

B-85

File No. 3525-43  
Docket No. SA-82  
Adopted: April 22, 1944  
Released: April 22, 1944

REPORT OF THE CIVIL AERONAUTICS BOARD  
on the  
Investigation of an Accident Involving Aircraft in  
Scheduled Air Carrier Operation

An accident involving an aircraft of United States registry, NC 16014, a Douglas DC3, which was being operated by American Airlines, Inc., occurred about one mile west of Trammel, Kentucky (approximately 15 miles southeast of Bowling Green, Kentucky), about 10:43 p.m. (CWT) on July 28, 1943. The flight was identified by the air carrier as Flight 63 and was being operated in scheduled air carrier service between Cleveland, Ohio and Memphis, Tennessee, with intermediate stops at Columbus, Dayton, Cincinnati, Louisville, and Nashville. All four members of the crew and sixteen passengers (including an infant) were fatally injured. The two remaining passengers escaped with serious injuries. The aircraft struck the ground in nearly level flight and proceeded forward about 1000 feet, during which time both engines, the right wing, and various smaller components were torn away. It was completely destroyed by impact and fire.

CONDUCT OF INVESTIGATION

The Washington Office of the Civil Aeronautics Board (hereinafter referred to as the Board) received notification about 4:00 a.m. on July 29, 1943, and immediately initiated an investigation in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. 1/ Edward Warner, Vice Chairman of the Board, Allen P. Bourdon, Chief, Investigation Division, Safety Bureau of the Board, and Senior Air Safety Investigators Fred G. Powell and Herbert V. Shebat, proceeded to the scene of the accident, arriving there during the early forenoon of July 30, 1943. The wreckage of the airliner at Trammel had been placed under civil police guard and was so kept until a complete examination had been made by investigators of the Board.

Hearing

In connection with the investigation, the Board ordered a public hearing in which Allen P. Bourdon was designated as presiding officer.

The hearing was held in three sessions - the first at Bowling Green, Kentucky on August 3, 1943; the second at New York, N.Y., August 30, and 31, 1943; and a third at New York, N.Y. on September 27, 1943. During the hearing the following Safety Bureau personnel participated: Mr. John M. Chamberlain, Assistant Director; Messrs. Herbert V. Shebat, and Fred G. Powell, Senior Air Safety Investigators; Earl L. Smith, Air Safety Investigator; George M. French, Meteorological Specialist; and Victor M. Clark, Senior Reports Editor.

1/ Section 702(a) (2) provides that it shall be the duty of the Board to "Investigate such accidents and report to the Authority the facts, conditions, and circumstances relating to each accident and the probable cause thereof."

On the basis of all evidence accumulated during the investigation, the Board now makes its report in accordance with the provisions of the Civil Aeronautics Act of 1938, as amended.

### SUMMARY AND ANALYSIS OF EVIDENCE

#### Air Carrier

At the time of the accident American Airlines, Inc. (hereinafter referred to as American), a Delaware corporation, was operating as an air carrier under a certificate of public convenience and necessity and an air carrier operating certificate, both issued pursuant to the Civil Aeronautics Act of 1938, as amended. These certificates authorized the corporation to engage in air transportation with respect to persons, property and mail between various points in the United States, including Cleveland, Columbus, Dayton, Cincinnati, Louisville and Nashville.

#### Flight Personnel

The crew of Flight 63 consisted of Harry A. Stiller, captain; Robert M. McClure, first officer; and Josephine Kane, stewardess. Captain B. A. Carpenter, a pilot employed by American, was on route familiarization detail on the subject flight.

Captain Stiller, age 32, was employed by American on May 22, 1939. He was assigned as first officer on June 26, 1939, and as a first officer-reserve captain on March 24, 1942. He held an airline transport pilot certificate with single and multi-engine land, 160-2700 h.p. ratings. He had accumulated approximately 4315 flying hours, 3040 of which were while in the employ of American. Approximately 2700 hours of the above time were on DC3 equipment. He had flown approximately 248 hours in the three months preceding the accident. His last physical examination, required by Civil Air Regulations, was accomplished May 22, 1943. The date of his last flight over the subject route was July 25, 1943. He had his last instrument check on July 24, 1943, while his last monthly route qualification report was June 30, 1943.

First Officer McClure, age 28, held a commercial pilot certificate with single-engine land, 0-400 h.p. and instrument ratings. He was employed by American March 11, 1943, and was assigned as a first officer on May 10, 1943. He had accumulated approximately 970 hours of flight time, about 238 of which were in DC3 equipment while in the employ of American. His last physical examination, required by the Civil Air Regulations, was accomplished February 1, 1943.

Stewardess Josephine Kane, a nurse registered in the State of Massachusetts, had been in the employ of American since March 1, 1943.

Captain Bayard A. Carpenter, a veteran airline pilot, held an airline transport pilot certificate and had been in the employ of American since May 15, 1928. He had accumulated approximately 15,244 hours of flight time, about 14,661 of which were flown while in the employ of American. He was assigned as a member of the crew of the subject flight for the purpose of maintaining his route competency on Route 22.

