SA-301 File No. 1-0014

C I V I L A E R O N A U T I C S B O A R D
ACCIDENT INVESTIGATION REPORT

Adopted: July 5, 1955 Released: July 8, 1955

TRANS WORLD AIRLINES, INC. - CASTLETON, INC.,
NEAR GREATER CINCINNATI AIRPORT, COVINGTON, KENTUCKY,
JANUARY 12, 1955

The Accident

At 0904,[1] January 12, 1955, a Trans World Airlines Martin 202A, N 93211, and a Douglas DC-3C, N 999B, owned by Castleton, Inc., collided near the Greater Cincinnati Airport approximately two minutes after takeoff of the TWA flight. All 13 persons aboard the TWA aircraft and the two pilots, sole occupants of the DC-3, were killed. Both aircraft were demolished as a result of collision, ground impact, and fire.

History of the Flight

TWA Flight 694 departed Greater Cincinnati Airport at 0902 on an Instrument Flight Rules flight plan to Cleveland, Ohio, with a scheduled stop at Dayton. The crew consisted of Captain James W. Quinn, First Officer Robert K. Childress, and Hostess Patricia A. Stermer. Gross weight of the aircraft at takeoff was 35,572 pounds (allowable 41,600 pounds) and the load was properly distributed with regard to center of gravity limits. The flight was cleared for a right turn after takeoff from runway 22.

At 0904 controllers in the tower overheard the words, "Kenton Tower, TWA six nine four . . ."[2] expressed in a normal tone of voice. The carrier signal was heard for three or four seconds after this message fragment. Several attempts were made

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1/ All times referred to herein are eastern standard and based on the 24-hour clock.

2/ Synonymous with Greater Cincinnati Airport Tower.

to contact the flight in the next few seconds. The controllers then saw a flash of fire and smoke rising from the ground about two miles west-southwest of the tower. Within a short time it was learned that the Martin 202 and an unreported DC-3 had collided.

Between 0715 and 0722, Captain Arthur A. Werkhaven, pilot of the DC-3, was furnished weather information at the Battle Creek, Michigan, Interstate Airways Communications Station for various points along the route Battle Creek to Lexington, Kentucky, and thence to Miami, Florida. Captain Werkhaven advised the station chief who furnished this weather information that he was going to Lexington to pick up some passengers and then proceeding to Florida. He remarked that he would proceed in accordance with Visual Flight Rules to Lexington and if the weather lowered en route, would file in flight for an IFR clearance. The station received a call from the aircraft at 0733, just before it took off, requesting the current ceiling at Battle Creek. The flight was advised that ceiling was 3,100 feet and was requested to furnish a pilot report on ceiling after takeoff. The pilot replied that he did not believe he would get that high but would call if he did. Information on the surface wind, altimeter settings, and time was transmitted and the flight acknowledged the message. This was the last radio contact. While Captain Werkhaven was in the station, the station chief observed that the aircraft was being checked on the ramp by the copilot, Edward C. Agner.

No radio facilities along the route were contacted by the

pilots of N 999B and no flight plan was filed before departure or in the air. The presence of N 999B in the Cincinnati area was unknown to CAA Air Route Traffic Control and the Cincinnati tower.

Investigation

Immediately after the accident, when notified by the tower, the U. S. Weather Bureau office at the airport administration building took an observation. This report, designated as Special No. 6, was completed at 0907, only three minutes after the accident. Conditions were reported as: Ceiling measured 800 feet variable, overcast; visibility 4 miles; light freezing drizzle, fog; temperature 28; dewpoint 25; wind southwest, 11 knots; altimeter setting 29.99 inches; remarks -- ceiling 700 feet variable to 900 feet.

The accident occurred within the boundaries of the Greater Cincinnati Airport control zone, which is 10 miles in diameter with the center at the airport.

