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DIRIGIBLE DISASTERS

REPORT

OF THE

JOINT COMMITTEE TO INVESTIGATE DIRIGIBLE DISASTERS

PURSUANT TO

H.Con.Res. 15

A CONCURRENT RESOLUTION TO INVESTIGATE THE
CAUSES OF DIRIGIBLE DISASTERS

TOGETHER WITH

THE VIEWS OF MR. JOHNSON



PRESENTED BY MR. WALSH

JUNE 14, 1933.—Referred to the Committee on Naval Affairs
and ordered to be printed

JOINT COMMITTEE TO INVESTIGATE DIRIGIBLE DISASTERS

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AIRSHIP INVESTIGATION

To the Senate and House of Representatives of the United States of America:

The joint select committee appointed under House Concurrent Resolution 15, Seventy-third Congress, first session, agreed to April 13, 1933, relating to the crash of the Navy dirigible *Akron*, submits the following report:

NARRATIVE OF EVENTS

At 7:28 p.m. on April 3, 1933, the U.S.S. *Akron* took off from her station at Lakehurst, N.J., on the flight that was to end in her destruction. The ship was proceeding in accordance with an officially authorized mission, for the purpose of training and for calibrating naval radio compass stations in the first naval district at Newport, R.I., and elsewhere. Apparently additional exercises were in the scope of her mission; other missions to execute in the way of tests, fuel consumption, etc., which might be carried out during the flight.

Lt. Comdr. H. V. Wiley, executive officer of the *Akron* and senior survivor of the disaster, about 11 o'clock a.m. on April 3, 1933, telephoned Lt. Herbert M. Wescoat, the *Akron's* aerological officer, to ask his opinion of the advisability of making the flight. Lieutenant Wescoat told Lieutenant Commander Wiley that he would be able to take the ship from the hangar at sunset, but that he was doubtful that suitable visibility would exist in the vicinity of Newport the following morning. Lieutenant Commander Wiley's recollection is that the prediction was for light winds for sunset with fog along the New Jersey coast and extending inland somewhat during the night and probably continuing in the Newport area until noon the next day. At 6 p.m. on April 3, 1933, Lieutenant Commander Wiley states that the wind was light and from the north to the northeast, visibility was very poor and fog forming. The temperature had fallen very rapidly since 2 p.m.

When the ship was on the field at about 7 p.m. fog formed rapidly and at the time of take-off the ceiling was only about 300 feet. At the time of take-off, Lieutenant Commander Wiley testified that it was known to be clear over toward Philadelphia and that there was nothing unusual about going up under fog conditions; that when the ship left Lakehurst there was no evidence to indicate that there was a storm in the area around Philadelphia; that the weather maps showed that it was all right for the ship to take off. It is the opinion of Lieutenant Commander Wiley that at the time of departure, from the different weather forecasts, there came no warning as to thunderstorms. It is also his opinion that weather conditions were such as to justify the trip and cause no apprehension. The evidence indicates general agreement on the part of the officers on the station that available information gave no cause for apprehension. This is not entirely in accord with the view of Mr. Charles L. Mitchell, Chief Forecaster of the Weather Bureau, who, viewing the disaster in retro-

spect, interprets the weather map of 8 a.m., April 3, 1933, as containing distinct warnings of the possible development of dangerous weather from the southwest.

Leaving Lakehurst at 7:28 p.m. the *Akron* proceeded nearly due west to Philadelphia, arriving there at 8:10 p.m. About 15 miles west of Lakehurst the ground could be seen and visibility was fairly good in the vicinity of Philadelphia at 8:10 p.m. Thence she followed the Delaware River toward Wilmington and the Delaware Capes. The plan had been to have an airplane join the *Akron* after the take-off. Commander McCord, by wireless, directed the plane not to join the *Akron*. This was due to the poor conditions of visibility. Between 8:20 and 8:30 p.m. the witness observed lightning to the southward at a distance of some 25 miles. About 8:35 p.m., in the course of the reception of the 8 p.m. weather report from Washington, information of a thunderstorm condition at Washington was received. Lieutenant Commander Wiley expressed to Commander McCord his judgment that it was advisable to steer a westerly course. Commander McCord replied that he had seen lightning likewise in the west. Lieutenant Commander Wiley testified that his reason for the statement was that in his opinion a westerly course would bring them to the safe semicircle of the storm.

The course was changed to a southeasterly direction. As the lightning came closer, the course would be changed to the left away from the lightning and in the neighborhood of Landisville, N.J., the course was set in a northeasterly direction to the vicinity of Lakehurst. On the leg from Landisville to Lakehurst there were several minor alterations of course to avoid areas of the more intense lightning. A change of course to the east was made, carrying the ship to the coast line about 10 p.m. Commander McCord went to the aerology room to examine the weather map. In his absence from the control car Lieutenant Commander Wiley increased the elevation of the ship from 1,500 feet to 1,600 feet and so reported to Commander McCord on his return. Lieutenant Commander Wiley's reason for increasing the altitude of the ship was to get above the lower cloud layer so as better to observe the lightning and weather conditions. Another formation of stratified clouds was overhead at an altitude of five or six thousand feet. Shortly after leaving the coast, lightning became general, surrounding the ship. The vertical radio antennae were hauled in. The ship pursued an easterly course to sea until about 11 p.m.

