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REPORT OF THE CIVIL AERONAUTICS BOARD

Of the investigation of an accident
involving civil aircraft of the United
States NC 15592 which occurred near
Cincinnati, Ohio, on March 10, 1941.

Docket No. SA-34

CONDUCT OF INVESTIGATION

An accident involving aircraft NC 15592 occurred at the Municipal Airport, Cincinnati, Ohio, on March 10, 1941, about 8:35 p.m. (EST)^{1/} while the aircraft was operating in scheduled air carrier service between Chicago, Illinois, and Washington, D. C., as Trip 20 of American Airlines, Inc. (hereinafter referred to as "American"). The accident resulted in partial destruction of the aircraft and minor injuries to nine passengers and three members of the crew. The Washington office of the Civil Aeronautics Board (hereinafter referred to as the "Board") was officially notified of the accident about 9:30 p.m. that evening.

Inspection and Preservation of the Wreckage

Immediately after receiving this notification the Board initiated an investigation of the accident in accordance with the provisions of Section 702(a)(2) of the Civil Aeronautics Act of 1938, as amended, (hereinafter referred to as the "Act"). Accident investigators of the Board arrived at the Cincinnati Municipal Airport on the following day about 11:00 a.m. In accordance with the instructions of the Board, the damaged airplane had been placed under guard and had not been disturbed except to the extent necessary to remove passengers, mail and cargo from the wreckage. Upon arrival, the investigators of the Board had the aircraft

^{1/} All times used herein are Eastern Standard Time unless otherwise indicated.

removed to American's hangar, where a constant guard was maintained over the wreckage until the aircraft was released.

A thorough and complete examination was made of all parts of the aircraft, engine and propellers by representatives of the Board. At the termination of the hearing on March 20, 1941, the aircraft was released to American.

Public Hearing

In connection with the investigation of the accident a public hearing was held at Cincinnati, Ohio, beginning March 18 and continuing through March 20, 1941. G. Grant Mason, Jr., one of the five members of the Board, was designated by the Board to preside at the hearing. He was assisted by Henry L. Knight, Attorney of the Board, who acted as Associate Examiner; Jerome Lederer, Director of the Safety Bureau of the Board; Frank E. Caldwell, Chief of the Investigation Division of the Safety Bureau; James H. Douglas, Assistant to the Chief of the Investigation Division of the Safety Bureau; Paul A. Garrau, Air Safety Specialist in Meteorology of the Safety Bureau; and William K. Andrews, Chief of the Investigation Section of the Safety Bureau.

All of the evidence available to the Board at the time was presented at the hearing. Testimony was given by 31 witnesses and a total of 38 exhibits were received in evidence. One letter and eight depositions of the nine passengers were read into the record at the hearing.

While the Examiners and the representatives of the Safety

Bureau were the only ones designated to ask questions directly of the witnesses, the Presiding Examiner, acting under instruction of the Board, announced at the opening of the hearing that any person who had any evidence, questions or suggestions to present for consideration in the proceeding might submit them to the Examiner. In accordance with this suggestion, 21 written questions were so submitted and each one was propounded and answered during the hearing.

Upon the basis of all the evidence accumulated in the investigation the Board now makes its report in accordance with the provisions of the act.

II.

SUMMARY AND ANALYSIS OF EVIDENCE

Air Carrier

American, a Delaware corporation, was operating at the time of the accident as an air carrier under a currently effective certificate of public convenience and necessity and a currently effective air carrier operating certificate, both of which had been theretofore issued to it pursuant to the Act. Trip 21 was being conducted pursuant to authority contained in American's certificate of public convenience and necessity for Route No. 25 by which it is authorized to engage in air transportation of persons, property and mail between the terminal point Washington, D. C., the intermediate points Elkins, West Virginia; Clarksburg, West Virginia; Parkersburg, West Virginia; Charleston-

Dunbar, West Virginia; Huntington, West Virginia; Cincinnati, Ohio; and Indianapolis, Indiana; and the terminal point Chicago, Illinois.

Flight Personnel

On the flight in question the crew consisted of Captain Lester W. Bryant, First Officer James G. Murray and Flight Stewardess Audrey Marquiss.

Captain Bryant, aged 33, had accumulated a total of 10,965 hours of flight time prior to the accident and was at that time the holder of airline transport pilot certificate No. 2933. Since his employment by American on March 1, 1931, he had accumulated a total of 7,465 hours, of which his total time on DC-3 equipment amounted to 2,768 hours. Included in Captain Bryant's flight time was a total of approximately 771 hours of actual instrument operation and approximately 83 hours of flight time under simulated instrument conditions. His last physical examination required by the Civil Air Regulations was taken on January 9, 1941, and showed that he was in a satisfactory physical condition. Company records indicated that he was a well qualified and proficient pilot. In addition, Captain Bryant had been flying into and out of the Cincinnati Airport as a pilot on American's Route No. 25 for almost five years.