The main portion of the Martin wreckage was about 2-1/2 miles west of the airport control tower and approximately the same distance from the southwest end of runway 22,[3/] strewn for 685 feet on both sides of a gully. Examination of the Martin wreckage showed that the right wing was partially severed chordwise at collision about 22 feet from the centerline of the fuselage, and wrenched off while the aircraft was still in the air. The aircraft struck the ground in a fairly steep dive, which resulted in disintegration of the cockpit and its components to such degree

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3/ See attachment 1.

that no information was obtainable on the position of cockpit controls and radio equipment. Several seat belts were found with webbing broken, several had broken attach fittings, and in other cases attach fittings tore free of the fuselage structure. The cabin area was ripped apart at impact. The landing gear received major damage but it was ascertained that it was retracted when the aircraft struck the ground, as were the flaps. Inspection of the propeller domes showed that the pitch of the propeller blades at ground impact was 47 degrees. No evidence was disclosed in examination of the Martin wreckage to indicate any malfunction or failure prior to the collision. Portions of the DC-3 left wing outer panel were recovered at the Martin wreckage.

The DC-3 struck in an open, flat field about one mile south of the Martin, approximately 2-1/4 miles west-southwest of the control tower. The wreckage was strewn for 250 feet, but generally concentrated at the gouge formed by impact. A number of battered and torn sections of the left wing outboard of the flap and portions of the vertical tail were recovered between the two main wreckage sites. Further examination of the wreckage, coupled with this evidence, established that several feet of the left wing panel and portions of the vertical tail were torn off at the time of collision. The aircraft struck the ground in a steep dive, on the stub of the left wing, the nose section, and engines. The cockpit was demolished. No portions of the Martin structure were found at the main DC-3 wreckage site. Four propeller cuts were found across the top of the fuselage, two in the vertical

tail, and one in the left wing. The fin was badly crushed and torn, and the rudder was detached at the hinges. The landing gear was retracted. The flap mechanism was destroyed and therefore the position of the flaps at impact could not be ascertained. Examination of the propeller dome assemblies revealed that the pitch on the left propeller at ground impact was 41 degrees, and the right 39 degrees. All radio equipment was so severely damaged that it was impossible to ascertain with any certainty what, if any, equipment was in use, or to which frequency it might have been tuned.

About halfway between the two main wreckage areas various pieces of the DC-3 left wing structure, left aileron, and the base of the vertical tail were intermingled with a portion of the Martin right wing leading edge and wing skin.

Study of the wreckage of both aircraft disclosed that immediately prior to impact the aircraft approached each other at an angle of about 30 degrees from head on, with the longitudinal axis of the two aircraft crossing to the left of the Martin and to the right of the DC-3. The aircraft were banked relative to one another so that the left wing of the Martin was higher than the right wing of the DC-3, while the right outer wing of the Martin and the left outer wing of the DC-3 were in position to collide. In addition, the collision damage indicates that the Martin was climbing relative to the DC-3.

The first major components to come in contact were the left wing of the DC-3 and the right propeller of the Martin. The right

wing of the Martin and the left wing of the other aircraft then struck, resulting in disintegration of the DC-3 wing in the contact area, and causing such structural damage to the Martin right wing that it separated from the aircraft before ground impact. While the two wings were tearing through one another, the left propeller of the Martin started its cuts across the top of the DC-3 fuselage and through the vertical fin and rudder while the Martin moved across and to the rear of the other aircraft. Near the end of the contact period, the inboard side of the Martin left nacelle inflicted severe crushing damage on the DC-3 vertical tail. This caused portions of the DC-3 fin and rudder to separate in flight.

Several witnesses were found who saw or heard the two aircraft after collision. One of the witnesses[4/] heard the Martin take off. About two or three minutes later he heard a sharp sound to the southeast which resembled a clap of thunder or blasting. Immediately directing his attention toward the source of this unusual sound, he saw nothing except the low overcast for an appreciable time, testifying that it might have been as long as 30 seconds before he saw an aircraft dive out of the clouds and burst into a ball of flame when it struck the ground. He recalled that he could still hear the aircraft for a second or two after first seeing the fire. He later learned that the aircraft he saw was the Martin; it crashed about one mile away, between

4/ Position denoted on Attachment 1 by numeral 1; other witness positions are similarly noted by appropriate number, in the order mentioned in the report.

his position and the airport. At no time did this witness see the DC-3 and he had no conscious recollection of having heard it prior to collision.

