CIVIL AERONAUTICS BOARD
SAFETY BUREAU

ACCIDENT INVESTIGATION REPORT

Adopted: November 12, 1947 Released: November 13, 1947

EASTERN AIR LINES, INC., GALAX, VIRGINIA—JANUARY 12, 1947

The Accident

Eastern Air Lines' Flight 665, NC-88872, a Douglas DC-3, crashed near Galax, Virginia, at 0138E,* January 12, 1947, during an instrument letdown while en route to Smith Reynolds Airport, Winston-Salem, North Carolina. The aircraft was demolished as a result of impact and subsequent fire, and 15 of the 16 passengers and the crew of 3 were fatally injured. The one surviving passenger was seriously injured.

History of the Flight

Flight 665 originated at Detroit, Michigan, January 11, 1947, with its destination Winston-Salem and with routine stops scheduled at Cleveland and Akron, Ohio. That portion of the flight from Detroit to Akron was accomplished without incident. On an instrument flight plan, which specified Raleigh-Durham Airport, Raleigh, North Carolina, as the alternate airport, Flight 665 departed from Akron at 2307 and thereafter made routine position reports over East Liverpool, Ohio, Pittsburgh, Pennsylvania; and Elkins, West Virginia. At 0042, January 12, 1947, the flight reported over Roanoke, Virginia, at 10,000 feet, and, in accordance with a previous air traffic control clearance, reported that it was descending to 8,000 feet. Shortly thereafter, a clearance was delivered from Airway Traffic Control requiring the flight to maintain 7,000 feet to the Winston-Salem radio range station and to hold on the southeast leg of the Winston-Salem radio range until further advised. At this time the flight was informed that approach clearance to Smith Reynolds Airport could be expected at 0145.

Immediately after receipt of the traffic control clearance, the flight requested information concerning "essential traffic." A complete traffic report was transmitted to Flight 665, immediately following which, the flight requested permission to descend to 3,000 feet. However, because descent to this altitude might have conflicted with other traffic, Airway Traffic Control refused the request.

The flight reported its position over Greensboro at 7,000 feet at 0110 and five minutes thereafter reported over the Winston-Salem radio range station. At 0121 the flight was cleared to descend to 5,000 feet and it reported reaching that altitude at 0126. The flight was instructed to descend to 4,000 feet at 0127 and six minutes later was cleared to the Winston-Salem tower. Immediately after receipt of this clearance Flight 665 attempted to contact Winston-Salem tower on the company frequency. Eastern Air Lines' radio station at Charlotte, North Carolina, called the flight at 0135 in order to advise the pilot that he was transmitting on the wrong frequency. No acknowledgment was received from the flight for this contact and no further radio contacts were had with Flight 665.

At 0243 the Virginia State Police notified the Civil Aeronautics Administration Winston-Salem Communications Station that the aircraft had crashed near Galax, Virginia, at a point approximately 58 miles northwest of Winston-Salem.

Investigation

Investigation disclosed that, while on a magnetic bearing of 295 degrees, the aircraft had struck the ground on the top of a knoll in the Blue Ridge Mountains, 10 miles northwest of Galax, Virginia, at an elevation of 2,479 feet. Five hundred feet beyond the point of initial contact, the aircraft struck large trees which sheared the left wing at a point near the attach angle. As the aircraft continued through the tree tops for an additional

*All times referred to herein are Eastern Standard and based on the 24-hour clock

400 feet, the right wing was sheared at the landing light position and the right stabilizer and elevator were torn from the empennage. One hundred eighty feet beyond, the remainder of the aircraft again struck the ground and skidded along the surface during the last 60 feet of forward motion, coming to rest against the east embankment of Virginia State Highway No. 94. Fire broke out immediately thereafter, consuming the major portion of the fuselage and wing center section.