About 10:45 p.m. Commander McCord sent Lieutenant Commander Wiley to the aerology room to examine the weather map. Lieutenant Commander Wiley found the weather map to be about two thirds completed and inferred that the incompleteness thereof was due to the failure to receive some of the code signals sent in the 8 p.m. weather broadcast from Washington. Immediately Lieutenant Commander Wiley returned and rejoined Commander McCord in the control car and commented on the condition of the weather in terms that to a layman's mind mean that he considered the weather fraught with danger. Commander McCord announced his decision to "take it at sea." Surrounded by lightning flashes, the course was practically reversed back toward the coast in a direction south of west. About midnight the *Akron* came again to the coastline and through the fog lights were perceived. The course back to the coast

was run in less than the time estimated by the navigator, Lt. Comdr. Harold E. MacLellan, to be required. He had been assuming a wind from the southeast and changed his assumption to a northeast wind of 20 knots. On seeing the light on the coast the navigator commenced to take observations of the drift angle to work out the wind direction and speed. Before this process could be completed the course again was changed. The *Akron* proceeded on this course of 120° true in a direction south of east away from the coast until about 12:30 a.m. on the morning of April 4.

A sudden turbulence of air was encountered and the ship made a rapid descent from 1,600 feet to 700 feet as recorded on the altimeter. On this first descent, Lieutenant Commander Wiley testifies that the ship was slightly down by the bow. At 800 feet he dropped ballast and at 700 feet the ship began an ascent. On the recovery from this first descent the elevator man recovered good control of the ship at 1,300 feet and thence gradually worked her up to her previous altitude of 1,600 feet. Under good trim the ship continued its course at this altitude for a period of from 1 to 3 minutes when she made a rapid second descent. Lt. George C. Calnan, Construction Corps, first lieutenant of the ship, who had gone off watch at midnight, reappeared in the control car and took his station at the ballast board. Lieutenant Commander Wiley informed him of what ballast had been dropped. Lieutenant Calnan sang out the altitude at 800 feet. Lieutenant Commander Wiley, at about 1,000 feet, had given the signal "landing stations". Later he sang out "stand by for a crash". Lieutenant Calnan was releasing ballast. The engineer officer, Lt. R. F. Cross, took his station at the engine telegraph. The lower rudder control wires carried away. The upper rudder control wires carried away. The engine telegraph control wires parted. The control car crashed into the water, the officers and men at their appointed positions of duty. Commander McCord was at the left or port side of the control car near the elevator man and the ballast board. There was no confusion or loud conversation. Officers and men met their fate in accord with the highest traditions of the Navy.

Lieutenant Commander Wiley was washed from the control car on the impact of the control car on the water. Swimming some distance under water to become disengaged from the ship he came to the surface, swam around for about 10 minutes, swam toward the ship, then away from the ship, found a piece of wooden flotsam and clung thereto and in about half an hour was taken aboard the S.S. *Phoebus*, and temporarily lost consciousness.

M. E. Erwin, aviation metalsmith, dived through the ship's envelope, swam under water, disengaged himself from the ship, and after swimming around came in contact with an empty fuel tank. R. E. Deal, boatswain's mate, second class, by some unknown means extricated himself from the wreck and found the same empty fuel tank that supported Erwin.

Lucius W. Rutan, aviation chief machinist's mate, and Robert W. Copeland, chief radio man, who survived the actual crash, located the same empty fuel tank. Before being rescued by the *Phoebus*, Rutan was lost from the fuel tank and Copeland died aboard the *Phoebus*. Of the ship's company of 77 officers and men there were three survivors.

STRUCTURE

Great progress has been made in transplanting the German airship-building art to the United States. This started with the construction of the *Shenandoah* by the Navy, the importation of the German-built *Los Angeles* and the fabrication of the *Akron* and *Macon* by the Goodyear-Zeppelin Corporation of Akron, Ohio. The Goodyear-Zeppelin Co. has the service of a large coterie of personnel formerly connected with the German Zeppelin Corporation and has integrated them into its own engineering and manufacturing staff. If the development of airships is to be continued in the Navy, it is pertinent to comment that the dissipation of engineering and manufacturing facilities would be as material a handicap to airship development as would the disintegration of the ship-building industry be to the development of sea-going commerce.

The building of the *Akron* was authorized by Congress in 1926 in accordance with the 5-year building program. The appropriation for her construction became available with the passage of the 1927 naval appropriation bill for the fiscal year 1928. In accordance with the requirements of the Aircraft Procurement Act design competitions were held and the design offered by the Goodyear-Zeppelin Corporation of Akron, Ohio, was adjudged the best. On October 6, 1928, contract was closed for the construction of the *Akron* at a cost of \$5,375,000. Under the same contract the *Macon* was to be built at a price of \$2,450,000. Work on the construction of the *Akron* proceeded from October 1928 to September 24, 1931. As provided in the contract, the Department authorized 16 changes in design. The actual price paid for the *Akron* was \$5,358,000; this figure was the result amount of the contract price, cost of changes made by the Government, and penalties for failure to meet weight and speed guarantees.