Another witness heard an explosion which rattled the windows of his home. Quickly crossing the room, he looked out the west window and saw an aircraft headed north. For an instant it appeared to be in level flight near the base of the clouds, then go out of control, dive to the ground at about a 45-degree angle, and explode upon impact. He went to the scene immediately and learned that it was the TWA aircraft which he had observed.

A third "heard a loud noise," Looking up, he saw two aircraft to the northwest, just under the base of the overcast. The DC-3 was in a steep dive and the Martin was apparently trying to pull out of a dive. He got only a glimpse of the Martin before it disappeared behind two silos. Although this witness lived near the end of runway 22, he did not recall hearing the Martin take off.

Another witness, a seventh grade teacher in a school about a mile and a half north of the site of the intermingled wreckage, testified that she heard an aircraft west of her position, flying south, shortly before the time of the collision.

One of the teacher's students, a boy of 15, testified that he heard an aircraft and looked out the window. (Witness No. 5 on Attachment.) He saw it pass the end of the building, going west, and turned back to his school work. He did not note how the aircraft was colored nor did he recall any markings. The

aircraft appeared to be flying close to the base of the clouds. His attention was again drawn to the aircraft a few moments later, he said, when he heard a roar of engines, looked up, and almost at the same instant saw an explosion in the air, accompanied by a mushroom of smoke. He said that he saw "two tails" and the wreckage "came down in one heap." There was a flash of fire and smoke when it hit the ground. He stated that he told other students around him what he had seen and heard.

A sixth witness, who lived near the schoolhouse, was walking down the driveway at his home when he heard an aircraft take off from the airport. He then heard an aircraft coming from the north and it passed, going south, west of where he was standing. It seemed to him from the sound that this second aircraft was very low. He searched the sky but never saw either of the two aircraft apparently because of the "hazy condition." There were no obstructions between his position and the area where the two aircraft collided. While searching the sky, he heard a thud and an explosion, followed by a surge of engines from one of the aircraft. After hearing a second explosion and seeing smoke as an aircraft struck the ground, this witness went immediately to the scene, which was that of the Martin crash.

A seventh witness was standing outside a school in west Cincinnati when at about 0855 his attention was drawn to an aircraft flying much lower than usual, which he definitely identified as a DC-3. It continued past his position, flying in a southwesterly

direction, disappearing and reappearing in the overcast several times. Rain or wet snow was falling at the time. The aircraft appeared to be grayish in color, but he was unable to state whether this might be ascribed to the appearance of metal or paint; he observed no trim or markings. The Castleton DC-3 was painted gray with maroon trim.

Investigation disclosed that neither the Cincinnati INSAC station nor the Greater Cincinnati airport tower had any radio contact with the Castleton DC-3 or with any other DC-3.

The accident occurred within the control zone encompassing the Greater Cincinnati Airport. A control zone is an airspace of defined dimensions, extending upward from the surface, to include one or more airports. Civil Air Regulations specify that aircraft shall not be flown within a control zone beneath the ceiling when it is less than 1,000 feet, unless authorized by air traffic control.5/ If operating on an IFR clearance, a flight would already be under the jurisdiction of air traffic control for flight within a control zone; if on a VFR flight plan, or no flight plan, a clearance to operate within the control zone would have to be requested if weather conditions were IFR (ceiling less than 1,000 feet or visibility less than 3 miles). If the ceiling is less than 1,000 feet, an aircraft, if cleared, may operate within the zone, remaining underneath and clear of clouds. In this instance, the ceiling was less than 1,000 feet and no request was received from the DC-3 for a clearance to operate

5/ See Civil Air Regulations, Secs. 60.30, 60.31, 60.40, 60.73, and 60.74.

within the control zone.

While in the Battle Creek INSAC station, Captain Werkhaven reviewed weather reports for South Bend, Goshen, Fort Wayne, Dayton, Cincinnati, Louisville, and Lexington. He also reviewed terminal forecasts, pilot reports, and a special observation for Fort Wayne which showed the ceiling lowering from 3,000 to 1,500 feet with light freezing drizzle. Weather reports for stations along the route showed ceilings lowering from 3,100 feet in the Battle Creek area to 1,300 feet at Lexington, and that visibilities would gradually lower from eight miles at point of departure to two miles in the Lexington area.