No evidence was disclosed of malfunctioning of the aircraft's structure, power plants or control system prior to impact. Damage sustained by the engines and propellers indicated that, at the time of initial contact, the aircraft was operating under approximately normal cruise power. The flaps and landing gear were in a fully retracted position. It was determined that the altimeter setting of one of the altimeters was 29.98 inches. The other altimeter had been destroyed by fire. Propeller marks on the ground at the point of initial contact indicate that the aircraft was laterally and longitudinally level immediately before the accident.

The company radio receiver in the aircraft was found tuned to 4122.5 kilocycles, which is an Eastern Air Lines' frequency. The manually operated direction finding receiver was found tuned to 379 kilocycles, the frequency of the Winston-Salem radio range. The function switch for this receiver was turned to the "loop" position, and the loop itself was in a "wing tip null" or "rain static" position. The automatic direction finding receiver was found in the low frequency band; however, the exact frequency could not be determined. The function switch of this receiver was destroyed by fire.

Between the hours of 0054 and 0146, the radio range station at Winston-Salem had been functioning erratically due to intermittent power interruptions. From 0146 until 0244, the power was completely off and since no alternate power system is available at Winston-Salem, the radio range was inoperative during this period. Investigation disclosed that the power interruptions were due to a short circuit in the electrical system of the Duke Power Company. The power monitoring records obtained from the power company indicated four interruptions of less than 30 seconds duration each between 0054 and 0130. At 0134 and 0135, approximately four minutes before the accident, two interruptions were experienced of approximately one minute duration each.

Winston-Salem radio range is a medium-powered, loop type range without voice facilities, and its effective range is approximately 40 miles. Shortly before this accident the control of the Winston-Salem radio range had been taken over by the Civil Aeronautics Administration from the Army Air Forces. Up to the date of the accident no stand-by power supply had been provided, although the Civil Aeronautics Administration installed a separate generator for this purpose shortly thereafter. It was observed that three other radio range stations, the frequencies of which were identical to that of Winston-Salem, were located within a radius of 400 miles of the scene of the accident. Patterson Radio, Fairfield, Ohio, is located 271 miles north-northwest of Galax; Columbus Radio, Columbus, Georgia, is located approximately 378 miles southwest of Galax; and Myrtle Beach Radio, Myrtle Beach, North Carolina, is located approximately 235 miles southeast of Galax. Testimony of pilots who had been operating in this area indicated that at night interference may be expected on the Winston-Salem frequency from any of the above stations, except when in the proximity of the station. During test flights conducted shortly after the accident, it was determined that some interference or overriding from Patterson radio could be expected in the vicinity of Galax at any time. Because of the longer range and superior dependability of the Greensboro radio facility, the company operations specification required flights to approach Winston-Salem via Greensboro in order that it be necessary to use the Winston-Salem radio range *only* within its immediate vicinity.

Eastern Air Lines' Flight 664, northbound from Miami, Florida, landed at Winston-Salem at 0122, January 12, approximately 16 minutes prior to the time of the accident. Although the pilot of Flight 664 testified that some interference was observed from Columbus radio, no irregularity of the Winston-Salem range was noted within the normal holding and approach pattern for Winston-Salem.

An aftercast of the prevailing weather situation revealed that during the evening of January 11 a poorly defined high pressure system, centered in eastern North Carolina, lay over the southern Atlantic seaboard. The circulation about this high pressure system provided a flow of stable maritime air at low altitudes into western North Carolina and Virginia. Throughout this period no ceilings were reported in either Virginia or North Carolina until late in the night.

