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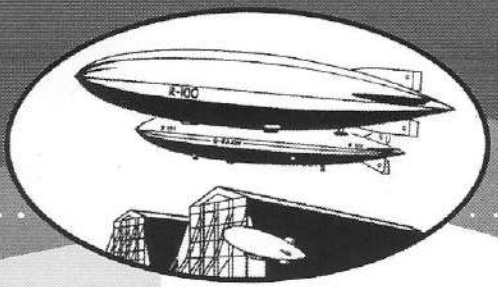
Dirigible



SELLING ON THE SIDES

AERIAL ADVERTS AND AN AUCTION

Dirigible

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FRONT COVER – A five-gallon drum of Zeppelin Motor Oil decorated with pictures of an airship in flight over a seascape, which was sold at auction in May [*See p43*]

BACK COVER – Two pictures that show how aerial advertising with airships evolved.

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***Dirigible* is the official journal** of the Airship Heritage Trust. It is published by the Trust three times a year and is distributed free to all current members. Back numbers of *Dirigible* are available for sale to the public at the Trust's discretion.

The Editor of *Dirigible* is pleased to consider for inclusion in *Dirigible*, articles, correspondence and other contributions (also 'review copies' of new publications and journals) on all matters concerned with the preservation and the history of airships and of subjects relevant to the science of lighter-than-air flight.

To submit articles, photographs or comments; or to request advertising information, write to: The Editor, 67 Gordon Road, London SE15 2AF. A suitably addressed envelope and full return postage must accompany submitted hard copies of articles and photographs that are required for return. No responsibility can be assumed for unsolicited materials.

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EDITORIAL

BANNERS MAKETH MONEY

It often seems to be the case that when any new technological device is invented it takes a considerable length of time before it finds a 'killer' application and begins to make money or play a useful part in human activities. In the case of airships this delay between first appearance and commercial success seems, unusually, to have been excessively long. The first recorded attempt at building a balloon that was intended to be 'dirigible' (i.e. steerable), and consequently capable of returning to its take-off place, was in Paris in 1784. But it wasn't until 1902 in London that anyone in the UK made a serious attempt at getting a sponsor to pay for their company name to be displayed in big letters on the sides of an airship.

That is not to say that other means of raising money with balloons had not been tried with varying degrees of success over the intervening years. For example, in the very early days, by simply charging onlookers to watch the balloon take-off and also by giving thrill-seeking passengers rides in the basket. Neither of these, however, was a real money-spinner because in the first case it was not easy to arrange privileged private views when such large objects could be easily viewed from afar, and in the second case unpredictable weather frequently led to disappointing last-minute cancellations.

But the initial UK trial of a flying bill-board was not a money-spinner either. In fact it turned out to be financial disaster when the airship owner and pilot, Stanley Spencer, was bankrupted as a result of losing his legal challenge against his sponsor, Mellins Foods of Peckham. The case hinged on what constituted 'a flight' and the court decided that Spencer's airship, floating a hundred or so feet up in the air at the end of a long rope, being towed by a team of men around the grounds of the Crystal Palace, several miles from the City, did not constitute his promised 'flights over London'.

But it could be argued that Spencer was hard done by because if we step momentarily into the arcane world of contracts and definitions of legal language then we can ask what is meant exactly by the word 'over'. If the meaning is 'vertically above' then the advertisers that insisted on it might actually be hugely disappointed by the result. Nobody on the ground would be able to see banners on the sides of an airship that flew directly above them and straight over their heads. It would approach head-on. Show its belly as it flew overhead and leave with only its tail showing as it disappeared. Thus any advert or message displayed on the ship's sides could not and would not be seen.

What the court and Mellins failed to recognise is that when Spencer circled a hundred feet up on his tethering rope a huge number of people in the local Crystal Palace area would have seen the banners on the airship's flanks. As soon as the word 'Mellins' appeared over the tree-tops or above the roofs of neighbouring buildings it would have been spotted and talked about. So the advert was doing its job, and, because the ship was not simply left statically pointing in one direction but was moved around the grounds, masses of people in a wide, surrounding circular area would have seen it.

This latter observation reveals that when putting an advertisement onto an airship there is a 'footprint of visibility' within which the lettering or logo can be seen. This area on the ground within which the message can be read extends laterally on either side of the ship but, as already noted, there is a blind-spot for those ground-based onlookers who happen to be directly under the flight-path. Moreover, the area within which the message will have maximum impact depends on several factors that include the size of the lettering, the distance from the onlookers and the height that the ship is flying at above the ground. There were no restrictions on height in Spencer's day but today's aerial advertisers cannot legally fly below 1,500 ft over a built-up area. They are, however, allowed to fly lower over open countryside provided they stay at least 500 ft away from any buildings or structures.

The result of this legislation, which many over-excited advertisers coming fresh to aerial advertising today often fail to grasp, is that it is a better strategy for a balloon or airship to fly closely alongside towns or settlements, and stay low over woods, parks, golf-courses and farmland, rather than insisting they fly directly over the population centre which can only be done at a greater altitude. Thus, Spencer's circling of Crystal Palace may not have been what his sponsor had in mind but it must have got the locals talking about the name 'Mellins'.

Another factor that is often overlooked is noise. Flying silently by is a wonderfully 'green' thing to do today but it is not what you want if you are advertising. There is little point paying to display a beautiful banner on an aircraft unless lots of people look up at it. This was clearly not appreciated by the next airship pioneers who followed on from Stanley Spencer.

As reported on p20 in this *Dirigible*, the Airship Development Company took up the aerial advertising idea between the two World Wars and, in 1929, equipped their purpose-built little blimp, the *AD-1*, with an electric motor. This enabled it to fly so quietly that people on the ground at the Newcastle Air Pageant could hear the airship's occupants talking to each other while it was in flight.

Modern airships that are currently carrying aerial advertising don't make the same mistake and, although none of them will publicly admit it, they don't make any great effort to silence the engines of their aircraft. In fact, a blimp's big fabric gas-bag conveniently acts as an echo chamber and helps to produce a rather unusual throbbing sound that attracts people's attention and encourages them to look sky-ward. It is important in today's noisy world when Joe Public is constantly bombarded with the rumble of passing jumbo jets and the clattering of air-ambulance helicopters, to produce some odd sound which will arouse curiosity. This is one big advantage that the loud, intermittent roar of a modern hot air balloon burner gives them over their serenely silent, gas balloon rivals when it comes to aerial advertising.

Hot air balloons now dominate the field but airships have their niche too, partly because they are so rare that few busy citizens fail to notice when one passes by. But also because airships have another trick up their sleeve that hot air balloons find hard to match. Advertising from airships after dark is possible thanks to the next major technical advance that appeared almost twenty years after the ill-fated *AD-1*'s demise.

In 1948, the Ford car-making company in America decided to hire a blimp from Goodyear - see p19 – and had the genius idea of covering both sides of it with thousands of light bulbs. This meant it could mimic the famous illuminated 'ticker-tape' sign that displayed breaking news in New York's Times Square. The idea was an instant success and remained in use until the next technological break-through when the Lightship Group thought of turning the whole translucent gas-bag into one giant light bulb!

And finally I should like to record my congratulations to the AHT's hard-working webmaster, Alastair Lawson, who has nursed and nourished our website through 25 years of online adventures – see p33. Happy Anniversary, Alastair!

GILES CAMPLIN – EDITOR

THE NEWEST FLYING-MACHINE

By Herbert C. Fyfe

From *The Strand Magazine* (Vol. xvii pp 596/601)

Submitted by Paul Ross

Although Dr. K. I. Danilewsky does not pretend to have completely solved the question of aerial navigation, he has undoubtedly gone farther than anyone else in the construction of a balloon which can be steered with perfect ease in any required direction without the aid of engine or screw.

Those who build flying machines may be divided into three classes, First, there are those who believe that the coming airship will be in the nature of the present-day balloon, *i.e.*, a substance filled with gas and lighter than the air it displaces in the course of its travels; their object is to find some means or other by which it will be possible to guide the balloon in any required direction, and even to force it against the wind. Innumerable "dirigible balloons" have from time to time been proposed, and many have been constructed. But in the present instance we shall confine ourselves to the apparatus invented by Dr. K. I. Danilewsky, of Kharkov, Russia, who has very kindly allowed some of his photographs to be reproduced here for the first time, and has supplied information about his experiments and results.

Secondly, there are those who pin their faith in machines heavier than the air, propelled by steam, or electricity, or liquid fuel. The experiments of Langley, Maxim, and others will be familiar to most readers; it must suffice to say that no aerial machine of this sort has yet ascended with a passenger inside.

The third class are those who seek to unravel the problems of the air by the construction of gliding apparatus in which they place themselves, and, putting off into the air from an elevation, endeavour to reach the ground in safety The best-known in this line is Mr. Pilcher. Herr Lilienthal, it will be remembered, lost his life while attempting a flight.

So much then for past history. The newest "dirigible flying machine" now claims our attention. Dr. K. I. Danilewsky, its inventor, read a paper on the apparatus in the sub-section of Aeronautics at the tenth meeting of naturalists and physicians, held quite recently at Kieff. He has been so good as to translate some of his remarks for us, and these are here summarized. Dr. Danilewsky, says that the results arrived at so far can be expressed in the following way :-

1. The machine enables us, in the simplest manner possible, to ascend easily to any given height, and to descend safely *an unlimited number of times*, without throwing out any ballast or letting out the gas.
2. It enables us to actively direct the machine in calm weather in any required direction.
3. When a fair wind comes we are enabled to make full use of it.
4. The machine once being loaded we can use it daily and hourly for eight or nine days.
5. What I consider as matter of great importance is the cheapness of the machine, its safety in flying, and the extreme simplicity of its construction, so that any mechanic can make one on the same model.

"This is what I have done in the course of the last eighteen months. As to flying against the wind – the machine is unable to do it yet. Such an apparatus cannot be produced nor can the solution of the question of flight and suspension in the air be arrived at by the effort of one man and a few experiments, but by hundreds of people and tens of thousands of experiments. The man who attempts to make a flying-machine is regarded (in Russia at least) with distrust, and he finds most people opposed to his ideas. I feel, however, convinced that such a machine must come, and every year We are nearer to the desired end.

"The idea which led me to the construction of my dirigible balloon is very simple, and can be thus expressed. If a man's strength be not sufficient to raise him into the air, he can raise himself if part of his weight be subtracted. The latter condition is arrived at by using by using a balloon filled with hydrogen. This extremely plain idea I bore in mind years ago when a student of the University. I could, however, only prove the truth of it in 1897 and 1898, and I have now found that by the use of a balloon filled with hydrogen the weight of the man is eliminated from problem, and he can use all his efforts to propel and steer the machine which supports him".

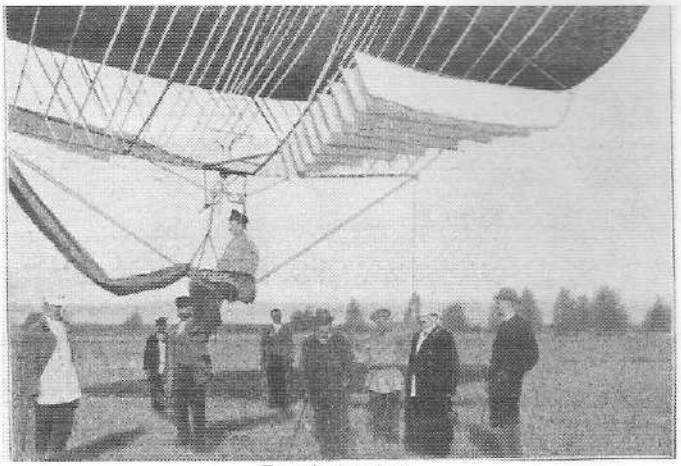
From the photographs here reproduced the reader will be able to get a very good idea of the form and shape of Dr Danilewsky's balloon. The inflated portion is shaped like a cigar, being pointed at one end and flat at the other. Over a portion of the body is placed a covering, and from this stout cords are led down to the metal bar which serves to support the aeronaut, who is seated in a chair firmly secured to the bar. On each side of him are placed the "wings" and it is by the manipulation of these that he is able to steer the balloon in calm weather in any direction he may wish to go. The nature of these "wings" can be best seen in the first photograph, where several workmen are holding up different patterns. By means of ropes and pulleys the "wings" and can be easily inclined at any angle.

The "wings"

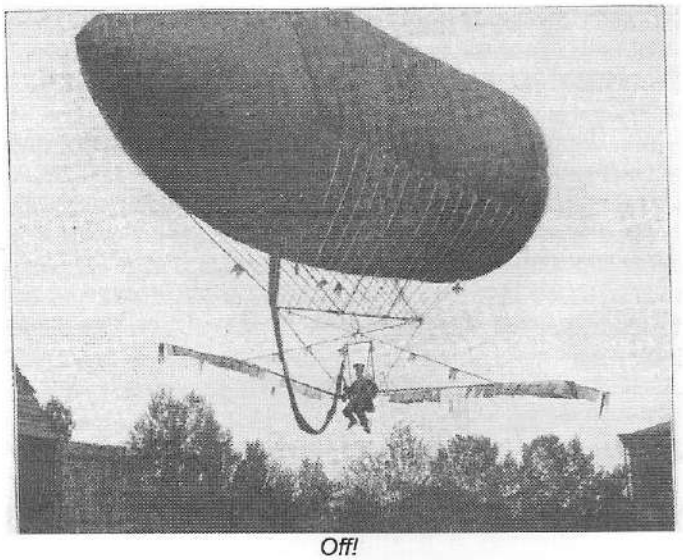
Dr Danilewsky's first experiments were made in October, 1897, and are thus recorded in the inventor's notebook: "In the course of 112 hours twenty-five ascents were made: height attained was about 280ft. Some of the ascents were made with the machine tied to a rope, others without".

The apparatus for supplying the hydrogen became a damaged, and the experiments were postponed till June, 1898, when the same balloon was used, the wings this time being 16ft. 4in. long. Ten ascents were made to 70ft. The next day twenty ascents were made to about 105ft., with wings of 14ft. It was found that the wings of 14ft. were still too long, and that the surface of the ends of the wings offered resistance, and consequently that the strokes were weak. Some days later

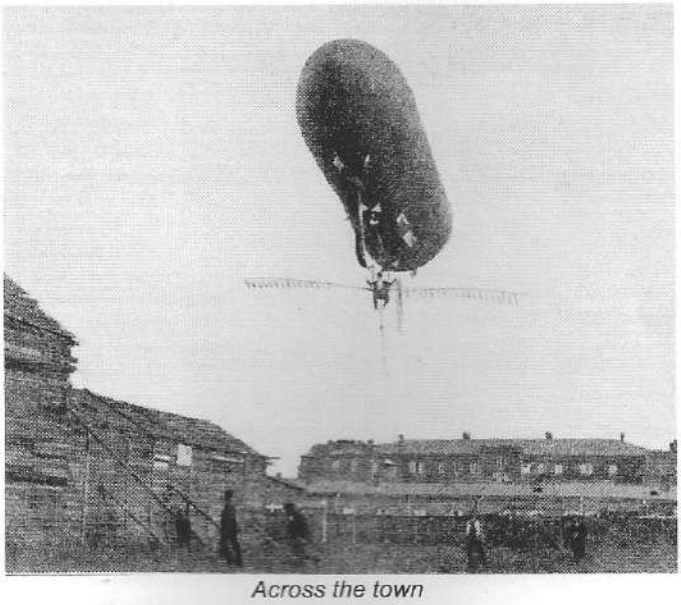
wings of 11ft. 8in. were tried – the working surface was thus increased, and it was found that the wings developed much greater power when ascending, lifting about 20 lb. and offering hardly any resistance.



Ready to start



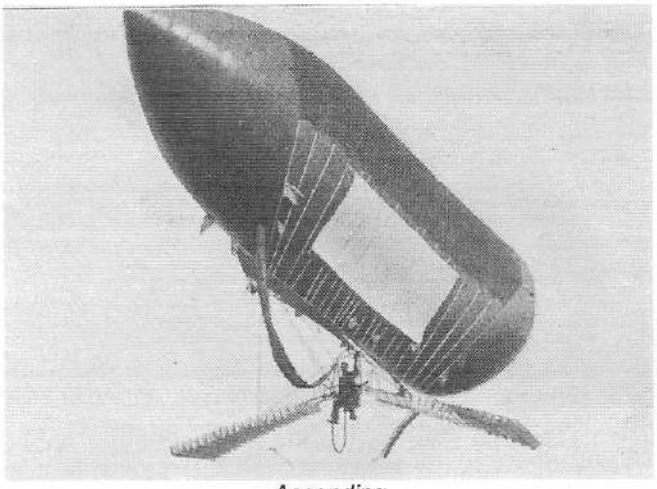
Off!



Across the town

It was decided that in case of a too-quick descent the wings should be changed into parachutes to slacken the descent. On the 24th June, in the presence of a representative of the Russian War Office, Colonel G. B. Yassewitch, fifteen ascents were made to a height of about 280ft., the balloon carrying 8 lb. weight. The descent was slow and easy, and the balloon was kept immovable at a certain height by the aeronaut, and also turned several times round and round, as ordered by Dr. Danilewsky. Resuming experiments again on the 27th of June, 1898, the wings were now arranged so that they could be changed into parachutes when the balloon was descending.

On the 4th of July ten ascents were made to a height of from 280ft. to 350ft. Dr. Danilewsky remarks on these as follows:- "The aeronaut gave too little reserve weight, and the machine rose briskly, after which it began to descend very slowly. Then he put the wings at an angle of 45deg. and travelled for some time horizontally. There was difficulty in turning the balloon round in consequence of the joint between the balloon and the wings being weak, and the joint must he made less pliable".

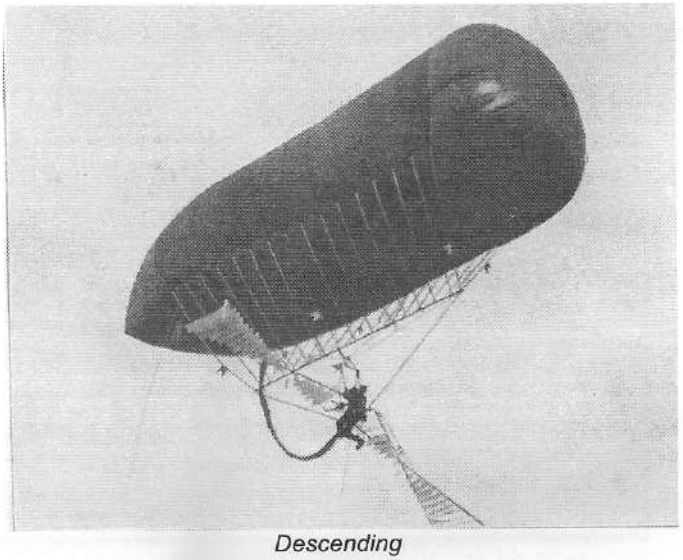


Ascending

The experiments on the 14th of July are thus detailed by Dr. Danilewsky:- "After several ascents in the yard the aeronaut was told to cross to another yard, 350ft. distant. The machine was to pass in a straight line, but when it had risen it met with a side current of wind. After continuing for a considerable distance the aeronaut briskly turned the head of the balloon against the wind, *and kept the balloon immovable for five minutes* by the manipulation of the wings".

Dr. Danilewsky drew the following conclusions from these trials:- 1. Having to struggle with different currents of the air one must be experienced in tacking about.

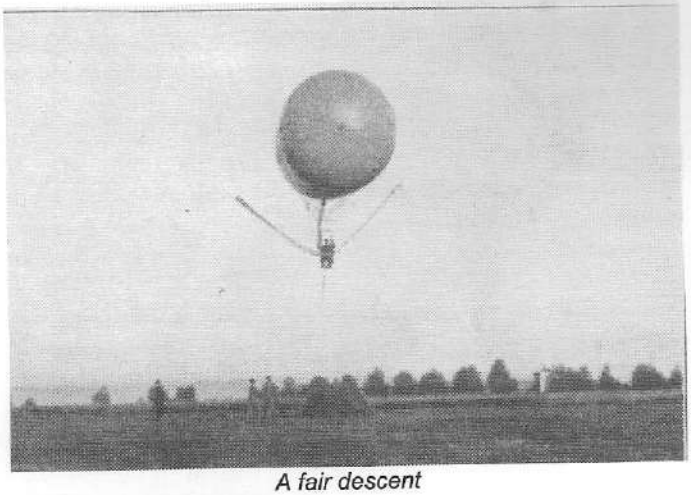
2. In order to utilize the whole power of the wings for progressive movement, it is necessary to rise high in the air, and then the wings can be placed at 90 deg. without any risk of descending. In the latter case, to keep the machine from descending it is better to open the parachute.



Descending

In subsequent trials it was found that when the weather was calm, the aeronaut could keep the balloon immovable, by working the wings, for some considerable period, provided the wind was not blowing more than a certain number of miles an hour. On the 6th of August some experiments in the open were tried. When at a height of 280ft., the machine was carried away by the current towards the town.

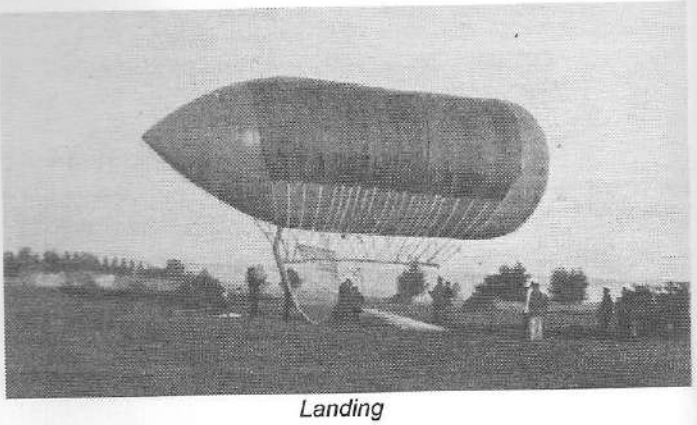
"Several times the aeronaut turned the head of the balloon against the wind, and fixing the wings for progressive movement, struggled against the current, *and actually moved slowly against it*".



A fair descent

The next trials were made on the 14th of August. Dr. Danilewsky writes of these:- "The machine turns without much difficulty when tacking about. Having fixed the wings at 45deg., the aeronaut moved horizontally for about 140ft., keeping about 210ft. above the ground. In the last ascent the aluminium beam broke, and the machine descended slowly to the ground.

The conclusions I arrived at from these experiments were: firstly, that, flying horizontally, the new wings pushed the air with more strength than the old ones; secondly, that the balloon of the new shape turned easier than before".



Landing

At the close of his lecture before the Congress of Naturalists and Physicians at Kieff, Dr. Danilewsky spoke as follows:- "What is the conclusion we can arrive at after till has been said? There can be only one conclusion: that we are near the *practical* solution of the great problem of a man being able to fly".

How near, the reader can form his own opinion from the photographs shown in these pages, which depict the machine in various stages of actual flight. The inventor, in his modesty, rather understates his case. He might have justly claimed that the problem is already solved.

Dr. Danilewsky has drawn up a comparative table giving an estimate of a practical application of a balloon of the present type and his own "flying apparatus".

As this sums up the question very clearly, this table is here reproduced:-

COMPARATIVE TABLE GIVING AN ESTIMATE OF A PRACTICAL APPLICATION OF A BALLOON OF THE PRESENT TYPE, AND A FLYING APPARATUS INVENTED BY DR. DANILEWSKY

	As Applied to a Balloon.	As Applied to a Flying Apparatus.
1. The filling with hydrogen, the riggings, and in general the complete equipment for flight, requires	from 15 men and upwards.	From 3 to 4 men.
2. Time required for all preparations at the same conditions of filling	from 3 to 4 hours.	From ½ an hour to 1 hour.
3. The transport of an apparatus filled and fitted out for removal of troops	is not practised.	Requires 2 men.
4. The transport when folded up or taken to pieces, requires	from 15 men and upwards.	3 men.
5. The transport of the apparatus and all its appurtenances, including propeller, but without hydraulic cartridge, requires	from 7 carts and upwards.	1 cart.
6. The use of the apparatus as a captive balloon, requires	a propeller.	None.
7. The ascension of a free apparatus, as generally practised, is accomplished	at a height previously known, which is fixed according to the inner arrangement of the balloon.	At a height beginning at one mètre from the earth, quite at option of the aeronaut.
8. The free flight in calm weather	cannot be accomplished.	Can be accomplished.
9. The free flight in different currents of air and at different heights	carries away with the current it happens to encounter.	Is according to the will of the aeronaut, who looks out for a propitious wind.
10. The moment of descent	is under the control of the aeronaut until his store of ballast is exhausted.	Is always under the control of the aeronaut, quite independent of any ballast.
11. The descent to earth	is most frequently a risk.	Is most frequently no risk.
12. The repeated ascending and descending	is impossible.	Is possible innumerable times.
13. One filling with hydrogen serves	for one flight; at the utmost for two.	For innumerable times within 8 to 9 days, notwithstanding insignificant accidents caused by the escape of hydrogen by diffusion.

RIGID AIRSHIP HANDLING NOTES

By "Rigid Airship" [probably George Meager]
Originally published in *THE AIRSHIP* (Summer 1948)
These notes were compiled nearly 20 years ago, and refer to airships of 5,000,000 ft.³
The author hopes that they will provoke discussion. Editors

In flight.

In flight the Captain of a ship must always have an accurate knowledge of the fore and aft trim and static condition of the ship. As the ship leaves the ground or mooring Tower in approximately horizontal trim this can be easily maintained by using fuel from tanks on either side of the centre of buoyancy so that the true moment is not altered. A table showing the fuel distribution for all quantities on-board should always be carried and adhered to by the Officer of the Watch, who is responsible that fuel is pumped from the correct tanks during his period of duty. The static trim is indicated by the average angle of pitch at which the ship is flying. In bumpy weather when the ship is pitching heavily this may be difficult to estimate. The rate of rise and fall as the ship pitches up and down should then be closely observed and the difference will immediately indicate the general static condition. If the average angle of pitch can be estimated the actual amount of static heaviness can be obtained from the aerodynamic lift chart, the speed of the ship through the air being known.

A ship in trim but light will fly bow down so that if a constant altitude is being maintained the ship's axis is at an angle to the flight path and the maximum pressure is on the top of the bow. This tends to make the ship dive still further so that "Up" elevator must be put on to maintain the required angle of pitch. If the ship becomes lighter the angle of pitch for a constant altitude increases and more "Up" elevator must be applied to counteract the increased force on the bow. If extremely light it may actually becoming impossible to prevent the ship losing height unless gas is valved or the speed reduced. Conversely, if heavy, "Down" elevator is required. As heaviness increases the angle on the elevator must also increase until the angle of pitch exceeds the angle of maximum of dynamic lift when the ship will lose speed and height and if no action is taken, will hit the ground tail first. Such extremes in the lightness or heaviness should never be experienced under normal conditions as the ship should always be kept near equilibrium (say 3% of gross lift). It is generally better to adjust the lift of the ship during flight by taking the ship above the pressure height. All bags will then blow off gas together and the correct fore and aft trim is maintained. The actual lift lost can also readily be calculated if the ascent over the pressure height is accurately noted. Another advantage of using the automatic valves is that the more impure gas at the bottom of the bags is valved and also there is no danger should a valve stick open. A most remote possibility but still to be considered.