Forecasts available before departure showed the existence of an overcast over the entire route, with ceilings ranging from 3,000-4,000 feet in southern Michigan to 1,000 feet in the Cincinnati-Lexington area, precipitation throughout, and icing in the clouds. The overcast was composed of strato-cumulus clouds, the top of which was between 6,000 and 7,000 feet in Michigan and 4,000-5,000 feet in Kentucky.

When the DC-3 departed, there was a warm front slightly north of Battle Creek and a cold front several hundred miles to the west. The entire route lay in the warm sector between the fronts. Winds were southwesterly at 15 knots or less at the surface and at 2,000 feet, from about 240 degrees at 15-20 knots. Below freezing temperatures existed over the route from the surface upward and icing existed in precipitation areas and in the clouds.

The ceiling progressively lowered as the DC-3 proceeded southward, becoming as low as 1,000 feet in northeastern Indiana, with visibility occasionally becoming two miles in light snow showers. By the time the flight arrived in the Richmond-Dayton area, ceiling was about 800 feet, with very light freezing drizzle and possibly occasional light snow.

The weather broadcast by Dayton Radio in its regular half-hourly broadcast at 0845 included Greater Cincinnati Airport weather as being ceiling measured 1,100 feet, overcast, visibility four miles. In Cincinnati's 0845 broadcast, a special observation completed at 0843 was broadcast both at the beginning and end of the weather report. The 0843 special was: Measured ceiling 900 feet, overcast; visibility four miles; very light freezing drizzle, fog; wind southwest 11 knots; altimeter setting 30.00 inches. This special was later broadcast by Dayton at 0858.

Fog in the area of the airport at the time of the accident was light but extended from the ground to the base of the clouds.

Ceiling at Cincinnati was measured by a recording ceilometer. Its record reflected the following readings: 900 feet at 0842; 800 feet at 0847 and 0854; 700 feet at 0859; 900 feet at 0906; and 700 feet at 0912, 0918, and 0924.

The wind at the base of the overcast (700-900 feet above the ground) was from about 240 degrees at 18 knots; therefore, the clouds over the site of the DC-3 wreckage at the time of the accident were moving east-northeast approximately over the ceilometer six minutes later (0910).

There were five controllers on duty in the airport control tower at the time of the accident. The local controller who issued the takeoff clearance to the Martin took note from the tower clock at his position that takeoff occurred at 0902. The approach controller also noted that the aircraft was airborne at 0902 and logged this fact. The local controller stated that he had the Martin in sight from the time it began the ground run until it apparently disappeared in the clouds just after starting a right climbing turn. The aircraft was airborne at the intersection of runways 22, 27, and 31. He saw the landing gear retract but had no recollection of flap position. The takeoff appeared to be normal in all respects. He was not sure where the right climbing turn began, stating that it might have started while the aircraft was still within the airport boundary, but also that the turn may have been made some distance beyond the southwest end of the runway. When fire rose from the ground (Martin impact), two of the controllers noted that the tower clock showed 0904.

The tower clock was of the type which presents the hours and minutes in numeral form, similar to the mileage recorder of an automobile odometer. The seconds reading also appears in numeral form. The minute numeral jumps to the next at the moment the seconds drum reaches 60. None of the controllers made note of the seconds indication when they observed the above events.

The elapsed time from takeoff of the Martin 202, possible flight paths of both aircraft, and the techniques and flying

habits of both captains were thoroughly investigated.

Captain Werkhaven had been employed as a pilot for Castleton since 1939 with the exception of a three-year period during World War II when he was a B-24 production test pilot. He held an airline transport pilot rating, and had been flying since about 1924. Captain Werkhaven had been flying this DC-3 since purchase by the company in 1950 and had acquired about 1,500 hours in it. His total time was 11,555 hours.

TWA flight operations procedures specify that aircraft are to climb straight ahead until reaching an altitude of 500 feet. The flaps are then retracted, power reduced to climb power, and a climbing turn to the desired heading is commenced.

