The increasing usability of airships in research and for commercial tours is also anticipated to have a significant impact on the revenue of the global market. Air travel companies are readily adopting airships as they are focused on revolutionizing their services and offering consumers newer experiences. The attempts of that changing hospitality in air travel and discovering newer routes has triggered the uptake of airships in the tourism industry. Furthermore, airships are also being used in the transportation industry. Thus airships are being popularly used in industries such as mining, automobile, oil, and manufacturing.

Operational Complexities Hinder Market Growth

Despite the continued growth in the global airships market, the global market does face some tough challenges. The key factor hindering the growth of the airships market is their speed of travel. Airships travels at a remarkable slow speed and thus not being adopted as a primary mode of transport in several sectors. Additionally, the operational complexities are also hampering the growth of the global market. The usage of hydrogen and helium makes these airships very dangerous, marring their safety for a significant extent.

This review is based on Transparency Market Research's report, titled "Airships Market - Global Industry Analysis, Size, Share, Growth, Trends and Forecast 2016 - 2024." **Ω**

Comments Regarding the Role of the Airship in the New Low-Carbon Era

By Juergen K. Bock, Tech. Comm. Chairman

Introduction

The author is since 1977 member of the Lighter-Than-Air Committee of the German Aerospace Association (DGLR) and has consequently seen many airship projects to fail for a number of reasons, most of them due to the lack of capital but mainly due to the lack of technological continuity in contrast to the history of heavier-than-air transport. While the era of large airships ended with the *Hindenburg*, the fixed-wing aircraft technology reached an unexpected ceiling.

The result of this growth, however, is an ever-growing demand of energy from carbon-based fuel which produces an alarming increase of CO2 in the earth atmosphere which urgently requires carbon-free or, at least, low-carbon fuel. Furthermore, drastic savings of fuel consumption could be achieved by using LTA transport systems at lower speed. The rock solid requirements are economy, ecology and operational flexibility.

In the following the apparent status will be analyzed and commented accordingly.

1. Buoyant Airships

Buoyant airships have been proposed as potential aerial carriers fueled with preferably liquid methane; the ideal fuel would be liquid hydrogen, however this type of fuel would require rather complex storage facilities. Potential lifting gases are helium or hydrogen, whereas helium would require an additional exhaust gas condenser for keeping the equilibrium w.r.t. the amount of burnt methane, thus creating the economically absurd situation of producing ballast water and pay for its transportation. The more intelligent solution would be the use of hydrogen and use part of it as an additional fuel gas in combination with the liquid fuel (similar as the Blaugas mixture on *Graf Zeppelin* LZ-127). The decisive advantage would be the increasing pressure height the airship could achieve during the mission, enabling increased airspeed and improved capability to avoid foul weather zones. A buoyant airship for transoceanic service must have at least the dimensions of the last zeppelins LZ-129 and LZ-130 and should be equipped with landing wheels to enable airplane-type landings instead of a tremendous landing crew. In this context it should be emphasized that the prevailing rule “helium only” is absolutely counterproductive regarding aerial transportation economy. The lesser lifting power of 8 percent as compared with hydrogen results in a reduction of useful load of about 16 percent, assuming a dead weight of 50 percent of the gross weight, not even calculating the weight of fuel and other consumables. Therefore it is highly questionable if any shipping enterprise will accept such a reduction of payload carrying capability, not to mention the price difference between helium and hydrogen.

2. Fire Prevention

The key requirements are the prevention of oxyhydrogen gas due to diffusion and/or pin holes in the gas cells as well as the ignition due electrostatic discharges or other ignition sources, plus the strict avoidance of flammable materials and coatings as e.g. in the case of the *Hindenburg*. Oxyhydrogen can be avoided if the surroundings of gas cells or the contents of ballonets, respectively, will be filled with a continuous stream of clean and dried exhaust gases, considering the use of clean methane and hydrogen as propellants. The design of such an exhaust gas processing is mandatory and eliminates e.g. the helium purification process of the past. Electrostatic discharges, however, are a potential problem in most modern blimp designs, since practically all of them are using synthetic materials.

3. Non-Rigid Pressure Airships

Non-rigid pressure airships are the dominant contemporary designs of small airships which are mainly used for advertising and special tasks but not for efficient cargo transportation. Moreover, they are the main reason for this technologic setback due the relatively low level of technical and operational requirements imposed on present-day advertising airships: essentially fair-weather operations of low range and payload at minimum size and investment. Thus previous experiences have been ignored and forgotten, and later concepts have repeated the same mistakes that had already been identified and remedied some 40/50 years ago.

Also two essential experiences of the past seem to be forgotten/ignored: Even before World War I it was stated that the lower limit size of any operationally and economically useful airship would be 14,000 cubic meters (DELAG), a figure that was decades later confirmed by the smallest serviceable US Navy airship series, the K-class. The second experience of the past concerns the maximum limit size of non-rigid pressure airships at about 30,000 m3. Beyond this limit, only rigid or semi-rigid should be preferred, potentially also metalclads and to be developed sandwich structures. The accidents of the

ZPG-3 and the *AirLander* give reasons of concern in this context!

4. The Great Step Toward the Hybrid

The first step in the right direction was performed by the US Navy and nowhere else. It was the introduction of the ZPG-2 series with the tricycle landing gear and the ballast haul system. Allegedly this novel design concept came from Douglas aircraft engineers. Considering the cockpit, one could get the impression to be onboard a conventional airplane. In a way it is true. The ZPG-2 was technically a hybrid or an all-weather HTL which took-off and landed safely even at a stiff crosswind and which could even safely perform autonomous ground operation maneuvers. One may say, the nucleus of the future LTA development was drafted in the 1950s! The reader will be amazed to learn how these experienced innovations have been completely ignored in the subsequent attempts of LTA-revival !

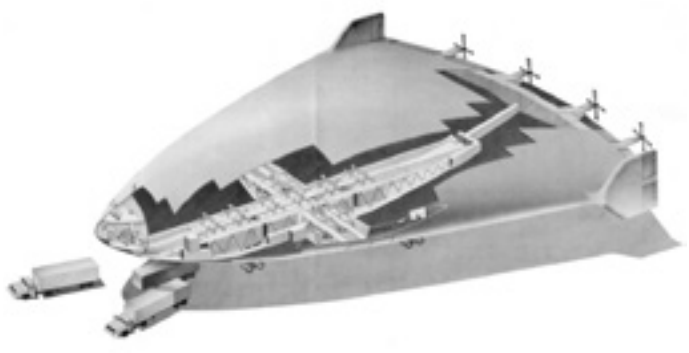
5. Examples of Conventional Airship Projects since 1980

The Skyship production series failed its commercial acceptance by starting at too small a type for economic passenger transportation and comfort far below the aforementioned minimum volume of 14,000 cubic meters and ignored the proven take-off and landing technique. On the other hand the design introduced the shrouded vectored thrust, which allow the thrust vector to be turned by approximately ± 90 degrees. Vectored thrust certainly has its merits, for it is excellent for heavy take-offs from confined fields and for making "light" landings in light winds. However, airships with vectored thrust, approaching the field slowly with the propellers vectored up to counteract heaviness, are losing practically all yaw control and the ship drifts away even with a light crosswind shift.

In Germany, the first amateurish design of the 5,000 m3 Zeppelin NT (Neuer Technolgie) caused incredulous astonishment. It ignored the US Navy experience completely, since it was the firm belief that the name "Zeppelin" would encompass all LTA wisdom of the world. Nevertheless, Hapag-Lloyd, as a potential investor, analyzed the project and recommended urgently an enlargement of the ship from originally 5,000 to 7,000 m3 in order to allow at least for the accommodation of an ample number of passengers. Later, in the midst of the construction phase, even this enlargement turned out to be inefficient and a cylindrical enlargement had to be inserted, thus increasing the over-all volume to about 8,000 m3. The hero, who saved the entire project from complete failure, was not an LTA-man, but an experienced aircraft engineer, Dr. Bernd Straeter, who deserves the merit of making the Z-NT a success after all, despite of all conceptual shortcomings. Anyway, the Z-NT is the first operational "rigid" airship built in Friedrichshafen after six decades, and the first "rigid" airship with only three longerons, nevertheless still below the 14,000 m3 mark.

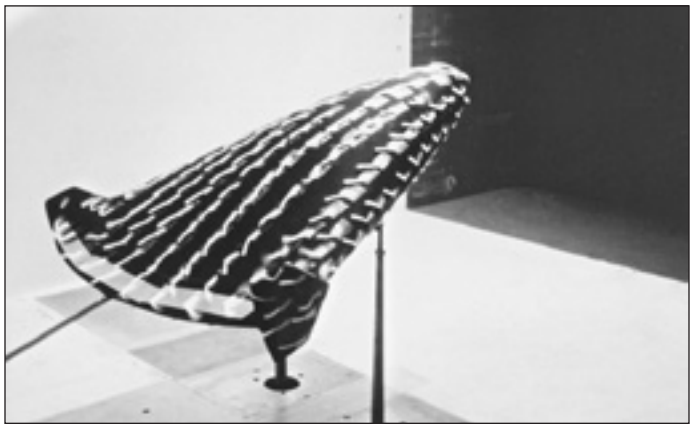
6. The CargoLifter Experience

In March 1995, the author was approached by a Siemens representative to discuss the feasibility of an airship for the transport of a 500 ton nuclear reactor from the seaport over an extremely difficult traversable road system in India. The outcome of a first requirements analysis was a compact, even spherical airship configuration for short-range operation, while the long-range haul would be accomplished by the unbeatable low freight rates of sea transportation. The Siemens representative, as a potential investor, relayed this information to an entrepreneur who surprised the annual national LTA convention with his presentation of the concept of a cargo airship, which would transport goods worldwide from point-to-point – the CargoLifter. He limited the payload arbitrarily to 160 tons and established the range to 14,000 km, thus ignoring the actual needs of Siemens' realistic problems completely. Nevertheless, the emotional enthusiasm was amazing, although many professionals should have known better. A 150 million euro hangar was erected with no regard for the traditional airship construction requirements. Despite many glossy papers, not even an engineering mockup of the rigid part of the envisioned airship was realized. Finally bankruptcy was inevitable in 2002 and the dream of the many private investors collapsed, the irrational vision of airships faded away and with it the enthusiasm for the traditional airship.