First Officer Murray, aged 24, had accumulated a total of 1,549 hours of flight time prior to the accident and was at that time the holder of airline transport pilot certificate No. 43065

valid only for scheduled operations as a second pilot. Included in this accumulated time was 775 hours as copilot since his employment by American on June 1, 1939. Of his total flight time with American 718 hours had been on Douglas equipment. His experience included 183 hours of instrument operation. His last physical examination required by the Civil Air Regulations was taken on November 25, 1940, and showed him to be in satisfactory physical condition. Before starting regular service with American in scheduled operation First Officer Murray had completed the prescribed company course of training for first officers.

Regular line checks had been given to both pilots at regular intervals, the latest one having been given to Captain Bryant on January 10, 1941. In addition, Captain Bryant had been given an instrument approach check at the Chicago Airport on March 5, 1941. Prior to leaving Chicago on Trip 20 both pilots had had a rest period of 28 hours and 22 minutes and their only flight time during the 24 hours prior to the accident had been 2 hours and 20 minutes which was the elapsed time between Chicago and the Cincinnati Airport.

Thus it appears from the evidence that both Captain Bryant and First Officer Murray were physically qualified to perform their duties on the day of the accident and held the proper certificates of competency for the flight and equipment involved.

Airplane and Equipment

Aircraft NC 15592 was a Douglas Model DC-3B manufactured by the Douglas Aircraft Corporation of Santa Monica, California, and was purchased by American on July 11, 1940. It was powered by two Wright Cyclone G102 engines each rated at 1100 h.p. for take-off and was equipped with Hamilton Standard hydromatic propellers. The hub model of these propellers was 23E50 and the blade design of both propellers was 6153A-18. This aircraft and equipment had been approved by the Civil Aeronautics Administration for air carrier operation over routes flown by American for 21 passengers and a crew of four. The airplane, as equipped with de-icers, had been certificated for operation with a standard gross weight of 24,546 pounds and a provisional gross weight of 24,946 pounds.^{2/} At the time of departure of Trip 20 from Chicago the gross weight of the aircraft was 23,126 pounds including mail, cargo, 621 gallons of fuel, 40 gallons of oil, nine passengers, and a crew of three. The record further shows that the airplane was loaded in accordance with the current approved loading schedule prescribed by the Civil Aeronautics Administration, which was attached to the airworthiness certificate of the airplane.

The airplane and its equipment had received the overhauls.

^{2/} The standard gross weight of an aircraft is the maximum allowable gross weight for landing, while the provisional gross weight of an aircraft is the maximum allowable gross weight for take-off. When an aircraft takes off at its maximum provisional gross weight, the weight of the aircraft must be reduced by gasoline consumption at least to the standard gross weight for landing prior to arrival at its next scheduled stop. If sufficient gasoline has not been consumed between the time of take-off and any emergency landing, gasoline can be dumped by the use of tested and approved dump valves in order to reduce the total weight to the approved gross weight for landing.

periodic inspections and checks which are provided for in company practice and approved by the Civil Aeronautics Administration.

History of the Flight

American's Trip 20 of March 10, 1941, originating at the Chicago, Illinois, Municipal Airport and operating as a scheduled air carrier from Chicago, Illinois, to Washington, D. C., with an intermediate stop at Cincinnati, Ohio, was dispatched non-stop to Cincinnati at 5:15 p.m. (CST).

Prior to departure from Chicago, Captain Bryant, with the assistance of the company meteorologist and the assistant flight superintendent, prepared a flight plan for the route from Chicago, Illinois, to Washington, D. C. This flight plan was based on a trip forecast and terminal forecasts prepared by the company meteorologist using weather data issued by the United States Weather Bureau for various points along the route. (See Appendix A).

The weather sequence reports indicated that at the time instrument conditions prevailed at Chicago, Indianapolis, and Louisville, and that contact conditions, with ceilings of 4000 feet or better, existed at Cincinnati, Washington, Pittsburgh, and Columbus. The latter city was designated as an alternate terminal on this trip in accordance with company procedure. The weather along the route and at Columbus was expected to remain well above the minimums prescribed by the company operations manual until after the flight was scheduled to arrive at Cincinnati or at Columbus, if necessary.

The 1:30 p.m. weather maps used in making the trip forecast

showed a low pressure system centered over Illinois with a warm front extending southeastward from the center and a cold front extending southward from the center. To the north of the intersection of the warm and cold fronts an occluded front extended for a distance of 200 miles. There was a marked wind shift across the occlusion with easterly winds on the north and east side and northwesterly winds on the western side. This whole system was moving northeastward about 20 to 25 miles per hour. A forecast based on the last six-hour movement of the frontal system placed the point of occlusion of the warm and cold fronts between Louisville and Cincinnati at 7:30 p.m.