As stated above the angle of pitch of the ship when maintaining a constant altitude is a sure indication of whether the ship is light or heavy or in bumpy conditions the rate of climb as compared to the rate of descent, e.g., if the rate of climb when pitched up is greater than the rate of descent when pitched down the ship is obviously light and vice versa. The fore and aft trim is, however, not quite so easy to estimate.

As previously stated, an airship in horizontal pitched flight tends to increase the angle of pitch and if free to turn in a vertical plane stability is not reached until the angle of pitch is 40° – to counteract this tendency opposite elevator must be applied so that a light ship, in trim, flying bow down carries "Up" elevator and a heavy ship flying bow up carries "Down" elevator. If the ship is light it is obvious that the angle of elevator could be reduced by shifting ballast aft and if too much ballast is shifted it might even be necessary to apply "Down" elevator. Conversely, if the ship is heavy, the amount of "Down" elevator can be reduced by shifting ballast forward until a horizontal path is maintained with the elevator amidship, the ship still flying pitched up.

From the above brief explanation the following table has been prepared showing the condition of the ship under varying conditions of pitch and elevator control, assuming a horizontal flight path:

Pitch	*Elevator*	*Static Condition*	*Trim*	*Remarks*
Horizontal	Amidships	Equilibrium	Horizontal	
"	Slightly up	"	Bow heavy	Adjust trim.
"	Hard up	"	Bow heavy	Dangerous ; take urgent action.
"	Slightly Down	"	Bow light	Adjust trim.
"	Hard Down	"	Bow very light	Dangerous ; take urgent action.
Bow Down	Hard up	Light	Bow heavy	Adjust trim.
"	Slightly up	"	Horizontal	
"	Amidships	"	Bow slightly light	
"	Slightly Down	"	Bow light	Adjust trim.
"	Hard Down	"	Bow very light	Dangerous ; take urgent action.
Bow Up	Hard up	Heavy	Bow very heavy	Dangerous ; take urgent action.
"	Slightly up	"	Bow heavy	Adjust trim.
"	Amidships	"	Bow slightly heavy	
"	Slightly Down	"	Horizontal	
"	Hard Down	"	Bow light	Adjust trim.

The extreme cases given in the above table should, of course, never be reached in practice as lift and trim conditions change gradually so that there is plenty of time to adjust before there is any immediate danger. The different probabilities should, however, be clearly understood so that in an emergency the correct action is taken instinctively.

During flight watch-keeping routine continues in accordance with the watch bill; on the flights of over 24 hours, working in three watches is the most efficient arrangement and to avoid long night watches it is recommended that three hour watches should be kept up from 20.00 hours until 08.00 hours. Watch-keepers on the control wheels should be relieved every two hours or even less in a rough weather. When turning over the man relieved should standby until his relief is a thoroughly accustom to the "feel" of the ship.

The course to steer and height the ship is flying at must be chalked up in a prominent position so that there can be no misunderstanding.

Flight emergencies.

It is impossible to lay down rules dealing with such emergencies as may occur during flight. The duty of the captain of the ship is it to use his experience in order that emergencies may be avoided, or at least anticipated, so that the necessary precautions can be taken. The more common emergencies are undoubtedly caused by adverse weather conditions and it is for this reason at all airship officers should be trained meteorologists and for longer flights a meteorological officer should be carried. In thundery weather the ship should fly well below the pressure height and as low as possible so that if severe up currents are encountered the ship will be able to rise without blowing off gas. The crew must be warned to keep a careful watch on the gas bags in order to place them correctly if the ship should be carried up and the most skilled coxswain should be on duty on the elevator wheel.

It is often possible to avoid thunderstorms by careful navigation but if this is impossible the ship should be flown at cruising speed with all engines running in order that full power is available should the maximum control be required. Extreme angles can be avoided and it must be remembered that if the ship is being carried down in a strong down current it is more efficient to fly only a few degrees up by the bow at full speed rather than to lose airspeed by using maximum "Up" elevator and a large angle of climb. If carried up above the pressure height so that considerable lift is lost ballast should be jettisoned as soon as the ship starts to descend and before any momentum has been gained. In such storms torrential rain will probably be encountered so that the heaviness from this cause as well as the loss of gas must be considered.

Landing.

The evolution requiring the most skill and experience is undoubtedly landing and the larger the ship the more care and judgement must be exercised. It is impossible to lay down hard and fast rules as each occasion must be judged by the conditions but a brief description of a normal landing to a high mooring tower and also to the ground will be given.

Mooring Tower Landing.

It should first be borne in mind that there must be no hurry to get down. The time of landing transmitted to the base by W.T. should therefore give the captain of the ship plenty of time to get the ship down to a low altitude close to the aerodrome before the mooring tower reports ready.

This is more important than would at first appear for the following reasons:–

(1) Except in cases where there is much low cloud or very low visibility it is advisable whenever possible to discharge gas for landing by climbing above the pressure height in preference to using the manoeuvring valves for two reasons:

(a) By climbing above the pressure height the exact amount of gas discharged to maybe calculated.

(b) After a long flight when the height is considerable the percentage fullness of the bags after landing may be about 60% or even less. If individual bags are valved there is a danger of reducing their volume to less than 50% which, if an axial girder or equatorial valves are fitted, may do damage to the bags.

(c) If all bags are valved equally by going above the pressure height and then descending there is practically no danger of bags being damaged due to small rips in the wiring system as all bags go up together as the ship descends. If individual bags are valved the relative movement between adjacent bags may lead to damage.

(2) When descending the gas superheats at the approximate rate of 2° per one thousand feet. Sufficient time must therefore be allowed for the gas to cool down to the air temperature otherwise it will be necessary to valve a considerable amount of gas at the last moment if a landing is made at once, and if there should be some subsequent delay the ship will become heavy necessitating a further discharge of ballast.

When the ship is approaching the aerodrome she should be flown at such an angle of pitch that a constant altitude is maintained. From the "Dynamic Lift Diagram" the degree of lightness or heaviness can then be deducted. This result should be checked at a reduced speed when the angle of pitch is more pronounced so that greater accuracy can be obtained. If, for example, it is thus ascertained that a ship of 5,000,000 ft.^{3} capacity is five tons light she should be taken to the pressure height and then flown on an even keel, due to her lightness she will continue to ascend and she should be allowed to ascend in this manner to 900 feet above the pressure height. The rate of climb should be checked at intervals to prevent her being carried above the equilibrium point by her momentum. The ship should then be brought down slowly to 1,500 feet, a careful note of the gas and air temperatures being taken. It will most probably be noticed that the rise in air temperature legs behind the rise in gas temperature; or in other words, that the gas superheats during the descent. At 1,500 feet the ship will therefore be light due to the fact that only 4-5 tons of lift have been lost by valving and that lift has been gained on the descent. Gas, however, should not be valved immediately as the gas temperature will fall rapidly leaving the ship in correct equilibrium for approaching the aerodrome. The above description assumes that the trim of the ship is approximately correct, as under normal conditions, the trim should remain unaltered during flight and if for some special reason or such as the partial deflation of a gas bag the ship becomes bow heavy or light then immediate action to correct should be taken either by the use of the manoeuvring valves or by a temporary adjustment in the fuel consumption table.

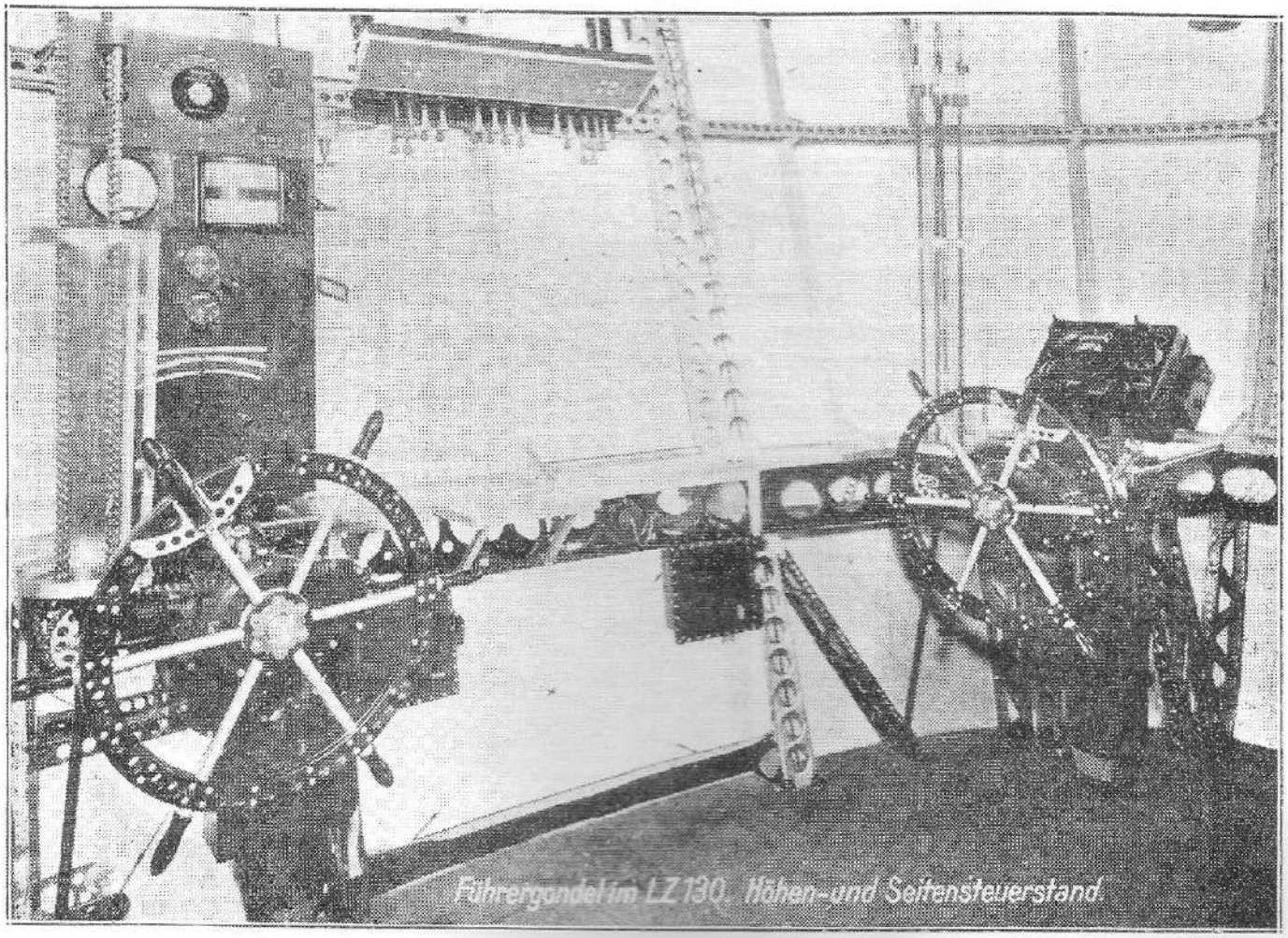
The ship is now 1,500 feet and in approximately the correct condition for landing. Course should therefore be set for the aerodrome which must be approached up wind. When in position, say 5 miles down wind, it is advisable to slow down all engines to check the static condition and trim of the

ship and then to approach the aerodrome reducing height gradually to 1,000 feet. With little or no wind two engines should be running astern after engines being used to drive the ship ahead. The main morning wire is lowered about 450 feet as the ship crosses the aerodrome boundary, the officer in charge of the mooring winches standing by to lower it right out when instructed by the captain of the ship.

At the same time as the main wire is being lowered the height should be reduced to about 700 feet and this height carefully maintained as the mooring tower is approached. With little or no wind the ahead engines must be shut off in plenty of time and the astern engines opened out to prevent overshooting the mark. If there is any danger of this no attempt should be made to couple on the wires and a red Verey light should be fired to indicate that another landing will be made. It is impossible to lay down rules as to the speed of approach, and this can only be learnt by practice.

The general tendency at first is to approach too fast and as this can develop into a very serious situation if the ship is too low and the ground crew connect the wires the error of approaching too slow is obviously preferable. Engines can always be opened out again until the bow is over the landing mark when the main wire should be run out smartly for the ground crew to connect. The ideal landing when practice has been obtained by a number of slow landings is to approach at such a speed that the ship is under full control until the last moment and then use maximum astern power for the last half mile, the ship to rest exactly over the landing patch and as such a height that the wire has not touched the ground until the last 400 feet are veered into the hands of the ground crew. A landing of this description calls for good judgement by the captain of the ship, especially if there is little wind, and also a well-trained crew who answer the telegraphs without a moment's delay so that it should not be attempted until a large number of successful landings have been made. The main wire should not touch the ground until the last 400 feet are veered when actually over the landing patch. If it is veered too early the ground crew will have difficulty in retrieving the end which will have to be dragged for a considerable distance across the aerodrome in order to reach the tower wire.

When coupled on the ship should be held stationary or allowed to rise slowly but ballast should not be dropped forward in order to adjust the trim until the slack in the main wire has been taken up, unless of course the ship proves to be slightly heavy when ballast should be immediately released. As soon as the main wire is taut ballast should be released forward and the trim adjusted by shifting the crew or fuel until the ship is 2 to 3 tons light and about 5° down by the stern. This angle can be decreased in heavy winds provided the ship is riding steadily and there is no tendency for the bow to drop. At the same time, as the trim is being adjusted, the yaw guys should be paid out, care being taken that they do not foul the main wire or each other as they are being lowered. When being hauled in the responsibility of the captain of the ship is to keep the ship in correct trim and static condition. In the ship it is most difficult to estimate of the degree of lightness so the release of ballast should be done in cooperation with the officer in charge of the mooring tower who is in a better position to make an accurate estimation of his requirements. The two essential points to remember are to keep the ship light and well



Controls of LZ 130, Graf Zeppelin, showing elevator and steering wheels, also ballast controls at height Coxswain's instrument board.

down by the tail. In a strong wind it will be found that the ship rides easier with the wind on the bow as it is impossible to keep her dead into the wind. If she yaws considerably to one side the helmsman can often be assisted by using one of the astern engines for a short period. As the ship is being hauled in the ballast weigh bridles should be lowered down so that the ballast weights can be connected at the same time as the mooring cone makes contact. If this is done smartly by the ground crew the passengers can then disembark without any delay, ballast also being pumped on-board as soon as the hose is connected.

Meteorological Conditions when Landing.

The best conditions for landing will generally be found from a few hours before sunset to a few hours after sunrise. The air conditions during this period are generally free from bumps and there is often an inversion of temperature near the ground which conveniently decreases the lift as the ship is being hauled in to the mooring tower.

Landing in the heat of the day in the middle of summer requires great care as the air conditions are generally turbulent and the air near the ground may be superheated by radiation so that lift is lost as height decreases. On the other hand, the gas inside the ship superheats rapidly when the speed is reduced to approach the mooring tower so that good judgement is required when ballasting up, these two factors being taken into consideration. Landing under such conditions is much facilitated by plenty of astern power and then the ship is under full control until close to the tower when full astern power can be used to bring her to rest over the landing patch. If the conditions are thundery it is generally better to wait until they improve, especially if thunderstorms are expected over the aerodrome. With close cooperation with the base meteorological staff it might be possible to select a quiet period between storms but this is a risky proceeding and should not be attempted unless an immediate landing is of vital importance.

Ground Landing.

A ground landing when the ship has to be brought to rest at least 200 feet from the ground instead of 700 or 800 feet when making a landing to a tower is obviously a more difficult operation and even greater care should be taken when ballasting up. The general procedure for landing is exactly the same as already described, except that height must be reduced earlier but the aerodrome boundary should not be crossed under 500 feet. If landing in the middle of the day, during the summer, special note must be taken of the ground temperature as the air near the ground and perhaps up to 200 or 300 feet will probably be very warm or, in other words, that lift will be lost as the ship is being hauled down. Landings should therefore be made whenever possible between dusk and dawn when conditions are more steady and an inversion of temperature will probably be found up to 200 feet.

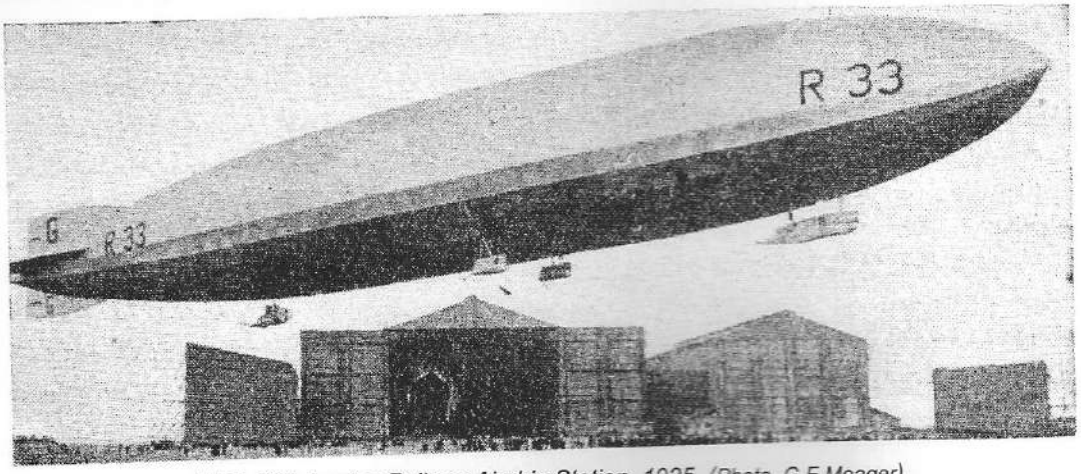
Leaving the Tower

A large rigid should be about half-a-ton light when slipping and in fore and aft trim. The lift is obtained from the indicator at the mast head and to avoid a false reading the captain of the ship should, therefore, watch the inclinometer closely and instruct the Mooring Tower Officer when to take the reading. When "ballasting up", the water pipe and telephone should be left connected up so that adjustments of ballast can be made without delay and these should only be disconnected just prior to slipping. The electric power cable should be disconnected about 15 minutes before slipping, the power supply being switched over to the ship's dynamos.

The ship is now ready to leave with two or three engines running dead slow. The actual order to "slip" should be passed to the Officer i/c Mooring Tower when the ship is about 3° down by the stern and the helm over to the "right" or "left" which ensures that the airship will swing clear of the tower when slipped.

As soon as the order to slip is given a careful watch must be kept ahead on the tower structure so that the slightest movement can be detected. The airship should float clear without any jerk, gradually rising in an almost horizontal position. As soon as she has swung clear open up two or three engines to cruising speed so as to gain aerodynamic control without delay. If the airship rises very slowly and then possibly starts falling release emergency ballast forward immediately – half-a-ton should be sufficient to give the required rate of rise. If through some miscalculation the airship is very light on leaving the bow will rise rapidly and an angle of about 25° or more may be reached if immediate action to release ballast aft is not taken. It is impossible to lay down how much ballast should be released as this depends on the degree of lightness forward. If a distinct jerk is felt when the slipping pennant is released it is better to let go one ton at once so as to check the angular acceleration as soon as possible. At the same time the engines should be opened out in order to get the ship under control without delay.

As soon as the ship is clear of the tower the slipping pennant is unrove and the main wire rove through the mooring cone ready for landing. (*Note* – the original idea of using the main wire as a slipping pennant by fitting a stopper at the correct distance from the end is not satisfactory as the stopper often damages the wire and is liable to slip if the ship is very light when the stops are taken out). Watch-keeping routine then commences – if possible the crew being worked in three watches as this has been found to be the most efficient arrangement, especially on long flights. ♣



HMA R33 leaving Pulham Airship Station, 1925. (Photo. G.F.Meager)

SOME HISTORICAL INFORMATION EXTRACTED BY THE EDITOR FROM:

GOODYEAR AEROSPACE CORPORATION PARAMETRIC STUDY OF DYNAMIC LIFT AEROSTATS FOR FUTURE NAVAL MISSIONS [1]

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SECTION II – ALL STATIC-LIFT AND "DYNASTAT" ... VEHICLES

The airship as it has previously been configured is a powered, streamlined body-of-revolution air-displacement vehicle deriving its buoyancy from the difference in weight of the helium gas within its hull or envelope and the weight of the ambient atmosphere thus displaced. Dynamic forces were used primarily for control and maneuvering, with very little deliberate exploitation of dynamic lift forces to sustain "heaviness".

Two distinct structural types gave rise to a definition of dirigibles [2] based on this difference: rigid, or unpressurized, airships (Zeppelins); non-rigid, or pressurized airships (Blimps). A third type, semi-rigid, is a blend of these two.

The rigid types such as the *Akron*, *Macon*, and *Hindenburg* were built up of bulkhead rings, transverse girders, and a network of pre-tensioned diagonal shear wires. An outer fabric cover provided a wind and weather cover. Lifting gas was contained in several independent gas-tight cells, supported between bulkhead ring nettings. The gas cells were partially filled at sea-level, pressure height by definition being the altitude at which expansion of the gas completely filled the cells. Climb beyond pressure height necessarily required the valving and irrevocable loss of helium to prevent over-pressuring and rupture of the cells. Large poppet valves were provided with automatic spring settings for over-pressure protection. Manual valving was also possible.

The non-rigid or pressure airship consists of a hull of coated fabric filled with helium and pressured slightly above ambient. Several ballonets, or air compartments, are curtained off within the envelope. They are normally located forward, aft, and amidships. The maximum ballonet capacity is a function of the design pressure height.

Pressurization of the envelope is accomplished by scooping air for the ballonets from the prop-wash or pumping with electric blowers through an air distribution system to the ballonets. Dampers, air lines, and exhaust valves at the ballonets permit both control of envelope pressure and relative fullness of fore-and-aft ballonets for trimming in pitch. As the ship ascends expansion of the helium is permitted without loss of gas by deflation of the ballonets. Pressure height is the altitude at which the ballonets are completely deflated, the envelope at that point being 100 percent full of helium. Further ascent could only occur with valving of helium. It is possible for a ship to be flown so high, with consequent valving of helium, that upon descent the ballonets are pumped full before the ground has been reached. Further descent, with envelope pressurization, can only be accomplished then by pumping air directly into the helium provided an emergency access of air line to helium is provided.

Rate of ascent with a pressure airship may be limited by engine power - if the ship is "heavy" - but is structurally limited by the ballonet valves' capacity to exhaust air. Conversely, rate of descent is limited by the air system's capacity to pump air into the ballonets as the helium contracts with increasing ambient pressure.

Car structure and engine nacelles on a rigid airship are extended from convenient bulkhead rings and longitudinal girders. On a non-rigid, the car structure weight is distributed to the fabric envelope by means of several catenary systems. Usually two identical internal catenary curtains, either side of [the centreline] on the top of the envelope, tie to the upper envelope along two fore-and-aft "Y"-joints. Vertical tension cables from the roof of the car carry weight to fitting points on the curtains. The curtains spread the load to the upper envelope, deforming it slightly out-of-round at the "Y" intersection. A catenary system around the car-lower envelope intersection distributes pitching or yawing loads to the envelope. Fins on a non-rigid are cable-braced to finger patches tangent to the cable-envelope intersections. Power plant installations on a non-rigid have always been extensions from the hard car structure.

The semi-rigid airship generally differed from the non-rigid by utilizing a nose-to-tail rigid keel rather than the catenary curtains for distributing car weight to the fabric envelope. It was still a pressure airship, requiring slight pressurization to permit resistance of hull bending moments without envelope wrinkling. Its cross-sectional shape tended more to a pear-shape because the entire car weight was applied to the bottom of the envelope.

The large rigid airships maintained neutral buoyancy, as fuel weight diminished, by manufacturing water ballast from the engine exhausts. Suitable radiator equipment condensed the moisture in the hot exhaust gases and the condensate could be stored in the emptied fuel tanks. If sufficient radiator capacity is provided an excess of ballast is available.

The smaller blimps reballasted by, picking up sea-water to be stored in emptied fiberglass fuel tanks. Since helium costs $35.00/1,000 cubic feet and 1,000 cubic feet will lift 63½ pounds, the cost of valving helium to compensate for excess lift is on the order of $0.55 per pound of "lift", obviously a considerable cost for a sizeable fuel weight burn off. ... ...

... a. Straight and Level Flight in Static Equilibrium

The air flow produces positive pressures only on the foremost portion of the bow and on the stern-most portion of the tail; the remainder of the body is subjected to negative aerodynamic pressures. These, in effect, add to the pressure

[1] *Dirigible Editor comment* – NB. This article assumes all airships are filled with helium and discounts hydrogen-filled airships.

[2] dirigible, n. Specif. A lighter-than-air aircraft having its own motive power, which may be steered in any desired direction by its crew. Attrib. with hangar. : dirigible, a. Of aircraft or airborne devices: That can be directed or steered. : dirigible balloon. A balloon, esp. a nonspherical balloon, that can be steered. : U.S. Air Force Dictionary, 1956, no specific structural type is implicit in the term "dirigible".

differential between the gas and air content of the ship and the ambient air and thus, affect the stress distribution in the structure whatever design construction approach is selected.

The distribution of the aerodynamic pressure along the length of the airship is a function of the airspeed and of the characteristics of the envelope contour, primarily the fineness ratio, cylinder coefficient, and abscissa of the maximum diameter.

b. Horizontal Flight of a Heavy or Light Airship with an Angle of Attack

The pressure distribution follows the general law

$$\frac{p}{q} = A + B\cos\phi + C\cos(2\phi)$$

where the coefficients A, B, and C are functions of the aforementioned contour characteristics of the envelope, also of the angle of attack and of the abscissa ϕ in any cross section is the angle between the vertical axis and the radius to the particular point on the envelope (ϕ = o at the bottom, π at the top).

It is observed that the component q B cos ϕ is the only one that contributes to the dynamic lift of the airship. The total dynamic lift of the un-feathered ship is found to be

$$L_d = q \int_0^{2\pi} \int_0^{l} B\, r \cos^2\phi \, d\phi \, dx$$

All three components of the pressure, however, affect the stress distribution in the hull structure. ... ...

... ... c. Maximum Rate of Ascent

The climbing airship must release air from the ballonets and - upon reaching pressure height - gas through the gas valves. The maximum rate of ascent requires full opening of either valve type. This in turn necessitates an increase in pressure, over and above the pressure differential for which the valve is set to start opening.

This may happen simultaneously with, or as a direct consequence of, a gust that pushes the airship upward. It is therefore recommended that the design of the envelope, whether metal-clad or fabric, be for a limit pressure equal to the total pressure necessary to meet the gust condition plus the "valve -opening pressure", (the difference in the pressure required to start the valve to open and the pressure required to open it all the way). ... ...

SECTION VI – AERODYNAMICS ...

... 6. STABILITY

Wind tunnel test of airship models with and without tails have shown that the horizontal tail surfaces carry a large part of the dynamic lift in flight. Elevator deflection also provides large changes in lift and all exact calculations must be made with the control surfaces in trim. ...

... Airplanes with varying degrees of stability and instability have been built and flown successfully. In general, airplanes that are statically unstable are not as comfortable to fly as airplanes which have both stick-fixed and stick-free stability. Accordingly this stability requirement has been incorporated into all recent airplane specifications.

