File No. 1-0074

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: January 6, 1959 **RELEASED:** January 9, 1959

MIDAIR COLLISION - CAPITAL AIRLINES, INC., VISCOUNT, N 7410, AND MARYLAND AIR NATIONAL GUARD T-33, NEAR BRUNSWICK, MARYLAND, MAY 20, 1958

SYNPOSIS

On may 20, 1958, about 1129 e. d. t., a Capital Airlines Viscount, N 7410, and a Maryland Air National Guard T-33, 35966, collided in the air about four miles east-northeast of Brunswick, Maryland. Seven passengers and the crew of four aboard the Viscount were killed. A passenger in the T-33 was killed but the pilot, although severely burned, parachuted safely. Both aircraft were totally destroyed by inflight collision, ground impact, and the ensuing fire.

The collision occurred at an altitude of about 8,000 feet on Victor Airway 44 while the Viscount was descending en route from Pittsburgh to Baltimore-Friendship Airport. It was operating on an instrument flight rules flight plan but in visual flight rules weather conditions. The T-33 pilot was on a VFR proficiency flight from Martin Airport, Baltimore, Maryland. Just before the collision the aircraft were observed in the area west of Brunswick flying parallel easterly courses with the T-33 some distance behind and to the left of the Viscount. The T-33 quickly overtook the Viscount and made a gentle right turn, during which it struck the forward left side of the fuselage of the Viscount.

Both aircraft were being operated in visual flight rules weather conditions and it was therefore the responsibility of each crew to provide separation from other aircraft by visual reference. The right-of-way rules contained in the Civil Air Regulations clearly set out the pilot's responsibility in the overtaking situation.1/

It is the Board's aim to provide for a positive control system of aircraft separation which will not depend upon the "see and be seen" principle to prevent the occurrence of collision accidents. The Board has been actively engaged for some time in the development of such a program. Its full implementation is several years away and will be dependent on additional technical improvements in equipment and on the expansion of the air traffic control facilities to accommodate the ever increasing amount of traffic.

Since the accident the USAF and Capital Airlines, along with other carriers, in an effort to reduce collision hazards, have required, in general, that all aircraft on airways above 10,000 feet be operated in accordance with IFR.

1/ Civil Air Regulations Part 60.14.

USCOMM-DC-25578

Investigation

Capital Airlines (CAP) Flight 300 is a regular flight from Chicago, Illinois, to Baltimore, Maryland, with one en route stop at Pittsburgh, Pennsylvania. The flight of May 20 departed Chicago at 0755 c. d. t. and proceeded to Pittsburgh. The crew consisted of Captain K. J. Brady, First Officer P. F. Meyer, and Stewardesses J. Hunt and H. Irrizzary. The aircraft did not require service or maintenance at Pittsburgh. It was properly loaded and dispatched and at 1050[2/] took off for Baltimore. An IFR flight plan had been filed and clearance obtained to cruise at 11,000 feet to Millsboro intersection, thence to Baltimore via Victor Airways 92 and 44.

At 1115, when crossing Grantsville intersection on course, the flight contacted Washington Center (Washington Air Route Traffic Control) reporting its position and estimating Martinsburg at 1127. Washington Center acknowledged this call and recorded the report on the flight progress strip. At approximately 1124 Center cleared the flight to the Lisbon intersection to descend to and maintain 7,000 feet. At 1126 Capital 300 reported over Martinsburg, leaving 10,000 feet, estimating Baltimore at 1139. When this report was received, Center was able to establish identification of the flight by radar.

Recordings of the conversation between Center and Flight 300 were analyzed. From these it was determined that approximately 41 seconds after the flight reported over Martinsburg it was given a further clearance by the Center controller to descend to cross Sugar Loaf intersection at 5,000 and to maintain 5,000. CAP 300 acknowledged this clearance and reported leaving 9,000 feet. This transmission was made approximately 48 seconds past 1126 and was the last transmission from the flight.