### The Aircraft

The aircraft, NC 16014, was a Douglas DC3-G102, twin-engine passenger plane, Serial No. 1552, and had been flown a total of 17,991 hours. The time since its last major overhaul was 1015 hours. It was manufactured by Douglas Aircraft Company, Inc., and American, the registered owner at the time of the accident, purchased it on October 3, 1936. This aircraft was equipped with 2 Wright G-102 engines, each of which had been operated 435 hours since its last major overhaul, and 2 Hamilton Standard hydromatic 3-bladed propellers.

### History of the Flight

Flight 63 originated at and left Cleveland about 5:42 p.m. EDT, cleared to Memphis on American's Route 22 with intermediate stops scheduled at Columbus, Dayton, Cincinnati, Louisville and Nashville. En route from Dayton to Cincinnati, the trip encountered adverse weather which, together with unreported Army traffic, made it seem advisable to return to Dayton. The situation at Cincinnati improved and after a delay of about 30 to 40 minutes the flight proceeded to Cincinnati and thence to Louisville, where it landed at 9:42 p.m. CWT<sup>2/</sup>. It was refueled and cleared to take off at 9:54 p.m. to fly at 4000 feet with estimated time of arrival at Nashville of 10:54 p.m. At 9:54 p.m., apparently just before take-off from Louisville, Captain Stiller requested Louisville to advise Nashville that he wanted to change his flight plan to proceed to Smiths Grove, Kentucky at 2500 feet and continue to Nashville at 2000 feet. This change was subsequently approved by Nashville and relayed to the flight by Smiths Grove Airways Communications Station. (Smiths Grove is located on American Route 22, approximately 69 miles in a northeasterly direction from Nashville.) At approximately 10:22 p.m. when the flight was about 15 miles northeast of Smiths Grove the following radio contact was made with the airways communication station at Smiths Grove: "Route 22, trip 63 over Smiths Grove at 10:29 p.m. at 2500 feet." Although static interference made radio telephone communication impossible between the flight and American's stations at Nashville or Louisville, this report was relayed to Nashville and Louisville via interphone by the Smiths Grove radio operator. At 10:28 p.m. the flight advised the Smiths Grove Station by radio of the presence of an aircraft approximately 3 miles south of Smiths Grove, flying at about 5000 feet. The station operator informed the flight that he was aware of its presence and that it was an Army plane practicing on the Smiths Grove range. Acknowledgment of this information was the last message received from the flight. Shortly thereafter, when Flight 63 failed to report, there followed an intensive radio search by at least twenty radio communication stations. At about 1:00 a.m., July 29, the police at Trammel notified American at Nashville of the crash of Flight 63 at Trammel. (Trammel is on American Route 22, about 21 miles southwest of Smiths Grove.)

### Examination of the Wreckage

Examination of the wreckage did not reveal any evidence whatsoever which would indicate any mechanical or structural failure of the aircraft in flight. Examination of both engines revealed that they were functioning normally at the time of impact. There was adequate fuel aboard. Inspection

<sup>2/</sup> All times hereinafter referred to are Central War Time.

of the propellers disclosed settings of  $23\frac{1}{2}^{\circ}$  on the left propeller and  $24^{\circ}$  on the right. It appears probable that these settings were indicative of the settings immediately prior to impact. The wreckage was found on the airway less than 2 miles from the "on course" signal of the Smiths Grove Radio Range. The rolling terrain of the locale varies from 695 to 720 feet above sea level. Examination of the wreckage and of marks and cuts on the ground and trees revealed that the aircraft, while level laterally and descending about  $11^{\circ}$  from horizontal, initially struck and cut a path through a small grove of trees, 35 feet in depth about 16 feet above the ground. It struck the ground approximately 85 feet beyond the point of first contact with the trees, continued on an almost straight course ( $221^{\circ}$ ) through another small clump of trees, then across an open field and stopped in an upright position among several larger trees, about 1000 feet beyond the point of first impact. Just prior to coming to rest, the right wing was sheared from the fuselage by impact with a large tree and it was found approximately 25 feet behind the fuselage. The left wing, minus the tip, with portions of the center section, had been bent upward and over and was found lying across the top of the fuselage. Pieces of the wreckage, including the left wing tip, were scattered over the entire distance, indicating that the airplane disintegrated all along its path from impact with trees and the ground. The right engine struck the ground around 90 feet beyond the point of first impact of the aircraft with the trees, tore loose and rolled forward about 500 feet. The left engine struck the ground approximately 650 feet beyond the point of impact with the trees, tore loose and rolled forward about 375 feet, coming to rest some 25 feet beyond the wrecked fuselage. The left wheel was found still farther forward and across a road, almost 1200 feet beyond the point where the aircraft first struck the trees. There was no indication that fire had started on the aircraft before the initial impact, as all parts of the wreckage which gave indication of fire were found at or near the final resting place of the fuselage and the two wings. (See sketch, opposite page, prepared by engineers of American in collaboration with investigators of the Board.)