7. The AEREON Hybrid 1966

The first endeavors for creating an economic hybrid airship had been undertaken by the AEREON Corporation in 1966, based on Fitzpatrick's thesis of a "weightless" carrier system. In other words, an LTA system the dead weight which would be carried by aerostatic lift and the useful load carried by aerodynamic lift, thus reducing the dimensions of a prospective craft considerably. It became clear that the conventional airship form would not suffice as a lifting body; therefore an arrangement of three side-by-side zeppelins ("tripelin") was tested with moderate success. Consequently a series of platforms of rounded delta shapes have been investigated, resulting in a "deltoid" configuration, which was tested in a Forrestal wind tunnel in 1967 and was found - to the general surprise - to be stall-free for angles of attack of more than 30°. Having a closer look at the aspect ratio of the deltoid, it turned out to be about equal to the aspect ratio of a circular disk wing which is known to be stall-free and which would allow take-offs and landings at extremely low speed. The concept of the "deltoid pumpkin seed" was developed to an air freighter to transport containerized cargo over distances, consequently arousing the interest of shippers, economists, engineers, LTA experts etc. The latter ones with curiosity, but in the background with the killer argument: "This is not the way an airship looks like!" – a psychological phenomenon which dangerously hampers the understanding and progress of LTA technology!



8. The Airship Theorem

The Airship Theorem concerns the basic geometry of airships with respect to their functions and history of development:

All started out with spherical balloon which is generally a passive float, but can also be maneuvered by means of thrusters, as will be discussed later on.

In order to create a buoyant airship, one has to reduce the drag coefficient by elongating the sphere preferably to the lengthy ellipsoid of 1:4.5 or 1:6 which corresponds to the general geometry of conventional airships. The aerodynamic lift coefficient is in practice predominantly created by the empennage, which is not considered in this context.

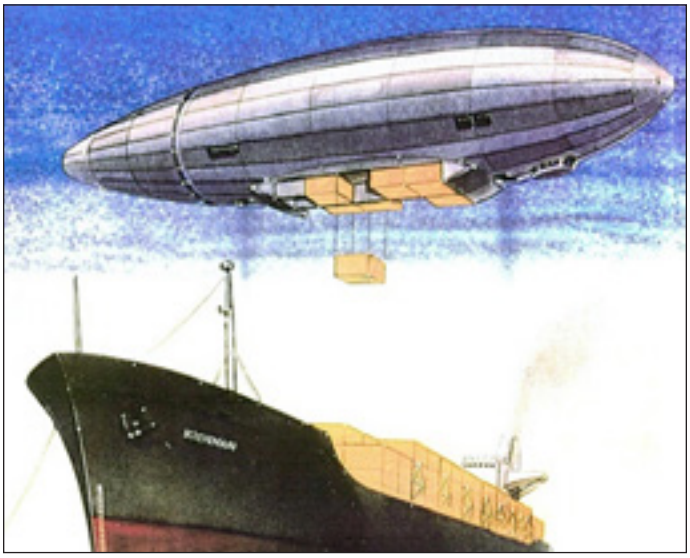
In the case of a hybrid airship, however, a sufficient high aerodynamic lift coefficient is requested. Therefore, the originating sphere will be squeezed until it reaches a minimum volume-related drag coefficient and a corresponding lift/drag ratio of about 10 for the resulting discus. While the flight mechanical stability of a conventional airship is achieved by means of an empennage, this will be accomplished in the case of a discus by controlling the location of the c.g. The additional aerostatic lift alleviates the practical trimming control to a great extent.

The advantages of the described discus configuration are obvious due to the reduced linear dimensions, flexible control and due to the combination of static and dynamic lift which allows variable STOL and VTOL capabilities for multiple missions.

9a. A Critical View: Transport Airships Under Development

The configurations shown are derivatives of elongated airships comparable with the last types of classic zeppelins LZ-129 and LZ-130. They would require a mooring mast and a swinging circle of at least 500m in diameter plus elaborate mechanical ground-handling equipment. As hybrids they are less efficient because of their relatively narrow platforms, which present only a dynamic lift coefficient which is too small to create substantial dynamic lift as compared with the inherent static lift. Moreover, it is not sure if they are stall-free at higher angles of attack, which would be disastrous for a transport airship. It should be recalled that stalls have occurred with conventional airships quite often. It is not clear from the illustrations what types of construction are intended. If non-rigid designs on the basis of the blimp technology are considered, it would be analogous to a giant rubber dinghy used as a container ship. Furthermore, some of

the "glossy paper" designs ignore the general payload accommodation technique of the past via hoists and suspension cables, which transferred the heavy weight of the payload into the main structure of the hull. Zeppelins accommodated in this manner automobiles and light airplanes. Other examples are the aircraft carriers *Akron* and *Macon*! Said paper designs, however, envision in most cases a payload ramp and a roller floor as being used in cargo airplanes. This concept is good for fuselages of conventional cargo planes, but not for the extensive stress path of an airship. Instead, the AEREON project planned in 1966 for containerized payload an overhead gantry crane which hoisted the containers on-board via a belly door. The suspension from the overhead gantry crane allowed furthermore a proper trimming of the payload mass. A method of payload hoisting, suspension and trimming appears therefore to be the adequate method for transport airships.



John Mellburg illustration for Airships International, which passed away with its founding members.

Generally missing is a discussion of the requirements regarding the whole spectrum of applicable missions. The article refers obviously to long-range missions with specific terminals, while e.g. the Canadian scenarios with their multiple service demands would call for short-range operation in areas with little or no infrastructure. It is obvious that the pertaining requirements will be different, possibly in the line of a flying crane as a substitute for the heavy-load helicopter.

9b. Advocacy for the Spherical Airship

Coming back to existing experiences and go a large step backward for a new attempt back to the original aeronautical aircraft – the spherical balloon: The Canadian 21st Century Airships Corporation promoted a powered spherical airship and proved its maneuverability in numerous manned models, even in high altitude flights. As a matter of fact, the exclusive use of thrusters for control and propulsion would have made it an ideal tool to overcome the existing transport conditions in the wide Arctic zones of Northern Canada.

Colting's manned models having only 2,000 - 4,000 cubic meters of volume, were – indeed - too small for practical use and the thruster system was not yet optimized for efficient drag reduction, since this would have exceeded his available budget at that time. A practical prototype should have been a 30–40 meter diameter weatherproof sphere with a rigid substructure, having a more favorable volume/surface ratio (in correspondence to the lift/drag ratio). The general rejection of the spherical airship was based on the argument that it would be drifting off course even at moderate wind conditions and does not comply with the usual configuration of an airship. As a result, an obvious chance was lost for short-range cargo haul operation.

In Conclusion

The lack of efficient system engineering with overriding competence is obvious. System engineering shall be strictly oriented to the principles of

- economic, environmental and operational requirements,
- technical experiences and potentials,
- fundamental operational impacts.

In consideration of the tremendous past research and development efforts in the field of heavier-than-air technology, a coordinated effort is mandatory, including the methodology of applicable aerospace engineering, as well. **Ω**

SHORT LINES

Highlands Natural Resources plc Announces Definitive Helios Two Gas Analysis Results Gas analyses has confirmed the presence of 0.31% to 0.33% helium at the Helios Two Natural Gas and Helium Project in Montana. It's similar to the concentrations of helium exploited at the Hugoton Field, which has historically supplied approximately two thirds of the domestic helium supply via infrastructure operated by BLM. That infrastructure as well as the associated helium reserves are now expected to be decommissioned and depleted by 2021, creating a potentially significant demand for replacement sources of domestic helium in the United States. As a result, helium prices have risen to US$107 per mcf (approximately 3,050% more valuable than methane, which trades for ~US$3.50 per mcf). Private helium transactions are reported to achieve significantly higher prices. Ω

GASWORLD magazine reports "some in the industry believe helium will increasingly become a primary drilling target over the next five years.... While a significant amount of helium produced in the US today still comes from the BLM system, that system is in decline and will be phased out by 2021 per US legislation. Development of new US sources to offset the decline in domestic helium supply is critical to avoiding the US becoming a net importer of helium in the future." Ω

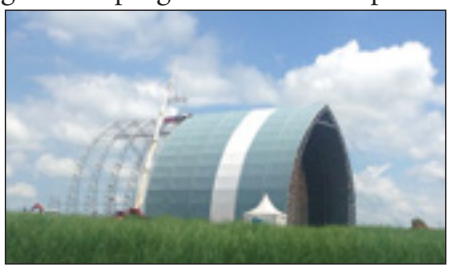
CSIRO has potentially removed a major roadblock in commercial graphene production, developing a low-cost soybean-based graphene material that can be used by electronics manufacturers. CSIRO developed the novel "GraphAir" technology, which it says eliminates the need for a highly-controlled environment. Essentially, the technology grows graphene film in ambient air with a natural precursor, making its production faster and simpler than previous graphene, which is grown in a highly-controlled environment with explosive compressed gases, requiring long hours of operation at high temperatures and extensive vacuum processing. Ω

Xebec Launches Compact Hydrogen PSA Purification Units for Industrial and Fuel Cell Applications On October 18th Xebec Adsorption Inc. announced the introduction of a complete range of new high performance, Fast Cycle Pressure Swing Adsorption (PSA) Systems capable of hydrogen purification of up to 6.0 hydrogen grade (99.9999%). Standard models handle up to 18,000 SCFM (30,000 NCMH), operating within a pressure envelope of 50 - 450 psi. Ω

BEAM Inflatable Habitat Completes Six Months In Space Ars Technica (11/22) reports that NASA has provided an update on its Bigelow Expandable Activity Module (BEAM) inflatable space habitat, which has completed six months in orbit. BEAM Program Manager Steve Munday said, "BEAM is the first of its kind, so we're learning as we go, and this data will improve our structural and thermal models and analyses going forward."... and... Bigelow, NASA Discussing Expanded Use Of BEAM On ISS SPACE (1/22) reports that "Bigelow Aerospace is in discussions with NASA about extended use" of its experimental Bigelow Expandable Activity Module (BEAM) on the ISS. The first BEAM was added to the ISS last year for a planned term of two years. Bigelow said in a January 18 tweet that the installed BEAM "continues to outperform expectations," and explained that the company and the agency "are in agreement to evolve BEAM into becoming an everyday asset aboard the ISS." Ω