The Washington Center controller who was controlling CAP 300 stated that at the time the target was first identified on the radarscope, Flight 300 was on V-44 proceeding eastward and there was no other traffic noted within 15 miles of it. In addition, no other target was seen in the vicinity of Flight 300 at the time of the final radio contact. He said that a few minutes after the final transmission, on one sweep of the antenna he saw a faint return of a target near CAP 300. On the next sweep the target had disappeared and the "blip" which was known to have been the Viscount was somewhat enlarged. The controller initiated a call to the flight to determine its altitude and to advise of possible VFR traffic but was unable to contact Flight 300. The target of Capital 300 remained almost stationary on the scope for about a minute and then faded. It was determined that this call was made three minutes and three seconds after Flight 300 had made its report over Martinsburg.

Captain J. R. McCoy of the Maryland Air National Guard (Md. ANG) had arrived at Martin Airport several hours before his flight. He had planned several days prior to this to take a member of the National Guard in a T-33 jet aircraft on a familiarization flight in the local flying area.

2/ All times herein are eastern daylight based on the 24-hour clock unless otherwise noted.

When the passenger arrived at the field, Captain McCoy began preparations for the flight. He said he briefed the passenger on use of the personal equipment, oxygen, radio and interphone, and emergency procedures. He filed a local VFR clearance (AF Form 113) and obtained a weather briefing from the U. S. Weather Bureau facility at Baltimore-Friendship Airport by telephone. Captain McCoy said he then proceeded to the aircraft and conducted a "walk-around" inspection. After satisfying himself that the aircraft was in good condition, he gave his passenger a last check and entered the cockpit to begin the flight.

ANG 35966 took off from runway 14 at 1107. The flight proceeded southward, climbing to 3,000 feet. Captain McCoy said the weather briefing he had received before takeoff indicated there would be an overcast at 5,500 feet in the Baltimore area. He said that to his best recollection this was the condition he found. He continued south to about Gibson Island, Maryland, on Chesapeake Bay, keeping below the overcast, and then turned to a westerly heading, passing north of Washington and south of Friendship Airport to Leesburg, Virginia. (See Attachment A.)

Captain McCoy could not recall his various altitudes, headings, or speeds because he was not flying a constant course. He said it was not uncommon for these to vary considerably on a VFR flight. He said the clouds in the Washington area were about 10,000 feet and that he had at one time climbed to about 9,000 feet between Washington and Leesburg. From Leesburg, he proceeded up the Potomac River to Harper's Ferry, West Virginia. He remembered descending from 8,000 to 5,000 feet just prior to reaching Harper's Ferry to allow his passenger to photograph this scenic spot. He also remembered that he had selected 85 percent r. p. m. but could not recall his airspeed. He said he made a left turn around Harper's Ferry at 5,000 feet and picked up an easterly heading, intending to proceed to Baltimore via the Frederick, Maryland area. According to Captain McCoy, after straightening out on this course, he began a slow climb, still maintaining 85 percent r. p. m. He did not know his airspeed or rate of climb but did recall seeing the altimeter indicating 8,000 feet. At this point he said, he thought the aircraft exploded. He did not know how he got clear of the aircraft, which was tumbling and afire, but recalled opening his parachute and descending to the ground. He then walked some distance to a farmhouse and requested to be taken to a hospital. There Captain McCoy learned for the first time his aircraft had been involved in a collision.

Captain McCoy, in answer to various questions, said the weather conditions he had encountered had improved as he proceeded west. Near Washington, D. C., the base of the overcast was approximately 10,000 feet. In the accident area there was less than 2/10 cloud coverage and he had remained below these scattered clouds. He said the flight had been a normal VFR proficiency flight and he had not made use of any radio navigation aids, although he was at all times guarding the UHF radio frequency 236.6 mc. (Martin Tower). He also said the airplane had performed satisfactorily and no mechanical difficulty was encountered.

Captain McCoy further testified that he did not perform any aerobatics nor did his passenger handle the controls of the aircraft at any time. He

stated that he maintained a constant lookout for other aircraft throughout his flight. He further said the windshield and canopy of the T-33 were clean and that no distraction or cockpit duties had interfered with his lookout prior to the accident.