The radio equipment and all of the instruments were completely demolished. However, the fact that the flight was in communication with Smiths Grove radio just a few minutes prior to the accident and was proceeding directly on course, indicates that the radio equipment and navigational instruments were functioning properly.

#### Witnesses

Lieutenant Fellows, a pilot in the United States Army Air Forces, held a commercial pilot certificate, had been flying for approximately 16 years, and had accumulated about 5000 hours of solo flight time. He had boarded Flight 63 at Dayton. He testified that the flight had proceeded to the vicinity of Cincinnati and, presumably on account of weather, returned to Dayton. He stated that after a delay of 30 to 40 minutes the flight again left Dayton, landed at Cincinnati and that after leaving Cincinnati, he fell asleep and was not aware of the flight landing or taking off at Louisville. He said that he was occupying the extreme front single seat on the right side of the plane and that about "5 or 10 minutes" before the accident, the flight encountered severe turbulence which awakened him. He stated that his window curtain was open at the time and that he could "see the storm ahead and I tightened up my safety belt . . . . The weather, outside of the storm, was not bad. I don't think it was what you would call instrument



weather. It was fairly clear." He told of seeing the storm directly in front of them, that it covered quite an area and, although he could not see its boundaries, he "noticed it was an unusually severe storm, unusually turbulent, and more lightning than I had ever seen in a storm before." He said there was heavy rain, that he was unable to estimate the altitude of the airplane, and that he did not notice any change of power during the five or ten minutes preceding the crash, but that "just immediately prior to the crash there was quite a sudden change in pressure, and of course a light feeling on the seat, which indicated a sudden loss of altitude to me . . . . It seemed that maybe just as we hit there was, I believe, almost full application of power -- at least a greatly increased application of power. And immediately thereafter the plane started hitting the ground, or the trees, whatever it was, almost instantaneous, it seemed. Everything seemed to happen at the same time." He stated that, "After the plane came to rest it was afire . . . . It seemed like I was surrounded by fire . . . . I know I didn't see another person in the cabin of the airplane. I didn't hear a sound outside of the sound of the crash. It seems there was a bulkhead, or whatever it was, in front. I believe it came down across between me and the other pile of seats. . . . I noticed there was a hole outside of the fuselage. But it was all afire outside as well as inside. I crawled out that, out of the fire, and started running. From there on I don't recall very much of what happened until I was walking up this trail, or whatever it was, toward the house. I do recall sitting by a tree with another survivor, and it seems to me I -- tried to open the cabin door of the airplane, but I don't fully recall as to whether I did or not." At another time during his testimony he stated that he noticed a sudden loss of altitude immediately before the accident and that in addition to having "that light feeling," his "ears immediately blocked." When asked if he would estimate this sudden loss of altitude, he stated that he did not "believe it was much over 500 feet" and added that this was something "that is quite hard to tell." When questioned as to his having any apprehension about going into or near the storm, he answered, "Yes, I will say I was quite uneasy about going into the storm. It was the worst storm that I was ever in, in an airplane," and added, "In my opinion, I have no reason to believe the airplane was struck by lightning." He testified further that he had had considerable experience flying DC3 (Douglas) and B-24 (Consolidated) equipment, and had approximately 100 hours of night flying experience, but that he had always avoided flying through thunderstorms and, in fact, had never done so.

Mr. Samuel Kurtz Hoffman had somewhat the same experiences and impressions as Lieutenant Fellows. He was employed by an aircraft engine manufacturer as their chief engineer and had traveled considerably on the airlines. He held a private pilot certificate and had logged about 80 solo hours. He too had boarded the plane at Dayton and described its return to Dayton as occasioned by the information he had received from the stewardess that "an Army plane was lost in the overcast over Cincinnati." He added that "Shortly after that we took off again and made the scheduled stop at Cincinnati, and took off from there, and made another scheduled stop at Louisville, and I happen to know pretty definitely when we actually took off at Louisville . . . . by my watch it was 9:48 Central Time." (Inasmuch as the official time of take-off was just after 9:54 it would seem that Hoffman's watch was about six minutes slow.) He stated that during the flight he had occupied the aisle seat in the third row from the rear on the left side and that he had some conversation with Mr. Ingram, a fellow passenger, who was seated