By the same criteria airships which were known to fly quite well should have been seriously unstable. It was at this point that the airship pioneers developed the dynamic stability criteria now used for airship design, involving the use of rotary stability derivatives. ...

... The several types of stability are defined as follows:

Rectilinear inherent dynamic stability of an airship is that quality which causes the angular velocity and attitude resulting from an initial disturbance of the motion of the ship to decrease with time without benefit of control adjustment and with relatively small consequent course deviation.

Curvilinear inherent dynamic stability is defined as the quality which causes the flight path resulting from an initial disturbance to approach asymptotically a circle of definite radius. The following combinations of the stability conditions are possible: (a) Rectilinear dynamic stability, curvilinear dynamic stability; (b) Rectilinear dynamic instability, curvilinear dynamic stability; (c) Rectilinear dynamic instability, curvilinear dynamic instability

These types of stability are shown in *Figure 48*.

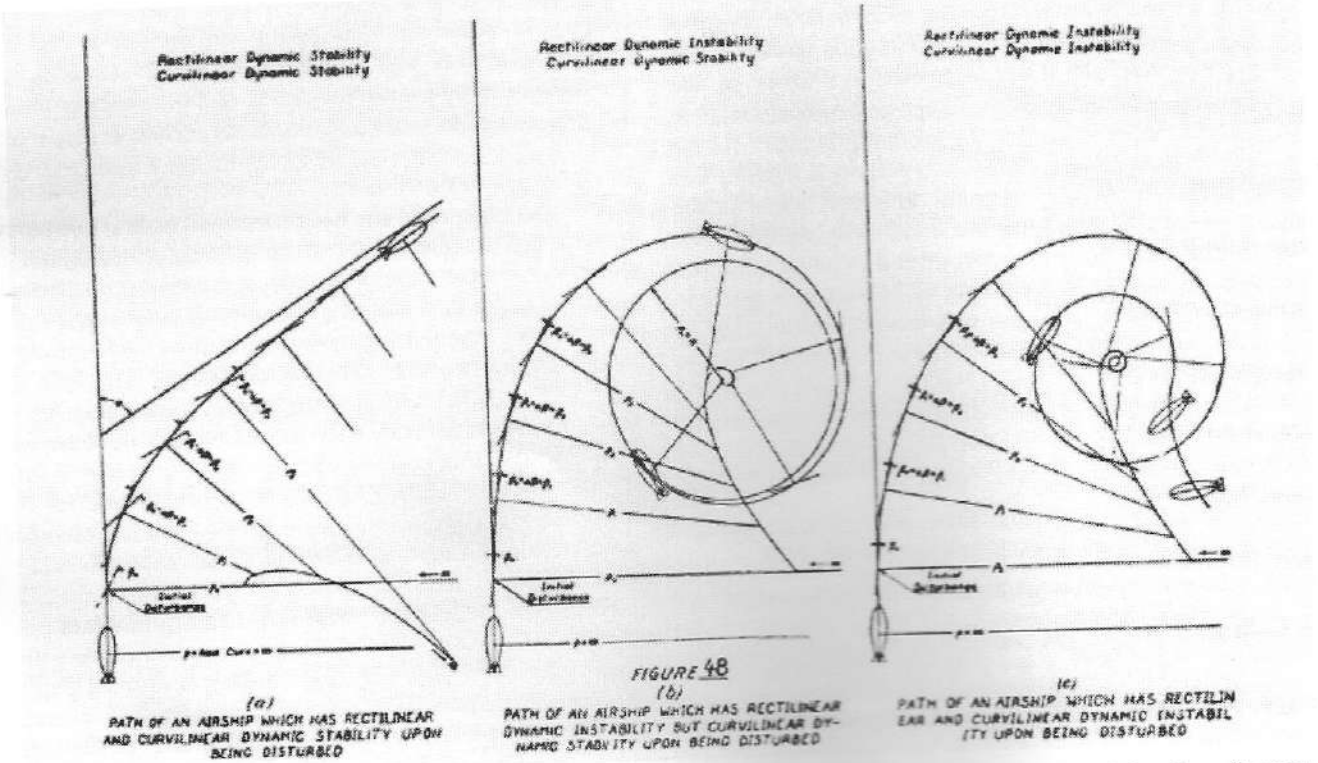


FIGURE 48

(a) PATH OF AN AIRSHIP WHICH HAS RECTILINEAR AND CURVILINEAR DYNAMIC STABILITY UPON BEING DISTURBED

(b) PATH OF AN AIRSHIP WHICH HAS RECTILINEAR DYNAMIC INSTABILITY BUT CURVILINEAR DYNAMIC STABILITY UPON BEING DISTURBED

(c) PATH OF AN AIRSHIP WHICH HAS RECTILINEAR AND CURVILINEAR DYNAMIC INSTABILITY UPON BEING DISTURBED

In the first case, (a) after a disturbance the airship straightens out on a new heading. One or more oscillations may occur about the new heading but it would be desirable for this to be damped out.

In the second case, (b) the airship seeks the circumference of a definite circle and continues to fly in a constant-radius turn. The angle of yaw produces a side force which exactly balances centrifugal force.

In the third case, (c) the airship spirals inward with decreasing radius and increasing yaw until it tumbles due to flow breakdown.

Case (a) is typical of a stable airplane whereas case (b) is typical of a stable airship.

A mathematical determination of the concept of dynamic stability can be evaluated from the differential equations of motion based on the theory of small oscillation. For a condition of dynamic stability to exist the real roots are indications of non-oscillatory convergent modes. In general, the more negative the root, the shorter the time required for an arbitrary perturbation to damp to a fraction of its initial amplitude and the better the handling qualities of the airship in equilibrium flight. If the real roots are positive the motion of the airship is dynamically unstable, which is undesirable because it is characterized by a succession of tight curves and application of relatively large rudder deflections to maintain course.

The evaluation of inherent dynamic stability without the assistance of autopilots or servos is a relatively simple problem when considering small disturbances from equilibrium flight, once the stability derivatives are known.

For the airship to be stable by this criteria, the following expression must be negative:

$$I = m' + \left(n'm'' - m'n''\right)/2k_x \neq 0 \text{ (preferably about -0.5)}$$

m' = slope of moment curve C_{m_α}

n' = slope of lift curve C_{l_α}

m'' = rotary moment derivatives $C_{m_q} \times V/\Psi^{1/3}$

n'' = rotary lift derivative $C_{l_q} \times V/(\Psi)^{1/3}$

k_x = longitudinal virtual mass coefficient $(1 + k_1)$

k_1 = longitudinal additional mass coefficient (varies from .09 to .13 for airships)

$C_l = L/\Psi^{2/3}(1/2\rho V^2)$

$C_m = M/V(1/2\rho V^2)$

α = angle of attack - radians

q = angular velocity - radians/second

The more negative the numbers, the more stable the airship. Airships have been built with this number varying between -182 and -580. One of the more successful is the *ZPN-1* which had a stability index of -503 longitudinally and -526 laterally. ... ...

SECTION VII – OPERATIONAL CONSIDERATIONS

1. CREW ACCOMMODATIONS AND COMFORT

Airships, both rigid and non-rigid, traditionally have had comfortable but not luxurious accommodations for the crew. The configurations examined in this study are not exceptions. ...

... Examples of two recent designs are given below.

The latest airship, the *ZPG-3W* carried a crew of 21. An upper deck of the car was devoted solely to crew's quarters. A bunkroom separate from the rest of the quarters contained nine bunks and lockers for personal effects. Aft of the bunkroom was a galley and eating facilities. The galley contained facilities for preparing hot meals, refrigeration for frozen and non-frozen food, a sink and stowage for cooking and eating utensils and for dry foods. The dining area contained comfortable seating at tables. These facilities doubled as a recreation area suitable for games, reading or writing. Heating and ventilation were controlled so that the sleeping area could be kept cooler for sleeping. Most toilet facilities were installed on the lower deck for isolation from the living quarters. These facilities consisted of toilets and wash basins with mirrors and shaver outlets. In addition a wash basin was installed on the upper deck. No showers were installed due to the weight of the water requirements. These facilities were provided at a weight of 2,000 pounds, exclusive of structure weight and empty of food. ...

... 3. ALL WEATHER CAPABILITY

No vehicle is truly all-weather in that it can effectively perform its assigned mission in any weather condition which may occur. One possible exception is a submarine which operates at depths below weather effects.

However, many vehicles can survive severe weather conditions without damage to operational effectiveness and resume an operational mission after the weather has moved on. An airship with its remarkable endurance is one such airborne vehicle.

Wind has been the traditional handicap to the older slower airship models. Although high winds are not a threat to the structural integrity of an airship, they have hindered operational effectiveness, especially when a required course was into such a wind. However, the endurance of these airships has enabled them to ride out a storm, and resume operations as soon as the storm has passed. If high winds threaten an airship transit operation flying the pressure pattern will often permit an airship to arrive at its destination, whether it be an operating position or return to base, close to schedule. ... ... Winds, especially turbulent winds, hamper ground operations of an airship. However airship endurance permits waiting for more favourable landing conditions or proceeding to an alternate base. An episode in the career of the *Graf Zeppelin* involved her waiting out a Brazilian revolution for three days off the coast before deciding that it was safe to proceed inland to a landing.

Previous airship models which were not flying statically heavy were able to pick up fuel from the runway or a truck on the runway if landing conditions were too turbulent. Inflight refuelling was accomplished by taking station over a naval surface tanker, winching up a fuel hose, and having fuel pressure-pumped aboard from the ship.

Icing, often a handicap to heavier-than-air craft, has never been a severe problem to airships. Although airships had been flown for many years under conditions conducive to icing with no bad effects, a program was instituted in 1954, extending over three winters, to obtain more definitive data. A *ZPG-2* airship with an envelope volume of 975,000ft^3, a length of 339ft and maximum diameter of 75ft, was instrumented and deliberately flown into weather conditions conducive to icing. In no case was ice accretion severe enough to affect airship control or flight characteristics, including one flight when an estimated 3,000 pounds of ice accumulated. The culmination of this test was a ten day patrol at a station off the east coast using five airships during January, 1957. During this period the worst conditions of icing, fog, sleet, snow, rain, and gale winds in many years were experienced. Thus a three-winter test formalized the experience of many years of prior airship operation with similar results.

Perhaps the most troublesome situation for a moored airship is the accumulation of a heavy, wet snow of several or more inches on the envelope and fin topsides. In several instances where this has unavoidably occurred, the Navy has

flushed the snow off with a fire hose. Some promising experiments had been conducted in which the envelope helium was heated to melt the topside snow, but the Navy did not think it necessary to make this operational.

Wet snow usually occurs near the ground and can be avoided in flight by a moderate increase in altitude.

Lightning has never caused concern with a helium-inflated airship. Although all aircraft attempt to avoid lightning areas, because of the turbulence that usually exists, there has been evidence of strikes on airship cars, fins, and topside radomes, but none causing detectable damage to an envelope. There have been reports of small holes in the covers of rigid airships, where charges hit the metal structure beneath, but the structure was not damaged.

4. VULNERABILITY TO WEAPONS

Very little is known about the vulnerability of [helium-inflated] airships to weapons fire. Experience is very limited and testing even more limited.

However, it is reasonable to believe that airships are no more vulnerable to the effects of weapons fire than other flight vehicles. In one respect airships offer a safety feature not available to other flight vehicles. Unless the envelope is shredded by enemy fire, severe damage to the car and/or power plants will not necessarily cause an immediate loss of craft and crew. The airship will lose altitude slowly - at a rate determined by the amount of envelope puncturing sustained - so that even with severe envelope damage the airship may safely reach the ground or even manage to be flown to home base.

Two historical instances bear this out. During WW-II an airship was shot down by a German submarine (the only such case on record). The airship settled slowly to the water with the loss of only one crewman. The airship floated for several hours after "landing" on the water.

In another instance an airship practicing carrier landings snagged a stern line and pulled a hole in the envelope described as "the size of two office desks". The airship slowly settled into the water and the entire crew was promptly rescued.

Envelope hits by solid or incendiary shells will cause damage directly proportional to the caliber and number of hits, with no tendency to tear the fabric. Explosive shells will probably cause more damage due to fragmentation effects. Blast effect from explosive shells would be small unless it occurred within the envelope, in which case it could cause more severe damage to the envelope. No armor or self-sealing fuel tanks have been installed in earlier airships. Both, of course, could be installed as in other combat aircraft. Conventional defensive weapons could easily be installed in an airship car or in appropriate pods on the envelope.

5. CREW SAFETY ...

... Damage to the lift gas container(s) is not ordinarily catastrophic. Even with sizeable damage to the envelope the airship can be safely landed after a slow loss of altitude. An example of this occurred to one of the Goodyear-operated airships several years ago. An external generator threw a 'V'-belt through the envelope causing an eighteen-inch tear. As the ship was quite heavy, the pilot was unable to return to base and landed, thirty minutes after the incident, at an unused airstrip. Emergency repairs prevented further loss of helium until the ground crew arrived. After temporary repairs and addition of helium, the airship was flown back to base for permanent repairs.

In another incident a few years ago, the advertising airship suffered abrupt loss of both engines during a cross-country trip in the St. Louis area during the winter. Water in the fuel had caused blockage by ice in the fuel lines. Fuel and other ballast was dropped until a neutral-buoyant condition was achieved. The two pilots aboard spent twenty minutes dismantling the fuel system in the car, eliminated the ice, and put the system back in service. The engines were restarted in the air and the ship flown to a base.

An inherent feature of the large rigid airships was nearly complete accessibility to all areas of the ship. Ordinarily, accessibility in the non-rigids, in flight, was limited to the car. However, many envelope areas could be reached through the airlines and ballonets. In the *ZPG-3W* an enclosed vertical ladder provided connection to the car and access through the helium to the topside radar and control room located at the top of the envelope. Because of accessibility much more inflight inspection and maintenance is possible than with heavier-than-air craft. A variety of spare parts and tools were often carried to facilitate inflight repairs or maintenance of components.

Airship safety has been considered inherently so high that parachutes for the crew were seldom carried. ... ...

SECTION IX – CONCLUSIONS ...

... 5. BALLASTING AND MAINTAINING BUOYANCY

Neutrally-buoyant airships have usually had the problem of excess lift as fuel weight is diminished. Valving of lifting gas is the obvious but expensive expedient. Ballasting by means of condensation of water vapor in the engine exhaust was the technique on several large rigids. With sufficient condensation apparatus, an excess of ballast can be manufactured for storage in emptied fuel tanks.

Some of the Naval "blimps" ballasted by dipping up sea water for storage in emptied fiberglass fuel tanks.

On occasion attempts have been made to recover fresh water from rain-run-off of the envelope. It is not known that this technique was ever utilized intentionally and deliberately for re-ballasting.

[*Clearly, Goodyear's engineers in 1968 were unaware of the experimental prototype rain-capturing systems that were successfully trialled by R100 and R101 in 1930. – Ed.*]

The *Graf Zeppelin* evaded the ballasting problem by fueling with "Blaugas", a gaseous fuel probably close to a blend of methane and propane. This gas had a specific gravity of 1.09 in relation to air so that it affected the ship heaviness very little as it was consumed. Ship total volume is the same since, on an equal BTU basis, the volume of helium to lift a given quantity of liquid fuel is approximately the same as the volume of the equivalent gaseous fuel.

Another technique which could be used would be the burning of gaseous hydrogen with liquid fuel. The hydrogen would be separately ballonetted within the main helium volume for isolation from the atmospheric oxygen. If burned at a 17 percent hydrogen, 83 percent liquid fuel rate, on a BTU basis, break-even on lift and weight would be maintained. ...

... 8. GROUND HANDLING

Ground handling of conventional airships was well-mechanized by 1960. Ships were moored at the apex of the bow, to self-propelled or towable masts. Vehicular "mules" with constant-tension winches were secured to handling lines from either side of the tail when the ship was moved. When moored, the ship was free to weathervane about the mast to minimize loads on the hull. The large rigids were sometimes secured by the lower fin to a riding-out car which permitted weather-vaning but prevented the tail from being carried up.

Ships were moved to a take-off location by towing on the mast. Upon release, the mast was withdrawn laterally. A buoyant ship merely flew away; a "heavy" ship made a running take-off on its wheel gear. ... ... ♣

TUSTIN'S WOODEN BLIMP HANGARS

By Mark Lutz © 2019

Submitted by Lorne Bohn with the author's permission

There were seventeen wooden World War Two hangars around the US mainland coasts by late 1943 - 21 hangars in total - the other four were metal. With the massive toll of US shipping along the Atlantic Coast in early 1942 due to U-boats, there was a desire to have many more anti-U-boat airships, and thus a number of more bases. There was also a desire to conserve steel for ships, tanks, guns, trucks, etc. Thus the hangars were built of wood - huge wood truss arches, with wood truss members in the 3 x 12 inch to 6 x 18 inch range. (The blimp door sections do have steel trusses).

MCAS Tustin / NAS Santa Ana Hangars.

'Santa Ana' was the name of the base during WW2. My father flew blimps from it in 1945. It is the seat of the local Orange County and seems to have done its growing 1920-1935. When I visited it in 2010, downtown Santa Ana, probably looked very much like it did when my father was there in 1945. Santa Ana is maybe ten miles from the base. Tustin was two miles away, just one block of rural stores along a country road during WW2. In 2010, the new buildings (offices) all belonged to Orange County which has grown enormously since WW2 as metro Los Angeles expanded into it.

That base became "Marine Air Station Tustin" about 1950 (for Marine Helicopter training, maintenance, and storage). It was closed in 1999. In 2010, by luck, I connected with the Navy's Caretaker officer for the closed base, who let me in to see the hangars, because, I think, of my father's WW2 service. Normally it is difficult to get in to see the Hangars.

The City of Tustin has ideas about making one hangar a Park. Orange County has plans for the other one. The Navy would be DELIGHTED to have these hangars off their hands. Orange County had a (2007?) plan to spend about $75 million turning "their" hangar into a park building. About half of that would go to installing and landscaping parking and drainage. The other half is for replacement bathrooms, electrical services and lighting and installing people doors (many) along the sides. I think the people door thing is stupid. The electric motors open the end doors in two minutes to a width of 220 feet ... masses of people can move through those openings, very fast.

But, there's this bureaucratic thing called "code" which mandates side doors. The electric lights DO work - just more code bureaucracy. (One would probably like more light than the WW2 light fixtures give) The bathrooms - well, while there are some they are inadequate for thousands of park visitors. When we were outside the hangar, I asked where to pee - the caretaker spread his arms wide and said 'anywhere'.

Both the City of Tustin and Orange County keep getting cold feet about turning their hangars into park facilities - they keep finding "issues" they hadn't considered, such as: what will the hangars do in an earthquake? Is earthquake reinforcing needed? How many cracked arch-truss members need repair? (Some do). How much is re-roofing it going to cost (I think it has something like twelve acres of roof - currently aluminum plating installed for the Navy circa 1955. It is gradually eroding and will need replacing soon.)

I hope both hangars can be saved. How much would it cost to build such structures today? 1,000 feet long, 300 feet wide, 175 feet tall, no support pillars inside - and all built of virgin Douglas Fir - very little, if any, of that left. People in the City of Tustin worry about termites - not valid - all the wood is heavily impregnated with "minlath" (if I remember the name correctly). This is zinc borate - a fire retardant that is also an insecticide and fungicide and by luck, not toxic to people or mammals. There is said to be about three pounds of zinc borate per cubic foot in the hangar wood.

There is plenty of paved parking - in the form of the 2,000 food diameter blimp landing mat (concrete), and the nearby runways (concrete). I think the concrete is from Marine Corps days, when it was a helicopter base - many Marine Vietnam War helicopter pilots trained there. I don't really understand the desire for re-shaping the land and replacing the pavement in a new configuration just for parking - I'd rather put that money into hangar repairs.

Anyway - my photos. I like them because they are the ONLY photos I know of which have a human (me) in them for scale. I find the eye just scales the hangars down in size without a human for reference. A lot of the photos are from a distance. I had my camera on a tripod and used the delay-timer to give me time to run and get in the picture.

The two outside photos were set up as far as I could run to get next to the hangar in the 10 second delay time.

The doorways are physically separate from the hangar itself - this part of the US has 'Santa Ana' winds which can be as strong as 100 mph. The engineer in charge didn't want the one million pound or so wind-load pushing on the trusses in their weak direction - for fear the entire hangar would be

blown down. Thus the wind load is taken by the massive door pillars and the very large box beam across the top. (All seventeen wood hangars were built with this doorway-hangar physical separation to prevent, say, thunderstorm wind gusts from blowing the hangar down) Each of the six door sections is 37ft 8ins wide by 120ft tall, and rides on its own steel rail down in the ground (3 rails). (Elsewhere you may see statements that the doors are 27ft 8ins wide - this is due to a typo in a 1943 article about the hangars in a Civil Engineering Journal, written by Arsham Amerikian - the engineer who designed them.)

The door 'leaves' or sections overlap a little when closed. As a check, multiply 27ft by 6 and you get 162 ft - while the doors really open 220 feet wide; 37 x 6 is 222ft ...).

Each Tustin door pillar sits on something like 100 pipe pilings filled with concrete. On one hangar, the pilings go down 40 feet. On the other, they go down 60 feet. (The location is a sediment deposition basin, which was a farm field growing beans when the Navy acquired it about 1941).

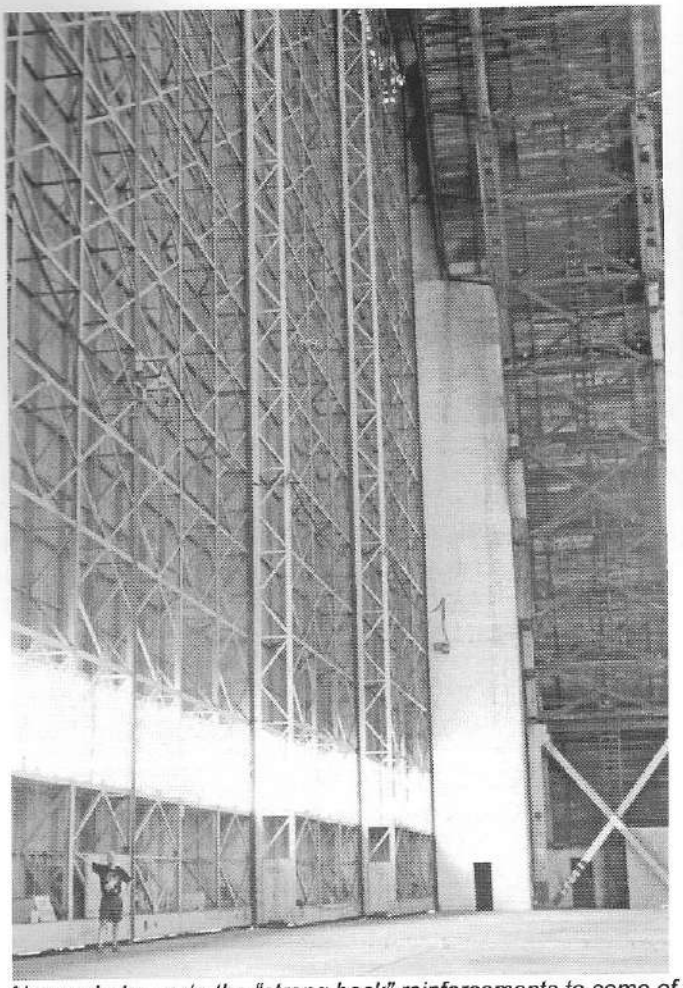
These two hangars are somewhat stronger than their "sister" hangars on the East Coast because the engineer knew there could be an earthquake here.

The Santa Ana winds are very real - erection of the original trusses had to start over several times 1942-1943 when the Santa Ana winds blew them down. The third time, the contractor started tying the trusses together with the roofing system immediately after each one went up rather than waiting 'til the next day to do that.

Above shows the 1,000 foot length - plus however much the doorway pillars add.

Here's a story which may belong to this hangar. Supposedly, during construction, a student pilot in a trainer plane or in an actual fighter flew into one of the concrete pillars in fog late 1942/early 1943. The concrete had just been poured and was still wet and the decision was made to just leave the plane in there and keep building.

I don't believe that, but I could be wrong. One wonders - if the plane is still there what about its pilot? Is the concrete pillar his grave? Also, the concrete main door pillars are hollow - not solid.



Above photo - note the "strong back" reinforcements to some of the truss members up high. Kind of ugly - but does the job. I think it was done by the Navy/Marines circa 1960 because some of the 3 x 12 inch timbers cracked in places.

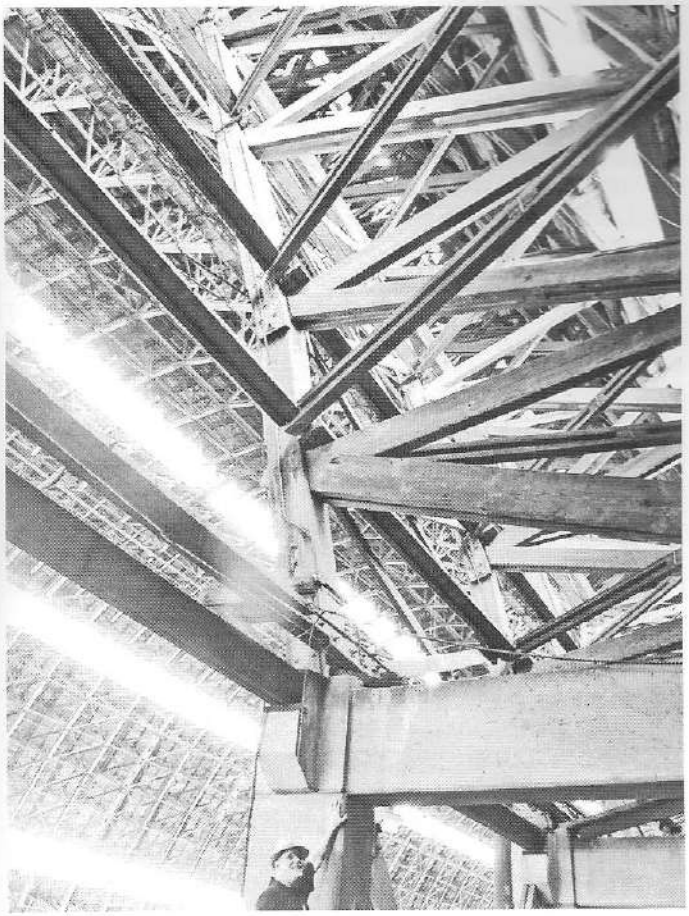
I've looked into wood cracking - continued load in the grain direction, plus heat, plus the zinc borate fire-retardant under pressure driven into the timbers, plus time, tend to result in such cracks. (Maybe a clamshell clamp tight around each member at each joint would be a fix?)

There is an electric motor in back of me in the door structure - it will open these doors fully in two minutes. There is a mechanical coupling so one motor, in one of the door panels on one side, opens both sides - all six panels or leaves. Also note the door in the pillar - which goes to the stairway inside the pillar.

Each inverted catenary arch truss is 20 feet 'thick', spans 300 feet from side-to-side (outside dimensions - 297 feet if you are picky) and is 175 feet high (outside) / 155 feet high (inside).