Numerous witnesses in the area were contacted, all of whom were in substantial agreement in their descriptions of the accident. They agreed that just before collision both aircraft were on approximately parallel easterly headings and did not appear to be climbing or descending. Most described the Viscount as flying straight and level and stated that it was ahead of the T-33 at all times until collision. The T-33 appeared to be traveling considerably faster and rapidly overtaking the Viscount from a position behind and to the left. The T-33 was then seen to make a shallow turn to its right during which it struck the forward part of the Viscount. The witnesses said there appeared to be a small explosion when the aircraft hit. After collision the aircraft separated and the T-33 continued on its original course for a short distance, then exploded. The Viscount appeared to pull up to a near stall, then spin steeply. This spin gradually lessened to a slow flat spin which continued until the Viscount hit the ground. These witnesses, as near as could be determined, placed the collision over a point approximately 14 miles east of the Martinsburg omni station and one mile south of its 107-degree radial. (See Attachment A.)

Most of these witnesses viewed the aircraft while looking toward the north. They said they watched as both aircraft passed in front of them from left to right. All of them were able to distinguish the difference between the Viscount and the T-33. These witnesses said that there were light fluffy clouds in the area with the amount of coverage variously estimated from one-tenth to one-fourth of the sky. Several witnesses said the jet was momentarily obscured by clouds and thought it either entered clouds or passed behind them; others said both aircraft were below the clouds.

The surface weather chart for 1100 e. d. t. on May 20, 1958, showed a cold front off the east coast extending from Nova Scotia to Norfolk, Virginia, and thence in a southwesterly direction through the Carolinas and Georgia. A deep low pressure area was centered over Hudson Bay with a ridge of high pressure over central United States.

Surface weather observation at Frederick, Maryland, at 1056 e. d. t. indicated there was a ceiling of broken clouds (nine-tenths coverage) estimated to be 12,000 feet high with visibility 15 miles. It also indicated there was a lower layer of cumulus clouds with bases at 5,000 feet. This lower layer amounted to less than one-tenth coverage. The 1157 e. d. t. observation showed there were scattered clouds at 4,500 feet which amounted to a one-tenth sky coverage; an estimated broken ceiling at 12,000 feet of approximately seven-tenths cloud coverage; and a visibility of 15 miles. Other reporting stations west of the accident site showed similar conditions. The 1000 Hagerstown, Maryland, observation was high broken clouds, visibility more than 15 miles. The 1100 observation reported scattered clouds at 5,000 and a layer of higher scattered clouds. At Martinsburg, West Virginia, the 1000 observation was 3,500 feet scattered, ceiling estimated 6,500 feet broken clouds; visibility 12 miles. At 1100 the observation was 4,500 feet scattered, high thin scattered; visibility 12 miles.

The cold front was moving eastward off the east coast. As shown by the observations, the cloudiness in the Brunswick, Maryland, area had been decreasing throughout the morning. At the public hearing a forecaster for the U. S. Weather Bureau testified that the weather reports around the area of the accident indicated there were approximately two-tenths to four-tenths clouds in the lower levels with bases around 3,500 to 4,000 feet. The witness stated, however, that because of the clearing situation which existed, cloud coverage could vary considerably in a few minutes. It would have been entirely possible for the coverage at a particular time in the area to have been as little as one-tenth to two-tenths.

The wreckage of both aircraft was widely scattered over an area of about one mile by 1-1/2 miles approximately four miles northeast by east of Brunswick. Although pieces of wreckage from both aircraft were intermingled over the entire area, there were concentrations along separate paths on the ground. Pieces of the fuselage forward of the wing of the Viscount were strewn along a path about 4,500 feet long, running roughly west to east. The remainder of the aircraft came to rest about 1,300 feet south of this line of wreckage. It hit in a nearly level attitude on a heading of 65 degrees with little horizontal speed. Impressions and furrows in the ground indicate the aircraft was in a flat spin to the right at ground impact.

Various pieces of the T-33 fell along a line about 7,500 feet long which diverged southeastward from the Viscount wreckage path. The wreckage path of the T-33 was on a bearing of approximately 155 degrees with the more dense portions of wreckage coming to rest in more southerly positions.

The main portion of the Viscount broke up and burned when it hit the ground. All four engines and propeller assemblies remained in their approximate proper positions. The Nos. 1 and 2 propellers showed no evidence of inflight impact damage. However, the blades of Nos. 3 and 4 propellers were severely nicked and scratched by inflight contact with metal objects. The fuselage from station 414 aft was severely damaged by ground impact but showed no evidence of inflight impact. The tail assembly was detached from the fuselage and bore evidence of having struck considerable debris which had scraped and dented it in numerous places.