Following the accident, the air carrier conducted two test flights to learn what the altitude and position of the aircraft at various stages would be if standard company procedures during instrument flight were followed. The test aircraft was a Martin 202A, and the flights were conducted under approximately the same wind conditions, aircraft loading, and from the same runway as used by Flight 694. The test pilot had given Captain Quinn all of his checks for the past 18 months, and TWA believed that this pilot could closely duplicate the techniques which Captain Quinn probably used. The results of the two runs showed that by using standard company power settings, airspeeds, and flight techniques the aircraft would fly over the intermingled wreckage at an altitude of 1,500 feet above the ground on a heading of 340 to 345 degrees and in an elapsed time of 2-1/2 minutes. TWA

concluded that since Captain Quinn was a conscientious and conservative pilot who had never been known to deviate from company policy, the collision probably occurred at an altitude of about 1,500 feet.

During the investigation an aeronautical engineer representing Castleton, Inc., conducted a detailed study of the wreckage and other evidence, and submitted a separate report of his findings to the Board. He concluded that the point of collision was very near the location of the recovered DC-3 wing tip since this unit fell nearly straight downward after the collision. His value of the closure angle between the two aircraft at the time of the collision substantially agreed with the value arrived at by the Board's investigators as reported earlier. A portion of this engineer's study was devoted to the calculated trajectory of the DC-3 following the collision. From this trajectory analysis, he concluded that the DC-3 struck the ground 14 seconds after the collision, and that it covered a distance of 3,000 feet over the ground and rolled somewhat beyond the vertical in this interval. The study further showed, he testified, that based on conservative assumptions the maximum collision altitude was 1,000 feet, and that if the elevator trim, the exact amount of left wing lost, and elevator control displacement (pilot's effort to raise the nose of the aircraft), were more precisely known the collision altitude might be as low as 500 feet. This engineer further stated that his study showed that the DC-3 heading was 170-180 degrees and the Martin 202A heading was 315-330 degrees. The

Martin 202A heading at the time of collision indicated, he believed, that the TWA pilot started his right turn at the far end of runway 22, and that the collision occurred 50 seconds later.

The air carrier, both aircraft, and the four pilots were currently certificated.

Analysis

The TWA flight was properly cleared for takeoff and the approved instrument flight plan was in order.

Since there were no radio contacts from the DC-3 it is unknown at what altitudes the flight was made. It would have been possible for the pilot to have conformed with VFR rules between Battle Creek and Cincinnati by flying through areas of low ceiling and visibility at less than 700 feet altitude (below airways) provided the aircraft was operated clear of clouds and visibility was not less than one mile.6/

Analysis of weather data indicated that the lower overcast was solid over the entire route, with the base 3,100 feet at Battle Creek and ranging from 700 to 1,000 feet along the route from northeastern Indiana to Lexington. The thickness of this lower overcast, composed of strato-cumulus clouds, was between 3,000 and 4,000 feet at Cincinnati.

Light icing was occurring in precipitation and in clouds along the route of the DC-3 and in the Cincinnati area. It is possible that visibility could have been reduced in either aircraft by windshield icing unless preventive measures were used.

6/ See Civil Air Regulations, Sections 60.30, 60.31, and 60.73.

Windshield deicing equipment was available on both aircraft.

It appears that in the collision area, visual reference to the ground was possible up to 900 feet above the surface. Although fog in the area was light, extending from the surface to the base of the overcast, it appears highly probable that visibility progressively decreased with altitude, and that visibility near the cloud base was considerably less than the surface visibility of four miles. There was very little forward visibility between 700 and 900 feet, and instrument conditions prevailed from 900 to about 4,100 feet.

Captain Werkhaven was briefed on weather conditions before departure and had knowledge from this that weather would become marginal as he proceeded. Since the flight was conducted without flight plan, in weather conditions which became poorer, and without communicating with any station en route, it is considered that he failed to exercise reasonable judgment and conducted this operation contrary to good operating practices. Good judgment would have dictated, in light of the weather situation, that the flight should have been planned and conducted so as to avoid flying at low altitudes in marginal VFR conditions.

The DC-3 was operating in the control zone without being cleared to do so by air traffic control. Since the ceiling was less than 1,000 feet, this clearance was required.

The DC-3 was equipped with several transmitters and receivers. It is therefore considered remote that total radio failure could have occurred.