The principal characteristics of the *Akron* were as follows:

Length overall.....	feet.....	785
Maximum diameter.....	do.....	132.9
Height overall.....	do.....	146.5
Nominal gas volume (gas cells 95 percent full).....	cubic feet.....	6, 500, 000
Number of gas cells.....	12
Weight empty or dead weight.....	pounds.....	243, 000
Useful load (average condition).....	do.....	180, 000
8 engines at 560 horsepower each.....	horsepower.....	4, 480
Maximum speed.....	knots.....	65.5
Cruising speed.....	do.....	45-55
Estimated still-air range at 50 knots (nautical miles).....	8, 000-9, 000
Complement: men 77, officers 12 (plus plane pilots).		

Allegations in the testimony of civilian witnesses criticized the engineering structure of the main transverse frames. This feature of the *Akron* was a departure from the conventional Zeppelin type of transverse frame construction with interior cross bracings; further it was stated that the main transverse frames of the *Akron* were similar to the main transverse frames of the British *R-101* which crashed at Beauvais, France. A representative of the Construction Corps of the Navy and the chief designer of the Goodyear-Zeppelin Corporation testified to essential differences be-

tween the main transverse frame construction of the British *R-101* and the *Akron*. In the testimony of the latter witness it was admitted that both the conventional type of main transverse frame with interior bracing, as found in the Zeppelin ships, and the main transverse frame type of the *Akron* are satisfactory engineering solutions of the same problem. There is no evidence in the record of inadequate structural strength or other disadvantage from the type of main transverse frame built into the *Akron*.

Throughout the building of the *Akron* an organization of Navy inspectors was present. The group consisted of 3 officers and 21 other personnel. Every piece of material entering the construction of the ship was weighed and inspected by these representatives of the Navy. It has been alleged that one or more communist workmen perpetrated sabotage during the construction period. This was investigated by agents of the Department of Justice, found its way into the courts, and the final legal disposition of the matter terminated with the recommendation of the United States attorney that no further steps be taken; that the accusation against the accused involved the omission of two rivets from the upper fin structure of the *Akron* which omission the accused reported to his superiors. There is no evidence in the record showing faulty construction due to inferior materials, sabotage, or faulty workmanship.

The usual trial flights took place between September 24, 1931, and October 9, 1931, and additional speed trials were run May 3, 1932. The ship was commissioned a vessel in the United States Navy. During her existence she flew approximately 1,700 hours and rode 950 hours at mooring masts.

Operations U.S.S. "Akron"

Period	Flight		At masts		Remarks
	H.	m.	H.	m.	
September 1931.....	20	26	10	29	
October-December 1931.....	306	08	4	16	
January-March 1932.....	101	43	1	42	
April-June 1932.....	400	23	627	09	Fin damaged Feb. 22. West coast operations, Commander Dresel relieved Lieutenant Commander Rosen-dahl June 22.
July-September 1932.....	268	42	-----	-----	
October-December 1932.....	176	58	-----	-----	
January-March 1933.....	431	00	300	00	Commander McCord relieved Commander Dresel Jan. 3, Panama operations.
April 1933.....	5	00	-----	-----	
Total (approximately).....	1,700	00	950	00	

During her service the *Akron* underwent a variety of experiences. She crossed the continent to cooperate with the fleet in maneuvers and she flew to Panama and Guantanamo. On February 22, 1932, when being undocked from the hangar at Lakehurst she suffered an accident to her fin and a portion of the rear structure. Testimony was given by a Member of Congress present on the occasion of the accident that the impact of the rear of the ship on the ground weakened the entire structure and made the ship unsafe. Testimony of both construction and operating personnel of the Navy shows that proper and thorough repairs were made, that the ship was inspected and surveyed in detail after the accident and that structurally she

was as sound and strong as before the accident and thereafter operated in a wholly satisfactory manner. Again, during the flight to the west coast under Commander Rosendahl, a longitudinal girder was bent. Turbulent weather was experienced during this trip, but it has never been established whether the buckling of the girder was due to the buffeting of the ship in turbulent air or to being stepped on by a member of the crew. This damage was repaired.

It is true that at the time of the last flight there were scheduled to be performed certain minor structural repairs or alterations. Likewise it is testified that the fact of their not having been completed at the time of her last flight manifests nothing of significance as to her sound and safe condition; that she was structurally strong and sound at the time of her take off on April 3.

CAUSE OF THE CRASH

Was an error of judgment committed in commencing the flight on the evening of April 3? Looking backward it is easy to say that the lives of splendid men and costly Government property would have been saved had the *Akron* remained in her hangar. Officers skilled in the relatively new science of aerology according to the existing standards of competence in the Navy studied the situation and perceived nothing in the available weather data to lead to a decision to cancel the flight. But when Mr. Charles L. Mitchell, chief forecaster of the Weather Bureau, testifies he asserts that the 8 a.m. weather map of April 3 was "loaded with dynamite." Specifically a small high pressure area centered over Virginia and was moving northeasterly. Moreover, the witness testified the forecast indicated secondary disturbances over the south Appalachian region likely to move northeast. The witness had never known of so general a storm area as occurred on the Atlantic seaboard between 3 p.m. on April 3 and 8 a.m. on April 4. It seems that there is much room for improvement in the aerological knowledge and experience of airship personnel. There is no substitute for experience. Whatever reason there may be to expect that expert airmanship can outmaneuver turbulent storm conditions of intense violence, in the present state of the art there seems no justification in peace-time training for undergoing unusual hazards to ship and lives.