Simultaneously a low pressure 'wave' was developing in the Gulf of Mexico immediately south of Alabama. By 2330 this "wave" had become well pronounced and showed signs of moving northeasterly at a fairly rapid rate. The northeasterly movement of the tropical maritime air caused an overrunning in the North Carolina and Virginia areas. At approximately 2200, rain began to fall from the higher maritime tropical air into cooler air on the surface. Rain continued and increased in intensity as the "wave" moved northeastward after midnight at a rate greater than had been anticipated. This rainfall increased the humidity of the lower layer of stable cool air until by 0028 no dew point spread existed. Such a condition made the formation of low ceilings and fog highly probable throughout this area. At 2228 the first reported ceiling was carried in the Winston-Salem Weather Bureau log as 4,200 feet, overcast. This ceiling had dropped in the following 4 hours to 400 feet, overcast. At 0127, eleven minutes before the time of the accident, Winston-Salem was reporting a measured ceiling of 800 feet, overcast, 1 mile visibility, light rain and fog.

The company forecast for the period over which Flight 665 was operating indicated the probability of contact conditions existing at Winston-Salem and the surrounding area at the estimated time of arrival. The United States Weather Bureau forecast indicated a lowering of ceilings which at 0430 were expected to be 400 feet, overcast, 1 mile visibility, occasionally 200 feet, overcast and 1/2 mile visibility. The low ceilings and visibility forecast by the Weather Bureau actually prevailed in the Virginia and North Carolina area approximately 3 hours sooner than had been anticipated.

Flight 665 was operating above, and at times between, layers of overcast and broken clouds between Pittsburgh and Roanoke. The tops of the lower overcast between Roanoke and Winston-Salem were at approximately 7,000 feet. Witnesses in the vicinity of the scene of the accident indicated that intermittent heavy rain was falling and that fog covered most of the area in the vicinity of Galax. It is probable, therefore, that the flight was being conducted "on instruments" from the time it reached 7,000 feet shortly after passing Roanoke until the time of the accident.

Inspection of the company communication records discloses that Flight 665 departed from Akron at 2307. The flight subsequently reported over Pittsburgh at 2337, over Roanoke at 0042, over Greensboro at 0110, and over Winston-Salem at 0115. The distance from Akron to Pittsburgh is 91 miles, from Pittsburgh to Roanoke 210 miles, from Roanoke to Greensboro 83 miles, and from Greensboro to Winston-Salem 14 miles. According to the position reports of Flight 665, the average ground speed between Akron and Pittsburgh was 183 miles per hour, from Pittsburgh to Roanoke 194 miles per hour, from Roanoke to Greensboro 178 miles per hour and from Greensboro to Winston-Salem 168 miles per hour.

The surface temperature throughout North Carolina and Virginia at the time of the accident was between 40 and 50 degrees and the temperature at the 10,000 foot level was between 20 and 25 degrees. At an indicated air speed of 150 miles per hour, the true air speed of Flight 665 would be approximately 173 miles per hour at 10,000 feet and 163 miles per hour at 5,000 feet. The winds aloft at 5,000 feet during the time of this flight were southwesterly between 30 and 35 miles per hour and at 10,000 feet were west-southwesterly between 40 and 45 miles per hour. Pilots flying in this area at the time of the accident reported westerly and southwesterly winds exceeding 50 miles per hour. That portion of the flight from Akron to Pittsburgh, which was conducted at 9,000 feet, would probably have been influenced by a tail wind component of at least 30 miles per hour. The ground speed, therefore, between Akron and Pittsburgh would be expected to have been slightly in excess of 200 miles per hour. That portion of the flight between Pittsburgh and Greensboro should have been influenced by an average head wind component of at least 25 miles per hour and probably close to 28 miles per hour. The average ground speed between Pittsburgh and Greensboro, therefore, could hardly be expected to exceed 150 miles per hour.

The minimum altitude specified in Eastern Air Lines' Operations Manual for the route from Roanoke to Greensboro is

6000 feet.** The minimum altitude for initial approach to the Winston-Salem radio range station is 2500 feet. Smith Reynolds Airport is located at a distance of 5.1 miles northwest of the Winston-Salem radio range station and the minimum indicated altitude specified in Eastern Air Lines' Airport Specifications for crossing Smith Reynolds Airport is 1469 feet. The total distance from Greensboro to Smith Reynolds Airport is slightly in excess of 19 miles and the descent required between these two points is almost 5000 feet. The elevation of the airport is 969 feet.