The Viscount fuselage from station 0 to station 132 was demolished. The lower portion, from the cockpit floor to the bottom of the fuselage, was the largest section remaining. All flight deck installations had been torn off the floor and the top surface of the floor was burned. Some torn edges of aircraft skin remained above the floorline, the inside surfaces of which were burned. Between stations 72 and 102 skin on the left side was torn and curled inward along a fairly straight line extending aft and downward to the floor level. Aft of station 47 the skin above the floor level on the right side of the fuselage was torn away by loads acting left to right.

The floor structure was crushed from the left to the midpoint of the fuselage between stations 92 and 112. To the rear of this point between stations 112 and 132 the floor structure, transverse beams, and lower bulkheads were severely damaged and crushed from left to right to the middle of the aircraft.

The nost gear was found in this portion of the aircraft and was in the fully retracted position. The retract strut and its supporting structure, which attaches to the forward side of the bulkhead at station 132, was torn out and the left end of the support structure was deformed to the right by loads acting from left to right.

The left nose gear pivot support, which was torn loose from the bulkhead at station 132, contains a fitting plate with 10 nuts in two parallel rows. These nuts and the bolt-thread ends had deposits of aluminum from the nose section of the right T-33 tip tank. A portion of the station 132 bulkhead angle located about 20 inches below the floorline was bowed inward and upward by impact. The rivet pattern on a piece of skin in this area also matched rivet imprints on the right side of the nose section of the T-33 right tip tank. Three pieces of skin from the left nose section just forward of station 132 near the floorline bore significant inflight impact markings. The entire outside of one piece which extended from the floorline to the first stringer below and approximately 1-1/2 feet forward from station 132 was covered with vertical scratches and black deposits from the T-33 wing fuel cells. In addition, there were a number of deep gouges running in various directions on this piece. The remaining two pieces, which extended upward from the floorline 17 inches between stations 90 and 132, were also covered with similar scratches and black deposits from the T-33 fuel cells.

Other portions of the fuselage nose section showed the same type of heavy impact markings and tearing of the left side in an area forward of a line extending roughly from station 122, 17 inches above the floorline to the front lower corner of the pilot's sliding window. Above and aft of this line to the top of the windows there was little damage; however, the window glass was shattered and, although still in place, bowed inward. The windshields were broken and the frames distorted to the right. Several small fragments of nose skin, which were still attached to these frames, and several small pieces of skin from just forward of the windshield were torn and severely distorted by loads acting left to right. The glass in the copilot's side windows was still in place but shattered and bowed outward. No significant pattern of scratches was found on the outside of any of the skin from the right side of the fuselage.

The skin on the top of the fuselage from the windshield aft to station 132 was severely battered and torn. In the area to the left of the fuselage centerline there were numerous scrapes and gouges running from left to right and slightly forward. In addition, there were several red and blue paint smears in this area. The alcohol de-icer tank, which is located in the ceiling of the fuselage left of the centerline and forward of station 132, had a deposit of blue paint on its left end. This end was also damaged by inflight impact. The rams horn antenna was broken from its position on top of the fuselage at station 132 and showed numerous red and blue paint markings on its left side. The antenna matched an imprint on the right side of the aft fuselage of the T-33 at the USAF roundel.

Most of what was found of the remainder of the forward fuselage, aft of station 132 to station 414, had little evidence of flight collision damage. There were, however, four areas in this section which did bear heavy impact markings. One was below the front entrance door on the left side. The skin

in the area between stations 132 and 222 and stringers 54 to 59 was missing, but that remaining around the edges of this hole was crushed inward. There were black deposits from the T-33 wing tank fuel cells above this same area from stringer 60 to 62. In addition, a double row of brazier head rivets through stringer 60 below the main entrance door had deposits of green anti-glare paint from the inboard surface of the T-33 right wing tip tank. Several fragments of skin from just forward of the door and between stringers 59 and 60 also had some deposits of green paint. Between stations 168 and 187 the green paint deposits were found just above the double row of rivets at stringer 60. Other small fragments of skin from this general area also bore evidence on their outside surface of the green paint from the T-33 tip tank. Scratches on the skin between stations 154 and 176 extended to a line between stringers 54 and 55. None of the green paint deposits were found in these scratches and they appeared to define the lower limit of the tip tank contact with the Viscount fuselage. Rearward the damage inflicted by the tip tank extended to the ice striker plate. On this plate, between stringers 56 and 57, and about station 232, there was an indentation of some 10 inches in length which matched the tip of the fin from the T-33 right tip tank.