along side of him, in the seat next to the window. Hoffman stated that Ingram had pointed out the operating mechanism of the emergency exit adjacent to the single seat across the aisle and inquired as to what it was. Hoffman explained that it was an emergency exit and called Ingram's attention to another one adjoining his (Ingram's) seat. Hoffman estimated that after they had been out of Louisville about one-half hour, Ingram opened the curtains and called his attention to thunderstorms off to the left of the flight and that shortly thereafter when he again looked at his watch it was 10:30 p.m. He stated that, "it was about that time that we were right in the middle of a severe thunderstorm - lightning on all sides, and it was extremely rough." He added, "I know that at the time I looked at my watch I had an impression that we were losing altitude, and I thought we were coming down in a general glide before the landing at Nashville, and I was a little surprised that we were arriving that soon . . . . I am quite sure the crash was within, oh, at the most, five minutes after I looked at my watch. I think it was sooner than that. We really weren't in the severe part of the storm very long . . . . We hit the ground the first time and I thought it was just the first landing on the airport, a very rough one, as if we hit extremely hard and bounced around." (The witness was evidently referring to the aircraft's first impact with the trees.) ". . . . I know that the engines were throttled back a bit either when we hit or shortly after we hit the storm. I am quite sure of it because either immediately before or concurrently with or immediately after hitting the ground the engines definitely were opened up again." Hoffman testified further that "The engines were operating in a perfectly normal fashion. I am very certain of that, and also that there was nothing the matter with the airplane . . . . it wasn't struck by lightning. Shortly before we hit the ground I did have a feeling that . . . . the airplane was in on what might be a three-point landing position, or in a climbing position . . . . It was rough, but I didn't think we were in any serious difficulty until we hit the ground the second time . . . . we could hear the metal ripping and the plane disintegrating. We slid along the ground a matter of some seconds . . . . and the whole thing didn't seem very rough. I can recall seeing the passengers bobbing around, but everybody was in his seat, presumably strapped in. It didn't seem a particularly rough ride at all until we finally hit another obstacle at the end of the run, and the lights went out about that time . . . . I can recall at least some other passengers getting up and being in the aisle, passing toward the rear. And throughout this whole thing I have absolutely no impression of panic. I didn't hear anyone make a sound . . . . The next thing I knew . . . . the plane was dark, and absolutely quiet." He added that Ingram and the passenger who had been seated across the aisle and a number of passengers who had been seated in front of him were gone. He stated that somehow or another he "knew it was useless to try and get out of the back door, I don't know how I knew - whether I saw a pile out there or not." His next thought of using the emergency exit and after much difficulty in tearing or breaking the transparent plastic guard he was able to grasp the operating lever which he pushed, turned and pulled but was unable to open the exit. He testified that he crawled to the other emergency exit on the opposite side of the plane and that he could not get that one open either. He stated that he thought "the fire was practically simultaneous with our hitting this last obstacle;" that fire was coming from the front part of the cabin and that the flames were within 3 or 4 feet of him. He testified that "the last thing I remember is pushing on the window and something giving. It seemed like a rubber pane, and I presume I was pushing hard enough that I just went on through and got out." He stated that when he regained his senses he was outside on the ground and that he got up and ran some 10 or 15 feet away from the plane. It was then that

he observed Lieutenant Fellows sitting on the ground about the same distance away from the plane. He added that after he got his bearings, "I made my way as best I could . . . and tried to get the main cabin door open and I couldn't budge it." He recalled that the door was open only about one-half inch and that he tried to get his fingers in the crack and open the door in that manner, but was unsuccessful. He stated that he had a recollection of trying to work the handle but was not "able to do anything with that." When asked if he was aware of the presence of a safety latch he stated that he didn't know there was such an additional safety latch or handle and that he could only recall seeing the regular door handle which he tried. He told how, on account of the injury to his leg, he sat under a nearby tree while Lieutenant Fellows went in search of aid. He stated that some time within half an hour to an hour after the crash the main cabin door swung open of its own accord. He remained at the scene of the crash until help arrived, in what he estimates to have been 2 1/2 hours after the crash.

First Lieutenant Paul E. Leas, United States Army Air Forces, stationed at Smyrna Air Base, which is located about 12 miles ESE of Nashville, testified that he was flying on the Smiths Grove Range in an Army B-24 airplane on the evening of the subject accident. He stated that he took off from the Smyrna Air Base at approximately 7:15 p.m. and returned about 12:30 a.m. He stated that most of this time he and his crew were within a radius of 15 miles of Smiths Grove station and a larger portion of this time in the ~~ENE~~ quadrant of the range. He recalled that during the evening the west leg of the range was the only one entirely free from storms; that the storm towards Trammel was plainly visible, and that the lightning was so bright that he had to keep his eyes averted from the storm because of the possibility of being blinded by the lightning. He estimated the storm to have a radius of about 8 miles, but could give no estimate regarding the cloud ceiling within the area. His testimony revealed that the storm appeared to become most active between 10:00 and 11:00 p.m. Broken clouds and smooth air prevailed in the area where he was flying and he estimated the ceiling to be about 6500 feet above sea level. He noted other individual storms at scattered points from south, by way of east, to northeast. He experienced no difficulty on his return to Smyrna Air Base, although he did encounter bumpy air under cumulus clouds.

Four witnesses, farmers, not experienced in aviation, witness and described the wind, rain and lightning, which accompanied the thunderstorm, as the most violent they had ever experienced. One witness and his wife took shelter in a storm cellar. One of them lived within 4 miles from the scene of the crash, while three lived within a few hundred yards. All of them had heard the airplane flying low overhead in the storm; however, on account of the severity of the storm none of them was able to observe it. The witness who lived nearest the scene of the accident recalled that the engines were running normally until he heard them "racing." He stated "at that particular time I heard a thumping noise, a different sound, and I thought it fell."