Although neither the trip forecast nor the terminal forecast, furnished Captain Bryant prior to departure, indicated any probability of Trip 20 encountering the storm front en route, the 5:30 p.m. (EST) Weather Bureau airway forecast contained information as to the existence of this storm area and the direction of its movement. This information was called to Captain Bryant's attention by the company meteorologist in a conversation prior to departure from Chicago. All the forecasts predicted the arrival of the storm in the vicinity of Cincinnati some time after midnight and on that assumption the assistant flight superintendent on duty at Chicago issued authority for Trip 20 to proceed non-stop on instruments from Chicago, Illinois, to Cincinnati, Ohio. Captain Bryant's flight plan, which he prepared after conference with the company

meteorologist, called for a cruising altitude of 5,000 feet for the Chicago-Cincinnati portion of the route. His flying time was estimated as one hour and nine minutes from Chicago to Indianapolis and 38 minutes from Indianapolis to Cincinnati. The flight plan and clearance were approved by the Airway Traffic Control ^{3/} at Chicago, Illinois, prior to the departure of the flight. The aircraft was fueled at Chicago to depart with 621 gallons of gasoline in the tanks, which was more than sufficient for the trip from Chicago to Cincinnati at normal cruising power; and in case of necessity, provided a sufficient reserve to proceed from Cincinnati to Columbus, the alternate terminal, and thereafter for more than four hours.

Trip 20, with Captain Bryant at the controls, departed from the loading ramp at Chicago Municipal Airport at 5:15 p.m. (CST), and took off at 5:24 p.m., after having been detained on the ground a few moments by the Chicago airport control tower ^{4/} on account of other traffic. Captain Bryant climbed the aircraft to 5,000 feet above sea level and, flying at this altitude in accordance with his flight plan, proceeded on instruments toward Cincinnati. Position

3/ The Airway Traffic Control staff, a part of the Civil Aeronautics Administration, regulates the flow of traffic over a civil airway during instrument weather conditions in order to eliminate the possibility of collision between aircraft. Before flying on a civil airway under instrument weather conditions approval must be secured from Airway Traffic Control for the flight, including the altitude at which it is to be flown.

4/ Airport control towers are erected and maintained by municipalities at various municipal airports for the purpose of regulating the flow of air traffic in the vicinity of the airport, in order to eliminate the possibility of collision between aircraft. These towers are normally equipped with radio receivers tuned to air carrier company frequencies, as well as those frequencies used by military and privately-owned aircraft. They are also usually equipped with a transmitter which operates on 278 kilocycles.

reports were made by radio over "fixes"^{5/} at the Goshen, Indiana, radio range intersection; Lafayette, Indiana; Indianapolis, Indiana; and Milroy, Indiana. At 7:45 p.m. (EST), shortly before reporting over Indianapolis, Trip 20 was contacted by American's company radio operator at Cincinnati and given the 7:35 p.m. Cincinnati weather report, which showed a ceiling of 2,300 feet, moderate rain and visibility of four miles. At 8:13 p.m. the company radio operator at Cincinnati informed Trip 20 that at that time the ceiling at Cincinnati was 1,300 feet varying occasionally to 1,800 feet, moderate rain and visibility of four miles. At 8:15 p.m. Trip 20 called the company radio operator at Cincinnati and reported that the flight had passed over Milroy, Indiana, (approximately 57 miles from Cincinnati) at 8:12 p.m. flying at 5,000 feet above sea level and was beginning its descent. Arrival in Cincinnati was then estimated to be at 8:34 p.m. The company radio operator at Cincinnati acknowledged receipt of the message and informed Trip 20 that the Cincinnati altimeter setting was 29.62, pressure altitude 760 feet^{6/} and that the surface winds were south-southeast. At 8:21 p.m. the company radio operator at Cincinnati again called Trip 20 and informed the crew of local airway traffic. At this time, Trip 20 requested that the Cincinnati surface winds be

5/ Points at which the exact position of the aircraft may be determined by radio, e.g., a fan marker, a cone of silence marker over a radio range station, or an intersection of radio ranges.

6/ All of American's aircraft are equipped with two sensitive type altimeters as required by Section 04.532(d) of the Civil Air Regulations. One of these instruments is kept adjusted in accordance with United States Weather Bureau reports to register altitude above sea level; the other is adjusted in accordance with information received by company radio from the point of intended landings, to register altitude above the surface of the ground at that point.

repeated. The Cincinnati company radio operator repeated, "Surface wind, south 10 miles per hour, Cincinnati altimeter 29.63, pressure altitude 760 feet." At 8:23 p.m., Trip 20 tried again to contact the Cincinnati company operator, but the attempt was unsuccessful due to rain static. After calling several more times, contact was made with the company radio operator at Chicago, and instructions were received from him to shift his transmitter to 3105 kilocycles and to contact the Cincinnati airport control tower for landing instructions.

Trip 20 then contacted the control tower and was advised that the wind was south 10 miles per hour and that he was to land on runway No. 6, which extends in a north-south direction. This report made no mention of squalls or gusty conditions in the vicinity of the Cincinnati Airport. As the flight descended, it broke out of the overcast and established contact over Harrison, Ohio (approximately 24 miles northwest of Cincinnati), at 3,000 feet above sea level, where turbulent air was encountered. Descent was continued along the west leg of the Cincinnati radio range; and when the lights of the city became visible, Captain Bryant altered his course to approach the airport along the Ohio River channel.