If the aerological data on which tactical decisions are made are obtained from Mr. Mitchell's organization, would it not be well simultaneously to elicit the benefit of its judgment and interpretation of these data at least pending the growth of a wider experience and more accurate scientific knowledge of naval personnel in this relatively new aerological science? Despite the confidence of the responsible officers of the Navy on the night of April 3 that the condition of the weather was not such as to require a cancellation of the flight, it is fairly established from the weather data available before the flight, that there was sufficient reason, in the exercise of prudence, to cancel the flight which was in the nature only of a routine training exercise. As battleships avoid shoals and other dangers of navigation in the absence of a war emergency so the airship should be handled in a manner reasonably to insure its presence on the scouting line in time of emergency and not to be lost by imprudent operations. Within the limitation of prudence there is

ample scope for necessary training. Testimony is given that there should be four general weather maps per diem as in Europe instead of two as in the United States. This seems a reasonable recommendation. Commercial air lines find it desirable to send out hourly weather reports along their routes. As experience has demonstrated to Europe the desirability of four weather maps a day, the varied and complex systems of transportation in continental United States would be well served if a like number could be instituted under our weather bureau.

NAVIGATION

By a strange fatality the course of the *Akron* on the night of her doom led her by successive stages into the vortex in which she was destroyed. It really seems that any other course than the one taken would have compassed her salvation. Was her destruction inevitable? Must it be concluded that blind destiny some day must bring every airship to a position where the vertical currents of intense storms will destroy her? The experience of Dr. Eckener and his colleagues points otherwise. It is a significant fact that in all the years of the operations of German Zeppelins in commercial transport there has not been the loss of a life of a single passenger. Lieutenant Commander Wiley, the senior survivor, reluctantly testified that on the fatal night of April 3-4, at every decisive point of the flight, he would have steered a course west to the safe semicircle of the storm. This is an application of the law of storms that has prevailed at sea from the days of sailing ships. Hindsight tells us that had the *Akron* taken a westerly course at any point in her flight up to and including the hour of midnight when she last left the coast going east, in all probability she would have found her way to safety. True, the commanding officer had seen lightning to the west. True, one cannot at this time reconstruct all of the data and considerations which were present in his mind. What information was available to him that was not available to Lieutenant Commander Wiley is not and cannot be known.

It was testified that had Lieutenant Commander Wiley been in command he would have steered west at 8:35 p.m., when the lightning was seen to the south, and it was known that there was a thunder storm over Washington. It was testified that Lieutenant Commander Wiley so expressed himself shortly thereafter to the commanding officer. It was testified that Lieutenant Commander Wiley, had he been in command, at every subsequent change of course would have steered to the west seeking the safe semicircle. Though baffled by the intense lightning and storm that surrounded the ship at sea at 11 p.m., still when the course was reversed to the westerly Lieutenant Commander Wiley was satisfied that safety, if any, lay in that direction. A sense of decency causes the mind to shrink from pronouncing judgment on the dead. Especially is this so when a brave officer has met his fate with the highest courage and devotion and we who sit puzzling to learn the lessons of the tragedy perhaps have never faced real danger. But a solemn duty rests upon this committee. In its hands may lie the fate, so far as this Nation is concerned, of an art that may serve as an important medium of transportation and an implement profoundly affecting the efficiency of the fleet.

THE CRASH

What caused the crash of the *Akron*? About 12:30 a.m., April 4, she was caught in a descending current of air and fell 900 feet from her recorded altitude of 1,600 feet to 700 feet. With the aid of dropping ballast and dynamic lift she was brought again to a cruising altitude of a recorded 1,600 feet, maintained the same for from 1 to 3 minutes, when again a down current thrust her toward the sea. Ballast dropping, engines running, she hit the water, stern first, tearing off the lower fin and lower rudder. Then the strain and stress caused by the terrific impact broke the upper rudder control wires and the engine telegraph wires. Of this we have the direct testimony of Lieutenant Commander Wiley. There is no direct testimony as to when and if the elevator control wires carried away. They were on the port side of the control car where Commander McCord and Lieutenant Calnan had their stations. Lieutenant Commander Wiley was conning the rudder control and could see the engine telegraph wires from his station.

Did the *Akron* break up in the air? At first Lieutenant Commander Wiley thought she did, but on further analysis and consideration he came to the conclusion that there was no structural failure until after the stern hit the water. Deal and Erwin testified to the contrary. They were not in the control car but in the body of the ship. Deal testified that he saw longitudinal girders Nos. 7 and 8 on the port side give way, and is of the opinion that a structural failure preceded the crash of the stern in the water. Neither of these men felt the shock which Wiley said was very sharply felt and preceded the crash. Both Deal and Erwin had been off duty and were in their bunks and emerged therefrom just prior to the crash. The issue is not free from doubt. Lieutenant Commander Wiley is the only survivor who was in the control car, and his net conclusion is probably the best evidence, and it may be inferred therefrom, not with certainty, that there was no structural failure until after the stern hit the water. Airships have broken up in the air. The British *E-38* during test flights precedent to the delivery of the ship to the United States was broken in the air in the midst of a sudden change of direction purposely applied by the rudder control. The resulting strain was too great for her structural strength. Likewise the naval court of inquiry investigating the *Shenandoah* disaster found that the ship broke up in the air due to the impact of aerodynamic forces experienced while in the grip of violent vertical currents. This is based on the testimony of survivors of the *Shenandoah* disaster.