Doctor Arcy O. Miller, the coroner, stated that the three pilots' bodies were found on the ground out in front of the airplane; that three more bodies were found in the front part of the cabin; one in the aisle about mid-way between the front and rear and the remaining victims were piled up against and adjacent to the door in the rear of the cabin. The three pilots were not so seriously burned and most probably were thrown clear of the



completely shattered nose of the airplane. From the slight descending angle of the aircraft at the time of impact with the trees, which undoubtedly broke the fall to the ground, it is reasonable to assume that the passengers were not seriously injured by the crash but had probably crowded the cabin door in an effort to escape the flames.

According to Bledsoe Payne, American's chief pilot, who had given Captain Stiller his pilots' line check on April 25, 1943, the report indicated "a very excellent job of flying. He was marked Standard - Careful, and uses good judgment." Also, referring to a copy of Captain Stiller's instrument approach report, given on July 24, 1943, by Mr. Payne, it was indicated that the flight was "in rough air, that his single-engine operation was good. The grading of the sheet indicates an excellent job of flying, the grade being 91%." He stated further that this was above average. He testified that while Captain Carpenter was, from the standpoint of company service, a pilot senior to Captain Stiller, "he would have no authority. The flight was in complete command of Captain Stiller," and further that "only in the case the Captain requested it" would he (Carpenter) be expected to act in an advisory capacity. When asked if there had been any fixed company policy so far as pilots were concerned with regard to thunderstorm areas, he stated that the policy was to "avoid them . . . as a safety factor and for passenger comfort." When queried as to whether or not they were prevented from going through thunderstorm areas provided they could find a spot that seemed reasonably safe, he answered, "No, they are not prevented. We give instructions to them in this manner, in the form of bulletins, in the form of personal contacts with the pilots. We discuss thunder activity in pilot meetings and general discussions regarding thunderstorm activity and thunderstorm flying." He stated in effect that the company does not forbid pilots to go through thunderstorms and that they did so at their own discretion. Mr. Payne offered in evidence three bulletins which had previously been distributed to all of American's Chief Pilots and Flight Officers, as follows: No. 1 - American's Operations Regulations, Section 402, Paragraph 13, which deals with aircraft lightning discharges and their effect, and the best possible means of avoiding them; No. 2 - entitled "Thunderstorms," issued February 22, 1941, by American's Assistant Operations Manager in Charge of Flying, to which was attached the following memorandum of transmittal, "Again we want to caution Flight Officers, whenever possible, not to conduct flights through thunderstorm activity which appears to be severe in intensity. There can be no set rules to determine when such conditions do exist. However, good judgment and forethought on the part of Flight Officers will generally prevent flying through severe turbulence;" No. 3 - A paper entitled, "Thunderstorm Characteristics and Flight Procedures," prepared by Mr. J. A. Browne, Meteorologist, with Transcontinental & Western Air, Inc., which was reproduced and released by the Safety Bureau of the Board as Safety Bulletin No. 154.

Weather

The synoptic weather map, compiled from reports made at 7:30 p.m. on the date of the accident, showed a high pressure area centered off the coast of southeastern United States. Trammel was located on the northwestern periphery of this high pressure area in a tropical marine air-mass flowing northward and eastward around this high pressure cell. The nearest frontal zone extended from west to east through northern Ohio and Indiana and was nearly stationary. Numerous moderate to heavy thunderstorms were occurring during the afternoon and evening over a wide band on either side of the front. These extended southward through Ohio as far south as Louisville. Later in the evening scattered local thunderstorms began developing in east and central Kentucky southward to about the Kentucky-Tennessee line, which situation existed at the time of the accident. Winds on the surface not affected by local storms were southwesterly. Winds aloft in the vicinity of the accident were indicated to be southwest, low levels veering to northwesterly about 10,000 feet, and velocity ranging from 20 m.p.h. at 2000 feet to less than 5 m.p.h. above 6000 feet. The nearest radiosonde station to Trammel is at Nashville. The record obtained there of the vertical structure of the air did not indicate the likelihood of thunderstorms, although at stations farther north thunderstorms were strongly indicated. The U. S. Weather Bureau forecasted widely scattered thundershowers in eastern Kentucky for the period 5:30 p.m. July 28 to 1:30 a.m., July 29, 1943, with scattered low and broken high clouds and unlimited ceiling elsewhere in Kentucky and Tennessee. Ceiling was expected to become 1000 to 2000 feet and visibility 1 to 3 miles in thunderstorms, with visibility elsewhere over 6 miles. Moderate to heavy turbulence in thundershowers was forecast. Trammel is nearly on the dividing line of eastern and western Kentucky, as used for forecasting by the Weather Bureau. The forecast issued by American's forecaster for the afternoon of July 28 was the one used for dispatching the flight and showed scattered thundershowers over the route between Cleveland and Nashville, followed by clear to high scattered clouds and smooth air after 7:00 p.m. The following weather observations were filed by the Weather Bureau on July 28, 1943:

9:30 p.m. CWT

Louisville, Kentucky - contact, ceiling estimated 3500 feet, high and lower broken clouds, visibility 5 miles, light rainshowers, sea level barometric pressure 1011.9 millibars, temperature 70, dew point 68, wind north-northeast 3, altimeter setting 29.87, wind variable.