They sit on concrete 'bents' which are about 20 feet high; each bent sits on a number of pipe pilings - I think each hangar used over 1,000 pilings. The trusses are 20 feet apart, so there are 51 trusses to span the 1,000 foot space. In places there are a few 6 x 18 inch timbers, but most of it is 3 x 12.

The timbers are virgin Douglas Fir that came from the state of Oregon, I think. They are bolted together, and the bolt heads and nuts sit on 'ring' washers, which have a shoulder (like a bit of cylinder attached to the washer plane) to keep the washers from moving around in the wood, and to spread the bolt load.



My photos have a greenish cast because the 'windows' part way up the arches are green translucent fiberglass - so all the light inside is greenish.

In the middle of this photo are the vertical ladders up the sides which were used by airship riggers to get to the top trolley-way

Riggers would suspend nets from up there to contain a Blimp envelope being inflated. There is a moving beam on rails up there - they would hang bosun's chairs from that and 'walk' along the top of the Blimp envelopes to inspect them for damage. A nicer way to get up there is to use the normal stairways inside the main blimp door concrete pillars - one stairway on each end - you're not hanging in space with catastrophe awaiting if your arms get tired or you miss-step on the ladders. There is a 'monitor' walkway along the top of the roof, and this hangar had an 'observation room' with windows all around one end of the roof opposite the landing pad. The companion hangar did not have this room. That one might have been an emergency control tower, or an abandoned control tower. (Any blimp on that end would be landing in a grassy field, not on pavement) Unfortunately that room was neglected for decades - all the windows broke, birds got in and left a deposit of poop and feathers several feet thick, then rain got in and picked up corrosive stuff from the bird poop. A few years ago, three of the trusses under this room failed at their tops and this room crashed through to the floor below. My guess is the bolts holding the trusses together rusted to the point of failure.

However, it is also true the most common place for wood splitting in the trusses is at the top - because that is where it is hottest, and heat, plus the zinc borate, plus never-ending stress on the wood at the bolt points, can cause wood to split, according to wood scientists. Perhaps you could say the bolting system was under-designed for the reduced strength of wood after years of service, but it was adequate for new wood ... the aging thing is probably over for the wood in this structure.

I was amused a few years ago by an article in *Science* claiming certain new tall wood buildings in the design stage were going to be the "largest wood structures in the world". These WW2 blimp hangars are bigger. :)

At the end of WW2 (August 1945) there were seventeen of these wooden hangars around the US mainland coasts. Today only seven are still standing, and three are at great risk of being torn down. The two at Moffett Field (at the south end of San Francisco Bay) are in the best shape - Google has long-term leases to them and is supposed to be paying for repairs to them. The two at Tustin (Southern Los Angeles metro) are in the next best shape. The two at Lakehurst, NJ are in need of repair due to long neglect of their roofing, and the one at Tillamook (North of Portland, Oregon) very badly needs a replacement roof and some structural repair. The Port of Tillamook, a small organization, owns it, and has nowhere near the necessary cash for its repairs. There is an Oregon Historical Association which is hoping to raise money for its repair - I think they currently have a few percent of the required funds.

Here's a list of where the blimp hangars were and which ones were still standing in 2019: [*with a few facts checked by Dirigible Editor on Wikipedia*]

NAS South Weymouth, Boston, MA; 1 wood hangar removed c.1953; 1 metal demolished c.1967. I wasn't able to locate the floor of the wood hangar in 2014. The floor and curved clamshell door tracks of the metal hangar were still visible, with a new road built across it. As the base is 'developed' it is likely both floors will disappear.

NAS Weeksville, Elizabeth City, NC; 1 wood destroyed by fire 1995; 1 metal still in use. The wood hangar was set on fire during repairs while being used by Westinghouse for Airship development. The floor and concrete door-arch supports still stand. The Southern Pine wood may not have been impregnated with zinc-borate fire retardant. The metal hangar, built before WW2, is still in use for making military aerostats. Therefore, probably off limits.

NAS Glynco, Central Georgia Coast; 2 wood hangars demolished 1971.

NAS Richmond, Miami FL; 3 destroyed by hurricane 1945. The Miami Zoo parking lot is the WW2 blimp landing pad. (My father flew from here in 1943). On left side as you drive in the Zoo stores mulch piles on one concrete hangar floor. On the right side Gold Coast Railway Museum sheds and tracks sit on the other two hangar floors. The concrete arch supports for one hangar are still in place, and on top of one of its four doorway pillars is an AM broadcasting antenna (tower). That hangar had hollow areas under it in the karst (limestone) rock, so it was built with a unique super wide pillar, rather than two narrower ones. The Railway Museum hangar floors have airplane-sized 'scoop-outs' in the concrete caused by the burning aluminum of WW2 fighter that turned the cement to powder which hurricanes blew away. Before the winds arrived, the Navy had most of the 25 blimps deflated and boxed with 350 or so airplanes, plus various vehicles in the hangars for protection. The hangars were designed for 120 mph winds; the hurricane peak gusts were estimated at 150 or 160 mph. As the hangars blew apart, timbers fell on the aircraft from 155 feet, smashing the fuel tanks and sparking the batteries. The winds fanned the resulting fires, pushing flames horizontal. A seven-man Navy crew couldn't hold a fire hose on the flames against the wind and only survived by retreating inside a concrete door pillar. Today there is a fee for entering the Railway Museum; but no discounts to see the airship hangar floors.

NAS Houma, New Orleans LA; 1 wood demolished in 1947. This hangar had a unique hemisphere door because the Mississippi River Delta soil quality was so poor that it could not support pillars. The door rode on curved rails, and when fully open, was at 90 degrees to the hangar main axis. There are streets in Houma around the former hangar location with names like "airship road".

NAS Hitchcock, Houston TX; 1 wood demolished in 1962 after damage by hurricane Carla in 1961. The concrete arch supports still stand in a fairly rural location.

NAS Tillamook, Portland OR; 1 wood destroyed by fire 1992, and 1 wood still in use as a museum. The one that burned was being used to store hay, which caught fire spontaneously. The wood was treated with fire retardant but it is not a fire stop and with fire playing on the wood continuously it slowly charred until it failed. The floor and concrete supports for the hangar arches are still there. It's companion wood hangar was still standing as of 2019. That one is a museum open to the public, but there are structural problems. The roof has been recovered twice; the advice roofers give is that three layers of roofing need to be removed before it can be re-roofed. The roof is immense and the Port of Tillamook, which owns the hangar, doesn't have anywhere near the money it would take to remove and replace the roof. There are also arch truss member cracking issues, and the box beam on at least one end has sagged enough that the doors cannot be opened. The other door motor system no longer works, so the museum people have been using a fork-lift truck to push the doors open and closed.

NAS Lakehurst, Lakehurst NJ; 2 wood, 1 metal extant. The Navy has, I believe, moved everything out of both WW2 wood blimp hangars (hangars 5 & 6 if I remember correctly). For the last decade or two of hangar use, there were nets to catch pieces of wood which sometimes fell from above. Both hangars have water damage. It looks unlikely they will be repaired, which means eventually they will be torn down. Lakehurst is still an active military base; thus getting close to the hangars may not be possible, though there is a small museum, open to the public and tourists can walk up to where the burnt-out airship *Hindenburg* frame came to rest. Hangar 1 housed the *Hindenburg* several times, the US Navy's almost-as-big airship *Akron*, and the WW1 Zeppelin-like airships *Shenandoah* and *Los Angeles*. It was heavily used for blimps during WW2 and the 1950s. However, inside Hangar 1 have been experimental / developmental aircraft-carrier launch catapults, so inside may be off limits to the public, and getting close to the outside of it may or may not be possible. Hangars 2,3,4 are WW1 era hangars - one for observation balloons, the other 2 for WW1 size blimps. Those 3 hangars still stand. The long, narrow shed used to store spare blimp envelopes is probably still standing on that base as well. Lakehurst also has two smaller Blimp hangars and a Balloon hangar. The Balloon hangar is from the ship-towed observation balloon days of WW1, and the smaller Blimp hangars fit the WW1 size blimps.

NAS Santa Ana, Los Angeles CA; 2 wood extant both in need of repair inside today's Tustin City limits. These hangars are behind fencing, and generally not accessible. However, once in a while Tustin or possibly Orange County have an event during which you can get close to the hangars on the outside. There are probably structural concerns which may make getting inside very difficult. The hangar where the observation room on the roof fell through (2015?) had been rented out (one end) to Aeros company, which had their airship prototype in their end. It had just been through a few preliminary tethered "flights" outside the hangar, when the room fell onto it and squished it. That same hangar (other end - most of the hangar) had been rented out for filming commercials - often of cars which were shown doing slide turns on the wet hangar floor - if you can find some of those commercials, you can spot the sides of the hangar in the background.

NAS Moffett Field, San Francisco CA; 2 wood, 1 metal extant. A bit of Moffett Field is open to the public, and there is a small museum for the public. However, most of the base is still considered active, including the part where the two wood hangars are still standing, making it difficult / impossible to get next to them. One of the Google principals has a modern airship under construction in one of the hangars, and one or the other hangar was used to develop Google's planned but cancelled network of internet balloons for use over South America. Between 2010 and 2014 Airship Ventures ran their *German Zeppelin NT* passenger sight-seeing airship out of one of the hangars. (Passengers did not get into the hangar - the airship was out on the landing area when passengers boarded it.) Google is supposed to be repairing both wood hangars as part of their long-term lease agreement; it appears work has been done on at least one of them, but there are concerns over how many of the arches in the other one are "loose / cracked" up at the top, with the resulting repair cost. The 1933 metal Hangar 1, with its clamshell doors, is bigger than the wood hangars. It has been "de-skinned" over concerns about the PCB fire retardant in the tar coating of the skin, and the asbestos mats which are (were) soaked in this tar. Google is supposed to pay for re-skinning it, but that project has been delayed. Some describe the open metal framework as a "bird-cage". ♣

FACTS ABOUT THE FORD DIRIGIBLE

Originally published in *THE AIRSHIP* (Summer 1948)

More notes on the Douglas Leigh Advertising Airships

From our American Correspondent

The dirigible, a Navy K-type airship, is four times the size of the blimps formerly used for advertising, with twenty times as much space for electrical display. The Ford ship is 265 feet long, 60 feet in diameter, one of the largest of the Navy airships. [*see photo on back cover of this Dirigible.*]

During the war, the K ships protected the Atlantic Seaboard and flew across the Atlantic to operate in the Mediterranean area. The K-type ships helped to protect the Island of Malta during the crucial days of that fortress; they helped in the defense of the British Isles; and also participated in the Allied landings in Normandy and Southern France.

During the war, the Navy dirigibles patrolled an area of over three million square miles (including waters of the Atlantic, Pacific and Mediterranean). In all, they flew escort for 89,000 allied ships laden with millions of troops and billions of dollars-worth of U.S. military equipment. During the entire war, *not one Allied vessel was lost while under protection of a dirigible.*

Also, after the U.S. Navy airships reached the Gibraltar area in mid-1944 not a single enemy submarine passed through The Strait either by day or night. In performing this great task the airship fleet made 55,900 operational flights and flew more than half a million hours in the air.

The Ford airship it is operated under the direction of the Ford Motor Company by the Douglas Leigh Sky Advertising Corporation. The idea for using the K-type airships for spectacular advertising belongs to Douglas Leigh, creator of most of the famous Broadway spectaculars. Mr Leigh and his staff laid the groundwork for the operation, and the first dirigibles were purchased from Surplus Property not long after Leigh was released from active duty with the Navy.

When Douglas Leigh first expressed a desire to buy airships, he was received enthusiastically by both the Surplus Property people and the Navy Department. Surplus Property welcomed him because up to that time no one else had expressed a desire to buy the huge airships, and it was considered that that they might be dismantled, and the rubber sold for making raincoats.

The Navy Department encouraged young Leigh, because his operation meant that valuable ex-Navy ships what be kept in first-class flying condition, and that they would be ready at all times to be returned to the Navy in case of national emergency. Also, this commercial operation meant that many ex-Navy lighter-than-air pilots, riggers and mechanics would be given good jobs – doing the same sort of work they did during the war.

The electrical displays on the Ford dirigible – the biggest in the world – were designed by Leigh, Vice-President, and Chief Engineer Fred Kerwer, who invented an entirely new method of applying electrical lights to the sides of airships. The Douglas Leigh Sky Advertising Corporation at Lakehurst (where the Leigh firm rents hangar space from the Navy) is under the executive direction of Captain Karl L. Lange, U.S.N.R. Lange is a lighter-than-air veteran of two world wars, ex-airship manager for Goodyear, and was formerly Chief of Staff to the world's top dirigible expert – Rear Admiral Charles E. Rosendahl.

Ford's new "Flying Spectacular" is more than a block long, and the most brilliant advertising display that has ever taken to the sky. One side of the flying spectacular will have a running sign 170 feet long, with letters of 20 feet high.

What appears from the ground to be single lights in the running sign are actually groups of seven lights arranged in clusters 16 inches in diameter, scientifically calculated to pinpoint at 1,000 feet. This new technique (Fred Kerwer's invention) permits maximum brilliancy within the airship lift available. Small bulbs are used to keep wind resistant [*sic*] at a minimum, while the brilliance is attained with the grouping of seven bulbs in each cluster.

This running sign works in general like the one around the New York Times building, in Times square, only it is infinitely larger. It reads the words and sentences in the sky – a continuous message and the biggest one in the world. In addition to information about new Ford cars and trucks, the running sign will carry weather reports and important news flashes.

On the same side as the running sign will be overlaid the phrase, "There's a Ford in your future". The 'F' in this "Ford" is 35 feet high and [the word is] 100 feet long – the largest electrical letter ever flashed. A thousand bulbs are used in this 'F' alone, and one stroke of the letter measures as much as 10 feet across. The entire phrase, "There's a Ford in your future", stretches 200 feet, or as long as a New York City block.

On the other side of the Ford airship will be the sign, "Ford's out front" – 170 feet long, and with letters and 32 feet high. Flashing alternately with this copy will be a tremendous "V-6" and "V-8", 40 feet high.

These gigantic signs our for night-time audiences. For day visibility, similar copy, painted in effective red and blue, will be of equal proportions.

The night spectaculars will be easily readable at three miles, and visible for more than five. The day-time signs will be visible almost as far.

More than 10,000 lamps and 10,000 individual sockets were used in this new flying spectacular – as well as 100,000 feet of wire, 30,000 feet of tape, 800 pounds of paint, and 500,000 cubic feet of helium. The helium in the ship alone is worth $11,000. The airship itself, when originally purchased by the Navy, cost approximately $400,000.

Ford's flying spectacular will operate seven days a week, weather permitting, and cover the Atlantic Seaboard from Washington, D.C. to Hartford, Connecticut. In this area of 40,000 square miles is the most important concentrated market in the world – 22 million people. The area includes:

South – Washington, Baltimore, Philadelphia, Wilmington, Atlantic City, Trenton, etc.

West – Scranton, Reading, Harrisburg, Allentown, Bethlehem, etc.

North–New York City, Newark, Hartford, New Haven, Bridgeport, Stamford, Jersey City, etc.

Besides these highly concentrated principal targets, the Ford ship will regularly cover football and baseball games, race track gatherings, auto races, and the highly populated beaches along the Jersey Coast and Long Island. ♣

MARKETING MERCHANDISE WITH THE *AD-1*

Compiled by *Dirigible* Editor from several sources including the AHT website.

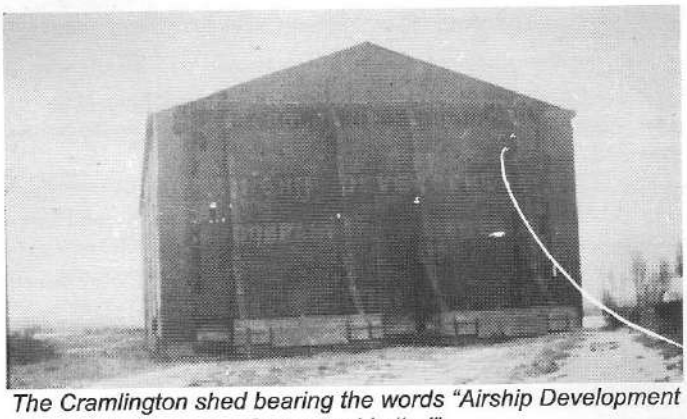
The first person to use an airship as a flying billboard in the UK was the London-based aeronautical pioneer, Stanley Spencer. His various exploits in the early 1900s have been recorded in past issues of *Dirigible*.* These and other past issues are all now freely available online and downloadable as pdf files from the AHT website: **www.airshipsonline.com/dirigible/index.html** (*see p33 in this issue*).

The advertising idea was taken up again after the First World War, when British Airships Ltd., came up with the concept of adapting newly-evolved, military lighter-than-air blimps for advertising purposes. Prior to this, airplane pilots would 'loop-the-loop' to leave a trail of smoke spelling out a word, phrase or logo. This was exciting to see but had one big disadvantage in that skywriting is short lived. A slower-moving airship was thought to be better for getting the sponsor's message across to those on the ground.

Cramlington

During World War One, a *Coastal class* airship shed, which measured 300 x 100 x 70 feet was constructed for the Royal Naval Air Service (RNAS), at Cramlington Aerodrome, near Newcastle. It had a small hydrogen gas-making plant behind it and the shed was unusual as it was painted brown to blend in with the local countryside. No wind-breaks were fitted despite the shed's exposed position aligned with the prevailing wind on a NE-SW axis.

Four non-rigid *Submarine Scout Twin* (*SST*) blimp-type airships were operational from RNAS Cramlington with some twenty officers, and 281 men stationed at the airship base during the War. Further airships were planned to be stationed here, however, with the Armistice, and the following Treaty of Versailles in June 1919, it was decided the airship station was no longer of use. Like most other airship stations in Britain, Cramlington was hastily abandoned, but unusually, it was not auctioned off or dismantled.



The Cramlington shed bearing the words "Airship Development Company Limited".

The Airship Development Company

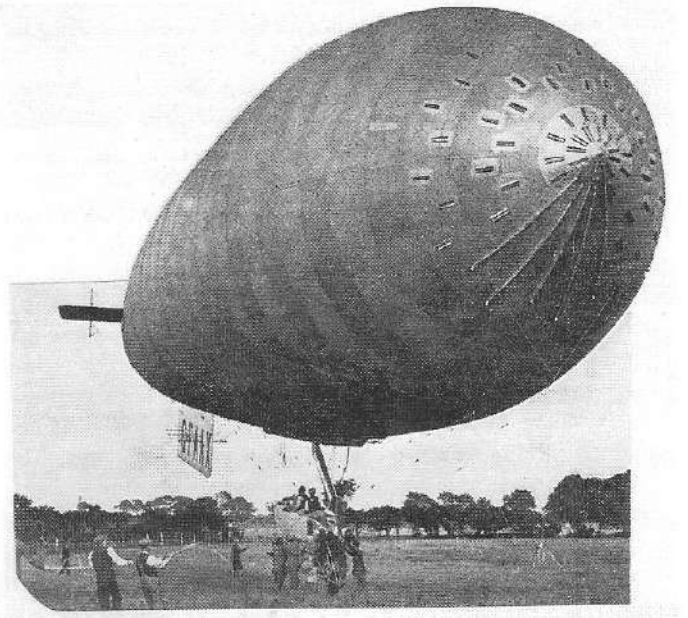
In the early 1920's a company considered using the facilities to operate an airship service to Norway but nothing came of this plan and some of the buildings around the shed, were subsequently used as a hostel for miners. Then in the closing years of that decade, the Imperial Airship Programme raised optimism in lighter-than-air transport which led British Airships Ltd., to think of reviving the fortunes of airships. The company, which later changed its name to The Airship Development Company (ADC), set to work and in 1929 began construction inside the Cramlington airship shed of a small non-rigid airship that was based on the designs of the Royal Naval Air Service *SS-type* coastal patrol blimps. The company recruited former Navy airship pilots with previous experience of patrolling the North Sea to protect shipping convoys and search for enemy submarines. Their expertise was invaluable.

* See - *No.24 (Winter 1996); No.40 (Vol. XIII No.3, Autumn 2002);* and *No.92 (Spring 2021)*

Construction and Design

The ADC's airship was designated the *AD-1* and registered in 1927 as non-rigid airship G-FAAX on the British List of Civil Aircraft with Certificate of Registration LA.27.

It was designed by Captain Weir-McCall, J.R. Pike and Engineer R.H. Schlotel, and was 138 feet long, 29 feet in diameter and 38 feet tall. The envelope was built by the Reginald Foster Dagnall Company (RFD) of Guildford and had a gas volume of 60,000 cu ft.



A PRIVATE BABY

This is the first small private airship to be passed by the British Air Ministry. It was built by the Airship Development Company, and is here seen being taken out for a first test trial

The underslung gondola/car was designed by J.R. Pike initially for a two-man crew but was later adapted to take three men. The ship was powered by a 100hp (75kW) *ABC Hornet* four-cylinder piston engine that was later replaced by a 75hp *Rolls-Royce Hawk*. This gave the finished ship a top speed of 50 mph with a useful lift of 15,000 lbs when powered by the *Hornet* engine and 12,000 lbs with the *Rolls Royce*.

The *AD-1* was itself advertised as being suitable for private flying, passenger flights, instruction, advertising, aerial photography and surveying. The main revenue was anticipated to come from advertising and for this role it had panels on both sides measuring 76 feet by 24 feet.

The newly assembled ship was first flown on Friday 13th September 1929 by Captain Weir-McCall, accompanied by ex-RNAS Coxswain, Sgt. Gerry Long. They made four further flights at Cramlington on 18th September 1929 after which Weir-McCall left the company. He was replaced by Captain 'Bingo' Beckford-Ball who carried out more flying at

Cramlington aerodrome in the following month. On October 5th the *AD-1* appeared at the Newcastle Air Pageant with a large notice on each side proclaiming *This Space to Let*. It reportedly circled around the airfield with its engine throttled back and was so quiet that the spectators could hear the two crew talking to each other. [*Having a quiet engine was big mistake for an advertising airship because sponsors want spectators to look up. See my Editorial on p 3. – Ed.*]

The AD-1 in its shed with the Newcastle Pageant Banner

On 6th November 1929, Captain George Meager, with Sgt. Long as crew, carried out an Air Ministry test flight in *AD-1* to award it a C of A, which was necessary for aerial work. The car was 'somewhat like' the *SS BE2c* of 1915-16. The test flight lasted an hour and a quarter, but only attained a maximum height of 1,500 ft as the engine kept spluttering and threatened to peter-out when attempting anything higher.

In December the *AD-1* was deflated for minor modifications. Re-inflated in May 1930 it made several flights with advertising banners laced to the envelope sides.

The AD 1 inside the Cramlington shed. Note the size of the advert in comparison to the man on the ladder.

Advertising Success

The ADC's first commercial success was with Walter Wilson's, a local supermarket chain, and the first recorded flight of the *AD-1* carrying their slogan - *Walter Wilson's on top* -was on 31st May, 1930. In June it carried banners for *Wilson's Fine Foods*. The *AD-1* flew for five hours over the North East of England, but its captain, Jack Beckford-Ball, picked up a two-guinea fine for flying too low over a farm in Ebchester. Newspaper reports said that the airship frightened a horse which bolted and injured itself so badly it was unable to work.

For a while the airship was a familiar sight as it toured around Tyneside, visiting Ashington, Morpeth, Blyth, Durham, Darlington, Bishop Auckland, West Hartlepool and Sunderland. However business was slow. Convincing other companies to advertise on an airship wasn't easy. In need of cash and with winter approaching it was decided that the *AD-1* would be better off plying its trade over larger populations such as London. On 21st June 1930 it departed Cramlington and on 26th June reached its Southern base near the old air airship station at Capel le Fern, Kent, where a mooring pit had been prepared to take it.

On 17th July the crew found sheltered moorings for their ship and in the lee of some trees at a girls' school at East Horsley in Surrey from where the *AD-1* made two flights over London. A publicity trip around the Houses of Parliament, over the City of London and another to St Paul's Cathedral. But a cable snagged, jamming the controls and one of the crew had to climb out of the gondola and steer the rudder manually while the engine started to splutter and threatened to cut out. Despite this and several other setbacks the ADC was able to obtain a contract with a tobacco company in Belgium and, on 16th September 1930, the *AD-1* was flown across the Channel to Ostend advertising *Gold Dollar Cigarettes*.

For this contract it was decided to replace the original *ABC Hornet* engine with a 75hp *Rolls-Royce Hawk* engine.

Destruction in Belgium

Unfortunately while moored out at Ichreghen in Belgium the airship was destroyed by a storm on 7th October 1930, only two days after the loss of the *R101*. The ship was torn from its moorings and the envelope was deflated and wrecked after it was ripped by neighbouring trees. With no income and no prospect of surviving through to the following summer, the ADC went in to liquidation on 11th October 1930.

The *AD-1* airship was dismantled and shipped back to Newcastle. The parts, along with all the company's materials were sold off by auction at Cramlington on 18th June 1931. By the time the company was wound up, construction had actually started on a second airship, the *AD-2*, and the two airship envelopes, which had cost £1,000 each to make, were sold for £22 10 shillings (£22.50p) to be made into dust-sheets for furniture. The engine went for £13 10s (the new owner planned to use it in a motor boat) and the Gondola with all the instrumentation fetched just £2.

Britain at the time was in deep recession. The airship shed at Cramlington was vacated and never used again by airships. Towards the end of its days, it was used for the manufacture of concrete lamp posts by Concrete Utilities Ltd.

The shed was eventually demolished in 1967 having outlived its contemporaries by many years - most other airship sheds had disappeared by the outbreak of World War II.

The *AD-1* deserves to be remembered as the only privately built and owned non-rigid airship produced in Britain between the wars and, the only British non-rigid airship to fly between 1921 and 1951.

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As you may notice, the website looks a bit dated compared to modern sites. The main reason for this is the amount of text content on it that we have to cover. This has always been our focus to give more to the public; think more of a *Wikipedia* than a simple brochure site. If any AHT member has time and expertise to help improve the site it would be greatly appreciated. Please let me know and we can work on it together.

Alastair Lawson
AHT Webmaster

The Airship with its new registrat

letters moored out at Cramlington

---ooo000ooo---

A long overlooked and unpublished email exchange:

RE: SODIUM FLARES

R101 Disaster 80th Centenary Lecture,
To the Royal Aeronautical Society on 4th October 2010

I spoke afterwards to Giles about the sodium flares that are suspected of having caused the fire. We agreed that there must have been some sort of protective wrapping to prevent them accidently igniting, and I said I'd investigate.

The material we [at the RAF Museum] have on pyrotechnics dates from the late 1930s/early 1940s and the best I could find was "*Flame float, Aircraft Navigation, Mk.I*". This is effectively a canvas bag containing Calcium Phosphide (CaP) - when water reaches the CaP "*Phosphine is evolved, inflating the inner fabric bag, and providing sufficient buoyancy to bring the flame float to the surface of the sea. The gas escapes from the neck of the outer fabric bag, and takes fire spontaneously in contact with the air*".

Before dropping the device, it has to be taken out of its metal cylinder - the lid is sealed by a metal strip soldered in position. You then "*draw the end of the pull-off line through the neck of the outer fabric bag, and give it a sharp pull to detach the sealing patch from the canister*".