Captain H. M. Haskew, the pilot of Flight 665, had completed the qualifications for the route from Akron to Winston-Salem on October 1, 1946, and was promoted to captain on October 2, 1946. Of his total flying time of 3511 hours, 230 hours had been accumulated as pilot in command of DC-3 equipment until the date of the accident. During the course of his service with the company as captain, Captain Haskew had made two flights involving stops at Winston-Salem.

Discussion

In view of the prevailing winds at the flight levels between 5,000 and 10,000 feet, it has been demonstrated that the ground speed of the DC-3 could hardly have been higher than 150 miles per hour south of Pittsburgh. The average ground speed computed on the basis of position reports over Pittsburgh and Roanoke was 44 miles per hour higher than the maximum ground speed possible under the existing conditions. It must be concluded, therefore, that the position report over Roanoke was in error and that the pilot must have been approximately 53 miles north of Roanoke at the time of this report. It appears, furthermore, that the position reports made "over" Greensboro and Winston-Salem were also in error. At 0115, when the flight reported over Winston-Salem, it was probably 62 miles north of Winston-Salem.

Had the pilot taken into consideration the existing winds aloft, reports of which were attached to the flight plan, he could not have reached a conclusion that the flight covered the distance between Pittsburgh and Roanoke at 194 miles per hour nor between Roanoke and Greensboro at 178 miles per hour. The reported static condition in the 200 to 400 kilocycle band rendered difficult the reception of radio ranges and other low frequency facilities. Since the flight from Pittsburgh to Roanoke is not conducted directly along the radio range legs of the facilities on that route, it is probable that Flight 665 was relying primarily upon automatic direction finding procedures. The existing static conditions no doubt rendered the use of the ADF difficult.

The minimum altitude established by the company between Roanoke and Greensboro is 6,000 feet. It cannot be understood why the pilot deliberately requested clearance from Airway Traffic Control to an altitude of 3,000 feet simply to expedite approach to Winston-Salem. It must be concluded, however, that, in the interest of avoiding a possible delay of a few minutes, the pilot desired to conduct the flight below the minimum altitude prescribed in the Operations Manual for this portion of the route.

While it is not known whether the flight was at any time tuned to Greensboro radio, it is very unlikely that the pilot had obtained a positive identification of station passage over the Greensboro radio range. Since this facility is a high powered Adcock range, it is unlikely that any serious difficulty would have been experienced in identifying station passage adequately. Had the pilot clearly identified his position over Greensboro, there would have been no occasion for him to hold a northwest heading for the length of time necessary to bring him 58 miles northwest of Winston-Salem. The time normally required to fly from the Greensboro radio range station to the Winston-Salem radio range station is 6 minutes. At a ground speed of 160 miles per hour, the flight would have required an additional 24 minutes to reach the scene of

** The terrain in the vicinity of Roanoke rises to a maximum elevation of 4,000 feet. Approximately 10 miles south of Roanoke and within 5 miles of the direct route between Roanoke and Greensboro, the elevation of the terrain is in excess of 3,500 feet. Southward of this area the terrain slopes downward to approximately 1,000 feet in the Greensboro and Winston-Salem area

the accident. Since it is hardly conceivable that an airline pilot would maintain a heading toward the Blue Ridge Mountains for 30 minutes and continue a descent below the terrain in this area, it must be concluded that the pilot at no time was over or near Greensboro and that, after passing the point at which he reported "over Roanoke," the remainder of the flight was conducted with both the direction finding receivers tuned to the Winston-Salem radio.