Smiths Grove, Kentucky - ceiling unlimited, high scattered clouds, lower scattered at 4500 feet, sea level barometric pressure 1011.9, millibars, temperature 80, dew point 69, wind southwest 8, altimeter setting 29.89, frequent cloud lightning south quadrants, occasionally vertical.

Nashville, Tennessee - contact, ceiling unlimited, scattered clouds at 5000 feet, sea level barometric pressure 1012.2 millibars, temperature 83, dew point 69, wind southwest 12, altimeter setting 29.90, thunderheads south and north, distant lightning clouds north.

10:30 p.m. CWT (About 13 minutes prior to the accident.)

Louisville, Kentucky - contact, ceiling unlimited, high overcast, visibility 5 miles, light rain, light fog, sea level barometric pressure 1011.9 millibars, temperature 70, dew point 68, wind south 4, altimeter setting 29.87, occasional lightning northwest.

Smiths Grove, Kentucky - ceiling unlimited, high scattered clouds, lower scattered at 4500 feet, sea level barometric pressure 1011.9 millibars, temperature 77, dew point 67, wind southwest 8, altimeter setting 29.89, frequent lightning southwest and east quadrants.

Nashville, Tennessee - contact, ceiling unlimited, scattered clouds at 5000 feet, sea level barometric pressure 1012.9 millibars, temperature 83, dew point 68, wind west-southwest 10, altimeter setting 29.92, thunderheads south and north, distant lightning clouds north.

11:05 p.m. CWT (About 22 minutes after the accident)

Smiths Grove, Kentucky - Special observations, ceiling unlimited, high scattered clouds, lower scattered at 4500 feet, thunderstorm, sea level barometric pressure 1011.9 millibars, temperature 77, dew point 67, wind south-southwest 13, light gusts, altimeter setting 29.89, frequent vertical lightning southwest.

11:30 p.m. CWT

Louisville, Kentucky - contact, ceiling unlimited, high overcast, lower scattered clouds at 5000 feet, visibility 6 miles, light rain, light fog, sea level barometric pressure 1011.2 millibars, temperature 70, dew point 68, wind south 7, altimeter setting 29.86.

Smiths Grove, Kentucky - ceiling 5000 feet, broken clouds, thunderstorm, sea level barometric pressure 1012.5 millibars, temperature 75, dew point 66, wind south-southwest 12, altimeter setting 29.91, frequent lightning southwest.

Nashville, Tennessee - contact, ceiling unlimited, scattered clouds at 5000 feet, sea level barometric pressure 1012.9 millibars, temperature 81, dew point 70, wind south-southwest 7, altimeter setting 29.92, thunderheads south and north, distant lightning clouds north.

An intensive study of the subject thunderstorm indicates that it developed west of Trammel about 8:00 p.m. and passed over to the eastward as a mild thunderstorm. Although the thunderclouds continued to move eastward, new cloud development became very active on the western side of the storm, while dissipation was occurring on the eastern side. This resulted in the thunderstorm actually extending back to westward into the wind and finally reaching its most severe proportions in the Trammel area about 10:00 p.m. It continued severe until 11:00 p.m., during which time it consisted of exceptionally severe lightning, very heavy rain and exceedingly strong surface winds.

From all of the evidence that could be obtained it appears that the total area of the storm extended about 6 miles westward from the scene of the accident and not more than 10 miles to the eastward. The severe portion of the storm covered an elliptical area with the longer axis about 6 miles, orientated west-northwest to east-southeast, and the shorter axis about 5 miles, from north-northeast to south-southwest. Trammel was located in the southwest quadrant of this storm area. It appears quite conclusive that the strong surface squall wind was a result of the fanning out of a vigorous downdraft from this thunderstorm. Investigation of the area indicated that the peak velocity of these strong surface winds radiated outward in all directions from the center of this severe storm area, but it could not be determined definitely whether these radiating winds were simultaneous from a single large downdraft or as a result of numerous such intermittent downdrafts. Damaged crops and trees indicated that at some time during the storm a strong southwest surface wind occurred on the side from which the flight approached. The general wind aloft at the altitude at which the flight was proceeding was indicated by Weather Bureau observations as also southwesterly. It was assumed from the testimony of the two survivors that a strong northeast or tailwind was blowing when the plane came to rest, and flattened cornfields and broken tree limbs substantiated their testimony.