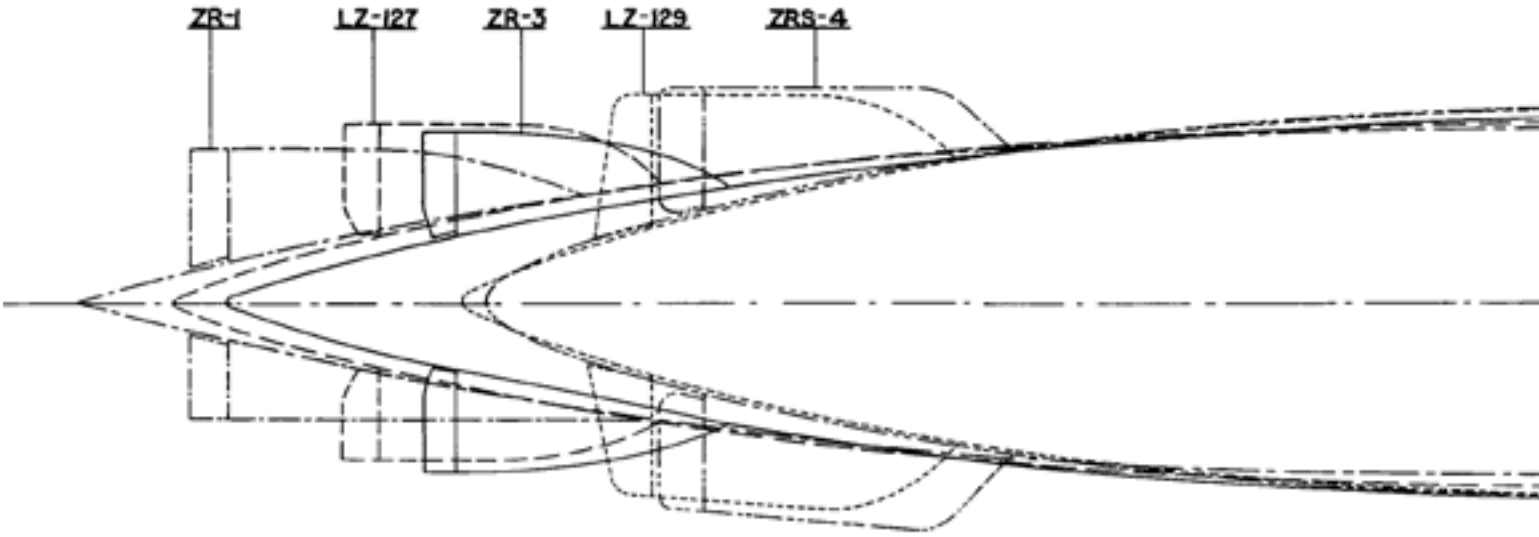
World View Plans Balloon Flights To Near Space Fast Company (12/19) reports that the startup company World View is "building enormous balloons that will gently float more than 100,000 feet into the atmosphere" in order to provide passengers a vista of Earth from space. According to sources, the first passenger flights could occur as early as 2018, and "dozens of customers have already reserved seats" for $75,000 each. The company was founded by Jane Poynter and Taber MacCallum, who "spent two years together in the early '90s in Biosphere 2." MacCallum said, "We realized that nobody had taken modern technology and applied it to stratospheric ballooning. ... We're talking about Tesla batteries, 3D printing, modern computation, and electronics. With these technologies, we're learning to do things, like very precisely changing our altitude in a balloon." **Ω**

This image shows significant progress on the airship hangar in Brazil, now said to be nearing completion. Hopefully some official word will be released soon. Ω



HISTORY

Durand Committee Report No. 2
WASHINGTON, D.C.
January 30, 1937
REVIEW AND ANALYSIS OF AIRSHIP DESIGN AND CONSTRUCTION, PAST AND PRESENT.

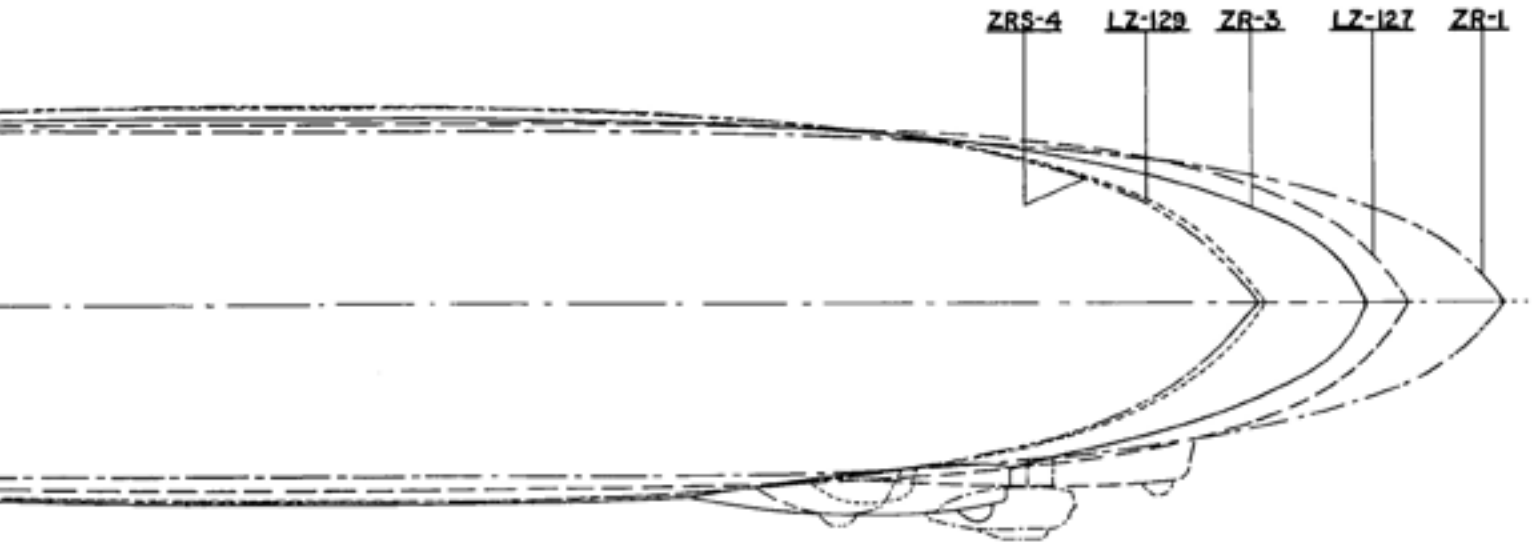


The special Board on Design and Construction of Airships has considered that phrase of its instructions calling for a "Review and Analysis of Airship Design and Construction, Past and Present" as implying such review and analysis on our own part and as a foundation for our "Recommendations as to Future Design and Construction," rather than as calling for a comprehensive presentation of the results of such study as a part of our report.

It will be proper to state at this point that much of the subject matter of such an analysis and review was already familiar to us as a Board, and that we have again made further studies of such parts of this subject matter as bear most directly on those phases of airship design and construction which are of special importance for our present investigations; and further that the recommendations already made in our report under date of January 16, 1936, as well as such other recommendations as we may make in further reports, derive from and are consistent with the results of such study.

These studies, however, have resulted in placing in specially convenient form certain basic airship data and there are, moreover, certain special phases of this general subject which merit presentation and discussion in some detail. As a background to the discussion of these special topics, it has therefore seemed desirable to present, in very brief abstract, a general picture of airship design and construction from the early forms of 30 years ago down to the forms representing present practice. Inasmuch, however, as our present inquiry is understood to deal more directly with airships of the rigid type, we have limited this abstract of review, for the most part, to constructions of this character. Following this brief review will be found a more extended discussion of certain special topics, under this general head, which we consider of importance in connection with the subject matter of our investigation. Much of the material of this abstract of review has been drawn from Design Memorandum No. 203 prepared by the Bureau of Aeronautics at the request of the Committee.

FIG. 1.
OUTLINE OF AIRSHIPS REDUCED TO COMMON SCALE OF $V^{2/3} = 19,850$ FT.



SCALE OF OUTLINES

NAME		SCALE
SHENANDOAH	ZR-1	1/250 x 1.07
LOS ANGELES	ZR-3	1/250
AKRON OR MACON	ZRS-4	1/250 x .724
GRAF-ZEPPELIN	LZ-127	1/250 x .86
	LZ-129	1/250 x .71

FINENESS RATIO

In Figure 1 are shown, reduced to a common scale value of the two-thirds power of the volume (V2/3), the longitudinal sections of a series of airships of the Zeppelin type which illustrate the general trend, during the last 15 or 20 years, of the ratio of length to maximum diameter. The value of this ratio for the *Shenandoah* typical of Zeppelin construction of that period was 8.44. The value for the *Akron* and the *Macon* was 5.91 and for the *Hindenburg*, the most recent of the Zeppelin types, 6.02. The present-day trend of opinion regarding this value is definitely against the relatively slender type of form as in the *Shenandoah*, and is apparently rather definitely settled on values of close to about 6.

AERODYNAMIC AND STRESS CONDITIONS UNDER OPERATION: FACTORS OF SAFETY

During the period of the development of airship design and construction, a wide variety of assumptions have been made regarding the possible aerodynamic conditions which should be considered controlling. In the *Los Angeles* and earlier Zeppelin practice, emphasis was placed on the forces arising from the action of the elevator and rudder. In the *Shenandoah*, special weight was given to the distributed forces arising from dynamic lift. In the *Akron - Macon* designs, special attention was given to the bow forces arising from the entrance of the ship into a gust. In the British ship R-l00, gust conditions were also given special consideration in laying down the strength criterion.

The methods of stress analysis applied to determine the actual loads in individual members of the airship under the aerodynamic conditions mentioned have been developed to a high degree of accuracy. The stress analysis in general includes the consideration of the longitudinal strength of the airship treated as a beam and the investigation of the strength and deflection of the transverse frames.

The aerodynamic assumptions and the stress analysis being given, the actual strength depends on the assumption of a certain safety factor which, under the most unfavorable conditions, should not be less than two.

A detailed discussion of the points involved in the problem of structural safety and especially of the choice of the safety factor are discussed in Appendix 1. At this point only a brief comparison of the general strength of different airships is given.

In order to compare stress conditions with special reference to the bending moment on the ship as a whole, in ships of different size and proportions, it is advantageous to reduce all cases to some common basis through the use of a nondimensional coefficient expressing the relation between the actual or assumed moment and some function of the principal characteristics of the ship. No procedure of this character can take account of all the existing factors in the problem, but significant indications are given by the use of a non-dimensional coefficient Cm in an equation of the form,

$M = Cm\ q\ V\ 2/3L$ where

M = maximum aerodynamic bending moment

Cm = non-dimensional coefficient of bending moment

q = dynamic pressure head @ full speed at 3000 ft. alt.