The Cincinnati Airport is located five miles east of the center of the City of Cincinnati at the juncture of the Little Miami and Ohio Rivers. The airport is bordered on its entire east side by a levee along the Little Miami River. There are three paved

runways which are numbered 1-4, 2-5, and 3-6. Runway 1-4 extends in a northwest-southeast direction and is 3,100 feet long. Runway 2-5 runs 3,656 feet in a northeast-southwest direction intersecting runway 1-4 in the northwest corner of the field at a right angle. Runway 3-6 runs approximately north and south and intersects runways 1-4 and 2-5. The over all length of the available landing area on this runway is approximately 5000 feet. However, only the segment of 2,561 feet between the points of intersection with the other runways is paved and the 2,400 feet north of the intersection with runway 2-5, while usable, is unpaved. At the midway point of runway 3-6 the curve of the levee approaches to a point within 300 feet of the runway, and the levee rises to a maximum height of 27 feet above the airport. However, from this point the levee curves to the east away from the runway in both a northeast and a southeast direction.

There are no flush type lights along the edges of the runways for use in night landings nor are there any neon approach lights at the end of the runways. Instead, the only identification marks appear in the boundary lighting system where two green range lights mark the flight path from the end of each runway. These lights are 150 or 200 feet apart and are located from 400 to 2400 feet from the end of the paved runways. The levee is lined with red obstruction lights which form a part of the boundary lighting system of the airport.

As Captain Bryant circled the airport to the left, in order

to reach a position from which to start his landing approach on runway No. 6, a moderate rain was falling. However, he stated that the airport lights were plainly visible at this time from the left window of the pilot's cockpit, and he estimated visibility through the side window to be two miles. During this circle Captain Bryant reached a point directly east of the airport and headed the ship in a northerly direction up the Little Miami River valley, continuing in this direction for approximately two miles. While at an altitude of about 450 feet above the level of the airport, a 180-degree left turn was made in order to approach runway No. 6 for a landing. Some time during or shortly after this maneuver, the landing lights of the airplane were turned on. Captain Bryant stated he was positive that he was lined up properly with runway No. 6 as he was flying at the proper angle to the new Turkey Bottom Road and could plainly see traffic lights along that road. A portion of this road is customarily used by pilots as a guide in lining up with the runway when making a landing under conditions of restricted visibility.

At a point about a mile north of the boundary of the airport, heavy rain was encountered which, according to the Captain's testimony, reduced his forward vision through the windshield to about one mile. The plane was not equipped with wipers or any other means of clearing the windshield of rain.^{7/} Captain Bryant also testified that as he continued his approach from the north he noticed that only one of the two green range lights for the No. 6 runway was burning. He stated that he had about 100 feet altitude when he passed over this one light and an

^{7/} Since the date of this accident, American has completed the installation of windshield wipers on all of its aircraft used in scheduled air carrier operations.

air speed of approximately 105 miles per hour and was endeavoring to contact the ground at the intersection of runways 5 and 6, as was the common practice of the airlines.

Captain Bryant stated that while the aircraft was gliding close to the ground prior to landing the wheels made very light contact with the ground at a point about 1,000 feet south of the runway range light in the unpaved portion of runway No. 6, north of the intersection with runway No. 5. Simultaneously with the contact a violent squall accompanied by heavy rain struck the aircraft, causing it to balloon up to a height of at least 25 feet, and its left wing to drop appreciably. In order to maintain control Captain Bryant applied partial power and by manipulating the controls, the airplane was returned to a level attitude. When the aircraft ballooned into the air he noticed a "green glow" dead ahead through the windshield which he believed to be the range lights at the south end of runway No. 6. Not being able to see any red obstruction lights and believing he was correctly lined up with runway No. 6 he then elected to continue his landing instead of going around a second time. Upon contacting the ground again in a normal landing position he suddenly saw that he was heading directly into the levee bordering the airport on the east side, and at that moment he first noticed the red obstruction lights along the top of the levee. He endeavored to avoid this levee by application of full right brake and full power to the left engine. Due to the wet, slippery surface of the field the aircraft did not groundloop as intended but turned only slightly sideways and skidded on into the levee. Captain Bryant stated that he was not able to see the red obstruction lights on the levee until he saw the levee itself in the glow of his landing lights.

First Officer Murray testified that during the landing approach the aircraft was in direct line with runway No. 6 and that at the time it passed over the airport boundary he could see the outline of the Aeronca factory on his right in what would be its normal location during a proper approach. He testified that at the same time he could see ahead of him the beacon light, the hangar lights, and lights in the vicinity of Ft. Thomas across the Ohio River. His recollection of the behavior of the aircraft following the encounter with the squall agreed with the description given by Captain Bryant. However, he did not recall having seen the green range lights at the south end of the runway or the red obstruction lights along the dike at the time the aircraft passed over the boundary of the field.

The airport control tower operator and several other witnesses who were present in the control tower, which is located in the northwest corner of the field, stated that they could see Trip 20 plainly as it circled the airport prior to landing and that it disappeared momentarily to the north of the airport and then reappeared as it approached runway No. 6 for a landing. These witnesses stated that after passing the edge of the field the aircraft rose slightly and power was applied to the engines. Some of the witnesses stated that it seemed that at this time the heading of the aircraft was changed. Due to the distance and the angle involved it is not thought possible for these witnesses to have determined accurately whether or not the aircraft actually changed its heading at this point, or, if so, to what extent.