It is probable that during critical periods of the *Akron's* flight the ship was flying at an altitude of 300 feet more or less lower than the reading of the barometric altimeter. Change of pressure in storm conditions might well cause a considerable error as to altitude and the error would be on the side of the actual altitude being less than that recorded on the altimeter. The ship carried an echosounding device, an auxiliary instrument for ascertaining altitude by a pistol discharge and a stop watch. This device is susceptible of error, but appears not to have been used at all in the emergency.

Did the rupture of gas cells cause or contribute to the crash of the *Akron*? It seems not. If there had been any appreciable escape of helium for many minutes prior to the crash it would have been reported to the officers in the control car. Though there may have been other structural failures than those reported by the survivors, Deal does not report the ruptured girders 7 and 8 actually to have pierced a gas cell. Lieutenant Commander Wiley is clearly of the opinion that the crash was not due to loss of helium from ruptured gas cells or escape through the valves. From all the testimony the inference is that the vast mass of the *Akron* gained a downward momentum when caught in the grip of a down current; that the actual emergency dropping of such ballast as was dropped and the dynamic lift derived from the engine power was insufficient to create an upward thrust adequate to lift her against the down current.

It is not evident from the testimony that stopping the engines just before the crash would have saved the ship. A novel engineering feature of the *Akron* permitted a rotation of the propellers through an arc so as to apply tractive forces of the propellers and engines either downward to facilitate landing or upward. To utilize the function of this innovation requires slowing down the engines for about 45 seconds of time. In the emergency that destroyed the *Akron* this feature was not employed. It seems that the swift succession of events and lack of time did not suggest the desirability of the attempt.

The evidence does not show that any orders were given to cut away fuel tanks in a last effort to stop the fatal descent of the ship. The desirability of so doing was apparent to Deal, as appears from his testimony before the naval court of inquiry, and he considered taking such action on his own responsibility. Cutting away and dropping the fuel tanks would have eliminated a great weight from the ship. Of course it cannot be determined if such action would have saved her. There seems no prospect that an airship can be built which would be useful as a means of transportation and scouting that is capable of resisting the most intense vertical currents that may be encountered anywhere in nature. Therefore they must be avoided.

The ship crashed and some considerable number of the ship's company were hurled into the water alive. The only survivors were from among those who were able to make their way to flotsam, Lieutenant Commander Wiley to a piece of wood, Deal, Erwin, Copeland, and Rutan to an empty fuel tank. Orders in effect at the time of this accident required life belts to be carried aboard the *Akron* sufficient in number for the ship's company. Lieutenant Commander Wiley thinks they were so carried but states that since he was not in his cabin during the voyage he is not in position to know definitely if a life belt was in its accustomed place under his bunk. Lieut. Comdr. J. L. Kenworthy, acting commandant of the naval station at Lakehurst, gives direct testimony that the life belts were not aboard but were in the storeroom at Lakehurst. This is a breach of discipline. It cannot be definitely stated that the presence on board of an adequate number of life belts would have caused more lives to be saved. Other flotation gear was aboard in the form of cushions and rafts. Lieutenant Commander Wiley is of the opinion that the presence of life belts on board would not have

increased the number of survivors. It is a tenable opinion that compliance with regulations might have afforded a better chance of escape to a larger number. In this connection it is not understood how the Navy court of inquiry on the *Akron* disaster can sustain its finding no. 6 "at the time of take-off on April 3, 1933, the *Akron* was fully and properly manned and equipped in material readiness for flight and with no unauthorized persons on board." If the Navy Department orders require life belts to be aboard and they were not aboard the ship could not have been properly equipped.

Was the crash caused by the ship being struck by lightning? There is no evidence to this effect. Of all recorded airship disasters there is but one Zeppelin definitely stated to have been lost when, in valving hydrogen gas, lightning struck the ship and fire destroyed it. The helium in the *Akron* was not susceptible to explosion by lightning. There is no evidence of the ship being struck and the consensus of engineering opinion seems to be that such a ship is relatively immune to lightning.

RADIO COMMUNICATIONS

The ship was equipped with elaborate radio installations weighing about 2 tons. There is no evidence that the radio equipment was not of the best. So far as the condition of extreme static permitted, the 8 p.m. weather map was broadcast in code signals from the naval radio station at Arlington and so much of the information as was received was translated to the weather map in the aerology room of the *Akron*. At 9:46 p.m., Washington called the *Akron*, asking the operator by conventional signals "Have you anything for me?" The *Akron* immediately replied, "I have nothing for you." There was no difficulty in that final exchange of messages. The naval communications officer is of the opinion that if the *Akron* had not received the full weather report at that time she would have asked for a repetition of at least part of it. At about 10 o'clock p.m., the radio trailing antennae of the *Akron* were pulled in. It would seem that the *Akron* was in a position to ask Washington for any weather information desired. The attempt may have been made but there is no record of it. The log of the Washington station shows several attempts made to reach the *Akron* between 10 p.m. and midnight and between midnight and 2 a.m. No reply was received. If the *Akron* had called Washington after 10 o'clock Washington would have heard because the static cleared up at Washington after 10 o'clock. An air mail pilot, who flew from Newark to Richmond during this same period, testified that his radio functioned satisfactorily and all weather reports were received. He was flying on the western edge of the storm. It was testified that the *Akron* could still send on high frequency and reach Washington with only the fixed antennae. She had not only ultra-high frequency but also an intermediate frequency set.