This text seems to be dated 1941 - it's therefore rather unlikely that the device was in use in 1930, although the illustration in the manual shows an example with a filing date of 11/38. The questions that strike me are:

a. Might this be a derivative of the "sodium flare" and is there anything other than anecdotal evidence that the flares contained sodium? It's a rather reactive metal that surely wouldn't have been carried in its pure form - I seem to remember from school that it was kept under oil to prevent it coming into contact (and reacting) with air.

b. If the *R101* carried a similar device, would it have been stored in a similar sealed container - or was the container introduced after other flares had caused fires in aircraft?

I seem to have raised more questions than I've answered ...

Peter Elliott
Senior Keeper [now retired]
Department of Research & Information Services
Royal Air Force Museum, Hendon

The response from lead lecturer Peter Davison was:

[Sir Peter] Masefield always referred to the flares as 'Calcium' rather than 'Sodium' which may make a difference. I have read somewhere that they required some form of priming though I do not know if that process was, for example, a paper wrapper to protect the thrower if they had wet hands (or in a dinghy) or if immersion was enough to soak the wrapper too.

If kept in a tin box there must have been some risk or the weight would have been discarded, just like the biscuit tins. ... Reading the list of navaids on the *R34* flight, Meager lists '*Holmes Lights*' for use as flares by night.

Google finds this: "*In July 1873 he demonstrated his Patent Signal Light to the Liverpool shipping company P and W Maclellan and was awarded a Certificate of Merit. It was based on the use of Calcium phosphide; which they initially made themselves at Feltham, Middlesex, before moving to Barking. Up to the end of World War I the Holmes' Marine Life Protection Association sold lifebuoy lights and distress lights; and sales increased dramatically during the war.*

"*The provision of Lifebuoy lights was mandatory for British seagoing vessels under Board of Trade Regulations. Holmes' lights were sold under various Trade names: The Handyman's Light for lifebuoys; the Manwell-Holmes Marine Light distress light for merchant vessels; and a modified Handyman Light for lifebuoys for the Admiralty. They also produced a distress signal, the Deck Flare. They were all charged with calcium carbide, it produced acetylene gas when water was dripped onto it. They also included a small quantity of calcium phosphide, which in contact with water produced impure phosphine, it spontaneously ignited, thereby igniting the acetylene.*

"*The Handyman lifebuoy light had a buoyancy chamber filled with air to keep it afloat. It was attached to the lifebuoy with a long cord, and to the boat with a shorter cord. When the lifebuoy was thrown overboard, the short cord pulled away two plugs, one to let sea water in and one to let gas out. For the mast-head distress signal light and the Deck Flare the two plugs were removed by hand and the units placed in a bucket of water*".

Sounds like a possible variant, at least it is Calcium based.

To which Peter Elliott replied:

Sodium/Calcium - what's a couple of places in the Periodic Table between friends? And if they're 'Holmes Lights', how could I resist saying "Elementary, my dear Davison"? The AP I looked at classified the devices as DANGEROUS GOODS (their capitals) so I would hope that - unlike biscuits, which are dangerous only in the long term - they would have been allowed to remain in their tins.

---ooo000ooo---

RE: BRITISH AIRSHIPS LIMITED

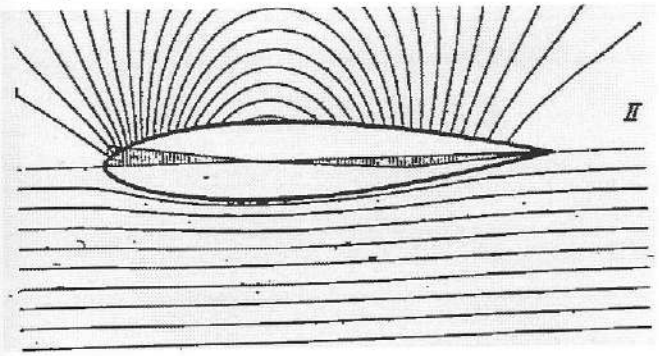
Dirigible 98, pp10/11

Regarding the British Airships Limited *BSR-1 Blueprint* on pages 10-11, it is possible to glean some information about this mystery airship from the blueprint itself. At 386 ft in length and an estimated 78 ft maximum diameter, this airship is very similar in size to the Italian

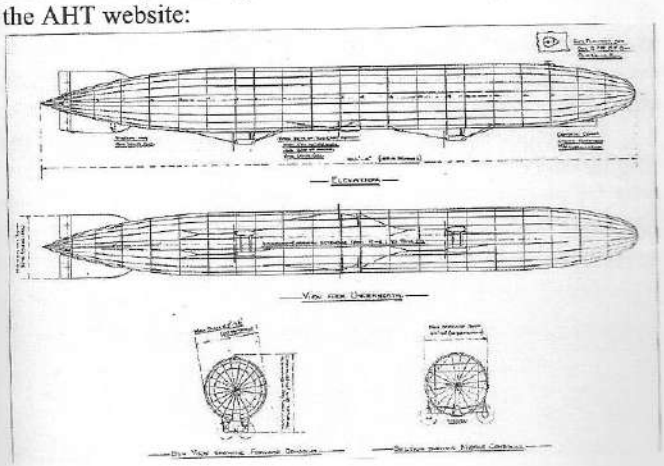
Norge or *Italia* airships. Like them, the *BSR-1* is a semi-rigid as the blueprint clearly shows. That would make it the only British-designed semi-rigid, though the *BSR-1* was never built.

Based on the *Norge* and *Italia*, I estimate that the *BSR-1* had a hydrogen volume of 18,000 to 19,000 cubic metres, enough to carry 20 people, fuel and ballast across the Atlantic. Because the *BSR-1* was to have four 275 hp engines, it would have been some 10 mph faster than either of the Italian airships, perhaps a top speed of 80 mph.

I find the lines of the *BSR-1* very elegant and reminiscent of the *R100*. Both airships show the influence of Dr. Georg Fuhrmann's best airship shape from his 1911 paper on airships – I am attaching his figure. He computed the least "draggy" shape for an airship using potential flow theory. His measured volumetric drag coefficient for this shape is still a record low. Even today's CFD software has been unable to come up with a more streamlined shape for an airship!



The *BSR-1* blueprint was drawn and traced by one 'RWH' who could have been some anonymous, underpaid draughtsman? *Dirigible*'s page 11 drawing shows the airship's side-view on top and the bottom view below it. This is third-angle projection, which was rare in the Britain of 1928, the date on the drawing. The drawing's third-angle projection suggests that RWH was not British, but I find this unlikely. I have seen third-angle projection used in some rare British airship drawings. Here is one showing the *R32* from the AHT website:



www.airshipsonline.com/airships/r32/images/r32plan.jpg

RWH could have been R.W.H. Bailey of Rolls Royce who designed the *Falcon III* engines that the *BSR-1* was supposed to use. He was also the head of R-R's 'draughting' department much earlier than 1928. I find it unlikely that he would draw an airship for a struggling company like British Airships Limited, unless R-R was involved in the project.

Sundar Narayan

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RE: FREDERICK McWADE

Dirigible 97, p 8.

Following Jane Harvey's request in *Dirigible*, I have discovered on Ancestry a bit of information about Frederick McWade and what he did after the *R101* crashed.

In 1939 there was a register of all people resident in England and Wales, to allow the issuing of identity cards. This register had, address, full name, exact date of birth and occupation. Upon searching for 'Frederick McWade', I came upon him living at 39 Stewartby, Bedford, in the residence of Frederick G Chapman. The entry is as follows:–

1. *Frederick G Chapman, male, married, date of birth 10th April 1902. Occupation, Maintenance engineer fitter brickworks.*
2. *Rose Chapman, female, married, date of birth 4th May 1902. Occupation, Unpaid domestic duties.*
3. *Donald Chapman, male, single, date of birth 11th Jan 1932. Occupation, at school.*
4. *Frederick McWade, male, married, date of birth 10th Nov 1872. Occupation, Works Manager, Aeronautical Engineer* – this was crossed out and replaced by – *Brickworks Experimental Engineer.*

Further investigation shows that Stewartby was a village built for the workers of The London Brick Company. In 1936, Marston Vale (very close to Stewartby), was the largest brickworks in the World!

Then doing further research I have found that Frederick was born in Birmingham and died in Aldershot.

This is précised from the website 'Find a Grave' (**findagrave.com**).

"Frederick McWade was born in Aston, Birmingham on the 11th of November 1872 the son of James McWade and his wife Elizabeth (nee Kelly). His father was a glass cutter.

"On the 16th of May 1888 his mother was asked for proof of his birth before he became a Civil Servant. She confirmed he was born in Aston in Birmingham on the 11th of November - so 'born in Glasgow' is wrong! However, when he joined the Royal Engineers in 1893, he did give his place of birth as Glasgow in Lanarkshire.

"In 1891 he was an engineer living at home with his family in Aston.

"Frederick married Emma Jane Maycroft in Aston on the 13th of December 1896. They moved to Aldershot where his engineering skills were used in the development of engines. In 1901 they were living in Victoria Villas in Aldershot with their eldest child, a daughter named Doris Nellie.

"In 1911 they had moved to Canterbury Road in Farnborough to be nearer to the Government Balloon Factory where he was Works Manager. Here their three sons were born. Frederick Leslie in 1903, Eric in 1906 and Neville Fulford in 1912.

"On the 14th of August 1908 an attempt to launch the *Nulli Secundus* airship at Farnborough was attempted by 'Samuel Cody, Colonel Capper and Lieutenant McWade' - most likely Frederick McWade. They flew for 15 minutes. Evidently Frederick was involved with *Nulli Secundus*, *Beta*, *Gamma*, *Delta* and *Eta* airships.

"According to an obituary Frederick was involved in the design and production of the first aircraft built in Britain. He likely worked with Samuel Cody on his earliest craft which were also built at Farnborough.

"In 1921 it was announced in the *London Gazette* that Frederick McWade had been appointed Head of the Inspection Department of the Royal Airship Works at Cardington near Bedford where they made airships including the ill-fated *R101*. It is known he had misgivings with the *R101*, but his reports were overlooked.

"In 1930 at the launch of the *R100* Frederick, who was on board, was described as the 'Air Ministry Inspector'.

"In 1939 Frederick was still living in Bedford. His wife was not. He was in a house with another family and was described as 'Aeronautical Engineer and Works Manager'.

"Post -war Frederick and Emma returned to Aldershot where Frederick died at their home, St Hubert in Highfield Avenue, Aldershot on the 23rd of February 1947. He was buried at Frimley on the 26th of February 1947.

"Emma died in Witney in Oxfordshire on the 17th of December 1956 and was buried at Frimley on the 20th of December 1956."

I am trying to contact the supplier of the above information via 'Find a Grave' to see if they might be related to Frederick.

John Baker
Archivist of the British Balloon & Airship Club
And the British Balloon Museum & Library

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RE: HYDROGEN ENGINES

Dirigible 98, p29

Andrew Barber asks about "Hydrogen Piston Engines in Airships" I have a copy of an article entitled *Lighter-Than-Aircraft* by Lt. Colonel T. R. Cave-Browne-Cave from *The Aeronautical Journal* dated June 1919, which includes a section on "*Water-recovery and use of hydrogen as fuel*" .

I have a feeling that there is a Burney article with similar content, however, I cannot be sure. If I find anything I shall pass that on as well.

A second article which might be of interest to Mr. Barber is found in the periodical *Aircraft Engineering*, December 1929 issue. *Airship Propulsion Methods - The relative merits of petrol, oil, hydrogen, Blau gas - separately or in combinations, considered and analysed*, by Major P. L. Teed, A.R.S.M, A.I.M.M.

Finally there is *The Ricardo Story* by Sir Harry Ricardo (Autobiography) published by Society of Automotive Engineers Inc.., 400 Commonwealth Drive, Warrendale, PA. While it has some content I fear that the old gentleman was winging it from memory with questionable results.

C.P. Hall II

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RE: *R100* TELEGRAPH

Airship Heritage News - Edition No.6

Regarding the request for information on engine telegraphs - I may have information that is useful.

I live in Diss and pop over to Flixton about once a year.

Last time I was there I took the image I have attached. This would appear to be different to the image in Edition No 6 of *Airship Heritage News* as the pointer on the one at Flixton is pale in colour.

Peter Paterson

Many thanks Peter for this photo. I was also able to read the text beside it. Sadly giving no suggestion as to the owner – i.e. loaned by?

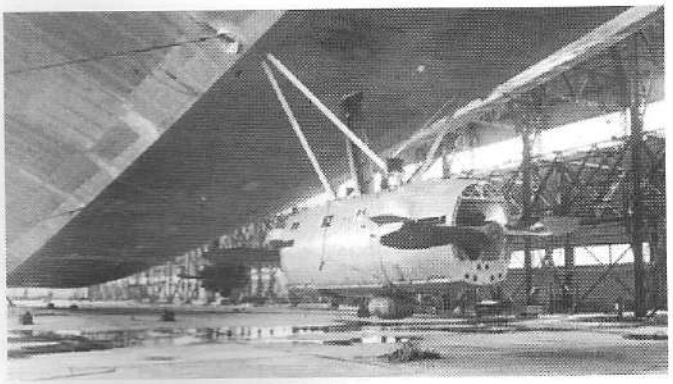
I have adjusted the photo as here – shame about the bird mess!

[*See also email from Peter Davison in Correspondence*]

Notice it is for a reversing engine car, ((AFT CAR), so the rear engine in the car.

The question now, is was it for the Control car, or the Engine car?

Certainly the wood mount is identical to the one returned by Hendon museum. Suggesting someone had several of these.



I shall contact Flixton to find out more.

Roger Allton

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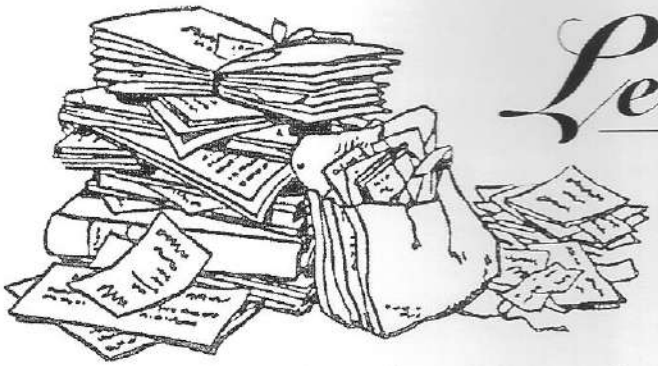

Letters Pages

Welcome to the AHT members letters and email page

This is your forum for exchanging information and views, commenting on items in *Dirigible* and generally sharing information with fellow members.

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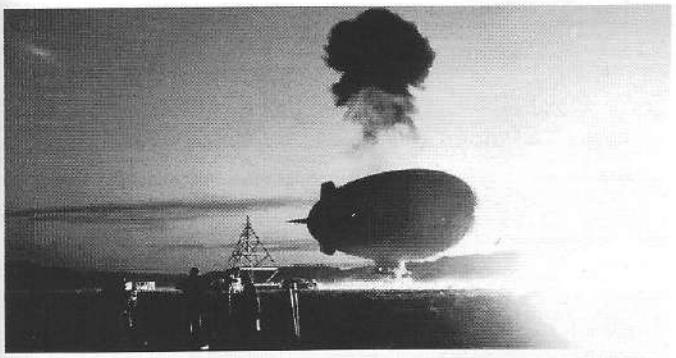
Email – 20 February 2023

USA Nuclear Test Airships

I found this interesting reading.

Arnold Nayler

www.businessinsider.com/us-military-nuked-airships-with-balloon-bombs-to-test-survival-2023-2



A picture from nuclear tests, codenamed Stokes, involving airships in 1957 during Operation Plumbbob. National Nuclear Security Administration/Nevada Site Office

A picture from nuclear tests, codenamed Stokes, involving airships in 1957 during Operation Plumbbob. National Nuclear Security Administration/Nevada Site Office

... Almost seven decades ago, the US military wanted to see if its airships — more commonly called blimps — could be potential carriers of nuclear weapons for anti-submarine warfare, so it blasted a few of them with nukes to find out. The tests were a part of *Operation Plumbbob*'s twenty-four above-ground nuclear tests from May to October 1957.

According to unclassified documents, the Navy sought to "*determine the response characteristics of the Model ZSG-3 airship when subjected to a nuclear detonation in order to establish criteria for safe escape distances for airship delivery of antisubmarine warfare special weapons*". ...

... "*In the 1950s, it was more or less the case that if anything could be nuclearized, we thought about nuclearizing it*", Stephen Schwartz, a consultant, writer, and expert on US nuclear weapons history and policy, told Insider. "*If we had already used blimps and airships effectively in World War II, then why wouldn't we consider putting nuclear weapons on them?*"

As NPR science desk Senior Editor and Correspondent Geoff Brumfiel noted in a recent Twitter thread ... blimps were especially useful for naval combat. These airships, he said, "*could hang around in the air for long periods of time*", act as scouts for potential naval threats, like submarines, and drop bombs on enemy targets from safe distances.

Their surveillance and offensive capabilities made them useful, but their slow speeds raised a number of questions about whether airships could drop nuclear weapons and actually survive the devastating explosion.

"*And they were right to certainly be concerned*", Schwartz said. "*A blimp is not an airplane. You can't just drop it off a blimp and scoot away. What happens to the blimp? What happens to the crew?*" ... And according to background information in the unclassified documents, there were also questions about how a nuclear explosion and its shockwave would spread depending on the "*depth of burst and receiver altitude.*" Testers had the resources to explore all of these ...

The tests, however, were marred with issues. Documents detail that the tests were difficult to conduct because of weather conditions at the Nevada Test Site. Airships broke free of their mooring, floating away from the site. Others were pushed away by the shockwave of the nuclear blast.

The most significant test of the project was carried out in August 1957. The test, called *Shot Stokes*, involved detonating a nuclear weapon while the airship hovered about 300 feet off the ground and over 40,000 feet from the detonation point.

Even at that distance, the result was rather conclusive. According to the testing data, the shockwave crushed the envelope of the airship "*within a fraction of a second after shock arrival.*" Other tears and failures followed, eventually causing the blimp to collapse.

A destroyed Model ZSG-3 airship, photographed 1957 at the Nevada Test Site. National Nuclear Security Administration / Nevada Field Office

A destroyed Model ZSG-3 airship, photographed 1957 at the Nevada Test Site. National Nuclear Security Admin. / Nevada Field Office

The US military eventually developed better aircraft and more effective ways of launching nuclear weapons, and the wild idea of using airships to drop nuclear weapons was lost to history. "*Not surprisingly, they discovered that blimps don't fare too well when exposed to the overpressures of even relatively small nuclear explosions, so that idea didn't go much further*", Schwartz said.

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Email – 03 March 2023

Horace Short's Patented Airship Valve

Attached is a copy of the Patent notes, dated November 9, 1911, that recently came into my possession, which Horace was granted on behalf of the Company - Short Brothers.

It is new to me but maybe not to you.

Why does the UK not celebrate its' magnificent engineering design and production achievements? They are second to none! It would take many pages to list them to show the world!

Barrie Walker
Short Brothers Commemoration Society
www.shortbrothersaviationpioneers.co.uk

"GB191104768A United Kingdom
Inventor: Horace Leonard Short, Albert Eustace Short, Hugh Oswald Short
Worldwide applications 1911 GB: Application events: Priority claimed from GB191104768T 1911-02-25
Application filed by Horace Leonard Short, Albert Eustace Short, Hugh Oswald Short 1911-11-09
Application granted: 1911-11-09. Publication of GB191104768A
Status: Expired

Improvements in or connected with Valves for Gas Containers Employed in Balloons or in Airships.

Abstract: 4768. Short, H. L., Short, A. E., and Short, H. O. Feb. 25. Lift valves; safety-valves.-A valve for the gas-container of a balloon or air-ship operating automatically or by hand has a seating consisting of a stretched annular elastic diaphragm against which the edge of a moving valve is pressed, the diaphragm being secured at its outer edge to the frame and at its inner edge to a floating inextensible ring. The elastic diaphragm 3 secured at its inner edge to a ring 4 is clamped between the sections of an annular frame 1 as also is the fabric 2 of the gas-container. The movable valve 5 of aluminium &c. is of disk form with a re-curved edge adapted to contact with the diaphragm 3. The valve 5 is guided by flexible cords 6 which are prefer-- ably slightly extensible and are secured to the frame 1 and to a flanged disk 7 on the valve 5. The cords are rendered extensible by attaching the ends of a spring at two points in each cord, the cord between these points being normally slack. The valve is held on its seating by an india-rubber or other spring 10 supported by a tripod 8 and connected either directly or, when a lever 12 described below is used, through cords 17 to the valve 5. To increase the effect of internal pressure on the valve a multiplying- lever 12 may be provided having its free end connected to a cone 15 or bellows of larger area. An operating-cord 11 is secured beneath the valve. Specifications 2481/10 and 5646/10 are referred to.

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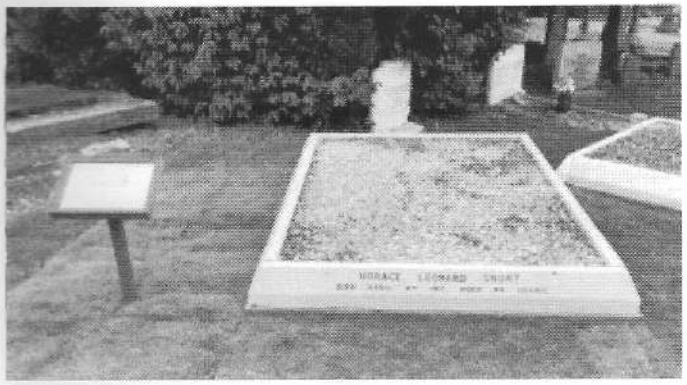
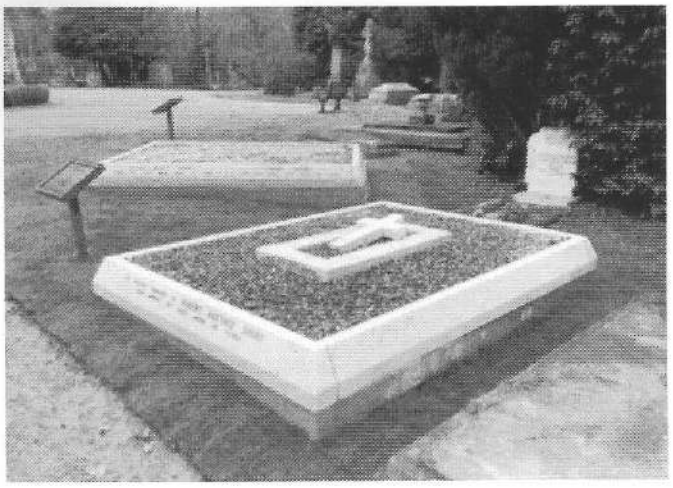
Email – 06 March 2023

SHORT BROTHERS COMMEMORATION SOCIETY NEWSLETTER No.16

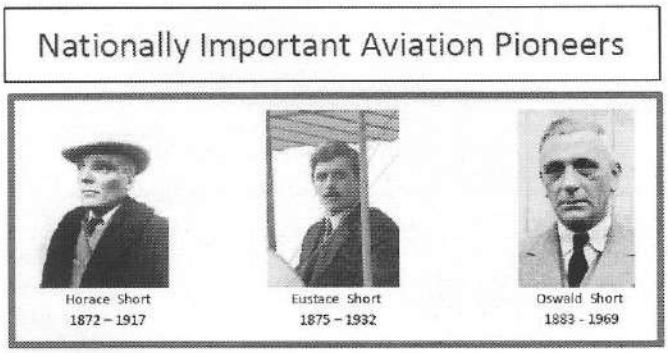
We are pleased to announce that the grave restorations at Hampstead Cemetery, (Fortune Green Road, London NW6 1DR) are now completed. ... This has only been possible due to the kind donations of members and others connected with aviation heritage. Thank you all.



Horace Leonard Short, his mother Emma 1848 – 1936 (nee Robinson) and sister Alice



Albert Eustace Short and his daughter Grace Olga aged 8 (central cross)



[*Hugh Oswald Short and his wife Violet Louise are buried at Linchmere Burial Ground, West Sussex GU27 3ND*]

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Email – 10 March 2023

Airship Disaster off Atlantic City

I thought this might be of interest to your readers.

Arnold Nayler

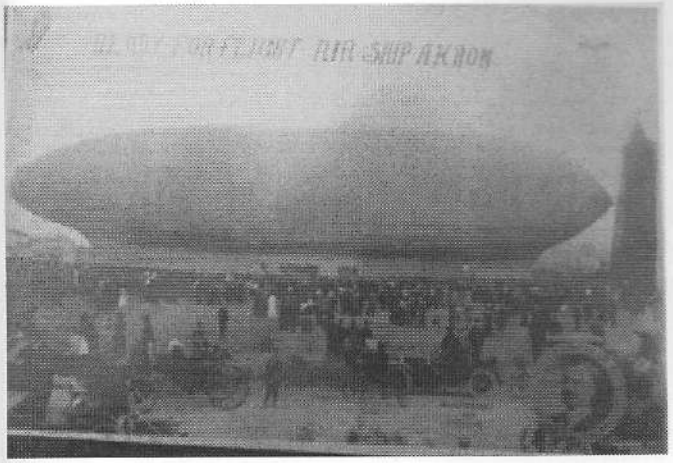
https://catcountry1073.com/ever-hear-of-the-airship-disaster-off-the-atlantic-city-coast/

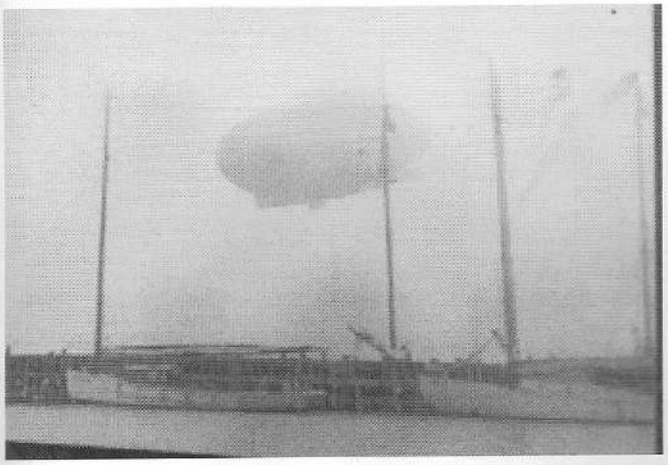
Ever Hear of the Airship Disaster Off the Atlantic City Coast?