V = air volume L = length

For comparative purposes, for ships of this general type, the value of Cm may be taken at .01. The stresses and apparent factors of safety for the *Shenandoah*, *Los Angeles*, *Akron,* an *Macon* designs, under this bending moment, assuming full load and gas pressure, are then as given in Table III.

GASES FOR CELL INFLATION

Hydrogen has been the standard gas for the inflation of the cells of airships in European practice. In the United States, helium, by reason of its safety against the possibility of explosion or fire hazard, has been preferred, even at the cost of some 10 percent in lifting capacity.

As fuel is consumed, ships inflated with hydrogen can, by a suitable valving of the hydrogen, either maintain altitude in static equilibrium or gain altitude if desired. With helium as the lifting gas, some form of water recovery from the exhaust engine gases is fitted in order to maintain altitude as fuel is consumed. This avoids valving the relatively expensive helium gas, but restricts the altitude to the original level. If altitude must be gained, ballast must be dropped (or the water recovery thrown out of operation) and helium valved as conditions may require.

AIRSHIP FRAMING

In all rigid airships, the framing comprises longitudinal and transverse members. The longitudinal members are in the form of girder structures and furnish the main support against deformation, as a whole, lengthwise of the ship.

The transverse members are in the form of ring frames made up as many-sided polygons, with suitable attachment to the longitudinal members, and furnish the main support against deformation of the structure in transverse directions.

In addition to these rigid members, diagonal systems of wires are fitted to serve as support for the outer envelope, to carry shear stresses, to give torsional strength and to aid generally in consolidating the transverse and longitudinal members into a self-contained structure.

Transverse framing: The main transverse frames are spaced in accordance with the subdivision of the ship into its gas-cell compartments. The divisions between these compartments are formed by some system of cross wiring, forming in effect a wire bulkhead. Where the wires are attached directly to the outer ring of the frame, as has been the usual type of construction, this bulkhead acts as a fore and aft support for the gas cell and carries its heaviest load in case of deflation (partial or complete)

TABLE III: FACTORS OF SAFETY IN U.S.S. SHENANDOAH, LOS ANGELES, AND MACON

	"*Shenandoah*"	"*Los Angeles*"	"*Macon*"
V, ft3	2,300,000	2,800,000	7,400,000
L, ft.	680	660	785
v, ft/sec	84.5	113	122
q, Lb/ft2	7.70	13.8	16.1
M, ft.1b	910,000	1,820,000	4,800,000
Z, ft.in2	171	260	900
M/Z, Lb/in2	5320	7000	5330
Static stress, Lb/in2	9700	9900	5300
Total stress, Lb/in2	15,020	16,900	10,630
Ultimate stress, Lb/in2	26,000	33,000	37,000
Factor of safety	1.73	1.95	3.48

q = .00108 v2 M = .01 q V2/3 L Speed of *Shenandoah* limited to 50 knots, although engine power sufficed for 58 knots.

of the cell on one side of the bulkhead. As an aid in carrying this cell pressure load, in the case of partial deflation on one side, a central longitudinal member has been fitted, in the form of either a rigid girder or a steel cable. The Zeppelin L-30 class, and its derivatives including the *Shenandoah*, were thus fitted with an axial steel cable.

In the *Graf Zeppelin*, there is a longitudinal girder structure a little below the axial line, lying between the hydrogen and fuel gas cells and carrying the hydrogen relief valves. The *Hindenburg* has an axial girder made up in sections running through a fabric tube in each gas cell and bolted to a ring in the center of each wired bulkhead. In the *Shenandoah* and earlier Zeppelin-type construction, the theoretical factor of safety in the extreme condition of a fully inflated cell on one side and a completely deflated cell on the other was only slightly more than one. In the *Los Angeles* and later types the strength of these frames was greatly increased, giving a minimum factor (theoretical) of about two.

The main frames of the *Akron* and the *Macon* were made of a specially deep-ringed form and the transverse wiring was attached to the frame by special "resiliency" devices, permitting a certain amount of movement against air pressure.

As originally designed, the frames were intended to carry the loads to which they would normally be subjected without aid from the transverse wire bulkhead, the latter serving only to separate the gas cells and to permit, through the operation of the resiliency devices, a considerable bulge of an inflated gas cell in case its neighbor should become deflated. It was found, however, that by increasing the pressure in the resiliency devices the bulkhead could be made to contribute largely to the strength of the frame. In the condition of extreme deflation on one side, a factor of safety of two was planned for, which became two and one-half under normal full-load conditions.

Intermediate between these widely spaced main frames, secondary frames are fitted, usually with a spacing of about 5 meters. These frames are relatively shallow in depth and are intended primarily to support the outer envelope and maintain the form of the ship smooth and continuous. They are subject to tension from gas pressure transmitted from the cells and to compression from the diagonal shear wiring, whichever may be the greater of the two. They are usually designed with a factor of safety of from two to two and one-half relative to such load. They may also be subject to some bending stress from the gas-cell pressure.

This distortion of the intermediate frames under gas pressure presents an objectionable feature, means for the avoidance of which has not as yet been found. Such distortion results in secondary stresses set up both in the intermediate frame girders themselves and in the longitudinals to which they are connected.

A further function of the intermediate frames is to subdivide the otherwise wholly unsupported length of the longitudinals between the main frames. No very satisfactory theory covering the action of these members, so widely dissimilar in dimension and cross section, has as yet been developed, but experimental test shows plainly that the degree of rigidity which can be thus obtained is ample to insure the stability of the longitudinals. This problem has become of increasing importance with the opening out of the distance between main frames and

the increase in the number of intermediate frames, as in the *Akron* and *Macon* designs compared with that of the *Los Angeles* or earlier Zeppelin-type ships.

LONGITUDINAL SUBDIVISION

The spacing of the main frames determines the longitudinal subdivision and the length of the cell compartments. Earlier Zeppelin practice including the *Shenandoah* [photo] and the British R-33 had a main frame spacing of 10 meters with one intermediate frame. In later Zeppelin practice, including the *Los Angeles*, the *Graf Zeppelin*, and also the British R-38, the spacing was increased to 15 meters with two intermediate frames. In the *Akron* and *Macon* designs, the main frame spacing was increased to 22.5 meters center to center. The frames were, however, 2.5 meters in width at the outer face and this left, therefore, 20 meters in the clear, which was subdivided into the usual 5-meter spaces by the insertion of three intermediate frames.

In the *Hindenburg* the frame spacing, except amidships, is kept at 15 meters with the usual two intermediate frames. For a short distance amidships, this spacing is increased to 16.5 meters.

Longitudinal framing: At the maximum diameter of the ship, the spacing of the longitudinal girders has remained close about 10 feet; thus 9 .76 feet, 11.95 feet, and 11.56 feet for the *Shenandoah*, *Los Angeles*, and *Akron - Macon* respectively. As the longitudinals converge toward the bow and stern, this spacing naturally becomes less.

In earlier Zeppelin practice up to 1919 as well as in the British R-33 class, two depths of longitudinals were fitted - 13 main and 12 intermediate. The main longitudinals were about 14 inches in depth and the intermediate 7.9 inches. In the German L-70 class and in the *Shenandoah*, the intermediate longitudinals were increased to 10 inches in depth.

Continued experience showed that this arrangement of main and secondary longitudinal members gave rise to certain undesirable results and that it was not the most efficient use of the structural weight involved, since the strength and stiffness of the secondary members were markedly less in proportion to their weight than for the principal members. In later Zeppelin practice, including the *Bodensee, Nordstern*, and *Los Angeles*, all longitudinals were 10 inches in depth except those at the top and bottom center where deeper structures were fitted in order to furnish corridors for passage fore and aft length of the ship.

In the *Akron* and the *Macon*, similarly, three corridors were provided , one at the top and two at the bottom, each about 50 degrees from the bottom center line. This arrangement, dictated primarily by the location of the engines within the envelope of the ship, gave three longitudinal structures of exceptional strength and stiffness. The longitudinals otherwise were 10 inches in depth.

As a further support for the outer envelope and to control flutter under the action of the propeller wake, light intermediate longitudinals were fitted on the *Akron* and the *Macon* over that portion of the outer surface affected. These light secondary longitudinals were not counted as having over-all structural value, and were fitted solely for the purpose of controlling the movements of the fabric under action of the propeller wake.

WIRING SYSTEMS

Two systems of diagonal wires cross the side panels of rigid airships. The shear wires have already been briefly noted. These wires are again commonly subdivided into two groups, known as the direct and indirect. The direct wires cross each panel between opposite corners. The indirect wires extend diagonally from corner to corner over two panels between the same frames, crossing the longitudinal at the mid-point between the frames.

The shear wires are attached at the outer corners of the joints between longitudinals and frames and thus serve as a direct support for the outer envelope which is attached to them by ties in order to reduce and control flutter when in flight. These wires are usually set up with an initial tension of about 10 percent of their ultimate strength. The gas-cell system of wires has the important function of receiving the immediate lift due to the buoyancy of the gas cells and transmitting the same to the structure of the ship.

There has been considerable variety in these systems of wiring. In the wartime Zeppelins, beginning with the L-30 class, the wires were arranged in a simple diamond

mesh attached to the inner faces of the longitudinals at points about 1 meter apart. Inside this system was a ramie-cord netting of about half-meter mesh to assist in holding and protecting the gas cells. The wiring was set up initially slack in order to permit the cell envelope to come within about 10 centimeters of the outer cover. In the *Shenandoah*, the cell netting was the same except for the initial tension of the wires which were just barely taut.

In the *Los Angeles*, the wires were attached only at the inner corners of the joints between frames and longitudinals, and thence ran at various angles across the panels. The wires were set up initially slack to permit bulging of the gas cells, as in the wartime Zeppelins, and the usual smaller mesh ramie-cord netting was fitted inside for protection of the cell wall.

In the *Akron* and the *Macon*, [photo above] the system of cell wiring first used in the *Los Angeles* was further developed and improved. The cord netting was omitted and the number of wires was greatly increased, thus forming a relatively close wire-mesh container for the cell. All wire terminals were at the girder joints and each wire crossed only one longitudinal. A further important feature was the setting up of these wires with initial tensions between 5 and 10 percent of the ultimate strength, so that they participated with the shear wires in taking the primary shear in the hull structure.

In the British ships of the R-38 and the later ships of the R-33 class, the cell wires ran circumferentially around the hull, passing through the base of the longitudinals and secured to inverted catenary wire loops in the planes of the side panels, thus carrying to the girder joints the forces resulting from the increase of the gas pressure upward from panel to panel.