The investigation disclosed the fact that the manually operated direction finding receiver was tuned to the Winston-Salem radio range at the time of the accident. If both the manual and the automatic direction finding set were tuned to Winston-Salem for a considerable period of time prior to the accident, a reasonable account of the resulting navigation errors can be made. In the vicinity of Galax and northward for a distance of 40 to 50 miles there existed, for Winston-Salem radio, a skip-distance within which at night there often is a strong overriding of Patterson radio. In the event of a momentary inoperation or fading of the Winston-Salem radio range station, the effect of the overriding by Patterson radio might be aggravated to the extent that a sudden reversal of the direction of the ADF indicator would result. It is very probable that such a reversal would have the appearance of the reversal normally experienced during passage over a radio station. At some point north of Winston-Salem the pilot might have experienced such a reversal and been led to believe that he had passed over the Winston-Salem station. This fact may very well account for the pilot having assumed a heading of 295 degrees shortly before the accident.

It must be noted that the pilot of the Eastern Air Lines' Flight 664, which landed at Winston-Salem 16 minutes before the time of the crash, experienced no difficulty with the signals received from the Winston-Salem radio range. In fact, this pilot was unaware that any interruptions in the range signals had occurred. However, all of the interruptions which occurred prior to the time this flight landed were of less than 30 seconds duration, and the interruptions of longer duration at 0134 and 0135 occurred after this flight had landed. The fact, therefore, that this flight may have had no difficulty with the Winston-Salem radio range signals does not preclude the possibility that, due to a momentary inoperation of the range, the pilot of Flight 665 erroneously believed that the aircraft had passed over the Winston-Salem radio range station.

If any aural signal were received from Winston-Salem radio when the aircraft was in the vicinity of Galax, that signal would be in the form of the west A-quadrant identification. The possibility that the pilot was receiving the primary aural signal from Patterson radio appears remote, particularly in view of the fact that the quadrant identification from that station would have been an "N" signal in the vicinity of Galax. Believing himself to have passed Winston-Salem, the pilot could readily have mistaken the west A-quadrant identification signal for that of the east A-quadrant. The extent of static interference and the erratic volume changes occurring as a result of "night effect" on the Winston-Salem loop range, as well as the interference of other stations, Patterson radio in particular, would render difficult quadrant identification on the basis of "builds" or "fades" of signal intensity. It therefore appears that at the time of the accident the pilot must have believed that he was southeast of Winston-Salem on a heading which would permit him to intercept the southeast leg when, in fact, he was northwest of Winston-Salem bearing away from the northwest leg at an angle 30 degrees to the left of that leg.

The magnetic bearing of 295 degrees carried the pilot directly into the Blue Ridge Mountains. During this portion of the flight the aircraft had been cleared to descend from 7,000 feet. The routine manner in which the subsequent altitude reports had been made indicates that the pilot anticipated no difficulty in completing the descent. Immediately prior to the accident the flight was being conducted over mountainous terrain, through intermittent heavy showers, and was no doubt in the overcast until reaching an elevation very close to that at the site of the accident.

In summarizing its investigation of this accident the Board concludes that the flight planning by the pilot of Flight 665 was not adequate. In the course of the flight the pilot must have

been to some extent inconvenienced by a substantial amount of static interference with the radio navigational facilities en route. The fact that he requested clearance to Winston-Salem from Roanoke at an altitude 3,000 feet lower than the approved company altitude is sufficiently indicative of the pilot's greater interest in arriving at Winston-Salem as close to schedule as possible rather than in conducting the flight according to the en route procedures established by the company. The pilot was without justification in his deviation from standard company route procedures in not flying directly to Greensboro from Roanoke. Instead of following procedures which would have enabled him to use the best radio facilities available, the Captain chose to fly directly to Winston-Salem from Roanoke thereby compromising the safety of the flight in order to gain a few minutes time.

Findings

On the basis of all available evidence the Boards finds that

1. The air carrier, aircraft and crew were properly certificated.

2. At the time of departure from Akron the aircraft was properly loaded with respect to center of gravity, and the actual take-off gross weight was approximately 400 pounds less than the allowable maximum.