Considerable study and analysis of the evidence was devoted to the question of the point in space where the collision took place. It must have occurred nearly over the site where portions of both aircraft were found intermingled. As to altitude, the testimony of ground witnesses, aircraft performance data, results of the test flight, and other studies were carefully examined and assayed.

It is reasonable to assume that the DC-3 was in level flight on a south heading. Whether it flew over Cincinnati or not could not be absolutely verified. However, the DC-3 seen by the witness in west Cincinnati was probably the Castleton DC-3. There were no other DC-3's known to be in the area and the aircraft he saw was headed in the general direction of the airport only a few minutes before the accident.

Since the DC-3 was not on an IFR flight plan, the pilot could be expected to have tried to remain in visual contact with the ground. Analysis of some witness testimony, however, indicates that it was being operated in the clouds. The controller was of the belief that he lost sight of the TWA aircraft because of its entry into the overcast. Further, it will be recalled that one witness stated that an appreciable period of time elapsed between hearing the collision and the time an aircraft came into view, apparently out of the overcast. One of the several witnesses, a schoolboy, stated that he saw an explosion in the air which may indicate that the collision occurred at the base of or in the overcast. Other witnesses saw fire from ground impact but not

an explosion in the air.

During the several seconds it took for the sound of collision to reach the witnesses, the inertia of the two aircraft would tend to make them continue along the same general paths they had immediately prior to the collision. As a result, the two aircraft may have changed altitude very little during the interval until the first witness saw the Martin.

Captain Werkhaven was a pilot of many years' experience and should have been well aware of the danger of flying in a control zone under the existing conditions without clearance. Had he requested a clearance to operate within the control zone, his presence would have been known and the tower would have given him separation from the other traffic.

The Martin 202A is capable of climbing at considerably higher rates than those indicated by the test flight. The test flight results indicated that collision occurred in the clouds, several hundred feet above the base of the overcast. However, the results of the study by Castleton indicated that the accident could have occurred between 500 and 1,000 feet. In considering the test flight results, the engineering studies, and all other pertinent evidence, the Board concludes that the accident occurred close to the base of, or in, the overcast.

Findings

On the basis of all available evidence the Board finds that:

1. The air carrier, both aircraft, and the four pilots were currently certificated.

2. TWA Flight 694, a Martin 202A, departed Greater Cincinnati Airport at 0902 on an approved IFR flight plan.

3. A Douglas DC-3C, owned by Castleton, Inc., departed Battle Creek, Michigan, under VFR conditions, at approximately 0733, destined for Lexington, Kentucky; no flight plan was filed.

4. The two aircraft collided about 2-1/2 miles west of the Greater Cincinnati Airport, in the control zone, at 0904.

5. The DC-3 was unknown traffic in the control zone.

6. No radio facilities were contacted by the pilots of the DC-3 after departing Battle Creek.

7. A solid overcast of strato-cumulus clouds existed between Battle Creek and Lexington with the base sloping from 3,100 feet at Battle Creek and ranging from 700 to 1,000 feet along the route from northeastern Indiana to Lexington.

8. Ceiling in the Cincinnati area at the time of the accident was measured 800 feet, variable 700-900 feet; visibility 4 miles; light freezing drizzle, light fog extending from the ground to the overcast; wind southwest 11 knots. Cloud cover was between 3,000 and 4,000 feet thick.

9. Instrument conditions prevailed in the control zone because the ceiling was less than 1,000 feet; this condition required an instrument flight plan or permission from the tower to operate within the zone.

Probable Cause

The Board determines that the probable cause of this accident was operation of the DC-3 in the control zone as unknown traffic, without clearance, very close to the base of, or in, the overcast.

BY THE CIVIL AERONAUTICS BOARD:

/s/ ROSS RIZLEY

/s/ JOSEPH P. ADAMS

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

Josh Lee, Member, did not participate in the adoption of this report.

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of the accident at 0930, January 12, 1955. An investigation was immediately initiated in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered and was held at Cincinnati, Ohio, on March 2, 3, and 4, 1955.

Air Carrier

Trans World Airlines, a Delaware corporation, is a scheduled air carrier with its principal offices at Kansas City, Missouri. It possesses a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to transport by air persons, property, and mail over various routes, including that between Cincinnati and Cleveland, Ohio.