In an effort to reconstruct the sequence of events immediately prior to the crash, from the known conditions within the storm area, it is reasonable to assume that the flight entered the northeast quadrant of the disturbance at the planned, indicated altitude of 2000 feet (approximately 1300 feet above the terrain) and proceeded in a headwind under increasingly turbulent conditions at reduced airspeed as a safety precaution. Within the storm, the flight encountered a downdraft of unusual severity in which an average vertical component of 1500 feet per minute is considered to be a very conservative estimate. This estimate was arrived at by the evaluation of the velocity of the fanout wind at the ground which was evidenced by the damaged crops and trees.

Assuming that the crew maintained constant power and airspeed after striking this severe downdraft, the airplane would have been losing altitude at a rate substantially equal to the vertical velocity of the surrounding air. Even if the pilot had increased the angle of attack in order to climb, which at the same time would have reduced his airspeed, the descent would have been likely to continue at a rate approaching 1,000 feet per minute. It appears from the evidence of the surviving witnesses that there was no increase in power during the early stages of the descent.

As such a downdraft approaches the ground, its vertical velocity is necessarily checked, and the moving air fans out into a horizontal wind. Existing knowledge of the structure of thunderstorms is not sufficiently exact to know at what altitude the vertical component of the air's motion is likely to begin to decay, nor how rapidly the vertical component disappears thereafter; but it is probable that by the time the aircraft had reached an altitude of 200 feet above substantially level ground the vertical motion of the air would have largely disappeared, and the direct influence of the downdraft in forcing the airplane down would also have disappeared. It is necessary to consider then what other factors might have operated to cause the descent to continue until the airplane struck the ground.

A possible explanation can be based on the assumption that the airplane as it approached the ground was in a portion of the descending air column from which the air was fanning out horizontally in the direction of flight, and it therefore passed out of the downdraft into a tailwind which may have been of high velocity. The immediate effect of passing out of the downdraft would have been to further increase the angle of attack, assuming that the attitude with respect to the horizon remained, at least momentarily, unchanged. At the same time, the airspeed again would have been decreased, by the velocity of the tailwind. An immediate loss of lift would have resulted; and to maintain level flight it would have been necessary to accelerate the airplane along its flight path until the speed relative to the ground had increased by the amount of the airspeed that had just been lost. This acceleration would have had to have been accomplished at a time when the angle of attack may already have been very near the stall, and the drag therefore high.

Although the above discussion is speculative to a certain extent it does indicate that the existing atmospheric conditions within the storm area were such that the airplane could easily have been forced down from its 1300-foot absolute altitude without any other contributing factors. The assumptions made and the conclusions reached appear to be well in line with the known facts.

The circumstances of this accident indicate the very strong desirability of intensified effort to add to existing knowledge of the structure of vertical air currents and of the way in which they behave on approaching ground surfaces of various configurations, and also of further studies and mathematical analysis of the actual behavior which would be expected of an airplane passing within a very short space of time out of a vertically descending current and thereafter into a tailwind.

Findings

1. The accident involving American Flight 63, which resulted in fatal injuries to the four members of the crew and sixteen passengers, and serious injuries to two passengers, occurred about one mile west of Trammel, Kentucky, about 10:43 p.m. on July 28, 1943. The aircraft was completely destroyed by impact and fire.

2. At the time of the accident, American held a certificate of public convenience and necessity and an air carrier operating certificate authorizing it to conduct the flight. Both certificates were currently effective.

3. Captain Stiller and First Officer McClure were physically qualified and held certificates authorizing them to perform their duties on the subject flight.

4. The aircraft, NC 16014, was currently certificated as airworthy at the time of the accident.

5. There was no evidence of failure of any part of the aircraft prior to impact.

6. American's Flight 63 of July 28, 1943, originated at Cleveland with Memphis as its final destination. It departed from Cleveland about 5:42 p.m. (EWT) having been cleared in accordance with company procedure.

7. The operation of the flight was normal until unreported traffic and adverse weather between Dayton and Cincinnati made it advisable to return to Dayton. After a delay of about 40 minutes, it proceeded to Cincinnati and Louisville and was en route to Nashville when it encountered an unusually severe thunderstorm.

8. Despite static interference, satisfactory two-way radio telephone communication was established between the flight and Smiths Grove range station at 10:22 p.m., and at 10:28 p.m. the last message was received from the flight by Smiths Grove in which there was nothing to indicate that it was not proceeding normally.

9. Weather reports which were furnished to the flight before it left Louisville for Nashville, indicated thunderheads south and north of Nashville, with frequent lightning to the north.

10. The aircraft crashed into trees on practically level terrain.

11. The loss of altitude and ultimate collision with the ground was due to severe turbulence and violent downdrafts which made it impossible to maintain altitude.

12. There was evidence that most of the occupants of the cabin were victims of suffocation or fire, or both, because of their inability to effect an exit from the aircraft.