Testimony was given that the following message from Commander McCord was received on April 3 by radio traffic station, Newark airport:

Akron will be flying along the New Jersey coast tonight, Monday. Request Newark and Washington guard 3,105 kilocycles.

Later the Newark radio station received the following message from the *Akron*:

Akron flying Lakehurst to Philadelphia to Delaware Capes; thence south along coast, 7:45.

The *Akron* was equipped with special receivers for listening in on the voice broadcasts from radio stations of the Department of Commerce Airways Division. The naval station at Lakehurst was connected with the teletype system of the Department of Commerce. On the night of the *Akron* crash all records indicate that weather broadcasts were properly sent from appropriate stations. But the condition of static and the weather through which the *Akron* was operating would normally reduce to a minimum the capacity of her radio for reception at least part of the time. Weak signals on 3,105 kilocycles, unintelligible through heavy static which almost blanketed them entirely were heard at 12:06 a.m. on April 4. Weak signals on this kilocycle were received at 12:06, 12:13, 12:18, up to 12:35 a.m. on April 4. These messages were coming in on "continuous wave." Transport planes sending messages normally would be utilizing voice, so it is quite possible that these unintelligible messages were the last words sent from the *Akron* up to the time of her destruction.

RECOMMENDATIONS

The *Akron* was the latest product of the engineering ability of Germans steeped in the tradition of the German Zeppelin Corporation. Engineering contributions were made by skilled officers of the United States Naval Construction Corps. The fabricating resources of the Goodyear-Zeppelin Corporation were applied to her construction. Every ounce of material, every rivet, every instrument that went into her was inspected by a large and qualified corps of naval inspectors. There was assembled a crew of experienced officers and men. She went to her destruction with the loss of 74 valuable lives and cost the Government \$5,358,000.

The *Shenandoah*, costing the Government \$2,200,000, was destroyed on September 3, 1925, with a loss of 14 lives.

The Army non-rigid dirigible *Roma*, costing the Government \$185,000, was destroyed on February 21, 1922, with a loss of 33 lives.

The British dirigible *R-101*, costing the British Government \$5,000,000, was destroyed at Beauvais, France, on October 4, 1930, with a loss of 48 lives, including Lord Thomson, Secretary of State for Air, and Sir Sefton Brancker, Director of Civil Aviation.

The *R-38*, costing the British Government \$2,000,000, about to be delivered to the Government of the United States, broke up in the air on August 24, 1921, with a loss of 44 lives, including 14 officers and men of the United States Navy.

In the light of these deplorable losses shall the Government of the United States continue to spend money on airships for the Army and Navy?

(By agreement between the services the development of rigid airship is left to the Navy. The Army employs only observation balloons and non-rigid airships experimentally for coastal patrol.)

Since the war the United States Navy has had three large airships—the *Shenandoah*, the *Los Angeles*, and the *Akron*. The *Shenandoah* and the *Akron* have been destroyed. The *Los Angeles* lived out a normal career and was decommissioned on June 30, 1932, for reasons of economy.

What is the history of progress? Disaster and sacrifice run through the experimental stages of development until a reasonable perfection has been attained.

The history of steam maritime navigation is not without its tragedies.

The same prevails in the history of railroads.

Each year the automobile takes a toll of life comparable to the outright battle deaths per year of the Army of the United States in the World War.

The evolution of the submarine carried many men to their deaths and continues from time to time to write a tragic story.

The rigid airship has been in the hands of our Navy about a decade. What was the record of human mortality in military and naval airplanes during the first 10 years of their service? And still the daily press records a succession of airplane deaths that do not deter airplane pilots from circumnavigating the globe nor half a million passengers per annum using the commercial airways of the Nation.

Even the development of the naval gun turret was costly in human life as well as money.

The fundamental question is whether the *Akron* and other airship disasters are to lead the Congress to compel the abandonment of airship development and operation by the Navy, scrap the costly installations at Lakehurst, N.J., and Sunnyvale, Calif., and withdraw from airship development either with acknowledgment of defeat or conviction that the game is not worth the candle.

In the last decade the Government has spent approximately \$40,000,000 on airship construction, development, and operation apart from the pay of personnel. Shall it be permitted to continue?

What considerations and counsel should determine this question? For authoritative solution of the problem so far as the Navy is concerned recourse normally will be had to the Secretary of the Navy and the General Board. What is the result?

The distinguished officers who constitute the General Board may be called the elder statesmen of the Navy. They cannot be held as prejudiced in favor of the airship by past service because they are not and never have been aviators. Ambition cannot warp their counsels, for their race is run. So far as it may be had from professional sailors a recommendation of continuance of the development of airships by the General Board of the Navy must carry great technical weight and be based only on a conviction of an actual or potential importance of the airship to the fleet. The various pronouncements of the General Board have received the approval of the several Secretaries of the Navy in office when the recommendations were made.

The latest statement of the General Board on the subject of airships, approved May 10, 1933, is as follows: "to develop * * * (b) lighter-than-air, to maintain as necessary the rigid airships now

built and building to determine their usefulness for naval and other governmental purposes and their commercial value."

The Chief of Operations, Admiral Wm. V. Pratt, the chief administrative naval officer, himself not a flier and at the age of retirement, concurs in the recommendation of the General Board and states his reasons.