Flight Personnel

1. TWA Martin 202A

Captain James W. Quinn, age 34, had been employed by TWA since December 18, 1942. He held a valid airman certificate with an airline transport pilot rating for multi-engine land aircraft, and type ratings for the Martin 202 and four other transport aircraft. He had 7,914 pilot hours, of which 791 had been acquired in Martin 202 aircraft, 498 hours of instrument flying time, and 60 hours flying time in the 30 days preceding the accident. Captain Quinn had a rest period of 23 hours before

this flight. His last first-class CAA physical examination was taken on August 20, 1954. He received his last route check on September 25, 1954, and his last instrument check on October 14, 1954.

First Officer Robert K. Childress, age 26, had been employed by TWA since March 1, 1954. He held a valid airman certificate with commercial pilot and instrument ratings. He had 1,009 pilot hours, of which 291 were in Martin 202 equipment and 115 were instrument flying time. Mr. Childress had flown 39 hours in the 30 days preceding the accident. His rest period prior to this flight was 23 hours. His last second-class CAA physical examination was taken on July 10, 1954.

Hostess Patricia A. Stermer, age 21, was employed by TWA on October 18, 1954.

2. Castleton, Inc., DC-3

Captain Arthur A. Werkhaven, age 51, had been employed as a pilot for The National Carbon Coated Paper Company (Division of Castleton, Inc.) since 1939, except for the period 1942-1945, when he was employed as a B-24 production test pilot with the Ford Motor Company. Captain Werkhaven held a valid airman certificate with an airline transport pilot rating, type rating for DC-3, and a flight instructor rating. He had 11,555 pilot hours, of which 384 were instrument flying time. Captain Werkhaven had flown 205 hours since July 2, 1954, and 25 hours in December. His rest period prior to this flight was in excess of 48 hours. Captain Werkhaven took his last first-class CAA physical on

July 2, 1954

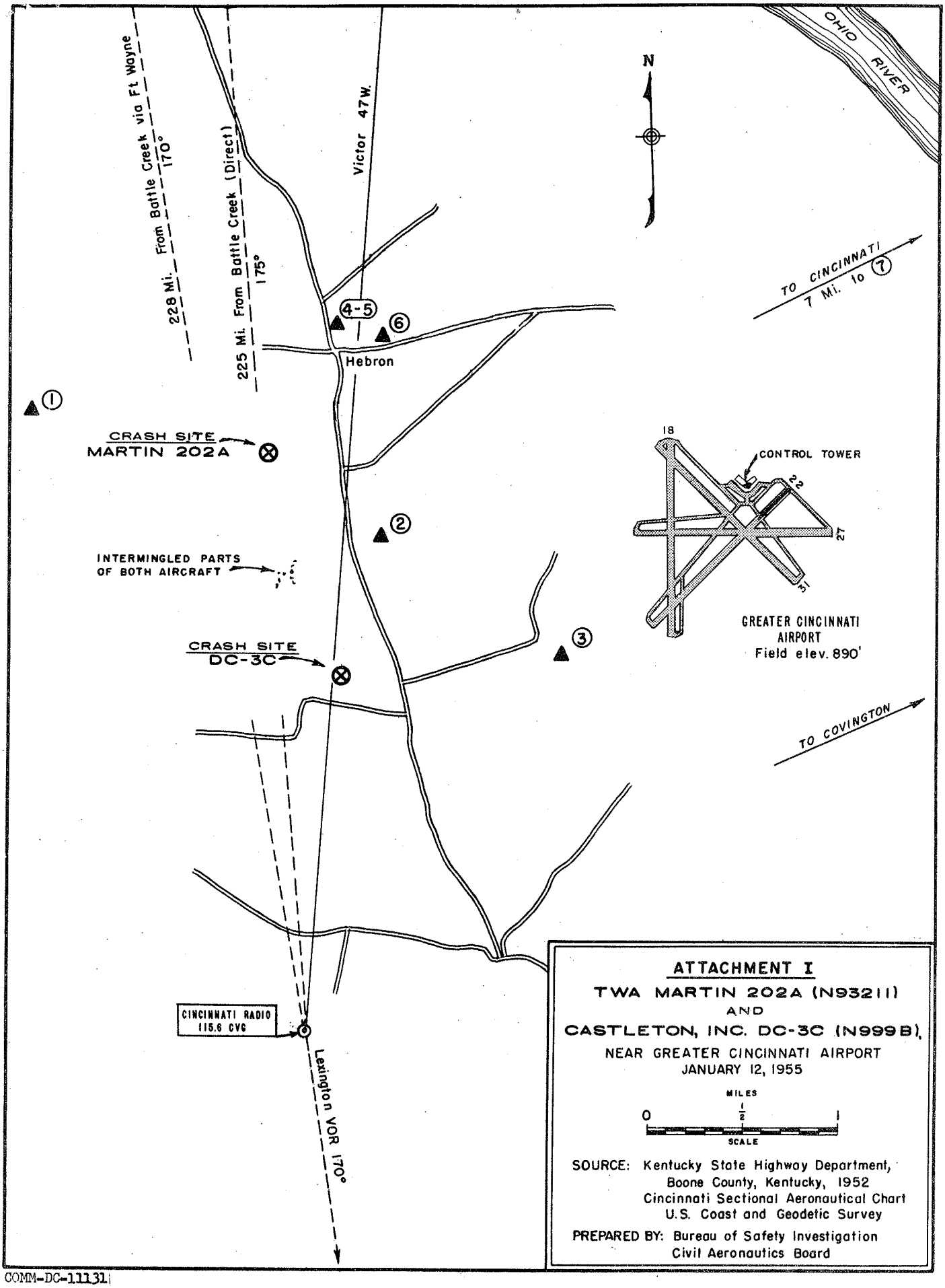
Edward C. Agner, age 37, had been employed by the National Carbon Coated Paper Company as a mechanic and copilot since 1950. He possessed a valid CAA airman certificate with a commercial pilot rating and an aircraft and engine mechanic's certificate. His last second-class CAA physical examination was taken on June 10, 1954. Mr. Agner had in excess of 1,667 pilot hours.