Another area of inflight impact damage was on the upper left side of the Viscount fuselage from stations 198 to 232 and between stringers 5 and 10. In this entire area the skin was torn, buckled, and curled by an object moving from left to right, with the most severe damage in an area bounded by station 215 to 232 and stringers 8 and 9. While no precise matching of this damage with the T-33 was possible, it appeared to have been made by the T-33 right horizontal stabilizer, the mangled tip of which was marked with blue and white paint similar to the paint on the Viscount fuselage in this area.

The forward cargo door located on the right side of the Viscount fuselage also showed inflight impact damage. A portion of the main bulkhead on the T-33 right tip tank had penetrated the door between stringers 57 and 58 just forward of station 176. The skin was curled outward indicating movement from left to right and a portion of the bulkhead remained lodged in the hole.

There were deposits of red paint from the tip of one of the Viscount propeller blades on the exterior surface of the Viscount right-hand ice striker plate. The plate was also cut and damaged by this inflight contact.

From the widely scattered wreckage of the T-33 it was evident the aircraft disintegrated in the air following the collision. The fuselage forward of station 228.3 came to rest inverted and burned. No evidence was found in this portion of wreckage to indicate heavy or consistent inflight impact loading. Most of the damage appeared to have resulted at ground impact with the exception of the canopy glass which was found in widely scattered locations and apparently shattered in flight. Portions of this canopy glass and other parts not in the area of ground fire showed evidence of burning or heavy deposits of soot.

The middle section of the fuselage was broken in numerous pieces. One section extending about two feet aft of the rear wing spar, was not severely deformed except for a small puncture in the center of the piece. Aft of this area the right-hand side of the fuselage was severely deformed and portions

of it were missing. No fire damage was present on these pieces of wreckage. The fillet covering the lower portion of this area was flattened inward by inflight impact, was covered with pock marks from shattered glass fragments, and had numerous scrape marks running downward and inward at various angles. There were white paint deposits in some of the scratches and black deposits on those more parallel with the longitudinal axis.

The left side of the center portion of the fuselage remained attached to the wing structure. There were minor scratches and distortions of this wreckage but no pattern of inflight impact damage could be ascertained.

The right side of the aft fuselage was torn and crumpled owing to forces acting rearward, downward, and inward. The lower right side aft of the attachment to the fuselage center section was covered with scratches running downward and rearward at about 45 degrees to the longitudinal axis of the airplane. There were white paint smears in the same general direction and pock marks from shattered glass fragments. The impression left by contact with the rams horn antenna was aft and above this area. Scratch marks from this impression extended down and rearward through the USAF roundel on the side of the fuselage.

The T-33 right tip tank received extensive inflight impact damage. The nose section had separated and was crushed inward with diagonal accordion-like pleats which indicated inward and rearward acting loads. In the green painted area just inboard of the top center of the tank there were scratches from a double row of rivets extending across the troughs and crests of the pleats. These rivet scratches ran inboard and aft at an angle of approximately 47 degrees to the longitudinal axis of the tank. On the outer side near the front end of this section of tank there was an impression made by the windshield alcohol de-icer filter of the Viscount. This filter is located at station 110, on the left side of the Viscount fuselage, eight inches inboard of the skin and 12 inches below the floorline.

The indentation from the Viscount nose gear pivot support previously mentioned was also on this portion of tip tank, approximately 17 inches forward of the joint where this section joins the cylindrical section of tank and a few inches above the centerline of the outboard side. Also at the centerline and about three inches ahead of the joint there was a distinctive rivet pattern made by flush rivets at the skin seam on the left side of the Viscount at station 132 between stringers 56 and 57.

The cylindrical or center section of the tank was severely distorted and torn. Inboard of the top centerline the aforementioned pattern made by the brazier head rivets, from the left side of the Viscount below the front loading door, ran nearly 90 degrees to the longitudinal axis of the tank. There were also some accordion-like pleats running fore and aft along the top centerline of the tank. The rivet pattern scratches ran into some but not all of these pleats. The tail cone or rear section of the tip tank also showed this pleating effect along its top center. In addition, there were numerous rivet scratches on its outer upper surface running inboard and aft at an angle of about 45 degrees from the longitudinal axis.