A survey of the scene of the accident disclosed wheel tracks in the soft ground indicating that the aircraft had contacted the ground, while headed in a south-southeasterly direction, at a point 600 feet north of the levee and 726 feet east of runway No. 6. The tracks left in the soft ground headed directly into the levee and indicated the heading taken by

the aircraft to be 15 degrees to the east of runway No. 6. The unpaved section of runway No. 6 north of the intersection of the north-south runway and the northeast-southwest runway showed no wheel tracks of any description which would indicate that the aircraft had touched the ground prior to reaching the intersection of the two runways.

Conduct of the Flight

The dispatching of the flight from Chicago, Illinois, to Cincinnati, Ohio, was in accordance with proper procedure. On the basis of current weather reports and forecasts, clearance was properly issued for instrument operation between these points.

It appears that the Cincinnati radio range was functioning in the proper manner during the period of the flight. The range was monitored by the Civil Aeronautics Administration's communication stations immediately after notification of the accident and nothing was discovered which would indicate any malfunctioning of the range. Captain Bryant testified that there was no malfunctioning of any of the radio aids either along the route flown or at Cincinnati.

Captain Bryant stated that there was no difficulty in the operation of the aircraft during the flight which indicated in any manner the presence of a mechanical or structural defect except that two-way radio communication with company stations was often interrupted by rain static. A subsequent examination of the wreckage gave no indication of any structural or mechanical failure prior to the crash and confirmed the testimony of Captain Bryant. After removal from the aircraft the radio receivers and transmitters were found to be functioning properly.

Investigation of all weather services involved disclosed that the official observational facilities maintained by the United States Weather Bureau functioned in an entirely normal manner throughout the flight. The observers on duty followed the approved procedures at all times and carried out their duties adequately. It further appears that weather reports were broadcast regularly by the radio ranges along the route, including the one at Cincinnati, and that Captain Bryant was thereby apprised of all weather conditions and changes therein along the entire route.

In this regard it should be noted that none of the forecasts which were furnished to Captain Bryant prior to departure from Chicago or during his flight to Cincinnati indicated the probability of his encountering storm conditions on arrival at Cincinnati. The United States Weather Bureau airway forecast at 5:30 p.m. predicted the arrival of the warm front at the Fort Wayne-Cincinnati line about 1:30 a.m. the next morning and during the period from 5:30 to 1:30 predicted light rain at Cincinnati with minimum ceilings of 3000 feet. The trip and terminal forecasts furnished Captain Bryant by the company meteorologist indicated light rain throughout the entire trip with ceilings of 2000 feet at Cincinnati on arrival. Both forecasts were based upon the assumption that the fronts in the developing low pressure system shown on the 1:30 p.m. weather map would not reach Cincinnati until after midnight. However, due to an unexpected acceleration of the entire low pressure area, Trip 20 intercepted the extreme apex of an occluding energetic depression about the time it arrived over the Cincinnati airport. At that time the ceiling had dropped to 1300 feet, the visibility was restricted by

moderate to heavy rain and considerable turbulence existed at all levels below 3000 feet. Coincident with the arrival of this frontal system, such turbulence, at times almost down to the surface, was to be expected as well as locally heavy rain squalls and a sharply defined transition from west-southwesterly winds in the upper levels to south and southeast winds in a shallow layer near the ground.

Although the frontal system reached Cincinnati earlier than was predicted and prior to the arrival of Trip 20, it must be understood that in the preparation of the forecasts the movement of the frontal system was computed upon the basis of the known movement of the air masses during a number of hours preceding the making of the forecasts. This was in accordance with the normal practice. The accuracy of forecasts depends as much upon the observational facilities available as it does upon experience in the science of meteorology. Additional facilities as well as further development of the science of meteorology are necessary in order that more accurate forecasts can be made in predicting the acceleration in movements of air masses.

The significance of the failure of the forecasts to predict accurately the movement of the storm fronts is mitigated by the fact that the company meteorologist at Chicago called to Captain Bryant's attention before departure the information contained in the Weather Bureau airway forecast and that contained in the 1:30 p.m. weather map. With this information in mind Captain Bryant testified that he was not surprised by the conditions which he encountered upon arrival at Cincinnati and that he understood what was happening. Even if the forecasts had accurately predicted the frontal movement, Trip 20, according to the normal practice, would have been dispatched if the ceilings and visibility had been expected to remain equal to or above approved minimums. In such a situation Captain Bryant,

having been warned of the possible arrival of the storm front, would have been expected to exercise his own judgment in attempting a landing.

Although weather conditions at Columbus were consistently better than those at Cincinnati, there was nothing in the weather reports transmitted to Captain Bryant en route which would indicate that he should not have attempted to land at Cincinnati. Nor did three pilots of American who landed during the hour preceding the arrival of Trip 20 report any unusual weather conditions. Throughout Captain Bryant's whole landing approach, conditions remained above contact minimums by a substantial margin. Until just before Captain Bryant's plane contacted the ground there were no indications that a landing could not be made without undue interference from the weather. The sudden rain squall which hit the aircraft just as its wheels touched the ground was a condition which could not reasonably have been anticipated.