THE BRITISH AIRSHIPS R-100 AND R-101

Brief note may be made of certain novel features embodied in the latest airships of British design, the R-l00 and the R-10l.

These designs were intended to save weight by reducing the number of main longitudinal and transverse members with a suitable increase in size. Thus the intermediate frames were eliminated and the longitudinals decreased in number, the entire strength being thus concentrated into a relatively small number of large members rather than a large number of smaller members. The gas-pressure load on the longitudinals was also removed by the use of a system of netting attached to the framing only and not touching the longitudinals between the frames. While these features of the design were sound so far as the saving of weight was concerned, it was found that such a system of large panels did not give adequate support to the outer envelope, and the great depth of air space between the envelope and the gas cells gave rise to a serious loss in lift. These disadvantages apparently outweighed any anticipated saving in the structure otherwise.

In the R-l00 the cover was kept taut by means of a system of catenary wires pulling it inward between the longitudinals, thus giving to the cross section of the ship a form somewhat resembling a fluted column. Experience seems to have shown that this method was far from satisfactory for the prevention of longitudinal waves in the fabric under flight conditions, and the general aerodynamic efficiency in comparison with that of a virtually rigid outer cover must have been poor.

In the R-101, intermediate longitudinals were fitted, which, from the spacing of the main frames of about 40 feet, had of necessity to be of considerable weight and depth. This final solution of the problem would apparently quite counterbalance any saving through the original idea of framing in large panels.

The main frames of the R-l00 were fitted with a radial system of wire braces with an axial boom to relieve the frame of some of the gas-pressure loads in case of partial or complete deflation of one cell.

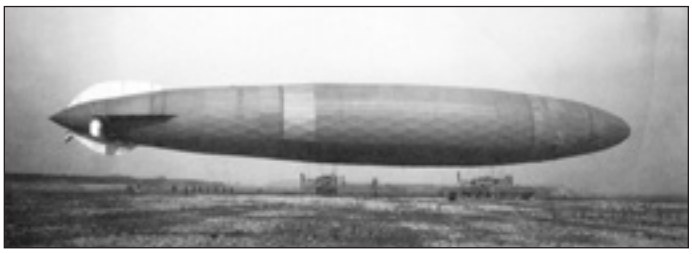
For the R-101, a novel type of stiff-ring frame was adopted, without reinforcement from the bulkhead wiring, which was so arranged that it could bulge largely to one side without putting a load on the frame.

For the main structural members of the R-100 and the R-101, triangular girders with tubular booms were employed. For the former the material was duralumin, and for the latter, stainless steel.

The gas-cell systems were designed especially to relieve the longitudinals of lateral gas-cell pressure.

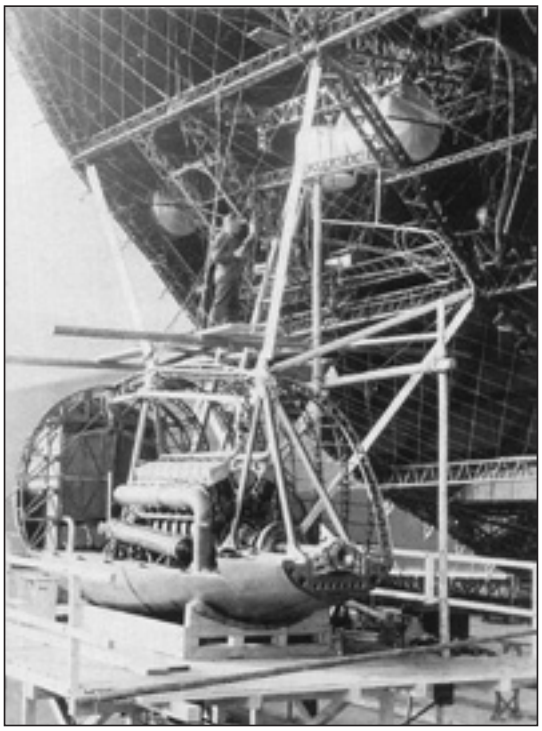
After the first trial flights of the R-101, in order to obtain increased lift and improved performance generally, the ship was lengthened by the insertion of an additional bay amidships. Shortly after, the first service flight was undertaken with the well-known result of the total loss of the ship in northern France.

It is understood that previous to this flight, in order to gain more gas volume, the cell wiring had been slackened off, resulting possibly in contact of the cell wall with the longitudinals of the ship. It was the finding of the Court of Inquiry, charged to examine into the casualty, that the chafing and cutting of the gas-cell fabric from contact with the special form of cell wiring, and perhaps also with the longitudinals of the ship, was the most probable cause of leakage of gas, loss of buoyancy, especially forward, with the resultant loss of the ship.



SCHUETTE-LANZ AIRSHIPS

In the years immediately preceding the Great War, the Schuette-Lanz Company of Germany developed a design for airship construction in which wood was employed as a principal structural material, and two ships embodying the features of this design were constructed. During the war, some 18 or 20 ships of this type were built and there developed a considerable rivalry between the Zeppelin and the Schuette-Lanz types. The first use of the streamlined form, as well as other improvements in airship design, are apparently to the credit of this organization. At the end of the war, the use of wood as a structural material had been discarded by this organization in favor of metal construction. However, no further ships were constructed by the Schuette-Lanz organization and its influence remains chiefly expressed in various details of design and construction which have influenced favorably the general advance of the art.



POWER PLANTS

All rigid airships except the R-101, the *Graf Zeppelin*, and the *Hindenburg* have used gasoline for fuel. The R-l0l used Beardmore compression ignition engines with Diesel fuel. The *Graf Zeppelin* used fuel gas and the *Hindenburg,* fuel oil with Diesel-type engines. Gasoline may be used on occasion, if desired, for lightening the ship.

In the earlier Zeppelins, special effort was made to locate the propeller thrust near the center line of longitudinal resistance, and to this end the engines were carried in center-line cars with long cross-shafts and bevel gear drive reaching up to the propeller shafts located well up on the side of the ship. Later, the cross-shaft drive was discontinued and standard Zeppelin practice up to the L-70 class comprised five engines in four power cars. Two of these cars were on the lower center-line, one forward and one aft, and two were wing cars located amidships. The rear center-line car had two engines geared to one pusher propeller, while all the other cars had one engine each with pusher propeller. The front and rear center-line propellers were in line but were located some 100 meters apart.

In the L-70 class, the same general arrangement was followed, except that another pair of wing cars was added. The two wing cars on each side were so located as to avoid overlap of the propeller slipstreams. The postwar *Bodensee* and *Nordstern* had four engines in three cars, one on the center line aft and one pair of wing cars near amidships. In the *Los Angele*s and the *Graf Zeppelin*, there are five power cars, each with a single Maybach reversible 12-cylinder V engine driving a pusher propeller. The cars are arranged with two pairs in wing positions with non-overlapping propeller slipstreams and one center-line position aft. The *Hindenburg* has two pairs of wing cars [photo] with non-overlapping slipstreams each car with a 16-cylinder V engine of the Diesel type.

In early British rigid-airship practice the R-9 was fitted with two center-line cars, each driving two wing propellers through a cross-shaft drive and with an arrangement permitting the tilting of the propellers about the cross-shaft axis thus providing for an oblique or vertical thrust. This arrangement anticipated, in this feature, the power drive for the *Akron* and the *Macon* as referred to below.

The British R-33 followed the prevailing German type of power drive of that period. The British R-I00 was fitted with six reversible RoIls Royce "Condor" engines installed in tandem in three cars. In the R-101 the power plant comprised five Beardmore "Tornado" heavy-oil engines, installed in five cars located as in the *Los Angeles* and the *Graf Zeppelin*. These engines, so far as is known, gave no serious trouble in operation but were disappointing in power output and overweight. They were intended to be fitted with reversible propellers, but due to difficulty in the development of suitable propellers of this type the engines were finally fitted with fixed-blade propellers, four for going ahead and one for backing.

The *Shenandoah* was fitted originally with six Packard six-in-line engines in six cars, two on the center line, fore and aft, and two pairs of wing cars with non-overlapping slip streams. Four of the engines drove their propellers through reduction and reverse gearing. The other two engines drove direct and could not be reversed. At a later time, the forward engine was removed.

The *Akron* and the *Macon* were fitted with eight Maybach engines but with a newly developed drive system permitting of tilting the propellers and obtaining a vertical component of thrust. With helium as the lifting gas, there was no longer any reason for keeping the engines outside the envelope of the ship and they were, therefore, located four each in side corridors.

The propellers were carried on shafts supported from outriggers and connected to the engines by suitable systems of bevel gears, permitting of tilting the propeller shaft from horizontal to vertical down. The propellers ran forward when pulling down and backward when pushing up. This feature made them of special use when landing a ship statically light, but less effective when taking off heavy. The value of the tilting feature of the propeller shaft is still not fully determined. It seems clear, however, that with pusher propellers instead of tractor, connected to the forward pair of engines, the vertical upward component of thrust could be made of great service in taking off heavy and in other special maneuvers.

The location of the engines within the hull along the side corridors naturally brought the propellers in line on each side. This arrangement was prejudicial to propeller efficiency, each propeller except the leading one working in the slipstream of those ahead. Severe vibrations also developed with all engines in operation, especially in the vicinity of the after propeller.