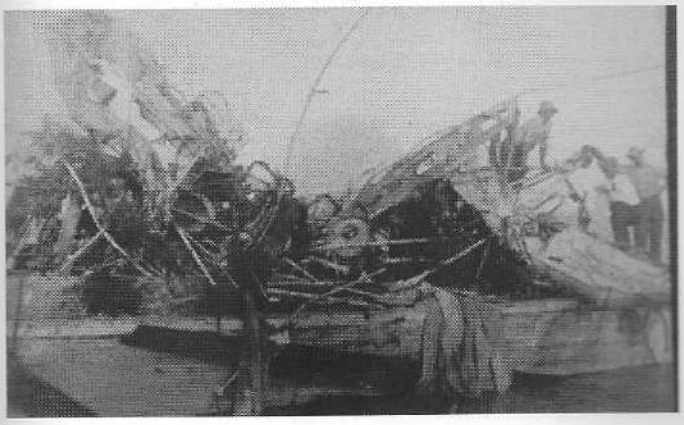
By Joe Kelly

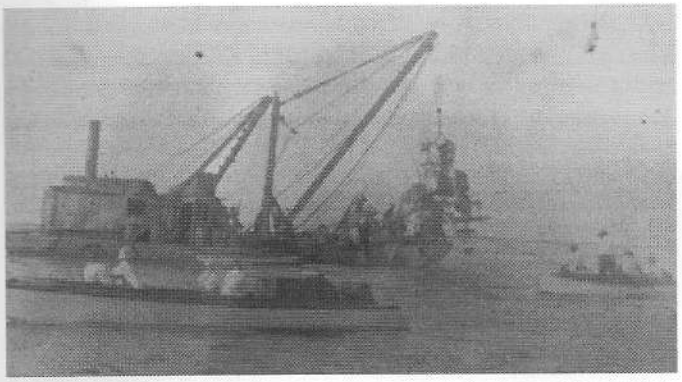
Did you know there was an airship disaster off the coast of Atlantic City more than 100 years ago? No doubt your history classes taught you about the *Hindenburg* disaster of 1937. The German airship burst into flames at Lakehurst, New Jersey. The disaster was caught on film ... Years earlier, though, another airship burst into flames, right off the coast of Atlantic City.

The *Akron* airship crashed shortly after takeoff back in 1912, killing all five men aboard. This happened as something like 20,000 people watched on, including the wives and family of the men aboard. According to news articles sited by **blimpinfo.com**, the *Akron* exploded only about 1,000 feet in the air, just off the coast. At least one of the bodies was recovered by members of the Briganine Beach Patrol.









[The above pictures of the event are part of a collection of historical photos which belonged to a descendant of the Vaniman family. As explained in the correspondence pages of Dirigible 82 (Autumn 2017), they were donated to Brian Brienen and his wife, Stacey, who own an antique shop in Pekin, IL, USA.]

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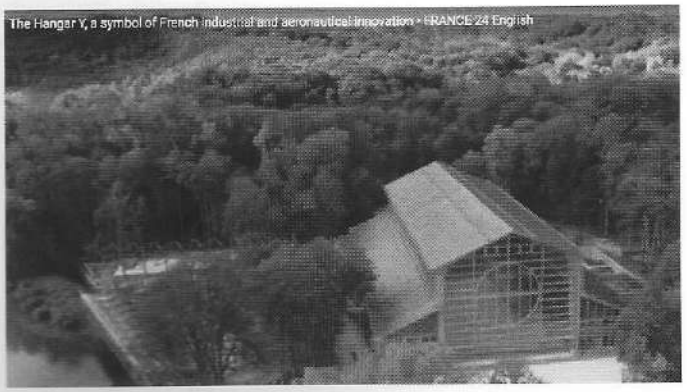
Email – 23 March 2023

Restoration of Hangar Y in France

According to this YouTube video a symbol of French industrial and aeronautical innovation where the very first airships were developed has been saved from ruin and oblivion. The Hangar Y, near Paris, is recognised as a major site of French industrial heritage and has been opened to the general public after millions of Euros of restoration work.

Arnold Nayler



https://youtu.be/fVhJg3to7Yc

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Email – 26 March 2023

Remembering Malcolm Wren

I am sure that you must remember Malcolm Wren who founded *Wren Skyships* and became involved with trying to start up *American Skyship Industries*.

I have just been sent, from the USA, this news item and photo of his *RS1 airship* RPA flying over quite a big meeting. The photo is new to me, but I believe that I did report on the event in [the Airship Association's Journal] *AIRSHIP* at the time.

Arnold Nayler

March 21, 1983 : While Malcolm Wren, chairman of the board of *Wren Skyships Ltd*, addressed 450 community leaders at Youngstown State University 40 years ago, a 22-foot model airship circled the Chestnut Room. Wren discussed the progress being made toward establishing *American Skyships Industries*, which would be based in Youngstown.

A 22-foot, radio-controlled airship circled the Chestnut Room in Kilcawley Center on the Campus of Youngstown State University, where 450 community leaders had come to hear a status report on *American Skyships Industries.*

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Email – 10 April 2023

Edinburgh Infirmary in 1916 (107 years ago)

Thought this might be worth a mention in Dirigible.

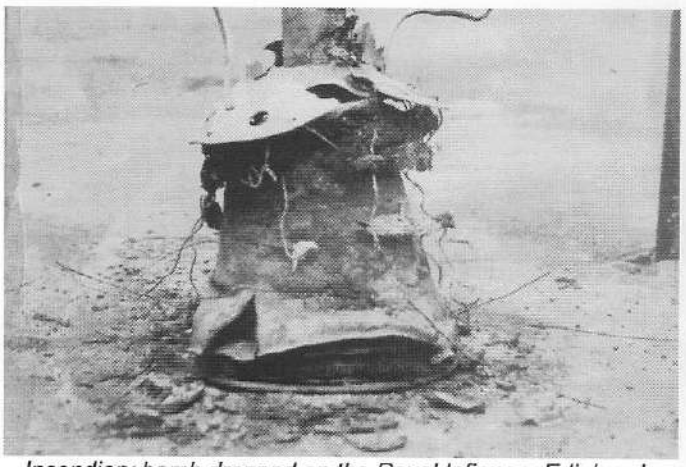
I don't remember seeing the bomb in the museum when I visited it some years ago.

Arnold Nayler

www.edinburghlive.co.uk/news/history/remembering-german-zeppelin-dropped-bomb-26659398

Remembering when a German Zeppelin dropped a bomb on Edinburgh's Royal Infirmary

The bomb fell on Edinburgh's Royal Infirmary during an air raid that was co-ordinated and executed by First World War German naval forces. 13 people died during the attack on April 2 1916.

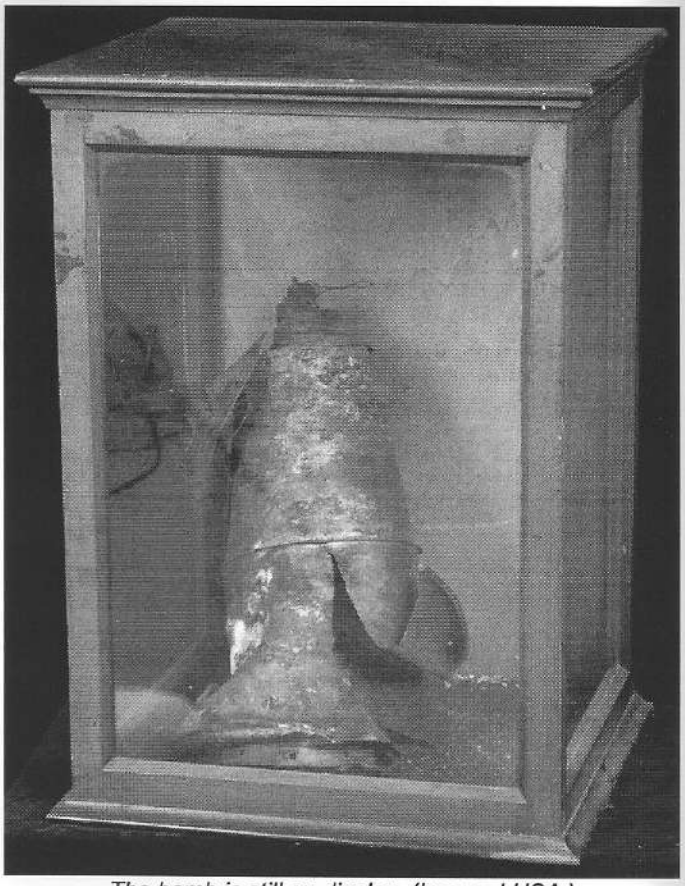


Incendiary bomb dropped on the Royal Infirmary Edinburgh.

The First World War Zeppelin air raid on the capital is still to this day regarded as one of the most tragic evenings in the history of modern Edinburgh. Taking place on the evening of April 2 1916, the event saw the single largest loss of civilian life on Scottish soil during the war.

An *L14 Zeppelin* dropped bombs across various sites in and around the city killing 13 and injuring dozens more during the raid. But what could have made the attack even more catastrophic was the dropping of an incendiary bomb on the boiler room of the Royal Infirmary of Edinburgh. Thankfully no staff or patients were killed or injured during the incident ...

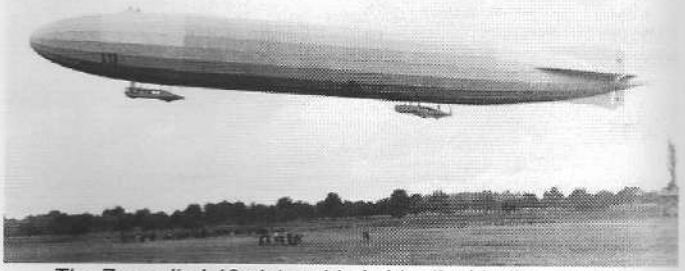
Lothian Health Services Archive continue to display the remnants of the shell that hit their boiler room in 1916, they describe it as: "*One of LHSA's most surprising objects is this incendiary bomb which fell on the boiler Room of the Royal Infirmary of Edinburgh during a WW1 air raid on Edinburgh by a German Zeppelin airship.*"



The bomb is still on display. (Image: LHSA.)

A total of 23 bombs were dropped on Leith and parts of the city centre, with the attack designed and executed on the command of Kapitanleutnant Alois Bocker – one of the German forces most experienced captains.

A young child was amongst the 13 killed in the raid which was carried out to try to provoke the Royal Navy - the main targets were the Forth Bridge and the Rosyth naval base. ...



The Zeppelin L13 sister ship is identical to the one that bombarded Edinburgh in 1916.

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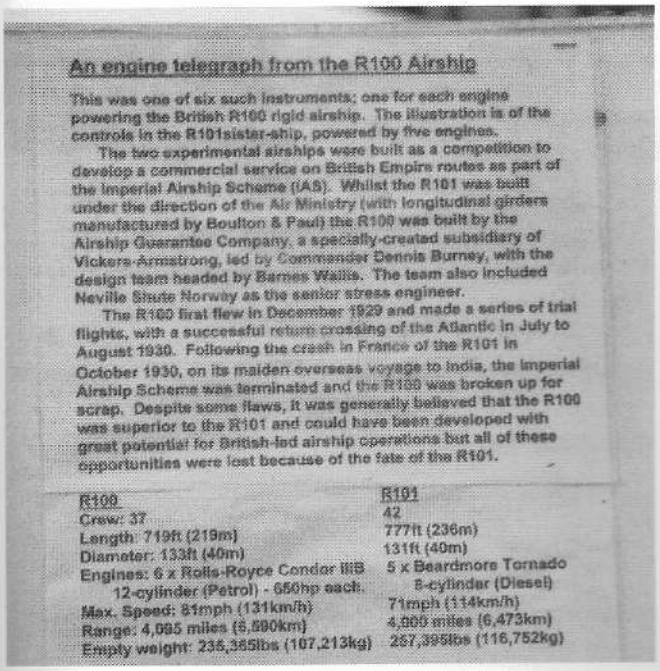
Email – 28 April 2023

***R100* Telegraph**

A visit to the Norfolk & Suffolk Aviation Museum at Flixton, just south of Norwich, (hence the Boulton-Paul connection), found this.

Peter Davison



An engine telegraph from the R100 Airship

This was one of six such instruments; one for each engine powering the British R100 rigid airship. The illustration is of the controls in the R101sister-ship, powered by five engines.

The two experimental airships were built as a competition to develop a commercial service on British Empire routes as part of the Imperial Airship Scheme (IAS). Whilst the R101 was built under the direction of the Air Ministry (with longitudinal girders manufactured by Boulton & Paul) the R100 was built by the Airship Guarantee Company, a specially-created subsidiary of Vickers-Armstrong, led by Commander Dennis Burney, with the design team headed by Barnes Wallis. The team also included Neville Shute Norway as the senior stress engineer.

The R100 first flew in December 1929 and made a series of trial flights, with a successful return crossing of the Atlantic in July to August 1930. Following the crash in France of the R101 in October 1930, on its maiden overseas voyage to India, the Imperial Airship Scheme was terminated and the R100 was broken up for scrap. Despite some flaws, it was generally believed that the R100 was superior to the R101 and could have been developed with great potential for British-led airship operations but all of these opportunities were lost because of the fate of the R101.

R100	R101
Crew: 37	42
Length: 719ft (219m)	777ft (236m)
Diameter: 133ft (40m)	131ft (40m)
Engines: 6 x Rolls-Royce Condor IIIB 12-cylinder (Petrol) - 650hp each.	5 x Beardmore Tornado 8-cylinder (Diesel)
Max. Speed: 81mph (131km/h)	71mph (114km/h)
Range: 4,695 miles (5,590km)	4,000 miles (6,473km)
Empty weight: 235,365lbs (107,213kg)	257,395lbs (116,752kg)

AHT Trustee Roger Allton added:

Many thanks Peter. Good to have a high resolution photo.

This is one of three telegraphs on the *R100* with this dial arrangement.

Responding to the reverse indication was not a simple matter. It involved: stop engine - brake propeller - select dog-clutch for reverse gear - release brake - restart engine. The propeller was now spinning with the blade aerofoil reversed, so not efficient.

It is said the nothing happens quickly in airship flight. My estimate is at least 2 minutes if not more, from telegraph indication, to effective reverse thrust. To save weight, Barnes Wallis did NOT include any clutches, though *Graf Zeppelin LZ127* did.

Was there a gong to draw attention to the telegraph, and could it be heard above the open engine exhausts of the 24 *Condor* cylinders?

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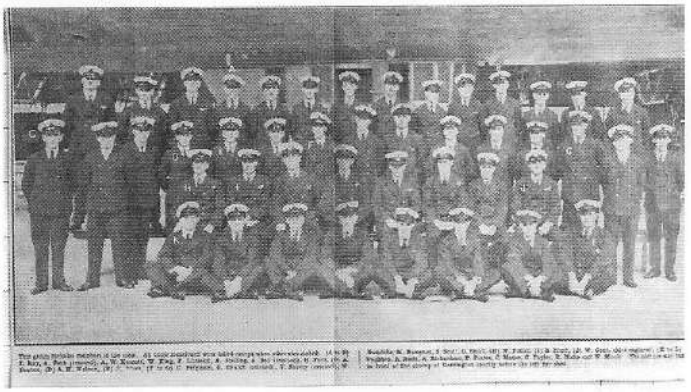
Email – 03 May 2023

***R101* CREW PHOTO**

The attached photo is currently for sale on eBay and I wondered if we had it in our collection? It shows more crew members than the photo in Nick Walmsley's book. I think J. Binks' name is partly obscured in the bottom line on the left hand side but it doesn't show him as a survivor.

Paul Ross



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Email – 12 May 2023

Benjamin Hamilton

I am a writer researching aspects of early Japanese aviation. I would like to obtain details of an Englishman, Benjamin Hamilton. He is a mysterious figure, the National Aerospace Library has no record of him. The only information I have is that in the Ueno Park, Tokyo, in April 1909, he demonstrated his airship, allegedly the first airship flight in Japan. (Source: *Japanese Aircraft 1910-1941* by Robert C Mikesh & Shorzoe Abe, published by Putnam, 1990).

I would be grateful for any information you are able to provide.

Dick Wise

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Email – 18 May 2023

The *Ghost Blimp L-8* Video

I finally finished the YouTube video. Here is the link:

https://youtu.be/6gEzCxR1VTw

Would appreciate you passing the word along to fellow members about this very over-hyped story.

Richard G Van Treuren
US Naval Airship Association

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Via Alan Shrimpton of the Airship Association:

Email – 03 June 2023

***R101* Outer Cover Question**

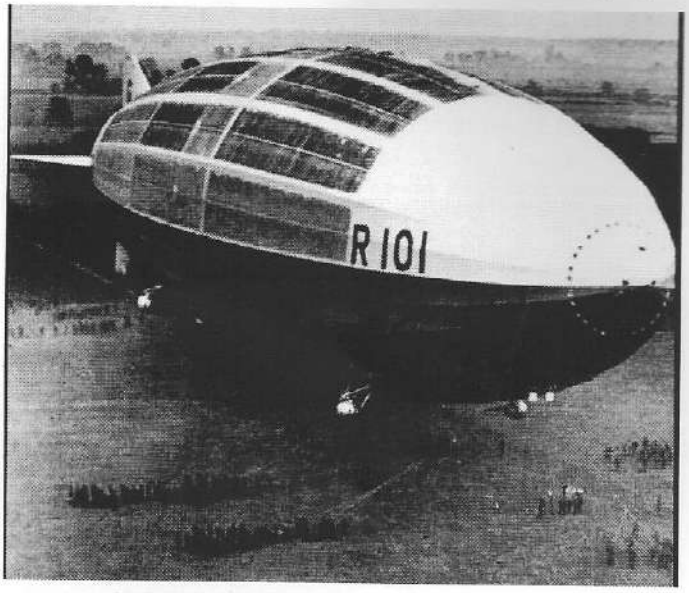
I had the following quick question from a friend of the Association, ... but I'm afraid I don't know the answer.

Can you help please? Is this to do with the doping problems they had?

Alan Shrimpton
Council Member and Editor: *AIRSHIP* Journal

Alan, do you know why the upper half of the *R101*'s outer covering looks so dark compared to the rest of the airship?

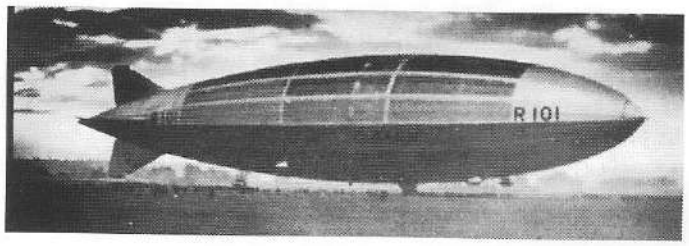
John Geoghegan



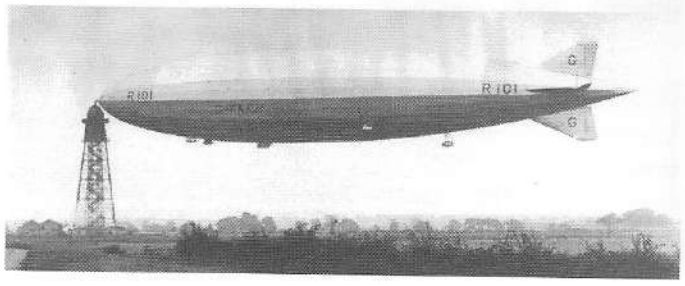
Dirigible referred Alan to an Email on 16 August 2017:

The Large Dark Shapes on *R101*

The *R101* was an experimental airship and one of the experiments was to try a new way of fitting the fabric external outer cover panels onto the rigid frame. The idea was to speed up the process of applying the aluminium 'dope' that protected the fabric from degradation by prolonged exposure to ultra-violet rays in sunlight. This was done traditionally by hand after the panels were fitted to the airship. It meant teams of men working high up in precarious positions. When *R101* was first assembled the larger panels were 'pre-doped' by men working safely and quickly on the floor and then fitted and tensioned on the ship. This resulted in millions of tiny cracks which are what you see as darker patches.



When *R101* was lengthened in the summer of 1930 the opportunity was taken to change all the pre-doped panels for new ones doped in the traditional way. Thus, the ship in her final configuration had no dark patches.



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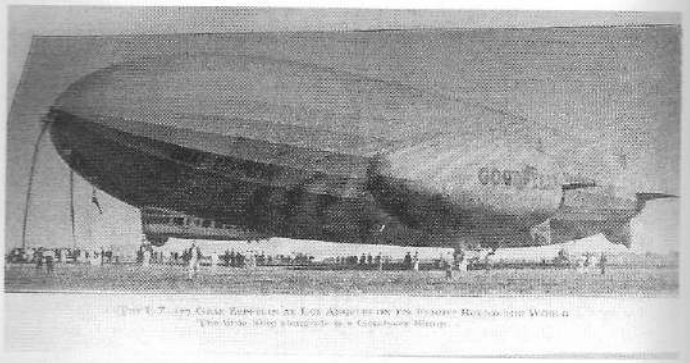
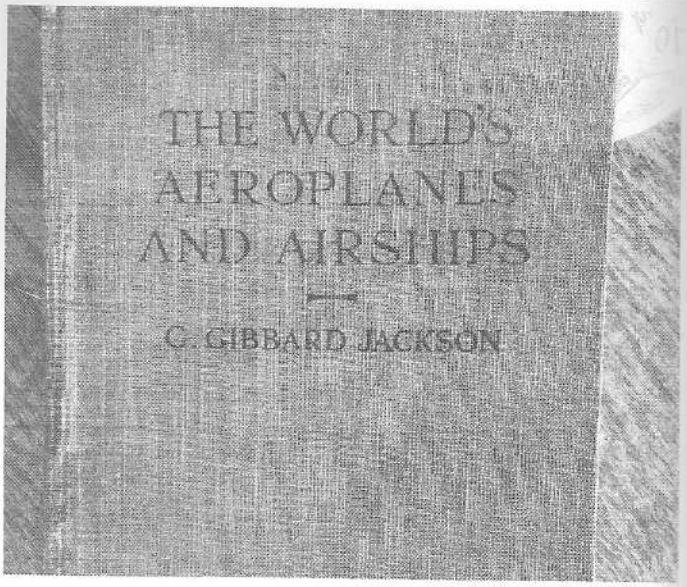
Email – 05 June 2023

Little and Large

Spotted this in an old book at an airfield that I visited yesterday

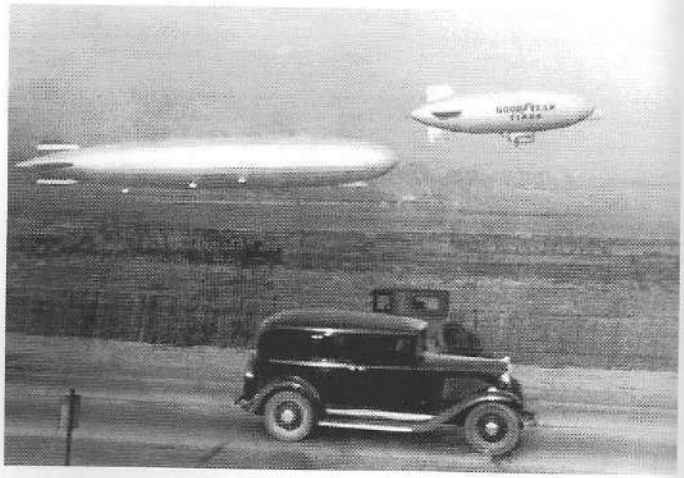
Andrew Barber





Richard VanTreuren added:

Believe it or not there are three separate film projects documenting the *Graf Zeppelin*'s round the world trip, and to my recall none of them show the Los Angeles blimp masted alongside; there is footage taken from it, but not of it on the ground.



Meanwhile, speaking of oddities, I just finished a video about one unique K-ship - *K-92*. Enjoy.

https://youtu.be/WbsFap1gd80

Richard VanTreuren
US Naval Airship Association

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"We need to be on the Internet" – a 25th anniversary

"We need to be on the internet" – I remember those immortal words which came out of my mouth at an AHT Council meeting back in December 1997. I saw nine heads turn and look at me. Our then executive secretary, Peter Garth asked "*All those in favour?*" and nine hands were raised. That was it, I gulped.

I had discovered the "Internet" at work, where we had one computer linked to the then mystery of the World Wide Web. Access was through the only available browser, *Netscape Navigator*, working on a dial-up speed of Kbps (kilobytes per second). Hearing the 'modem' chirping away, I was able to view and download pages very slowly, when my colleagues were not also queuing to get on the one terminal available in the office.

I would spend my lunchtimes and the evenings after work discovering this new world of colourful graphics, where slowly pixelated pages appeared before my eyes like one of those optical-illusion, 'magic picture posters' which were popular at the time. If you stared at the distorted dots long enough, then you'd see *something*, and that was pretty much how the Internet was when I made my suggestion in 1997.

Can we remember days before the 'Internet'? I can, but the Millennial generation following me are becoming the first to fully grow up not knowing what life and work was like "B.I." – before internet.

Having discovered this new world of the information superhighway at my fingertips, I would spend hours after work searching for information, fascinated to see what the *Netscape Navigator* would eventually deliver on AIRSHIPS and ZEPPELINS and CARDINGTON.

It was the mid 1990's, and the world wide web (WWW) was slowly growing and giving access to the general public - if you had a large enough desk, a bulky computer monitor, a compatible desktop computer with enough RAM, and a connection to a telephone land-line!

In December 1995, the WWW had 16 million users, which was 0.4% of the world population, and it was growing fast. By December 1996 there were 36 million users, 0.9% of the global population.

When I made my proposal to the AHT Council in 1997, I was 27 years old, and had heard talk about this new domain of an 'online world' where we could possibly reach a global audience, potentially of millions. I remember that summer I'd spoken to a my fellow Trustees, and they said "*well, put a proposal together, find out the costs and we'll discuss it*".

Looking up the costs, of a second-hand desk-top computer and associated equipment, I obtained a few quotes and put my reasoning and costings together as a proposal to the AHT board members. They discussed it at their next Council meeting and there was one lone voice who spoke up in disagreement to my outlined proposal. I looked up startled. It was our current *Dirigible* Editor, Giles Camplin. He said that he completely agreed with the idea and liked the concept, however he disagreed with the equipment I had sourced and listed. He suggested that if the AHT was going to do this, then why were they thinking about starting with second-hand equipment?

Giles felt that a potentially big project like this needed proper financial support and that we were at risk of selling ourselves short. Nods and voices in agreement were sounded wisely around the table, and the proposal was promptly amended so that funding was set aside for me to purchase a brand new computer and monitor in order to get the AHT on the internet as soon as possible. Unanimous agreement followed.

Within three weeks, a brand new 'DAN computer' was delivered to my flat, along with a 'dot matrix printer', and a rather bulky 'flat-bed scanner'. I soon had the extension leads clipped into the single plug socket in my spare bedroom.

And so, on that first evening, I sat there and stared blankly at the monitor with the *Windows 95* logo staring back at me.

What now? This was the first question to come into my head. Quickly followed by how was I going to do this? And, what was the AHT presence actually going to be on the internet?

I had a background in Insurance broking as my day job, I'd played on computers and printed out letters, I'd got my 'GCE O'-level' in computer studies on a BBC computer at school. But that was it.

So how do you build a website?

I had raided the AHT photo archive with the help of Den Burchmore, and got some gorgeous photos to start to work on. But what was I going to say? I needed more coffee, and a bike ride, and any other excuse to avoid sitting in front of the computer.

I'd made a rash promise to the AHT council that "*we'd be online by the September meeting and I'll come back with a full report*". However a lot of work with new technology needed to be done before then.

I remember sitting in my lounge with an A4 note-pad and pen when the idea of how to structure the "pages" first came to me. I wrote out page headings on what would be termed today as a 'mood board' and then placed the paper on the floor of the lounge, and re-arranged the order, along with the photos. That was it; I was staring at our new 9-page website. Front Page – Airships – Sheds – The Trust – Learning Zone – Membership – Dirigible – Links – Contact.