Rear Admiral E. J. King, Chief of the Bureau of Aeronautics, follows his distinguished predecessor, Admiral Moffett, in support of the airship.

What are the reasons given for the support by the array of professional and other witnesses? Primarily the airship is testified to be a naval scout of great range and speed as compared with surface vessels. The *Macon* type has a cruising range at 50 knots in still air of 8,000 to 9,000 nautical miles. She can carry within her envelope 5 airplanes which, issuing from it, extend her scouting range. The planes may be sent forth from the airship to see, without the certainty of the airship coming within the range of the enemy observation. The planes supplement the other defensive armament carried by the airships. Making the airship a scouting airplane carrier for use with the fleet is an American innovation. It is successful.

The scouting airship with its great range diminishes the scouting load on plane carriers and other surface craft. It supplants nothing. It supplements all.

Going back some 15 years to the naval operations of the World War it is found that the German airships performed valuable service to the German fleet in reconnaissance, in the location and destruction of mines and submarines and otherwise. Lord Jellicoe, commander in chief of the British fleet, gave eloquent testimony to their utility by deploring his own lack of them. In war, to know with certainty where the enemy is not, is only less important than knowing where he is. The function of obtaining negative and positive information is a fertile field in which the airship works.

Though vulnerable to certain extreme weather conditions in the present state of the art, airships can remain aloft in fogs and other low visibility conditions which cause airplanes to stay out of the air. They can remain stationary for long periods with a minimum expenditure of fuel. Increasing aerological knowledge and improved airmanship may reasonably be expected to increase the safety of the airship's operations.

As the world makes progress in the limitation and reduction of armament by mutual agreement the size of fleets diminishes. There are fewer surface ships for the scouting line. The opportunity for surprise attack is enhanced. To the same degree is enhanced the necessity on the scouting line of a scouting airship.

On the broad waters of the Atlantic it is essential that so far as possible our coasts be insured against surprise attack. The same necessity prevails on the Pacific and to a greater degree in partial proportion of the area of the Pacific Ocean to the Atlantic Ocean. The problem of protecting the insular possessions of the Nation is also involved.

True, England with the disaster to the *R-101*, intended for commercial purposes, abandoned airship construction. England has no

helium. Nevertheless, the airship personnel at Cardington—the English Lakehurst—is being augmented and lighter-than-air appropriations have been increased.

Whatever may be the defense plans for the outlying commonwealths of the British Empire the naval defense of the homeland is in relatively narrow waters. Nor by necessity should the practice of Great Britain be the measure of American policy. At least we know that the importance of noninflammable helium is sufficiently acknowledged by other nations to cause a very thorough search by them for helium in their own territories. For the present the United States has a practical monopoly of the helium production of the world. Add to this asset the development of a satisfactory Diesel-type motor for airships, the combination of noninflammable helium and practically noninflammable fuel and the airship will be relatively free from fire risk.

Without exception the surviving personnel of American airship disasters believe in the airship and court further service therein.

The highest naval authority recommends the continuance of the airship as an element of the fleet. It seems more in accord with the spirit and tradition of the United States to apply in the future the lessons of the *Akron* disaster than to let her loss be the signal of defeat.

The record sustains the recommendation that the operation, maintenance and development of airships be continued.

If the U.S.S. *Macon* satisfactorily completes her trial tests and is accepted by the Navy she should be commissioned.

Throughout the history of the operation of rigid airships by the United States Navy there has not been an adequate opportunity for the training of airship personnel. Only for a short time were there two ships simultaneously in commission—the *Los Angeles* and the *Akron*. The *Los Angeles* has been laid up for reasons of economy. If there is to be adequate opportunity for training so that a larger personnel may gain experience it is desirable that a training ship be commissioned. The *Los Angeles* might be recommissioned and used as a training ship pending the building of a new training ship embodying the recent developments of the engineering art.

It is evident from the record that airship operation is still relatively in the experimental stage. Navy personnel familiar with airship operation is limited in numbers. It is highly important that there should be continuity in experience, training, and the transmission of knowledge. There are many officers high in command in the Navy with little or no personal operating experience in any type of air craft. Time probably will remedy this. But there is no more reason to believe that a commander will be able to make an intelligent use of aircraft without personal experience than there is to believe that an experienced air man can make a successful fleet commander without personal experience on surface ships. A lack of appreciation on the part of high navy officials of the necessity of continuity in experience, training, and the transmission of knowledge may well retard the development of efficiency in the air service and affect adversely the efficiency of the fleet. It is hoped that naval administration will bear this thought in mind, apply it to the "lighter-than-air" division of naval aviation, thus furthering the

development of the art in the experimental stages and minimize the chance of such disasters as befell the *Akron* and the *Shenandoah*.

The airship operates in three dimensions as does the submarine. There are many analogies between a sea of water and a sea of air. The sea of air is subject perhaps even to more sudden and intense changes than the sea of water. The violent vertical air currents found in storm conditions are a menace to the life of aircraft. The experience of Dr. Eckener and other German navigators seems to show that airmanship can be developed to a point where the airship either may avoid or survive the storms. There is growing up a modern science of aerology. Recent developments are leading to a new art—the study of the upper air. The conditions in the upper air present some of the most valuable data upon which to base accurate weather forecasts. There is no substitute for knowledge and experience. The evidence before this committee justifies the recommendation to the Navy Department that it give greater attention to the training and experience of airship personnel in aerology.