The location of the engines within the hull envelope, with the resulting disappearance of the power cars and their attachment to the hull, seemed to promise a considerable reduction in the parasitic resistance. There remained, however, the parasitic resistance of the outriggers and of the engine radiators, which left only a moderate improvement in this respect and at the cost of loss of propulsive efficiency and of marked vibrations as noted above. On the whole, the balance of advantage seems to lie definitely on the side of the older arrangement of the engines in power cars located outside the hull and in non-overlapping slip-stream positions. **Ω**

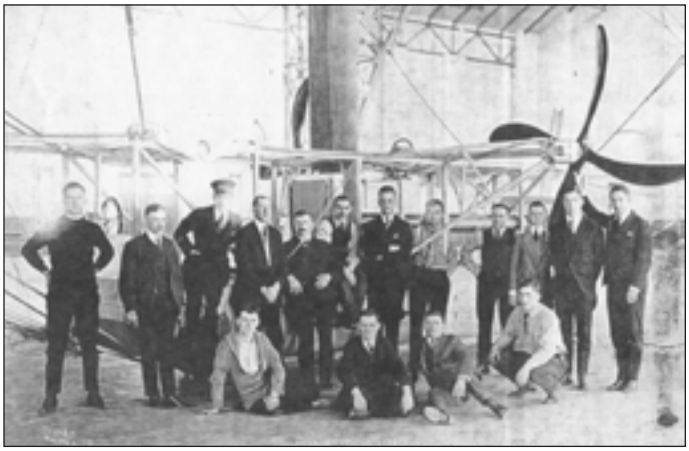
Ed. notes: The remaining portion of report No. 2, covering the Metalclad, was reproduced in the previous issue of TNB, #112, pgs. 23 & 24. Owing to the impossibility of reproducing the original charts and table scans, Figure 1 and the Safety Factor table are the only originals we could include here; the other photos were added by Ed. in response to a reader's complaint the material lacked visual interest. The late Al Robbins (see Black Blimp), then serving as Technical Comm. Chair and helping with their re-creation, stated reproducing the entire Durand Committee Reports was likely the most important thing NOON BALLOON could do. If we can locate and format copies of reports 3, 4 & 5 we will include them in future issues. **Ω**

USN LTA at 100 Years: The Navy's DN-1

Ed. by R G Van Treuren

Though a US Navy officer evidently noted early American motor-balloons at St. Louis before anyone heard of the Wright Brothers, little was published before a 1914 Scientific American announced "The Navy Wants Dirigibles." The New York Times on 11 March 1915 stated two dirigible balloons were to be purchased, noting "They will not be as large as Zeppelins, nor will they be of the rigid type," and were to be used for "practice." LCDR Frank M. McCrary and H.C. Richardson composed Schedule 8058 of 20 April 1915 which stated "A car...to allow of resting on the water, or of moving through same at slow speed; twin screws of swiveling type, secure means of mooring to a mooring mast, two motors...and transmission...to assist in rising, descending and maneuvering." Specifications also stated that the carrying capacity was to be for eight men to a ceiling of 3,000 feet without discharge of ballast. All this was to be accomplished in an airship 175 feet in length!

Connecticut Aeroplane Company (incorporated in Dec 1913 but changed to Connecticut Aircraft Company on 30 March 1914), had landed its first contract with the Army Signal Corps for military observation balloons of 30,000 cubic feet. On the 1st of June 1915 Navy contract no. 23681 was awarded to Thomas S. Baldwin in cooperation with the Connecticut for one dirigible extremely reasonable cost of $45,646.25.



Posing with the DN-1 car are (3rd from left) Herman Widner, a German with balloon experience; (6th from left) Walter Fritsche, assistant pilot; (3rd from right) James Boyle; and (far right) Ed Mullikan Jr., son of the company's treasurer. LTAS / Eric Brothers

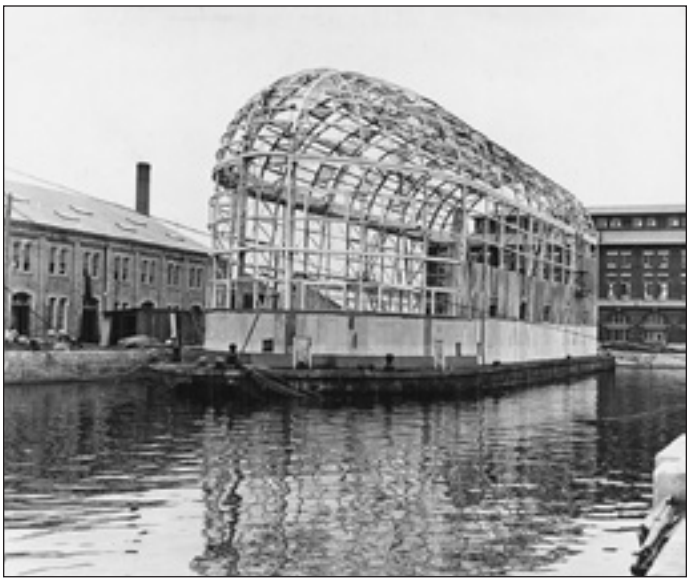
Connecticut Aircraft reportedly also consisted of a German engineer and mechanic, an Austrian test pilot (Hans Otto Stagel), James F. Boyle as Chief Engineer and J.J. Delaunay as production manager. As mentioned the civilian inspector was Thomas Baldwin and LCDR McCrary was the resident Navy inspector.

Dirigible, non-rigid No. 1's design was generally based on the German Parseval. The control car was built by the Fred Lawley shipyard in Neponset, Mass. The envelope, constructed by the U.S. Rubber Co. in New Haven, consisted of two plies of cloth with rubber inside, outside, and between the plies. The envelope was erected on a platform in the Portsmouth, New Hampshire, Navy Yard with a submarine as a stable mate.

The airship was air-inflated in the Connecticut State Armory in Hartford, the only structure in the area large enough to house the inflated airship in 1916. USN/NEAM

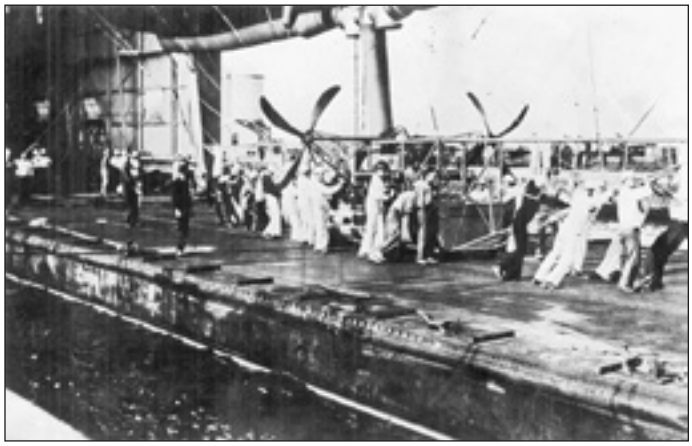
Difficulties were experienced with weight, the prop-swiveling transmission (which was eventually omitted), a leaking envelope and a poor power plant. It was evident that the contractor was incompetent, but had entered the contract with enthusiasm; the inexperienced Navy officers permitted continuance. Steering and stability problems were referred to MIT where Jerome Hunsaker and his assistant Donald Douglas used their wind tunnel and advised both the contractor and the Navy of recommended corrections.

DN-1 was reported almost complete and with delivery predicted before Christmas 1915, but in fact its containers did not arrive in Pensacola until 14 December 1916, long after this magazine predicted several would be flying. J. Shock, "US Navy Airships."



Though Count Zeppelin had long since brought his shed ashore, a floating hangar was constructed at NAS Pensacola. DN-1 assembly began inside it early 1917.

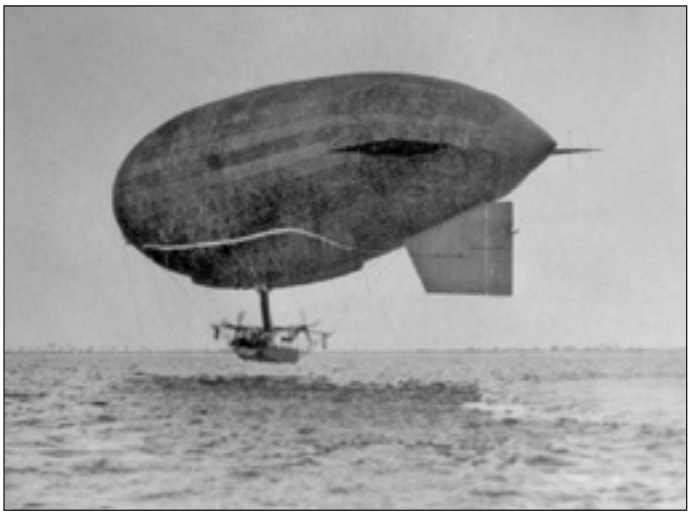
As the envelope was filled with 110,000 ft^3 of hydrogen it measured 175 feet in length, 35 feet in diameter and had a fineness ratio of 5.0. The car housed two Sturtevant 140 horsepower motors turning four-blade swiveling propellers, allowing vertical thrust through a transmission.



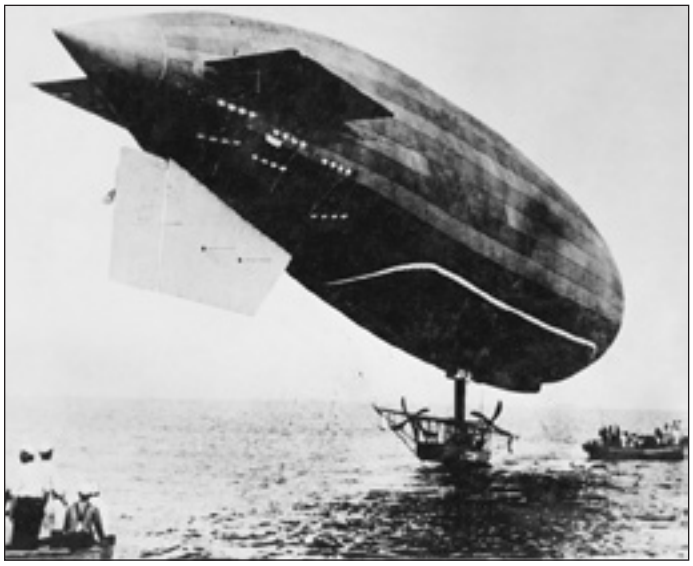
The long-awaited rollout, April 1917, quickly found Petty Officer James Slade (later B-ship pilot) up to his chin in the water. The close proximity to the hangar allowed the ship to be saved. NMNA / Steve Kozlovski

Static lift was supposed to be 1,604 pounds but one engine had to be removed to save weight. Thus finally struggling aloft on 20 April, company test pilot Hans Otto Stagel had difficulty attaining the required speed of 35 miles per hour. The speed was only attained when Stagel flew out to the horizon and pointed the airship downhill.

Flight tests were to be conducted with LCDR McCrary and LT Stanley V. Parker, U.S. Coast Guard, as pilots. (both photos) NMNA / Steve Kozlovski



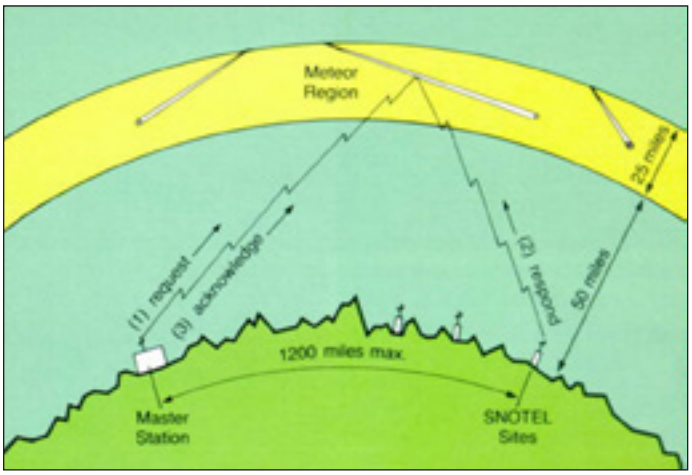
Some maneuvers were made that impressed the audience when the airship would fly along, then dip to the water, and then rise again. These maneuvers were actually to scoop up water to throw on the transmission, as the bronze bearing had melted.