At the time of the accident it had rained continuously at Cincinnati for more than four hours and the area of the airport outside of the paved runways was slippery. Otherwise, the surface of the airport was in good condition. The airport electrician testified that hourly observations and reports on the evening of the accident revealed that all obstruction, boundary, hazard, and range lights were burning continuously. However, it is important to note that his hourly observations were made from the airport control tower and that from this point all of the obstruction and range lights could not be seen. Among those hidden from view from the airport control tower were one of the green range lights at each end of runway 3-6. Captain Bryant and First Officer Murray stated that at the time of their landing only one green light was burning at the north end of runway 3-6 and that they never saw the lights at the south end of the runway during the

approach. Captain Curry, who landed American's Trip 52 on runway 3-6 at 7:35 p.m., stated that one of the two green range lights marking the southern approach to runway 3-6 was out at the time he landed. Accordingly, the weight of the evidence convinces us that at the time of the final approach only one range light was burning at the north end of runway No. 6.

One of the principal questions presented is whether or not during the final approach the aircraft was properly lined up for a landing on runway No. 6. In view of Captain Bryant's testimony that during his final approach he did not see the range lights at the southern end of the runway, the red obstruction lights on the dike, nor any of the lighting system of the field except the one green light at the north end of runway No. 6, and in view of the fact that his only other guide was that stretch of Turkey Bottom Road which bears at an angle of about 10 degrees to the west from the true line of the runway, there is the possibility that Captain Bryant over-corrected to the extent of 15 degrees. The straight line of the wheel tracks running into the dike would seem to indicate this fact. However, both Captain Bryant and First Officer Murray upon the basis of observed landmarks concurred in the contention that when passing the airport boundary the aircraft was properly lined up with runway No. 6, and that the alteration in heading occurred when the aircraft ballooned into the air after being struck by a gust of wind and rain at a time when its wheels were touching or nearly touching the unpaved portion of runway No. 6. If the Captain and First Officer are correct in their description of what occurred, a substantial alteration in the heading of the aircraft must have resulted during a very short period of time. Not only must its heading have been altered 15 degrees but the aircraft itself must have been borne to the east a distance of about 400 feet. However, it is not impossible for

such a movement of the aircraft to have resulted from a violent gust of wind. Moreover, the testimony of some of the witnesses in the airport control tower substantiates the crew's contention in that it seemed to them that an alteration in heading occurred before the aircraft reached the intersection of runway No. 5 and runway No. 6. Therefore, admitting the difficulties in lining up with the runway when only one range light was burning and also the unusual character of the maneuver which followed the gust of wind, there is no substantial evidence upon which we could find that either Captain Bryant or First Officer Murray was mistaken as to their alignment with the runway or as to the nature of the subsequent maneuvers of the aircraft immediately preceding the crash.

In considering the situation with which Captain Bryant was confronted when his aircraft ballooned into the air, there must be kept in mind not only the fact that the gust of wind was strong enough to alter the heading of the aircraft, but also the fact that the accompanying rain was so heavy as to virtually blot out all forward vision from the cockpit. In such weather conditions, and any conditions of limited visibility, the lighting system on the Cincinnati Airport is wholly inadequate to guide a pilot to a safe landing. There are no approach lights or runway lights which can be used by the pilot as a means of maintaining his correct heading after passing the boundary of the field. The only guides which a pilot has to assist him in maintaining alignment with a runway are two green lights at each end of the runway. In the situation in which Captain Bryant was confronted he had no directional

aids to rely on after passing the boundary of the airport except two green lights over a mile distant at the opposite side of the airport.

When the aircraft ballooned into the air, Captain Bryant had to make a split-second choice between two alternatives, i.e., of continuing to a landing or of applying additional power and circling the field for another landing approach. By his own statement Captain Bryant, when at the top of his rise, could safely have applied power and circled the field again, but instead he elected to land because he saw ahead of him in the windshield a "green glow" which he took to be the range lights at the southern end of runway 6. It was his testimony that he first saw this green glow when at the height of his rise and that at that time he was unable to see any of the red obstruction lights upon the levee.

To continue the landing as Captain Bryant did under the uncertain wind conditions and almost zero visibility forward from the cockpit which prevailed at the time, was not an exercise of the highest degree of caution reasonably to be expected of airline pilots. Under the circumstances, prudence would have required that, unless he were certain that he was correctly lined up with the runway after having been caught in the violent gust of wind, he should follow the safer course and continue flying, while power was still being applied to the engines. It was poor judgment to attempt to land upon such a poorly lighted airport in reliance solely upon a "green glow", when all other landmarks were obscured from his point of view. Wind and rain conditions were a warning that the storm front of which he was apprised before departure had reached Cincinnati and should have prompted him to exercise the utmost diligence. A second circle of the field would have given him an opportunity to determine more correctly the prevailing weather conditions, and would have permitted him either to

correctly line up again with the runway or, if necessary, to proceed to his alternate. Although we are unable to determine exactly the cause of the "green glow" seen by Captain Bryant in his windshield dead ahead, it is apparent from subsequent events that it was not from the range light or lights at the south end of runway 3-6.