### Discussion

Besides the customary door spring-latch in the center of the door, which has a handle inside and outside the cabin, the DC3 is equipped with a safety latch which consists of two lugs which engage two recesses in the rim of the door. These lugs are actuated by either of two handles, one inside and one out, and are located immediately adjacent to and near the lower portion of the door. In view of the fact that the wreckage was still afire and smoldering when the first two spectators arrived at the scene, it might be reasonable to assume that inasmuch as the door was already standing open, there would be no cause for them to tamper with anything so small and seemingly inconsequential as the small safety latch handle. A news reporter and a photographer were the next to arrive and after awaiting daylight, they made some photographs of the still smoldering airplane. One of these photographs plainly revealed the door open and the safety lugs and its handles in the disengaged position. Hoffman's testimony revealed that approximately one-half hour following the crash he saw the door of the aircraft swing open of its own accord, after having been exposed to the fire which followed impact. Therefore, it could not be definitely determined whether the safety latch had been disengaged by the stewardess from within the cabin immediately after the plane came to rest, which, if physically possible, she would be expected to do, or whether it was disengaged by one of the two survivors after their escape from the burning aircraft. Of the two theories, the former seems by far the most logical. The fact that Hoffman had made futile attempts from inside the cabin to open two of the three emergency exits after having turned their operating levers, as well as the fact that he could not get the door open from the outside, leads to the belief that the emergency exits as well as the door had been jammed by severe distortion of the fuselage, caused by impact, and that heat from the subsequent fire later released the jam and allowed the door to swing open.

### Thunderstorms

Since the advent of night, weather, and instrument flying by scheduled air carriers, the pilots of our domestic and intercontinental airlines have been an excellent source of information for the development of this necessary technique, without which our world-girdling air carrier and military operations would not have advanced to their present degree of efficiency. The United States Weather Bureau has made great strides during the last few years in forecasting weather conditions to be encountered along our airways. There is still too little known regarding the internal structure of thunderstorms, more particularly the development, maintenance, and magnitude of downdrafts. At the present time it is not possible for even an experienced meteorologist to evaluate accurately the severity of turbulence in a thunderstorm by visual observation from without the storm.

At present it is known that turbulence and lightning are so closely related in thunderstorm development that an increase in lightning activity strongly indicates a greater severity of turbulence. Due to the spotty distribution of the turbulence within a storm, pilots are likely to be misled when not encountering turbulence, even though it does exist somewhere in the

thunderstorm. Severe lightning, however, is the best warning we have of the presence of severe turbulence. Therefore, it is apparent that while flight in a thunderstorm area may not be hazardous, flight through a thunderstorm should be avoided.

Captain Stiller was well qualified to command the subject flight and, in addition to his first officer, he had available to him the advice and counsel of Captain Carpenter who, though assigned to this flight simply for the purpose of taking a route check, was a pilot with an enviable record of about 15 years of wide experience, having been employed by American in domestic and more recently in military operations, and had accumulated over 15,000 pilot hours, most of which were as captain. It is reasonable to assume that Captain Stiller would have consulted him regarding the advisability of attempting to negotiate the storm or that Captain Carpenter would have voluntarily expressed himself in this connection had it not appeared to both of them that the storm could be negotiated safely.

As no one in the pilot's compartment survived the crash, we can never know exactly what this crew observed with regard to the storm area they approached. However, from information available to them and from their observations, it must be assumed that they approached and entered the storm area with full confidence, based upon their combined experience level, that these conditions could be negotiated successfully.

PROBABLE CAUSE: Loss of control of the aircraft due to unusually severe turbulence and violent downdraft caused by a thunderstorm of unknown and unpredictable intensity.

#### CORRECTIVE ACTION

1. On October 22, 1943, the Board adopted an amendment to the Civil Air Regulations, to become effective on January 1, 1944, requiring that all emergency exits on all aircraft carrying passengers, even though now certificated, be clearly marked as such in letters not less than three-quarters inch high with luminous paint, such markings to be located either on or immediately adjacent to the pertinent exit and readily visible to passengers. The location and operation of the handles shall be marked with luminous paint.

Through the cooperation of the Air Transport Association these markings will be uniform on all domestic air carrier aircraft.

2. The Board has circulated to the industry for comment a proposed amendment to the Civil Air Regulation which requires that closed cabins on all aircraft carrying passengers shall be provided with at least one adequate and easily accessible external door. This amendment provides that, "It shall be possible to open such door from either inside or outside by the operation of one conveniently located handle. Hinged doors shall open outward."

3. Because of the technical problems involved in connection with the manufacture of future transport aircraft, the adoption of this amendment has been temporarily deferred to permit further study. In the meantime, the operators have agreed to alter the door latching mechanism on all existing airline aircraft in a manner that conforms to the proposed change and this project is well under way.



4. The Board, in cooperation with the Civil Aeronautics Administration, air carrier operators, and air transport manufacturers, has inaugurated a project to study and make recommendations regarding the redesign of cabin doors and emergency exits on air carrier aircraft as a safeguard against jamming in the event of accident.

5. The Board believes that there is a need for more information on the dynamics of thunderstorms and more accurate methods of forecasting severe developments. The Board has discussed the possibility of such research with the United States Weather Bureau and the National Advisory Committee for Aeronautics, and ways and means of its accomplishment are now being planned by those organizations.

APPROVED:

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