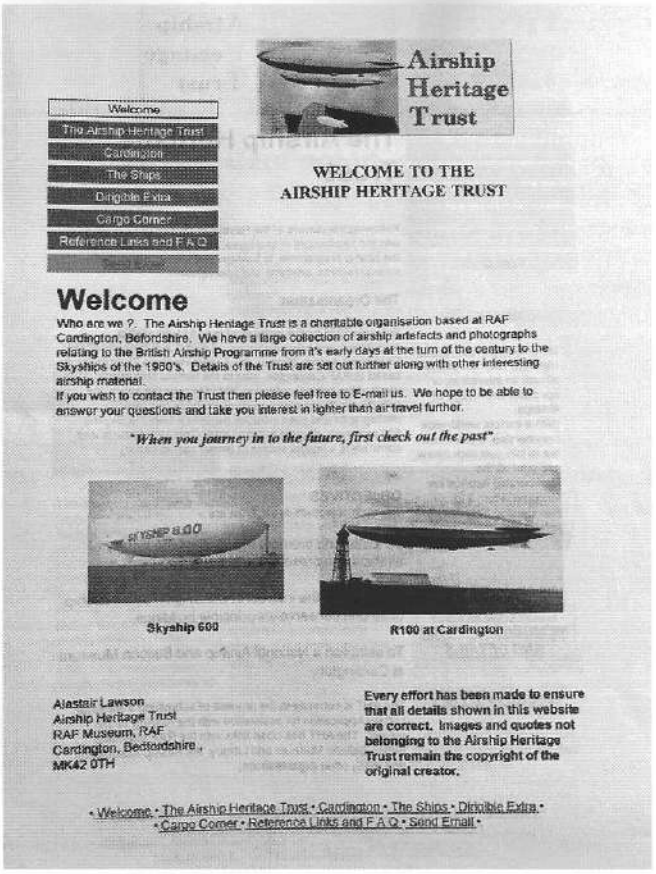
Below each of these areas I started to put sub-pages, and that is how the AHT website began.

Now, all I had to do was to get it online; easier said than done. The computer had come with some free software, a 'website builder' software called *Serif*, and that was all I had. Using it, I started building the pages, and scanning away.

After checking *Computer Weekly* magazine and finding the best 'internet provider' (ISP) in their listings, I selected and signed up with *NetDirect*. Here we go! "*Connect by entering all of the dial-up information*", and YES we have a connection!

With the pages coming together and the photos scanned, the website was slowly building one page at a time. Now to get it 'online'. This meant many calls to our ISP helpline, and many evening attempts to upload my work, but AHT finally went live online on Tuesday 11th August at ... 6:30am.

Our launch was at a time when 120 million people, representing 2.9% of the world population, were 'internet users'. By December 1998, it had grown to 3.6%.



Finally, "online" in 1998

The site grew, with more pages, more corrections, additional pictures, more corrections, new research and changes of technology. Struggling with the free software, in 2000 I finally took myself off to night school to "learn web design". Every Wednesday night I'd sit with other students who were trying to do the same as me. My heavily discounted student copy of *Dreamweaver* became the software of choice along with *Photoshop*. That summer I achieved a City and Guilds in Web Design, and plumbed my new knowledge in to expanding the website.

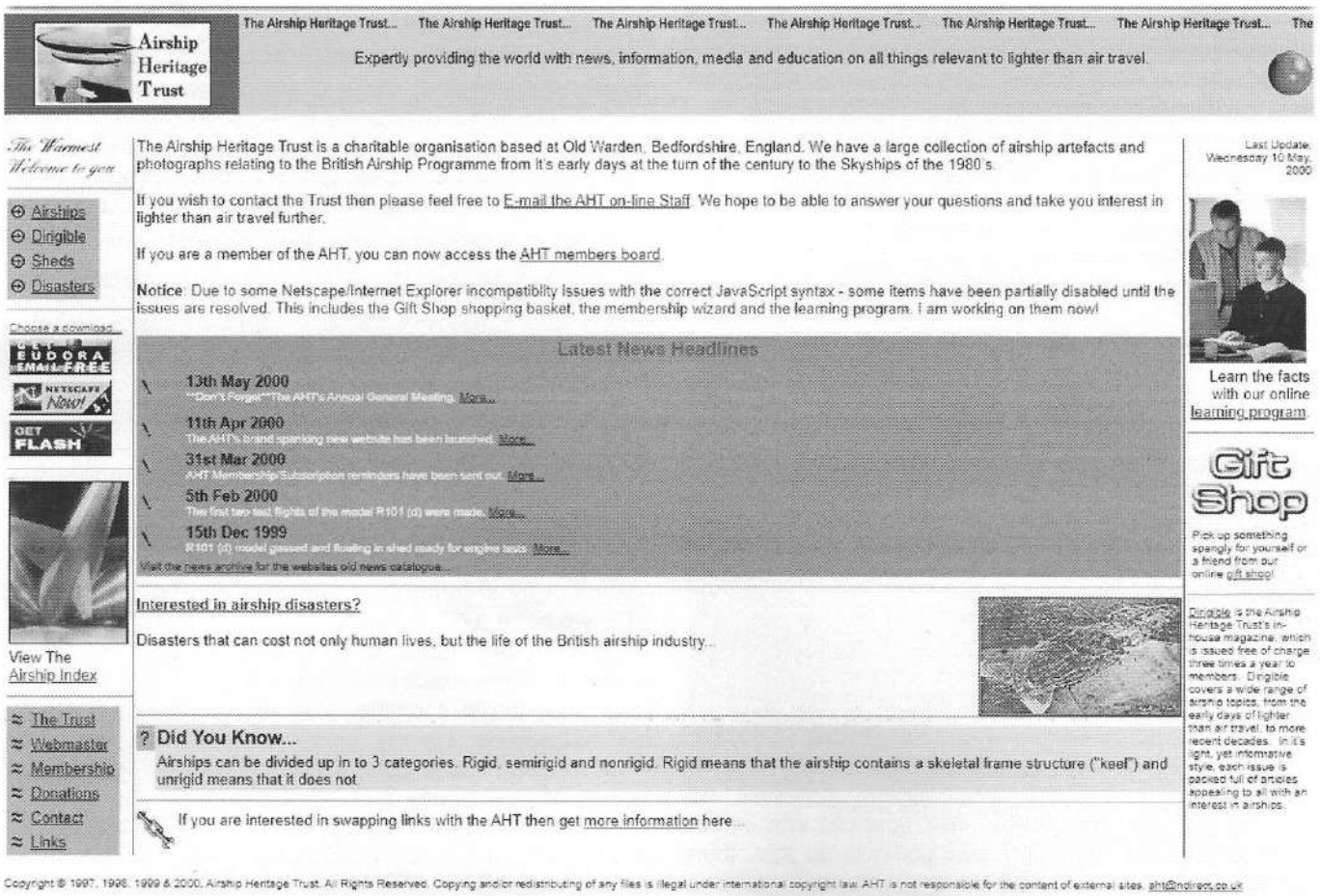
The site continued to grow, with over 230 pages by 2002, and after that, I stopped counting. It's now in the gigabyte size of data stored on there, coming up to 10GB and counting. As storage space got cheaper, then digitisation processes improved and sped up. I tasked myself with adding to the site the complete works of *Dirigible* magazine in PDF format, with a searchable Index for future generations.

Fast forward 25 years, and the Internet connects us all. With 5,544 million users or of 69% of the world population, and 1.13 billion websites, I'm pleased to say that we were there in the wild west early days. Names we remember come and go such as *Netscape Navigator*, *Firefox*, *Yahoo*, now that *Google* dominates.

[*Other search-engines are available. – Ed.*]

AHT were online with the first 2.3 million websites, and those many pages 'under construction'. Despite advances in technology and graphics, I'm still using the same software to maintain the website, as it's still going, and luckily can cope with changes in the latest screen-sized, Tablets and mobile phones.

I have endured many hours of frustration, but also enjoyed huge satisfaction when people come forward and help correct my mistakes and errors, and share new material, or pass on personal photos. In 2017 I ventured into the *YouTube* realm and began to create video content, which can be embedded in the webpages and shared with a much wider audience and with future generations to come.



"Four years in" the website in 2002 – styles change.

Who knew that during the pandemic, 2020 would be our best year for attracting new members to join us via the website. The world of outside was now 'inside' as people dived in to the internet to escape the boredom.

So what's next? Thanks to the expert skills of our member Stephan Niemeyer with his 3D animation and next generation Virtual Reality, we are looking to keep sharing airship knowledge with the world out there.

Coincidentally, thanks to the enormous profits made by his web browser technology, *Google*'s Sergey Brin is close to completing his new rigid airship at Moffett Field, Claifornia. Funny how things are connected.

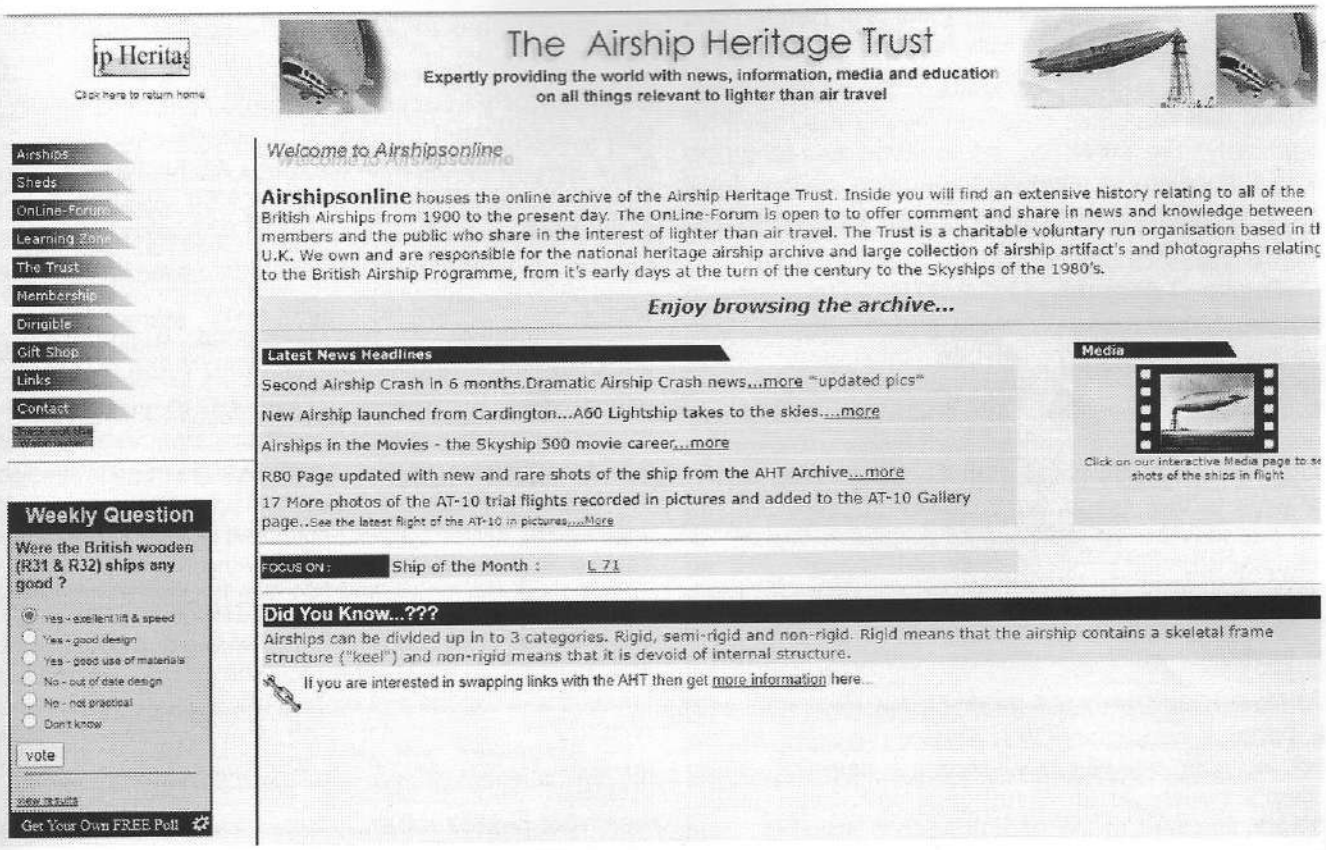
Twenty-five years on from my suggestion to the AHT Trustees and I'm still editing the website using *Dreamweaver*, and we are still with the same Internet Service Provider, who host the site and whose team on the helpdesk recognised my voice to help resolve those very late night distressed "*it's broken*" calls.

I am certain that the website has helped the Trust over the years complete one of our three principle objectives which is: *To foster and promote the study of the history of airships and to present this to the public*

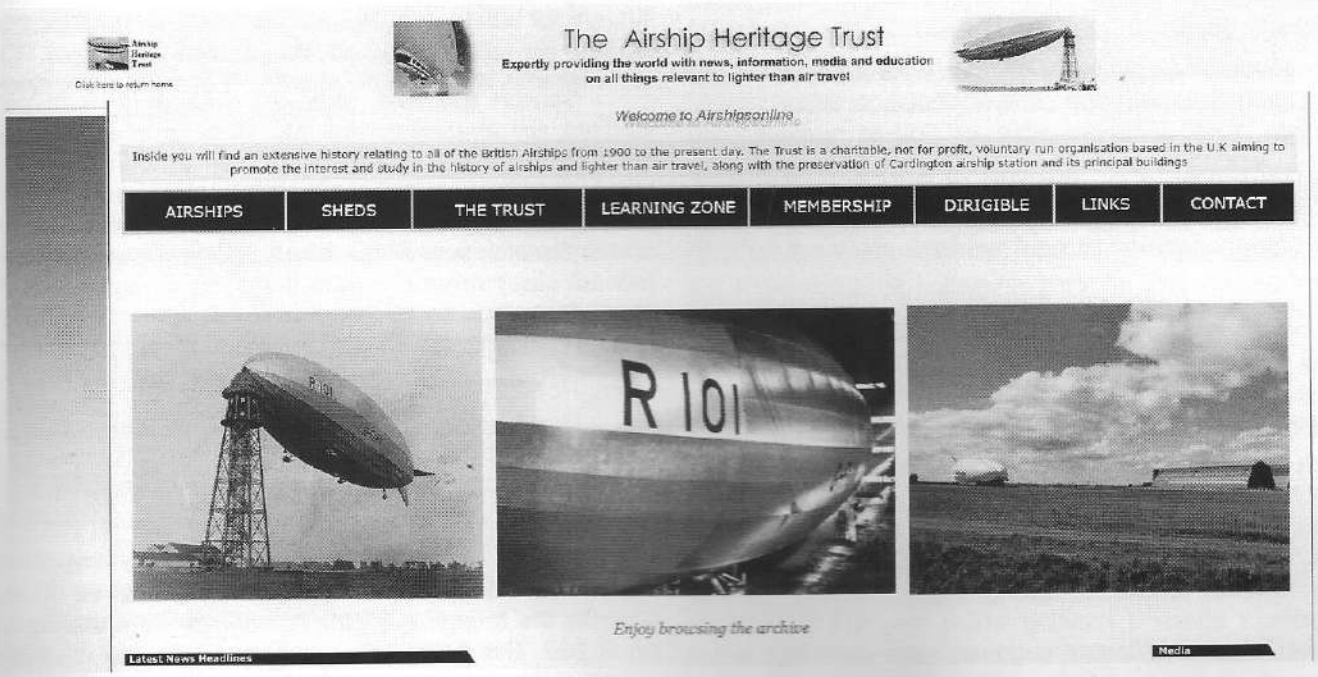
So, here's to the next 25 years of

airshipsonline.com

Alastair Lawson
Airship Heritage Trust Chairman and Webmaster



More evolution - and a more calming site in 2006



Evolution 2017

MUSEUM NEWS

Extracted by *Dirigible* Editor from a recent email exchange between AHT Trustee, Roger Allton and Guy Revell, the Collections Storage Manager at the Royal Air Force Museum, Stafford.

From: Guy Revell:

Dear Mr Allton, my colleague Gary Haines has forwarded to me your request for photography of a number of items related to the *R100* airship. To take each object in turn:

Control Wheel (RAF Museum Object No X002-3458) As Gary noted, the control wheel is at Hendon and I am therefore unable to help with this. ...

Engine Telegraph 74/A/804 - This item was on loan to us and has since been returned to the owner. ... Unfortunately, we have no information regarding the object's dimensions or method of operation, neither detail appears on our catalogue or in the correspondence regarding it.

Engine Telegraph 1993/0507/A - This item is radioactive and so kept in the dedicated radioactive store. Accessing it to produce a new photograph would probably not be in line with the legal requirement to keep staff radiation exposure "*As Low As Reasonably Practicable*" (ALARP) under the *Ionising Radiation Regulations 2017*. We could probably image it as part of other work in that space, but I cannot currently tell you when that may be. In the meantime, please find as an attachment our 'file' photograph for this object. All of the dial text should be legible with the exception of the manufacturer's details, ... I think this reads "*A. Robinson & Co Ltd/Manufacturers/Bootle/Liverpool*".

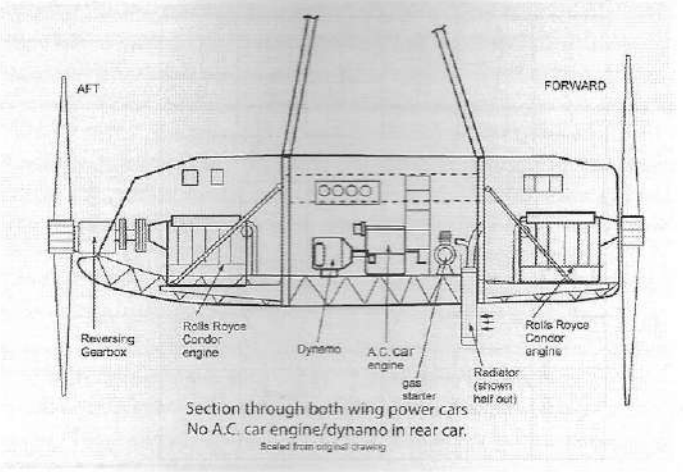
Generator unit X005-8436, Morse key (72/R/642) and airframe coupling (82/A/774) - ... images of this object, including one of a small plaque ... seem to confirm the item's identity as an *R.100* generator. I can't see a corresponding part in the engine nacelle drawing ... but perhaps it is part of another system aboard the aircraft?

From: Roger Allton:

Engine telegraph: 74/A/804. - As a Trust, we are seeking to establish the whereabouts of every airship artefact. Would it be possible for you to message the owner, asking that they contact me to ensure the registration of the location? ... Do you know how this telegraph was activated – by electricity, or Bowden cable, open cables etc.?

Engine telegraph: 1993/0507/A. - I assume that radioactivity is the response to the paint on the dial. ... Sadly there are very few *R-100* photos, unlike the *R101* which had Royal Airship Works (RAW) Cardington/Air Ministry PR backing.

Generator etc. - Are you sure that this is from the *R-100*? This below is a 220 volt DC dynamo I believe. Perhaps your item shows differently on the manufacturers plate? The *AC* 6 cyl lightweight car engine was governed to 3,000rpm, and ran during flight, without backup batteries. I attach a drawing which may not be correct, but the length of a metre, suggests your generator is not the same.



As you can perhaps tell from my queries, these items are of particular interest, and with the passing of years, accelerated by Covid restrictions, we do need to hurry our researches. Sadly many of our members with this knowledge have died recently, adding further impetus to our work.

From: Guy Revell:

... Further to our telephone conversation of Monday, herewith the promised reply re the *R.100* items held by the RAF Museum.

Engine Telegraph 74/A/804 - I am checking with the Museum's Registrar (who oversees all loans) to see if the Museum would be happy to pass your request for information to the owner (assuming that they are still at the last known address we hold for them).

Engine Telegraph 1993/0507/A - The radioactivity does indeed originate with the radium paint on the object dial. I am due to go into the radiation store soon and have made a note to take a photograph to send to you.

Generator unit X005-8436 - ... The provenance of the item suggests it may have been part of the radio fit.

Original *R.100* Drawings - I mentioned during our telephone conversation the possibility of original *R.100* drawings being held by The National Archives. A quick search of their catalogue gives some encouraging returns, especially in the AIR 12 and AIR 20 classes.

Search the RAF Museum's holdings - In case you are not already aware, the Museum's accessioned holdings can be searched via our online Inventory facility. Using the search term "*R.100*" returns over 10,000 results, although many of these appear to be false returns due to the inclusion of the full stop. Unfortunately, "*R100*" (no full stop) returns 0 hits. Items on loan to the RAF Museum, will not feature on Inventory.

From: Roger Allton:

Generator unit X005-8436 - I think this is a Radio item from *R-100*, since the drawing I have from Kew is as here, - also incl parts list on drawing ref. gearboxes. ... As you see on the drawing compared to the 6 cyl *AC* Cars engine, it must be considerably larger.

This telegraph, ... is very important, as it also controls the charging engine, so comes from a wing car on *R-100*. The 3,000 rpm mentioned, was the controlled speed of the charging engine. Otherwise it was stopped.

I am also interested that you do not mention the three damaged gearboxes from *R-100*. I think they are wrongly identified in your catalogue, as by Rolls-Royce. See parts list attached.

Is there any possible chance I can come to RAF Stafford to see the items ASAP, before they are in 'purdah'?

From: Guy Revell:

Generator unit X005-8436 – Unfortunately, this item is in part of the store that is currently out of bounds to staff whilst we await remedial works to the building, meaning we can't currently take any further photographs.

Engine Telegraph 1993/0507/A – I was able to access this item earlier in the week, but the conditions in which it is stored are not conducive to photography. All of our radioactive items are stored sealed in polythene as a safety measure and this causes many reflections and focusing problems. I took about 10 images and the best one is attached. Any attempts at photographing details through the polythene – such as the maker's plate – were entirely unsuccessful.

Gearboxes X003-8593, X003-8594 and X003-8595 – thank you for the steer on the potential misidentification of the manufacturer of these, I will pass it to the relevant Curator. I suspect that the Rolls Royce attribution was created in lieu of any better knowledge at the time. I had not previously mentioned the gearboxes as they had not formed part of your enquiry – as you will hopefully be able to see from the Inventory facility, the Museum holds at least 160 items, across all its collections, in which the *R.100* features in some way.

Regarding access to Stafford, this is sadly not possible at the moment. The Reserve Collection was never really resourced to facilitate visits by the public, but previously we would try to find a mutually convenient time for access by researchers. However, this is now no longer possible as we implement our Midlands Development Programme (MDP) which will include a new Collections Storage Hub. I am sorry to have to send you such a disappointing reply, but hopefully it will be of some comfort to know that the ultimate aim of the Museum's MDP is to make all of our *R.100* objects, as well as everything else held in storage, much more accessible to the public.

From: Roger Allton:

I think the mis-attribution of the three gear boxes is caused by their having been attached in use, to Rolls-Royce engines. The fact that they were left in situ after the engines were removed underlines I feel, that Rolls-Royce were not interested in them.

Note that the gearboxes were smashed on dismantling, (kicked off the engine cars, to drop 30 feet onto the concrete floor of the shed), and not returned to Rolls-Royce, as were the several engines.

(Note: one additional Rolls-Royce engine was used by RAW in case needed for the Government's *R-101* airship.)

Thanks again Guy for you help.

I am circulating this email to our Trustees and others.

LIBRARY NEWS

An email message forwarded by Charles Luffman:

FUTURE OF THE ABAC TECHNICAL DOCUMENT COLLECTION

----- Forwarded message -----
From: Marc de Piolenc <piolenc@archivale.com>
To: Airship List <airship-list@colorado.edu>
Sent: Tuesday, 30 May 2023 at 06:11:55 CEST
Subject: Future of ABAC technical document collection

When George Wright founded the [American-based] Association of Balloon and Airship Constructors in the early 1970s, his plan was to make it a source for technical information on lighter-than-air flight and on related topics like inflatable structures.

The ABAC library, originally an informal Collection of useful documents that the Association made available to members as photocopies for a reasonable fee, soon began to grow as retired poopie, baggers and correspondents from all over the world began contributing documents to it. George assigned serial access numbers and fired up his typewriter from time to time to keep the list up to date. Shortly before his death, Don Woodward digitized the list. Long after the most of the founders had gone their way and *Aerostation* had ceased publication, the technical collection continues to provide photocopies (rarely) and scanned documents to interested parties.

But the collection is now living in my half-basement/garage/workshop in the central Philippines, not the aviation center that southern California is, and my children have no interest in aviation or aerostation, so it is time to look for a suitable home for the masters. My thought is that I would provide the already scanned masters in groups. The institution that acquired them would of course get digital copies as well, and be free to make use of them as it wished. If I expire before the collection is fully transferred, the remaining masters will be sent over and the acquiring institution will have to scan the lastbatch. That said, I am in good health, nearly half of the 2,200 item collection is already scanned, and my wife and I scan more of them whenever there is time.

If anybody is interested, or knows of an institution that is, I will provide a copy of the database.

Marc de Piolenc
http://www.archivale.com/

AUCTION RESULTS

A diverse assembly of assorted items relating to 'Airships' and 'Zeppelins' went under the hammer as part of a '*Medals & Coins, Arms & Armour*' auction held on 17 May 2023 at the Woolley & Wallis Salerooms in Salisbury. Several of the larger Zeppelin items came from the collection of the late John Gair. Here are the results as published on the auctioneers' website:

A British War Medal 1914-20 awarded to Captain Ernest Clive Morris, Royal Air Force, (CAPT. E. C. MORRIS. R.A.F.), ... (36.11mm diameter)

Ernest Clive Morris served in the RFC and RAF as a pilot and Flight Commander from 1917 to 1919. In March 1918 he attacked *Zeppelin L42* after it had carried out a night-time bombing raid on Hartlepool but had to call off the attack when he couldn't gain sufficient altitude.

LOT 19 : Estimate: £80 - £120 : Sold for £180

A scarce 'Aero' or 'Zeppelin Gun',

being a 12 bore "Duplex" side-by-side box lock ejector ball and shotgun purchased by the R.N.A.S. in 1914 for anti-Zeppelin warfare, serial number 91675, nitro-proof barrels 30 in., matted top rib with vacant dovetail where the original back sight was fitted, barrels inscribed '*HOLLAND & HOLLAND*' (right) and '*PATENT "DUPLEX" CHOKE 98 NEW BOND STREET, LONDON.*' (left); plain Webley & Scott box lock with striker discs, automatic safety; chequered walnut stock; ion an associated fitted case and offered with a good quantity of cartridges and associated accessories including cartridge bags. Section 2 - SGC or RFD required to purchase.

Between 128 and 200 such guns were purchased for the Admiralty Aircraft Armament stores in White City to arm Observers in R.N.A.S. aircraft. They were for use with the '*Cartridge SA Chain Shot 12 bore Mark I*' which was loaded with balls linked by wires to attack the struts and fabric of enemy airships. Another example of this type is held by the Imperial War Museum, with serial number of 91717 - 43rd in sequence after the gun offered here.