While it appears that Captain Bryant used bad judgment in trying to complete a landing under prevailing conditions of wind and rain, the inadequate system of lighting on the Cincinnati Airport must be viewed as a substantial contributing factor in the accident. The absence of a complete system of lighting which would indicate the outlines of the runways was conducive to exactly the type of error made by Captain Bryant when he mistook a green glow of unknown origin for the range lights at the opposite end of the runway upon which he was intending to land. In the absence of such guides it was easy for Captain Bryant to become confused under existing conditions of wind and restricted visibility even though he had had five years' experience in flying into and out of the Cincinnati Airport.

Subsequent to the Board's hearing, American transferred Captain Bryant to first officer status on a different route for a period of six months from April 9, 1941.

CONCLUSION

Findings

We find upon all the evidence available to the Board at this time that the facts relating to the accident involving aircraft of United States registry NC 15592, which occurred at Cincinnati, Ohio, on March 10, 1941, were as follows:

1. The accident which occurred at approximately 8:35 p.m. (EST) on March 10, 1941, to American Airlines' Trip 20 of that date, resulted in major damage to the aircraft, NC 15592, and minor injuries to nine passengers and three members of the crew.
2. At the time of the accident American Airlines, Inc., held a currently effective certificate of public convenience and necessity and an air carrier operating certificate authorizing it to conduct the flight.
3. Captain Bryant and First Officer Murray were physically qualified and held proper certificates of competency to operate as air carrier pilots over a route between Chicago, Illinois, and Washington, D. C., via intermediate points.
4. Aircraft NC 15592 was currently certificated as airworthy at the time of the accident.
5. Trip 20 was cleared in accordance with proper procedure from Chicago, Illinois, to Cincinnati, Ohio.
6. At the time of departure from Chicago, Illinois, and at the time of the accident the gross weight of the aircraft did not exceed the permissible gross weight and the usable load was properly distributed.

7. At the time of departure from Chicago, Illinois, for Cincinnati, Ohio, the aircraft carried sufficient fuel to permit flight at normal cruising power to Cincinnati, thence to Columbus, its alternate airport, and thereafter for more than four hours.

8. Trip 20 proceeded normally from Chicago, Illinois, to Cincinnati Ohio, until the final approach for a landing at Cincinnati was begun.

9. Weather reports for Cincinnati and its vicinity consistently had indicated lowering ceilings and some precipitation. However, the weather at Cincinnati remained equal to or better than those weather minimums authorized in American's letter of competency for that route.

10. The existence of a storm center in southern Illinois and western Kentucky and the fact that it was moving northeastward toward the line of flight of Trip 20 were known to Captain Bryant at the time of departure from Chicago. All indications were that Trip 20 would reach Cincinnati considerably in advance of the arrival of the storm front and the forecasts furnished Captain Bryant so indicated.

11. An unexpected acceleration of the entire low pressure system resulted in the arrival of a storm front at Cincinnati coincidentally with the arrival of Trip 20 with resulting turbulence below 3000 feet, violent rain squalls and ceiling of 1300 feet.

12. After arriving in the vicinity of the Cincinnati Airport with weather conditions still above contact minimums, Captain Bryant circled the landing area to the left in a normal manner in order to effect a landing on runway No. 6.

13. While executing a landing at Cincinnati Airport, Trip 20 encountered a sudden squall condition accompanied by heavy rain which

ballooned the aircraft into the air and altered its heading.

14. At the top of the rise Captain Bryant, even though his forward visibility was almost zero, elected to continue his landing rather than to apply power and circle the field, and the aircraft contacted the ground to the left of the runway intended to be used and rolled into a levee which borders the airport along its eastern boundary.

15. Power was being applied to the left engine at the time the aircraft contacted the levee.

16. Captain Bryant was flying the aircraft during its approach to the airport and during the landing.

17. Aircraft NC 15592 and all its equipment were functioning normally until contacting the levee.

18. The lighting facilities installed at Lunken Airport are inadequate to provide a means of maintaining an aircraft in line with a runway after passing the boundary of the field under conditions of restricted visibility.

Probable Cause

On the basis of the foregoing findings and the entire record available to us at this time, we find that the probable cause of the accident to aircraft NC 15592 (American Airlines' Trip 20) on March 10, 1941, was the error in judgment on the part of the pilot in continuing an attempt to land during a period of restricted visibility from the cockpit due to heavy precipitation. A substantial factor, increasing the pilot's difficulties and the liability of error in judgment, was the inadequacy of the system of runway lighting on Lunken Airport, Cincinnati, Ohio.

BY THE CIVIL AERONAUTICS BOARD:

/s/ Edward Warner
Edward Warner, Acting Chairman

/s/ Oswald Ryan
Oswald Ryan, Member

/s/ G. Grant Mason, Jr.
G. Grant Mason, Jr., Member

/s/ George P. Baker
George P. Baker, Member

Harllee Branch, Chairman, did not take part in the adoption of this report.