The *Akron* disaster discloses the unreliability and inaccuracy of the present type of barometric altimeter. It is subject to error in recording as the atmospheric pressure changes with the rapid mutations accompanying storm conditions. Persistent effort should be made to improve the method of ascertaining rapidly and accurately the true altitude of airships under all conditions.

It is recommended that earnest efforts be made to develop for airships a Diesel type motor which will eliminate the necessity of carrying highly inflammable fuel aboard the ship. If this objective can be attained then, as aforesaid, Diesel type motors in connection with helium gas will eliminate most of the fire risk aboard airships.

It is shown from the evidence as previously stated that the safety regulations of the Navy Department relating to the carrying of safety belts were not obeyed. It is not only the duty of the Navy Department to prescribe full and adequate safety regulations for the operation of airships, but also it is its duty to enforce these regulations.

The concurrent resolution creating a Joint Committee to Investigate the Cause of Wrecks of Dirigibles, etc., authorizes and directs the committee to investigate the cause or causes of the wreck of the Navy dirigible *Akron*, etc., to fix responsibility for the same, to inquire generally into the question of the utility of dirigibles in military and naval establishments, and to make recommendations to the Senate and the House of Representatives as to the future use of dirigibles for military and naval purposes.

1. The proximate cause of the wreck of the *Akron* was the crash of the stern on the sea about 20 miles off Barnegat Light when in a swift vertical descent caused by a vertical down current of air in the midst of a thunder and lightning storm. There may have been other contributing causes.

2. Responsibility for the crash was the navigation of the ship into the storm conditions where she was destroyed.

3. Rigid airships by past experience in the World War and by recent exercises of the fleet are found to have special actual utility on the scouting line of the fleet. Still in the developmental stage,

there is a further potential utility to be developed only by experience. The rigid airship seems to have little utility in the operations of the Army. The allocation of airships to the Navy for development and operation is sound.

4. It is recommended that the Navy continue in the maintenance, development, and operation of airships.

5. It is recommended that the naval air station at Lakehurst, N.J., be the center of training and a center of experiment; that a most experienced airship commander be assigned to its command and that there be placed at his disposal experts in airship operation, aerology, radio, and other fields of instruction and research, and that free balloons and nonrigid airships be provided for training.

Administration of "lighter-than-air" by the Navy should insure continuity of personnel and experience. Only fully trained officers of wide airship experience should be in command of airships. Command of a training ship should be a prerequisite for command of a ship of the *Macon* type operating with the fleet.

Impediments to promotion of Navy officers should not be caused by their having specialized in the navigation of aircraft. Naturally every officer seeks promotion and will avoid any course that may deter, postpone or prevent promotion. If Navy regulations as now administered discourage capable and ambitious young naval officers from continuous and zealous study of and training with aircraft, then such regulations should be modified or such administration should cease.

6. It is recommended that a training ship be promptly built and that a new airship should be built to replace the *Akron*, embodying such new developments as experience may show to be desirable. This is in accord with the principle of the 5-year plan that contemplated the desirability of two airships operating with the fleet. In the meantime it is recommended that the *Los Angeles* be put back into commission for training and research pending the completion of a new training ship.

7. It is recommended that four general weather maps per diem be issued by the United States Weather Bureau instead of two as at present.

Supplementing the preceding report we believe the attention of Congress should be called to the following conclusions and recommendations in addition to those set forth in the report of the committee adopted June 10, 1933, and hereinbefore stated.

The Navy Department has not operated its Air Service in compliance with the spirit of paragraph 6 of section 3 of the act entitled "An act to authorize the construction and procurement of aircraft and aircraft equipment in the Navy and Marine Corps, and to adjust and define the status of the operating personnel in connection therewith", approved June 24, 1926, as amended, and this fact contributed to the loss of the *Akron*.

It is evident from the testimony that the lack of experience and lack of knowledge of the air and the air currents contributed largely to the disaster. The *Akron* was flying dangerously low in the storm area in view of the lack of dependability of the altimeter. We believe that had there been more experienced and better trained men (and such men were available) in command of the *Akron* the disaster

probably would not have happened. We feel bound to warn the Navy Department against following the same mistaken policy in the management of the *Macon* that contributed to the disaster to the *Akron*, so that every safeguard should surround the operation of the *Macon*.

We believe the Navy Department should energetically study—

1. The equipment of its training airships with duplicate controls so as to give its student officers more training in handling the controls of airships.

2. The use of stabilizers for the control of airships.

3. Means to determine the draft of airships under adverse weather conditions.

4. Means to determine more accurately the altitude of airships.

We respectfully call attention to the fact that the Navy Department's investigation of the wreck of the dirigible *Akron* was lacking in thoroughness, as is evidenced by the statement in the report of such investigation that the airship was "fully and properly manned and equipped in material readiness for flight", whereas there were in fact no life preservers on board the airship, as required by regulations.

We further call attention to the fact that the Navy Department has available and can obtain competent personnel to properly manage the experimental and highly specialized airship.

It is our opinion that in case the Navy Department has not corrected this situation before the convening of the next session of Congress that it will be necessary to enact further legislation seeking safe operation of aircraft, including probably such provisions as the creation of a Navy air corps.

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The chairman of the Joint Committee, Mr. King, Senator from Utah, has informed the committee that he will subsequently file minority views.