LOT 350 : Estimate: £700-£1,000 : Sold for £850

A piece of Great War Zeppelin wreckage, being a large riveted aluminium framework forming a bracket with reinforced apertures for a cable or stay, one side endorsed in pencil "*Brought Down in Essex by ... Sowby Sept 1916*", and the other side in paint "*ZEPPELIN. L.33*" ... The pencil note on the side of the relic disagrees with the painted identification, because it refers to the Billericay airship, whereas *L.33* was the Little Wigborough airship. (24 x 20 x 18 cm.)

LOT 362 : Estimate: £500 - £600 : Sold for £500

A Great War Zeppelin wooden propeller salvaged from Zeppelin *LZ112* (airship *L70*), the last Zeppelin to be shot down during the war, (79.35 cm long), the blades curved along one edge, the central depression pierced for bolts, painted with the words "*This Propeller was taken from the last Zeppelin to be shot down over England. Immingham August 1918*"; together with a reproduction of a portrait photograph of Commander Peter Strasser, who died in command of *L70*. ... On the 6th August 1918 *Zeppelin LZ112* (*L70*) was shot down over the sea near Immingham in Lincolnshire by a *de Havilland DH-4* flown by Major Egbert Cadbury, with Captain Robert Leckie as rear gunner. During the following weeks the wreckage was brought ashore, and a number of the Zeppelin crew received sea burials.

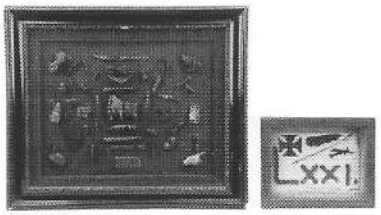
LOT 363 : Estimate: £300 - £400 : Sold for £300

An item of Zeppelin wreckage, being a crumpled piece of aluminium framework with a section of steel wire attached by way of a grommet; and an old collector's label stating that it is part of the Little Wigborough airship.

LOT 364 : Estimate: £300 - £400

Two framed displays of items salvaged from *Schütte-Lanz SL11*, which was shot down by Lieutenant William Leefe Robinson, V.C., R.F.C., at Cuffley, Hertfordshire, 3rd September 1916, in the action that earned him the Victoria Cross.

The first frame exhibiting engine radiator tubes formed into the numerals 'LXXI', a stay junction piece with sections of stay attached, and silhouettes of an airship, a German cross and a warplane marked out in ash, with an (erroneous) MS reference to airship *L21* to the card mount and a presentation note pasted to the reverse, (17 x 22cm).



The second, a larger frame displaying various fragments of metal, small components, wire, once-melted metal hardened into amorphous lumps, and other items, with an interior label '*FRAGMENTS OF THE 'ZEPPELIN' BROUGHT DOWN AT CUFFLEY, HERTS. BY Lt ROBINSON SEPT 3rd 1916*', (31 x 39cm).

Lieutenant William Leefe Robinson, Royal Flying Corps, was attached to *No.39 Squadron* (Home Defence) near Hornchurch in Essex, having been wounded over the Western Front. He took off on patrol before midnight on the 2nd September 1916, and early the following morning he sighted *SL11*, which at that time formed

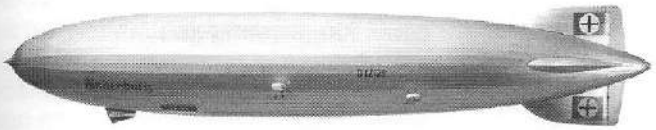
part of a huge sixteen airship raid. After an arduous period spent in pursuit and repeated attacks with incendiary bullets he brought the vessel down in flames. There was some confusion at the time about the identity of the ship he had destroyed, which is reflected in the attribution given by Sub. Lieut Albert L. Davis, who appears as the assembler and presenter of the first display. He describes the ash used as a being from "*structure & incinerated Germans*".

LOT 365 : Estimate: £300 - £400 : Sold for £300

A scarce Zeppelin cigar pipe, designed for use by smokers in airships to minimise the risk of fires, the two-part airship-shaped briar body joining in the middle to enclose the cigar completely except for a pipe-type mouthpiece and an aluminium bushed air inlet, stamped '"*L'ATLANTIDE" BTE S.G.D.G. FRANCE:ETRANGER A*', (142mm long).

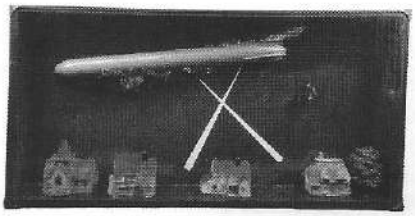
LOT 367 : Estimate: £80 - £120 : Sold for £70

A display model of '*Hindenburg*' (LZ129), which was destroyed by fire while attempting to berth in New Jersey in 1933, in the last of the great airship disasters; doped paper over a balsa frame with painted silver finish, (112 cm long).



LOT 368 : Estimate: £70 - £100 : Sold for £120

A large, partially scratch-built diorama depicting the shooting down of a Zeppelin by a British bi-plane, the airship marked '*L31*' and with applied flames and smoke, the bi-plane climbing away to the left, a model village below and the backing board painted to represent a night sky with searchlights, all within a deep glazed frame measuring 52 x 100 cm.



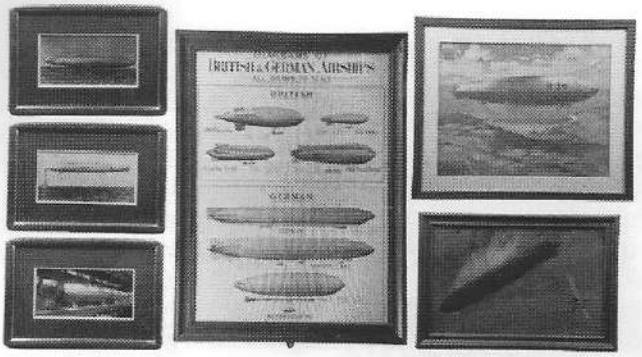
NB - It is not clear which Zeppelin this scene is intended to represent, since the German Navy Airship *LZ31* was destroyed by an accident in its hangar.

LOT 369 : Estimate: £60 - £80

Zeppelin Motor Oil: a five gallon oil drum, red, each side depicting an airship in flight over a seascape, *'ZEPPELIN MOTOR OIL / FLEET-WING OIL CORP.'*, with swing handle, (35 cm high)

LOT 370 : Estimate: £100 - £150 : Sold for £120

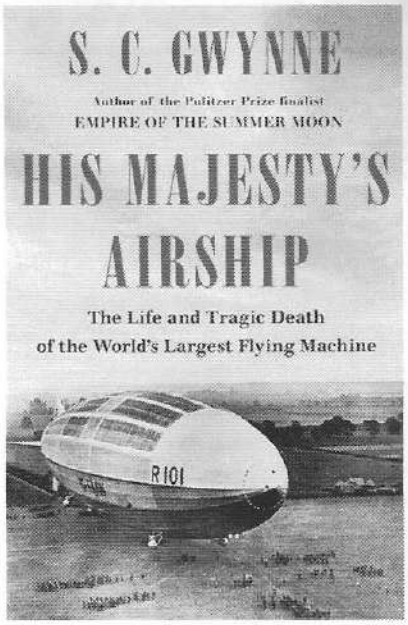
A quantity of airship themed art and display material in glazed frames, comprising: a watercolour drawing of *Zeppelin LZ37* being shot down on the 6th June 1915, the Zeppelin (the first to be shot down by an aeroplane during the war) shown descending in flames to left and centre, to the right a *Morane Parasol* piloted by the victorious Sub-Lieutenant Reginald Warneford who was awarded the V.C. for this action, unsigned but with title, (29 x 46 cm); an identification poster: '*Diagrams of British and German Airships*', (69 x 49 cm); three photographic prints of U.S. Navy airships; and a print of *R34* flying over a coastline. [6]



LOT 371 : Estimate: £150 - £200 : Sold for £150

A cased silver-plated cigar cutter and Vesta case, the cutter in the form of a Zeppelin, the forward gondola acting to release and depress the blade; the case embossed with the head and shoulders of Graf Zeppelin, his name embossed below, Friedrichshafen beyond with a Zeppelin airship overhead; in a shaped and fitted case.

LOT 372 : Estimate: £250 - £350 : Sold for £350



HIS MAJESTY'S AIRSHIP

By S. C. Gwynne

Hardcover : 320 pages
Published on : 12 October 2023
Published by : Oneworld Publications
ISBN-10 : 086154708X
ISBN-13 : 978-0861547081

PRESS RELEASE

The rise and fall of the world's largest airship.

The R101 was the ship of empire, meant to dazzle the world with her technological advancement and immense size. Faster than a plane, more luxurious than an ocean liner, the R101 would connect the furthest reaches of the British Empire. It was, however, not to be.

The spectacular crash of the British airship R101 in 1930 changed the world of aviation forever. While most people have heard of the fiery crash of the Hindenburg, a German ship that went down in New Jersey seven years later, the story of R101 – whose downfall killed many more people – has been largely forgotten. At the time, however, the outpouring of national grief in Britain was equalled only by what happened after the sinking of the Titanic.

In His Majesty's Airship, S. C. Gwynne recounts the epic narrative of the ill-fated airship and her eccentric champion, Christopher Thomson. With characteristic verve, Gwynne paints a luminous portrait of interwar Britain and reanimates the intrepid world of early aviation.

REVIEWS

When I was invited to review this book, I looked at the 'Praise for S C Gwynne' on the rear of the dust jacket where there are references to "the author's novelistic skills" and the fact that one of his other works was "written like the best kind of fiction". This put me on my guard.

The author of this book is an American journalist and this shows in his style of writing which tends towards the sensationalist. Much space is devoted to describing the character failings of the main players in the development of the Imperial Airship Scheme - particularly the Secretary of State for Air, Lord Thomson, Major Scott (Officer i/c of Flying and Training) and Wg. Cdr. Reginald Colmore (Director of Airship Development) - and how this affected the development programme and eventual demise of the *R101*.

For the lay reader with no previous knowledge of airships, it will no doubt prove entertaining but there are various areas where supposition seems to have taken the place of hard facts.

There are several annoying errors in the text - such as a reference to the victims' bodies being carried from Bedford to Cardington on gun-carriages whereas they were actually carried on RAF motor tenders. The author also repeats the myth that *R101*'s diesel engines were intended for railway locomotives. It is on record that Beardmore's initially developed compression ignition engines for aviation purposes (particularly airships) and only later proposed them for railway use.

[*See "The Origins of R101's Engines" by Jarvis Frith in Dirigible No.54 Summer 2008.*]

There are a few surprising statements in some of the photo captions, too. It is surely misleading to say that the *Mayfly* "broke in half on her first flight" when she never flew at all and the photo purporting to show crowds of relatives "gathered in front of the office of the *Bedfordshire Times*" after the crash actually shows them in front of the Royal Airship Works gatehouse opposite the Shortstown housing estate at Cardington.

I found the book an easy read but at the end, I doubted that it had told me anything new.

Paul Ross

S. C. Gwynne is a capable professional author who has done more research than most who have written on this topic and I wish I could offer a more glowing endorsement than I shall.

My major problem is with the structure of the volume. The odd numbered chapters are the story of *R101*'s last flight incrementally and chronologically. The even numbered chapters are background history. Biographical essays of some major participants are scattered throughout. It may seem unusual to criticize structural organization of a book, however, this one loses almost all sense of chronology within the even numbered chapters and who-knew-what-and-when is key to an understanding of the *R101* story.

To understand the relationship between the Royal Airship Works Officer in Charge of Design and Research, Lt. Col. Vincent Crane Richmond, and Lord Thomson, it is necessary to know such details as: when was the last time that Richmond told Thomson *R101* would carry 100 passengers to India? When did Richmond amend that to 24 passengers? When did Thomson learn that *R101*, as originally completed, couldn't fly to India at all?

It is key to know when Sqn. Ldr. Michael Rope (Assistant to the Chief Designer) reported the cover fabric unsafe in relation to when Thomson declared *R101* was being held in reserve to fly to Canada if *R100* could not? Also, when the then Air Member for Supply and Research, Sir John Higgins, started asking Thomson to allow the *R101* lengthening work to begin? And when did Higgins receive approval in writing and when did the project actually began? Such events reveal the principals' relationships to one another; but not in this volume.

Gwynne's comments bring the criticisms of Major Scott's drinking to a new and unprecedented level. Sir Peter Masefield in *To Ride the Storm* (1982) was the first to go from knowledge of liquor to over indulgence. ... Gwynne goes a step beyond by mis-quoting Masefield {whose] comment reads, "*Scott's speech was not clear*". Gwynne seems to reinterpret this as "*he was slurring his words.*" ... [The quote] is taken out of context as Masefield had just observed that Scott's comments

"did not describe written Air Ministry policy" so "*Scott's speech was not clear*" is subject to more than one interpretation. ...

I might point out that Scott, the smoker and drinker, is never reported smoking or drinking on board a ship he commanded unless one counts the imaginings of more than one author regarding what may have happened at dinner on *R101*'s final flight. It is very likely he had a few with newsmen onboard *R36* the day the tail collapsed in flight but he piloted the ship back to Pulham! ... I have known a few high performance folks who arguably drink more than they should, especially when either the Company or someone else is paying.

The book has two sections of photographs very few of which are unfamiliar to me. Two or three photos to the page means they are small, however, inside the back cover is a beautifully reproduced picture of *R101*'s first flight over London so detailed that one can see which engines are running and which are not.

Chapter 15, (*Solving The Mystery: What Caused The Crash*? is a rather carefully thought out history of the steps of the 1930 investigation and more recent ones as well.

There follows a theory that *R101* crashed because of two failures of wires connecting the elevator wheel to the control surfaces and an explanation as to why these wires may have failed?

Though the chapter is not without faults; e.g. Air Commodore Holt's Committee of Investigation is identified as "*Major J. C. Cooper's team*", it is a systematic progression drawing upon Bryan Lawton's essays, "*Control, response, and crash of HMA R101*" and "*R101 Airship Disaster and the Broken Elevator Cable*". I question that there was enough loose hydrogen, either during assembly 1927-29, or during 1930 to have the chemical effect suggested so I respectfully disagree regarding this cause and only offer a lukewarm commendation for "His Majesty's Airship".

C. P. Hall II

This formidable book represents a great deal of research undertaken beneath the shadow of lockdown followed by an intense post Covid effort to complete this fresh assessment of the facts from a different viewpoint than previous established works; principally *To Ride the Storm* by Masefield in 1982.

Inspired by a series of Royal Aeronautical Society papers it pulls together more recent theories regarding the 'final dive' of *R101* in France in 1930 adding much to the cause. However, it also lifts the veil on some of the personalities and attitudes. The 'polite' accident enquiry chose to 'get it over with' without blame or litigation; concluded in a few months; the only casualties being the project as a whole and the victims' families and airship workers.

Sam Gwynne exposes the 'flexible' relationship between Lord Thomson, Air Minister, and Marthe Bibesco, the drinking habits around Cardington; prevalent in business and military circles at the time, and the political devotion to the tree of authority that prevented doubts on viability being passed up the chain of command.

Add to this strong criticism of the use of hydrogen gas, unavoidable at the time and seen today as the safe option for future transportation in an environmentally aware world. Gwynne then stirs in some dramatic chapter headings and alternates chapters between the personal shortcomings and the project timeline and you get a story that captivates but confuses those unfamiliar with this decade of drama pre the world recession of the thirties.

No doubt this will upset some airship enthusiasts but every author has a right to an opinion, particularly when based on such thorough and referenced research.

Peter Davison

I had great hopes for this book having helped Sam Gwynne with his research but I am sadly disappointed with the result. The author was a journalist and this book is what is known in the gutter press as a good old-fashioned 'hatchet job'. It makes cruel, cheap-shot accusations of incompetence against those who can no longer defend themselves.

But, if you like playing the 'blame-game' you will probably enjoy the detailed character assassination of several of the project's leading-lights. Scott was apparently a work-shy alcoholic, Thomson was a dilettante, love-sick, social-climber and Colmore was a coward.

Some of this may have been true but I can see little point in raking it up now in a dumbed-down rehash of old tropes liberally sprinkled with misinformation - especially as the sensationalised accusations are housed in a chronological muddle that is both confusing and prejudicial.

A prime example being *R101* 2nd Officer, Maurice Steff, who is presumed to have been in control of the ship when it crashed.

In one chapter we are told that he was 'inexperienced', but in the *following* chapter, we learn that barely a month *before* the fateful night, Steff had successfully piloted *R100* through the violent 'white squall' when the ship was tossed about with great force and the fin-fabric so badly torn that the landing was delayed. Put these chapters in their correct time sequence and Steff appears well able to handle a large airship in rough weather. Scramble the time-line and doubt is thrown both on his ability and on the judgement of those who left him in command.

However, according to this historical mish-mash, the true villain lurking behind all the big airship disasters is the deadly dangerous gas hydrogen. This is where the blame should really lie.

And Gwynne has proof: "*But undeniably, at least fifteen giant rigid airships had gone up in immense and horrific hydrogen explosions ...*"

Listed among these casualties is *R27* which, according to a less hysterical account:* "*... was in the hangar at Howden [in August 1918 when] some riggers were ... attaching a spare SS-Zero car to a disused envelope. ... some petrol was spilt into the car [and] was ignited a little later by a spark when an operator tested W/T equipment. The flames ... expanded into a conflagration that totally destroyed not only the makeshift blimp and R27 but also SSZ.38 and SSZ.54 ...*"

But Gwynne knows where the truth lies: "*The presence of a good deal of gasoline on all these airships just made the fire worse. Hydrogen had no problem igniting gasoline.*"

How fitting then that another newspaper, *The New York Times,* should headline its review of this tabloid tirade against hydrogen as: "*When Ego Meets Hot Air, the Results Can Be Deadly.*"

Giles Camplin

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* *The British Airship at War 1914-1918 by Patrick Abbott, (Terence Dalton) (1989)*

SIMULTANEOUS EQUATIONS AND DIRIGIBLE AIRFRAMES:

An extract from *'Slide Rule'*, Nevile Shute's autobiography

By John Bradshaw of St. Martin's College
Found in *Mathematics in School*, (September 1993) by Sundar Narayan

There must be many examples of mathematical models currently in use which could demonstrate actual applications of school maths - but it is not so easy to find ones in which both the context and the maths is understandable by the pupils. The Editors would welcome examples which do in fact satisfy these requirements, but meanwhile here is a description of one from the past which pupils from the fourth to the sixth form have appreciated when studying the solution of simultaneous equations and subsequently the resolution of forces.

A little background information may be in order first. The novelist Nevile Shute's surname was Norway, it being dropped early so far as publication was concerned in order to disassociate his 'literary amusements' from his "real" job in the aircraft industry. At the time he describes in the following passages, 1924 and on, the Labour Government of the day invited bids for the construction of two experimental commercial airships. It transpired that Vickers Ltd were to build one (the R100) while the Air Ministry would build the other (the R101) in direct competition. It was seen to some extent to be "testing" the better principle: capitalism or State enterprise. As a result the Ministry team at Cardington were urgently pressed for rapid results throughout the five year project by Ramsay MacDonald's Committee and so were encouraged to cut corners and make approximations and unsupported assumptions. In sharp contrast, Barnes Wallis insisted that there be a firm theoretical basis for each and every feature of the Vickers design. Nevertheless, the completed airships first flew within a month of each other in 1929, but- the RIO1 was found to have insufficient lift and so was cut in half and another section grafted in to accommodate an extra gasbag. Spurning the R100's extended flight testing, the impatient Secretary of State for Air, Lord Thomson, insisted on flying to India in the R101 forthwith*

Almost certainly as a result of a structural failure, the RO11 dived into the ground at Beauvais, France on 5th October, 1930, killing all but six of the fifty-four persons on board.

Despite the fact that the R100 had successfully passed all her flight trials, performing as per the original specification, and had safely weathered storms over the Atlantic during a return trip to Canada, she was scrapped by order of the Air Ministry ostensibly on the grounds that airships were unsafe.

Slide Rule

"... Mr. B. N. Wallis,* who was then a designer of rigid airships working for Vickers Ltd, was gathering together a staff for the design of a very large airship to be known as the R100. I joined this staff in the capacity of Chief Calculator, which should not be misinterpreted. I knew nothing of airships at that time and the Airship Guarantee Company, a subsidiary of Vickers Ltd, employed three consultants who were to teach me the fundamentals of my job and carry out research into the methods. Professor Bairstow was our authority on aerodynamics, Professor Pippard on structures, and Mr. J. E. Temple was the most practical and useful of them all because he had been Chief Calculator for Wallis on the design of a former ship, the R.80, built by Vickers at the conclusion of the war. My job was to get together a staff of calculators to do the work on R.100, translating the theories of the consultants into the forces and stresses in each member of the ship and so providing the draughtsmen with the sizes for each girder and each wire.

"This was an important matter, for the previous experience of England in the construction of rigid airships had not been happy. Rigid airships had been built during the war upon the lines of the German airships that had been shot down. Vickers had had a hand in this programme with the construction of R.80 and other ships, and R.80 at any rate had been properly stressed according to the best aerodynamic data available at the time. Most of the other ships had been designed and built by a staff of government officials attached to the Air Ministry, but the methods of the German designers were not known, of course, and these ships had been built empirically and by copying the sizes of the girders in the German ships. The last of them was R.38. On her third flight a structural weakness in the girders was revealed, but was made light of. On her fourth flight she was doing turning trials over the Humber in very perfect weather when she broke in two, the front part catching fire and falling in the river and the rear part coming down on land. Forty-four lives were lost in the accident. At the enquiry into the disaster it came out that the officials responsible had made no calculations whatsoever of the aerodynamic forces acting on the ship in flight; it was not therefore very surprising that she broke when doing turns at full helm and full speed.

"My own work in the calculating office led at times to a satisfaction almost amounting to a religious experience. The stress calculations for each transverse frame, for instance, required a laborious mathematical computation by a pair of calculators that lasted for two or three months before a satisfactory and true solution to the forces could be guaranteed. To explain this for the benefit of engineers, I should say that each transverse frame consisted of a girder in the form of a stiff, sixteen-sided polygon with the flats at top and bottom; this girder was twenty-seven inches deep and up to a hundred and thirty feet in diameter. Sixteen steel cables ran from the centre of the polygon, the axis of the ship, to the corner points, bracing the polygonal girder against deflections. All loads, whether of gas lift, weights carried on the frame, or shear wire reactions, were applied to the corner points of the polygon, and except in the case of the ship turning these loads were symmetrical port and starboard.

* Barnes Wallis went on to design the *Vickers Wellington* bomber of WW II, which featured the light but immensely strong geodetic construction; the 'bouncing bomb'; ... and latterly the 'swing-wing' aircraft; to mention but three more products of his highly creative and fertile mind.

One half of the transverse frame, therefore, divided by a vertical plane passing through the axis of the ship, consisted of an encastre' arched rib with ends free to slide towards each other, and this arched rib was braced by eight radial wires, some of which would go slack through the deflection of the arched rib under the applied loads. Normally four or five wires would remain in tension, and for the first approximation the slack wires would be guessed. The forces and bending moments in the members could then be calculated by the solution of a lengthy simultaneous equation containing up to seven unknown quantities; this work usually occupied two calculators about a week, using a Fuller slide rule and working in pairs to check for arithmetical mistakes. In the solution it was usual to find a compression force in one or two of the radial wires; the whole process then had to be begun again using a different selection of wires.

"When a likely-looking solution had at last been obtained, deflection diagrams were set out for the movements of the various corners of the polygon under the bending moments and loads found in the various portions of the arched rib, and these yielded the extension of the radial wires under load, which was compared with the calculated loads found in the wires. It was usual to find a discrepancy, perhaps due to an arithmetical mistake by a tired calculator ten days before, and the calculations had to be repeated till this check was satisfied. When the deflections and the calculated loads agreed, it was not uncommon to discover that one of the wires thought to be slack was, in fact, in tension as revealed by the deflection diagrams, which meant that the two calculators had to moisten the lips and start again at the very beginning.

"The final check was to take vertical and horizontal components of the forces in every member of the frame to see that they equated to zero, that your pencil diagram was not sliding off the paper into the next room. When all forces were found to be in balance, and when all deflections proved to be in correspondence with the forces elongating the members, then we knew that we had reached the truth.

"As I say, it produced a satisfaction almost amounting to a religious experience. After literally months of labour, having filled perhaps fifty foolscap sheets with closely pencilled figures, after many disappointments and heartaches, the truth stood revealed, real, and perfect, and unquestionable; the very truth. It did one good; one was the better for the experience. It struck me at the time that those who built the great arches of the English cathedrals in mediaeval times must have known something of our mathematics, and perhaps passed through the same experience. ..."

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Sundar Narayan wonders if the *R100* stress calculations can be found?

"Prof. Pippard, Temple and Nevile Shute did them. The *R101* stress calculations were done by a team in the Ministry. All rigids had very statically indeterminate structures, making the stress calculations approximate. I think that this is why many of them failed. Also, knowledge about wind gusts was appallingly limited before 1940. Therefore, I am interested in what structural loads the designers assumed."

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SHED SCARED!

Scared of the Dark was a British reality television series broadcast on Channel 4, which premiered on 16 April 2023 ... Described as a "world first", eight celebrity contestants spent 180 hours (8 days) living, completing tasks, eating and sleeping in complete darkness in a specially built set ... inside an airship hangar at Cardington Airfield, Bedfordshire. The hangar is owned by Cardington Studios and has been used as a set for other films and television shows. ... Fifty infra-red cameras were installed to film the series.

The show was recorded in September 2022, and the celebrity contestants who entered the building were: Nicola Adams (former boxer); Chloe Burrows (former *Love Island* contestant); Chris Eubank (former super-middleweight boxer); Paul Gascoigne (former England footballer); Max George (lead singer of *The Wanted*); Chris McCausland (Comedian); Scarlett Moffatt (television personality) and Donna Preston (actor, writer and comedian).

Danny Dyer presented the show accompanied by clinical psychiatrist, Dr Tharaka Gunarathne, who monitored the contestants and analysed their activities. ... [as in] *I'm a Celebrity...Get Me Out of Here!*, the participants could shout "*I'm scared of the dark*" at any time, to leave a task, or the show. In a nod to Big Brother's *'Diary Room'*, the celebrities could also chat to a camera in a dimly lit room called *'The Vault'*.

... Eubank left the show in Episode 4, after having arguments with a number of the other participants and subsequently withdrawing from group activities. Max George left the show two days before the end after dwelling on memories of his late band-mate, Tom Parker, and declaring "*Being in the dark isn't nice. I'm going to go home today and start fixing a few things*".

The final episode on 20 April saw Paul Gascoigne declared winner of the series, following a vote by the remaining celebrities.

The Guardian reviewer gave only 1 out of 5 stars for the opening programme, describing it as "*Boring, derivative and occasionally downright horrible ... filled largely with stupid, boring challenges; contemptuous and derivative in the extreme*".

The Independent reviewer gave 4 out of 5 stars ... though bemoaned that the tasks distracted from the interpersonal dynamics and the "*psychological torture of being locked in a room with Chris Eubank*". The reviewer thought "*Channel 4 may just have stumbled on a winning formula*". (Sourced from *Wikipedia* The Free Online Encyclopaedia)

Stanley Spencer's first attempt at aerial advertising from Crystal Palace in 1902. – See p20

The Ford Company's blimp was the first to be fitted with 'running sign' lights for advertising at night in 1948. – See p19