APPENDIX A

TERMINAL FORECASTS:

- INDIANAPOLIS, INDIANA - Overcast, ceiling 1000 feet, visibility 2 to 4 miles, light rain.
- CINCINNATI, OHIO - Broken to overcast, ceiling 2000 to 4000 feet, visibility 2 to 5 miles, light rain and smoke.
- COLUMBUS, OHIO - Broken clouds, ceiling 4000 to 6000 feet, visibility 6 miles, smoky, occasional light rain.
- WASHINGTON, D. C. - Ceiling and visibility unrestricted; high scattered to broken clouds.

Trip Forecast General: Overcast Chicago, base of clouds reported 5000 feet, with top above 10,000 feet. No icing reported in overcast. Base of upper overcast lifting to unlimited through Indianapolis-Cincinnati-Columbus area, with top lower layer estimated 7,000 to 8,000 feet. Light rain — Chicago, Indianapolis, Cincinnati — and spreading through Columbus area. Cloudiness becoming overcast to broken unlimited ceilings, Pittsburgh; and broken clouds, Washington.

The Weather Bureau sequence data reports for various points along the route were as follows:

- CHICAGO, ILLINOIS
4:35 PM, CST - Ceiling estimated 4,500 feet, overcast, scattered clouds at 1,000, light rain, light smoke, visibility 1-1/2 miles, temperature 40, dew point 32, wind ENE 14 m.p.h., altimeter setting 29.56.
- LAFAYETTE, INDIANA
4:35 PM, CST - Ceiling estimated 2,000 feet, overcast, light rain, light fog, light smoke, visibility 1-1/2 miles, temperature 43, dew point 39, wind ESE 17, altimeter setting 29.50.

- INDIANAPOLIS, INDIANA - Ceiling estimated 1,200 feet, overcast,
4:35 PM, CST lower broken clouds, light rain, light fog, visibility 1-1/2 miles, temperature 44, dew point 42, wind southeast 12, altimeter setting 29.52.
- MILROY, INDIANA - Ceiling estimated 5,000 feet, overcast
4:35 PM, CST lower scattered clouds at 2,000, light rain, light fog, visibility 2 miles, temperature 44, dew point 40, wind southeast 23.
- CINCINNATI, OHIO - Ceiling estimated 4,000 feet, overcast,
4:35 PM, CST light rain, visibility 7 miles, temperature 49, dew point 38, wind east 13, altimeter setting 29.62. Remarks: light rain intermittent.
- TERRE HAUTE, INDIANA - Ceiling 800 feet, overcast, lower broken
4:35 PM, CST clouds, light rain, light fog, visibility 2-1/2 miles, temperature 45, dew point 44, wind southeast 17, altimeter setting 29.46.
- LOUISVILLE, KENTUCKY - Ceiling estimated 1,200 feet, overcast,
4:35 PM, CST lower broken clouds, light rain, light fog, visibility 2 miles, variable, temperature 49, dew point 48, wind SSE 7, altimeter setting 29.56.
- COLUMBUS, OHIO - Ceiling estimated 8,000 feet, overcast,
4:35 PM, CST light rain, light smoke, visibility 6 miles, temperature 44, dew point 28, wind ESE 13, altimeter setting 29.76.
- PITTSBURGH, PA. - Ceiling unlimited, high thin overcast,
4:35 PM, CST lower broken clouds at 7,000 feet, light smoke, visibility 4 miles, temperature 42, dew point 29, wind east 8, altimeter setting 29.88.
- WASHINGTON, D. C. - Ceiling unlimited, high thin scattered
4:35 PM, CST clouds, visibility better than 10 miles, temperature 53, dew point 30, wind SSE 3, altimeter setting 30.00.

Weather Bureau Airway Forecast - 5:30 p.m. to 1:30 a.m. (EST)

Deepending low near Effingham at 13:30 E (1:30 p.m. EST) will move to northeastern Indiana by close of period (i.e. 1:30 a.m.) with cold front south of Effingham moving rapidly eastward over southern Indiana and northern Kentucky sections of district and the occluded front moving over southern Lake Michigan and into northwestern Indiana. Warm front just south of Effingham-Louisville line at 13:30 E. Will advance to near Fort Wayne-Cincinnati line by close of period. Overcast with light intermittent rain through Indiana, southwestern Ohio and southwestern lower Michigan with ceilings between 3000 and 6000 lowering to between 400 and 800 with approach of cold front over western Indiana and Kentucky second half period and rain changing to snow following front. Broken to overcast high to intermediate clouds elsewhere to westward of mountains with clouds gradually thickening and lowering over northern Ohio and western Lake Erie sections. Through mountains and eastward scattered to broken high clouds except increasing to high overcast extreme western Pennsylvania and western Maryland second half period. Visibility between 3 and 5 in rain and lowering to less than one in snow. Visibility otherwise between 4 and 8. Icing clouds vicinity of cold front and severe icing in both clouds and precipitation vicinity of occluded and cold fronts. Winds aloft about 270 degrees 20 to 35 m.p.h. mountains eastward and 150 to 180 degrees 20 to 35 m.p.h. westward of mountains and shifting to 330 degrees 30 to 45 m.p.h. westward of cold and occluded fronts.