The Aircraft

N 93211, a Martin 202A, serial number 14081, was owned and operated by Trans World Airlines. The aircraft was currently certificated by the Civil Aeronautics Administration. It was powered by two Pratt and Whitney R-2800-CB16 engines and equipped with Hamilton Standard 43E60 reversible pitch propellers. Total time on the aircraft was 7,958 hours. Maintenance history and recent pilot reports indicated no discrepancies which would have adversely affected the airworthiness or operative condition of radio equipment during this last flight.

N 999B, a Douglas DC-3C, serial number 4255, was owned and operated by the National Carbon Coated Paper Company, a Division of Castleton, Inc., Sturgis, Michigan. The aircraft was purchased from the previous owner on October 9, 1950, and was principally used by company officials in furtherance of business. The most recent airworthiness inspection on the aircraft was made on May 25, 1954, at which time records indicate the aircraft had been flown 5,325 hours. A portion of the aircraft log recovered at the wreckage site reflected that the aircraft had been operated almost

352 hours in the period May 1954 to January 8, 1955. The aircraft was powered by two Pratt and Whitney R-1830-65-92 engines and equipped with Hamilton Standard 23E50-473 propellers. The wings and tail were equipped with B. F. Goodrich deicers. Alcohol deicing was installed for windshield, propellers, and carburetors, as well as a thermal system for the windshield. Identifiable radio equipment recovered from the wreckage consisted of a Collins type 51V UHF receiver, Collins type 18S-2 transceiver, Collins receiver type 51R-3, Bendix type MN-53A marker receiver, Collins omni range receiver, a Collins auto-tune transceiver, and an omni range bearing indicator.



ATTACHMENT I

TWA MARTIN 202A (N93211)
AND
CASTLETON, INC. DC-3C (N999B),
NEAR GREATER CINCINNATI AIRPORT
JANUARY 12, 1955

MILES
0 1/2 1
SCALE

SOURCE: Kentucky State Highway Department, Boone County, Kentucky, 1952
Cincinnati Sectional Aeronautical Chart
U.S. Coast and Geodetic Survey

PREPARED BY: Bureau of Safety Investigation
Civil Aeronautics Board

COMM-DC-11131