The next flight was made on the 27th. On the 29th of April, the DN-1 was damaged by an inexperienced handling party that attempted to drag the control car over the water. The damage out-valued the repair cost. With the greatly improved DN-3 expected soon to occupy the shed, DN-1 was dismantled and scrapped in the hangar. Thus ended the Navy's first airship, 100 years ago, April 1917. **Ω**

Project Meteor

By Marc J. Frattasio, AW1 USNR (Retired)



In 1931 American radio engineer and inventor Greenleaf W. Pickard observed that short bursts of unusually long-distance radio wave propagation tended to coincide with meteor showers. Subsequent research by other scientists over the next few years determined that the ionization trails created by meteors as they burned up in the Kennelly-Heaviside layer of the Earth's atmosphere, which depending upon the time of day is about 56 to 93 miles above sea level, reflected radio waves and could cause radio signals to propagate out to a substantially greater distance than normal. However, since a meteor's ionization trail lasts for only a few seconds at the most, the window of opportunity to use it for this purpose is extremely brief.

On August 1, 1955, the Air Force Cambridge Research Center, on behalf of Project Lincoln,* asked the Naval Air Development Unit (NADU) based at NAS South Weymouth, Massachusetts, to provide an airship for an experimental effort called Project Meteor. The purpose of Project Meteor was to determine the practicality of using meteor ionization trails to extend the range of short duration "burst" radio transmissions. In a "burst" radio transmission, the signal is compressed so that a larger volume of data is sent out over a much shorter period of time.

*Project Lincoln, which evolved into the famous MIT Lincoln Laboratory, was originally established in 1951 to develop an air defense system called the Semi-Automatic Ground Environment (SAGE). Over time Project Lincoln became involved with many other defense-related technology research projects. NADU was established in 1953 specifically to provide flight-testing support for Project Lincoln. As was the case with Project Lincoln, NADU started out working exclusively on the SAGE air defense system and then over time became involved in other efforts such as Project Meteor.

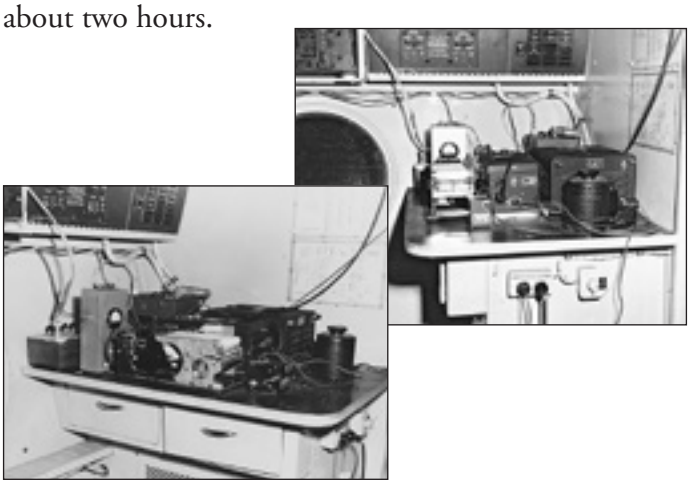
NADU's commanding officer, CDR Robert H. Wood, assigned LCDR Robert S. Bowser to serve as the project officer for Project Meteor. Two Goodyear ZPG-2 *Seafarer* blimps were made available for the project, Bureau Number 126718 and Bureau Number 126719. Both blimps were already engaged in supporting other research efforts for Project Lincoln at that time. BuNo 126718 was being used for a UHF radar-related project and BuNo 126719 was being used for icing tests. Since the other efforts that the blimps were involved with had a higher priority, the Project Meteor work was supposed to be accomplished on a "non-interference basis" only when there was nothing else going on.

NADU Goodyear ZPG-2 *Seafarer* blimps BuNo 126718 and BuNo 126719 over NAS South Weymouth on September 24, 1954. These were the first two ZPG-2s assigned to NADU. Both were assigned to Project Meteor. USN/ NARA/Author

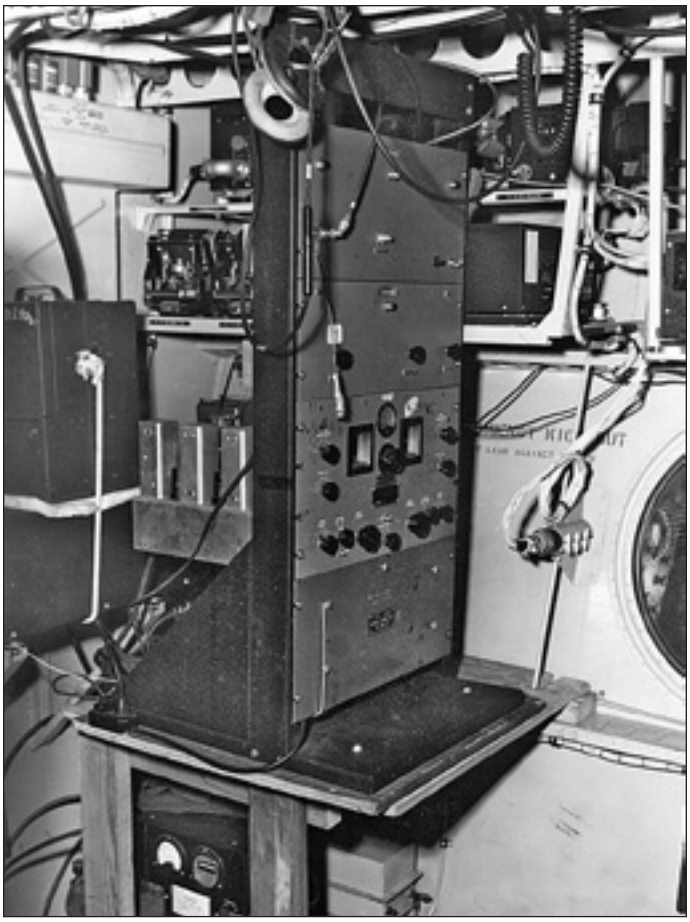
A radio receiver unit, a data recording unit, and a Yagi-Uda type directional antenna were furnished to NADU for installation in the aft section of the car of whichever blimp happened to be available.

Project Meteor Yagi-Uda antenna suspended from the bottom of the aft section of NADU ZPG-2 BuNo 126719's car, retracted position. USN/ NARA/Author

The antenna, which was mounted below the rearmost part of the car, had one driven element, one reflector, and three directors. It could be extended or raised a few feet to provide ground clearance for landing and could be rotated 360 degrees in azimuth. The Project Meteor equipment was configured in such a way that it could be removed from one blimp and installed on the other in about two hours.



Two views of the Project Meteor data recording equipment installed on board ZPG-2 BuNo 126719. This equipment appears to have been installed on the same side of the car from the radio receiver equipment (below). USN/ NARA/Author



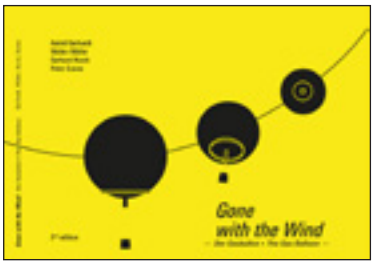
View of the Project Meteor antenna in the extended position seen from starboard. USN/ NARA/Author

During the latter half of August 1955, the Project Meteor equipment was installed on ZPG-2 BuNo 126719. This airship was selected to support Project Meteor first instead of ZPG-2 BuNo 126718 because the icing-related test work that it was primarily assigned to do was mainly performed during the cold weather months. As the year progressed and the weather turned colder and the UHF radar related work wound down, the Project Meteor equipment was moved to BuNo 126718. The blimps flew 12 flights for a total of about 100 flight hours in support of Project Meteor between August 1955 and April 1956. The flights were flown at altitudes between 1,000 and 4,000 feet out to a distance of about 100 miles on courses extending north, east, south, and west centered on Hanscom Field in Bedford, Massachusetts. Not coincidentally, Hanscom Field, which was a USAF Air Defense Command base at that time, was also the site of the AF Cambridge Research Center and Project Lincoln.

During the Project Meteor flights the blimps attempted to receive radio signals from a transmitter located about 1,200 miles away in Cedar Rapids, Iowa. This transmitter was only operated on Mondays and Tuesdays, which limited the days that Project Meteor flights could be performed.

NADU's work for Project Meteor was completed by April 20, 1956. Meteor burst communications, which are also known as meteor scatter communications, were subsequently employed for limited military purposes. This technique, which was entirely dependent upon an unreliable natural phenomenon, quickly fell out of favor after highly reliable communications satellites came into service in the early 1960s. It is still used, however, for certain scientific purposes and also by amateur radio enthusiasts. **Ω**

MEDIA WATCH



Gone with the Wind (Der Gasballon)
By Astrid Gerhardt, Walter Muller, Gerhard Hurck & Peter Cuneo
Reviewed by C. P. Hall II

This is the second edition of a book about the nuts and bolts, the physics and the nuances of free ballooning in a gas-filled aerostat. The standard page layout is interesting as the format is four columns to a page: the two on the left in the authors' native German, the two on the right are an English translation. As is pointed out, the translation is not a word-for-word conversion but often a vernacular explanation of the same points made in the original German text.

This is an authoritative work on the topic of 21st century free ballooning. Seventeen chapters and eleven appendices covering every aspect from the basic physics to details regarding the most up to date instrumentation, right down to a code of conduct covering safety and consideration of others. Certain aspects of such an undertaking require a specific example of a free balloon. The authors use "The Netless Gas balloon of Ballonbau Worner and its components." This type is specifically referenced throughout; however, examples of equipment not found on *Ballonbau Worner* craft are frequently cited as are comparisons to multiple lifting gases and, occasionally, hot air balloons as well.