3. While en route to Winston-Salem from Pittsburgh, the Captain erroneously reported his position as over Roanoke at 0042, when in fact at this time the flight was approximately 53 miles north of Roanoke.

4. Shortly after the time of the Roanoke position report, the pilot requested clearance to Winston-Salem at an altitude 3,000 feet lower than the minimum company en route altitude between Roanoke and Winston-Salem.

5. The pilot chose to deviate from the standard Eastern Air Lines' route procedures and fly directly to Winston-Salem.

6. Because Winston-Salem radio is a medium powered, loop type radio range station, the route from Roanoke to Winston-Salem is via Greensboro radio.

7. Considerable static interference existed in the low frequency band.

8. Considerable overriding of Winston-Salem radio is often experienced in the area north of Winston-Salem by Patterson radio.

9. At 0134, four minutes before the accident, the aircraft was approximately 53 miles northwest of the Winston-Salem radio range station.

10. At 0134 and 0135 two power interruptions of approximately one minute duration each occurred which caused a temporary failure of the Winston-Salem radio range station.

11. In the belief that he was in the close proximity of Winston-Salem, the pilot chose to establish a let-down without positively having identified the aircraft's position with respect to the Winston-Salem radio range station.

12. The flight continued its descent toward the Blue Ridge Mountains striking the ground at an elevation of 2,479 feet at a point 63 miles northwest of the Winston-Salem radio range station while on a direction of flight opposite to the direction of Winston-Salem.

Probable Cause

The probable cause of this accident was the action of the pilot in attempting a let-down without having positively determined the position of the aircraft. A contributing factor was the erroneous navigation of the pilot which on at least two occasions led him to believe that he was farther south than he actually was.

BY THE CIVIL AERONAUTICS BOARD:

/s/ J. M. LANDIS
/s/ HARLLEE BRANCH
/s/ JOSH LEE

Ryan, Vice Chairman, did not take part in the decision.

—17841

Supplemental Data

Investigation and Hearing

The Civil Aeronautics Board was notified of the accident January 12, 1947, and an investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Air Safety Investigators of the Board's New York office arrived at the scene of the accident the morning of January 12, and were subsequently assisted in the investigation by other investigators of the Safety Bureau staff. A public hearing was ordered by the Board and was held at Richmond, Virginia, January 21 and 22, 1947.

Air Carrier

Eastern Air Lines is incorporated under the laws of the State of Delaware, and maintains its general offices in Miami, Florida. At the date of the accident, it was operating 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 were current at the time of the accident and authorized the company to transport persons, property and mail between various points in the United States, including Akron, Ohio, and Winston-Salem, North Carolina.

Flight Personnel

Captain Harold N. Haskew, age 33, of Jacksonville, Florida, was employed by the company since February 18, 1943, and was pilot of the aircraft at the time of the accident. He possessed an air line transport pilot rating and had logged a total of 3,511 hours flying time, of which 1,939 hours had been obtained in DC-3 equipment. First Officer James J. Canepa, age 26, of Jacksonville, Florida, was co-pilot of the aircraft. He possessed a commercial pilot and instrument rating, and until the date of the accident he had logged a total of 1,560 hours, of which approximately 326 hours had been obtained in DC-3 aircraft. Mary McDermott of Miami, Florida, was flight attendant. Both pilots were properly certificated, and the captain was qualified over the route.

Aircraft

The Douglas DC-3C, NC 88872, was being operated by Eastern Air Lines under lease from the Defense Plant Corporation and was properly certificated at the time of the accident. It had been operated a total of 7,680 hours, of which 4,689 hours had been accumulated since conversion. It was equipped with two Wright G-202A engines on which Hamilton Standard propellers were installed. The left engine had been operated a total of 17,346 hours, and both engines had been operated a total of 784 hours since the last major overhaul. At the time of departure from Akron the total weight of the aircraft was within its maximum allowable gross and the load was distributed with respect to the center of gravity within approved limits.