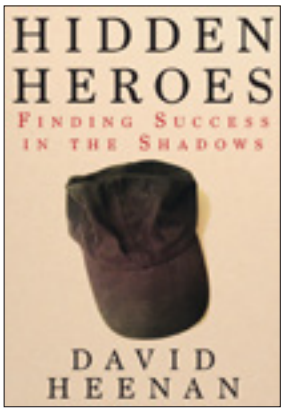
The combination of German and English side-by-side was a bonus for me, and anyone like me, whose High School and College German courses focused upon literature instead of technical subjects. One first reads the English, and then broadens ones vocabulary by searching out the German word on the left side of the page.

This brings me to one disagreement with the text though whether it is with the authors or with *Ballonbau Worner's* terminology seems an open question. The term in question Entleeroffnung/Parachute-Ventilation translated as "Deflation opening/parachute valve." My specific objection is to this use of the word "parachute." There must be a half dozen superior alternatives, which describe the valve's function, than "parachute" in English; while German is the powerful language from whence come the truly magnificent compound words such as (for a relevant example) *Schnellentleerungsfunktion*.

This is my only objection. The book is truly comprehensive for anyone, either interested in, or wishing to learn about, free ballooning. I read through it in one day while waiting to be empaneled for jury duty. I lucked out regarding jury duty and learned several useful tidbits of which I was unaware. I know that **Gone with the Wind** demands a Rhett and Scarlett joke, perhaps a little plantation humor, however, I have nothing. If you neither "don't know nothin' about birthin' no babie" nor about free ballooning and would like a comprehensive introduction about the latter topic, then this might be the book for you.

Gone with the Wind is hard cover, approx. 12" wide X 9" high, over 300 numbered pages, w/ color photos and numerous diagrams, tables, charts and illustrations. The price in the U.S. is $70 plus $5 S & H. It is currently available from Peter Cuneo, 1209 Florida St. N E, Albuquerque, NM 87110 or e-mail petercuneo@msn.com. Personal checks, PayPal, or credit cards are all acceptable. **Ω**

Hidden Heroes
by David Heenan
Reviewed by Ed.



The dust jacket reads, "We live in a starstruck society. We love our heroes, be they chief executives, entertainers or sports stars—men and women venerated for their celebrity status. But to see how the real work gets done, we must look beyond the superstar. In many cases the real work is performed by exceptional subordinates—hidden heroes who fly under the radar... Author David Heenan argues that in a world that often seems dark and cold, it's important to turn the spotlight on these stalwarts behind the scenes, to give them the credit they so richly deserve."

Chapter 8 of this book, "Underdogs of the Air," calls attention to our often ignored endeavors in aeronautics. Devoting some 14 pages to LTA, the author gives the reader a broad if anecdotal airship history, exposing the reader to LTA milestones - including ASW - which he points out are often underexposed or underappreciated by the general media. Derived from an extensive bibliography including works by and quotes from NAA members, the chapter successfully integrates LTA into the book's theme of pulling up the curtain to expose the real Wizard of Oz. While the author avoids new discoveries by quoting long-believed and published

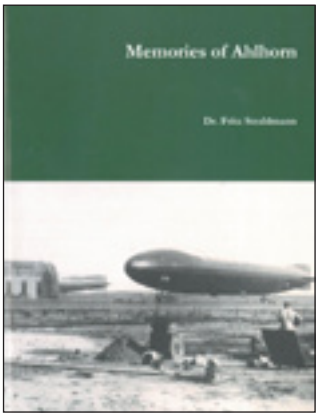
historical speculation, such controversy would have detracted from the book's main message. We therefore find ourselves forgiving, for example, the use of photo of the MZ-3A, remembering the book's overall purpose. Readers will undoubtedly find themselves kindred spirits and recall some hidden hero stories of their own.

"Hidden Heroes" is hard bound, 240 pages, available from Watermark Publishing, $24.95. **Ω**

FOUNDATION for Fall 2016 carries Ed.'s article "The US Navy and the *Hindenburg*." Released at the tail end of the 80th anniversary of this unique airshipman's relationship across the sea, Ed. quotes LCDR Scott Peck's 1936 reports extensively. **Ω**

The March AIR & SPACE Smithsonian devotes four pages to "The Highest Jump" by Mark Betancourt, covering the balloon-borne record skydive by Alan Eustace in 2014, and the subsequent donation of his suit to the museum. **Ω**

Memories of Ahlhorn
Compiled by Dr. Fritz Strahlmann (1926)
Translated by Alastair Reid (2016) Reviewed by C.P. Hall II



This anthology was originally published in German under the title "Zwei deutsche Luftschiffhafen des Weltkrieges, Ahlhorn und Wildeshausen." In the main the pivot point of the anthology is the Ahlhorn naval air station. Most of the essays were written by officers, others were written by those involved in base construction, one by a base medical officer and another by the Ahlhorn railroad station master from which rail service was provided to the base. The primary mention of Wildeshausen is the final essay by Dr. Strahlmann, himself.

Ahlhorn was conceived in 1915 incorporating all of the lessons learned from previous naval airship stations. It was located far enough from the coast as to be less affected by coastal weather phenomenon such as local fog. There were four hangars (later increased to six) arranged in pairs, each hangar capable of housing two airships; each pair oriented on a different axis so that the prevailing breeze was favorable for extracting airships from one pair or the other. Workshops, service building, barracks, hydrogen, fuel, and bomb storage were arranged with lessons learned elsewhere in mind. Ahlhorn began receiving Zeppelins late in 1916.

The essays by various individuals cover a broad range of naval base and LTA aviation topics. All are of some interest and several are both interesting and unique. Two examples which caught my eye: The airships assigned to Ahlhorn began with the 1.9 million cubic foot L30 and ran through the entire progression of "height-climber" modifications concluding with L71. The L49 was in the mid-range of this progression, lighter than the earlier models but hardly as fragile as those that would follow. Per L49's commanding officer, Kapitanleutnant Hans Gayer, on its delivery flight from Friedrichshafen to Wildeshausen the L49 was undergoing certain acceptance evolutions. Following a full power endurance run, the ship was brought up to 3,500 meters so that it could descend through 2,000 meters with the nose depressed no less than 15 degrees. There was a frame failure at the bow, fabric tore loose and entangled propellers, and the forward gas cell was partially deflated and its remaining contents contaminated. Dealing with this emergency is an interesting story. It caught my eye as I have argued that there is no record of any comparable test being required of or undertaken by either British airship, R-100 or R-101.

The majority of the contributors to this volume were Commissioned Naval Officers. Several were on active duty in November 1918 when mutiny struck the High Seas Fleet. Mutiny is a nasty business and the inclusion of a political component seems to have added to the bitterness by all concerned. What happened, what happened to the authors, the resulting bitterness comes through here in ways that it does not if all that you have read are the brief comments of Eckener and Lehmann. It is a revealing perspective, an insight that you might not expect when you purchased this title.

Memories of Ahlhorn is soft cover, 8"x11", 235 pages with many b&w photographs. It is available from Lulu for $13.53 plus S & H. I recommend it for anyone interested in several topics such as base design and construction, airship handing and flying, coping with aviation disasters and the collapse of military discipline at the macro level. Dr. Strahlmann assembled a remarkable collection of authors and Alastair Reid has provided us with a worthy English language version. **Ω**

Marc Frattasio points out that in covering his S. Weymouth book, "reviewer C. P. Hall states that I did not mention "...reported gunfire damage to the envelope..." in regard to the loss of ZP-11 ZNP-K type blimp K-14. That's not true. On page 190 of the book I wrote, "When the K-14's gasbag was pulled out of the water its rearmost section and stabilizer fins were missing. Upon detailed examination of the gasbag fifteen to twenty small holes, which investigators said might have been caused by bullets, were observed on the underside of the rearmost part recovered." That's certainly a mention of gunfire damage to the blimp's envelope! No complaints. Just trying to set the record straight." **Ω**

Army Zeppelins on the offensive

By Lieutenant Martin Lampel
Translated by Alastair Reid
Reviewed by C. P. Hall II

This is a tiny volume. It was published originally in June 1918 which is to say, after the German Army abandoned Zeppelins but before Germany lost the First World War. Each chapter is the story of an individual flight by a German Army Zeppelin. The flights of several Army Zeppelins are described; however, there is no mention of the German Army abandoning airship operations. There is no mention of the four "R" type Zeppelins flown by the Army. Some flights are air raids - others are transfer flights from one theater of action to another they all read more like travel brochures than offering details either about airship operating challenges, or about military operations and objectives.

I am told that all German airship operations were considered "secret" and this original work may have made it past the censors because of lack of detail, the author's positive attitude, and the abandonment of airships by the German Army one year prior to publication. The photos are mostly of the snapshot variety, crews in front of command gondolas, ship in hangar, ship flying over hangar, etc. As the book is a Lulu production, the photos are of Lulu quality. It is available from Lulu for $5.47 plus S & H. It is more interesting as a war time curiosity than as a reference work but the price is right for someone interested in a complete collection. **Ω**

READY ROOM

5 May 2017 Navy Lakehurst historical Society *Hindenburg* Disaster 80th Anniversary Dinner - Clarion Hotel

5-9 June 2017 Denver, CO; AIAA Aviation and Aeronautics Forum and Exposition (AIAA AVIATION 2017) includes LTA TC presentations.

30 September 2017 South Weymouth Closing 20th Anniversary Reunion Event, Randolph, Mass. www.anapatriotsquadron.org

Airship Association Conference & Model Regatta 19-21 OCT 2017 Bedford, UK

BLACK BLIMP

Al Robbins passed 7 JAN 17. An LTA sailor who left for college and upon being commissioned, returned to LTA, he served in LTA till it ended. Robbins was a mover and shaker in NAA for decades. **Ω**

Hurley Ashcraft passed in March of 2016. **Ω**

G. Robert Keiser, 91, passed Feb. 23, 2017. Keiser was a 24-year USN vet where he was a pilot of various Navy LTA and HTA craft, including the Goodyear ZPG-3W, and the Lockheed WV-2/EC-121 Super Constellation. He will be buried at Arlington National Cemetery. Keiser is survived by one daughter, one son, and four grandchildren. **Ω**

Warren Doede passed November 24, 2016.

Lawrence F. Rodrigues passed. A Nan-ship crewman, Rodrigues wrote of his experiences in his "Larry's U.S. Navy Airship Picture Book." Finishing 20 years after switching to AF blue, Larry became a University professor. **Ω**

Andreas Van Horn passed away. **Ω**

Zep NT recently being used as a maritime flying laboratory and sensor platform.
See “Expedition Clockwork Ocean” inside on page 9.

Architects rendering of how Goodyear's Carson, California, airship base will look when Wingfoot Two arrives later in the summer of 2017.