The T-33 entire right wing was shattered from the tip inboard to a line running inboard and aft at approximately 35 degrees from station 93 at the leading edge. Pieces of the top surface of wing and aileron from this area were heavily scratched and bore light blue and white paint marks. The

scratches, which were found only on the upper surface, ran inboard and aft at angles of approximately 42 degrees to 45 degrees to the longitudinal axis of the aircraft. The fractures in the shattered wing were consistent with downward and rearward-acting loads. One six-foot section of top surface stringer with pieces of skin attached was concaved downward. The most inboard detached piece of front upper spar cap extended from station 65 to station 105. At station 90 on the top surface of this piece there was heavy gouging and it was concaved downward. From this point inboard to the break, the spar cap was twisted nose down and bent aft and downward approximately 30 degrees. The most inboard detached piece of rear upper spar cap extending from station 32 to station 116 was bowed rearward about 20 degrees. No inflight impact markings were found on the left wing.

The main part of the T-33 empennage was found in one piece. With the exception of the right horizontal surfaces, very little damage was noted. The right horizontal stabilizer was severed and fragmented outboard of a line from station 40 at the leading edge to station 30 at the rear spar. Most of the tip portion was accounted for in two pieces. The forward piece was deformed inward and rearward and bore numerous light blue paint smears. Approximately one square foot of skin remained attached to this piece. There were scratches and blue and white paint deposits on the top surface in two different patterns. One pattern ran rearward and inboard at an angle of about 35 degrees to the centerline of the airplane, the other was at an approximate angle of 45 degrees.

Examination of the Viscount engines and propellers disclosed no evidence of operating difficulties prior to impact. As stated, the four engines remained in their approximate relative positions to the main wing spar and all four propellers were tight on their shafts.

The propeller blades, in addition to the damage previously mentioned, were bent in various directions and angles. The pitch changing mechanism in each was in good condition. The Nos. 1 and 2 propeller piston positions were 84°20' and 74°30', respectively, in the feather range. The Nos. 3 and 4 were positioned at 42°30' and 41°, respectively. The propeller control units on the Nos. 1 and 2 were found in the feather and one-sixteenth inch from feather position, respectively. The shutoff cock on the fuel control unit for No. 1 engine was halfway between closed and feathered position, while that for No. 2 was closed. The control pedestal was broken free of the cockpit area and found approximately one-fourth of a mile from the cockpit floor. The positions of throttles on this section of pedestal were found to be one-half open. The positions of the controls and the Nos. 1 and 2 propellers in the feather range, are not considered as reliable evidence of their operational positions prior to the accident. The distortion and mutilation of the engine control systems, sustained in the collision, could have repositioned the controls to the settings found during examination.

All four engines showed similar damage from ground impact and ground fire. The engine mount struts were bowed and the engine mount attachments were broken. The turbine assemblies were crushed by the airframe firewall and the auxiliary gear case.

The T-33 engine struck the ground, accessory section first, disintegrating that section as well as the accessory drive and compressor sections. The turbine buckets were broken from the turbine wheel but did not indicate evidence of rotation at ground impact. This was also true of the vanes of the

compressor unit. All the evidence indicated that the engines of both aircraft were operating normally prior to collision.

Maintenance records for both aircraft indicated they were maintained in an airworthy condition in accordance with applicable regulations. There were no outstanding discrepancies affecting their airworthiness.

Title I of the Civil Aeronautics Act of 1938, as amended, charges the Board with the responsibility for prescribing and revising Air Traffic Rules to regulate air commerce in such a manner as to best promote its development and safety. The statutory authority for the promulgation of these Air Traffic Rules is set out with particularity in Title VI of the Act. In addition, the procedure the Board must follow in its rule-making function is governed by the Administrative Procedures Act. This statutory authority was described by a witness from the General Rules Division, Bureau of Safety, Civil Aeronautics Board, at the public hearing. Part 60 of the Civil Air Regulations has been developed by the Board pursuant to this authority to govern the operation of all aircraft, civil and military. There are two major sets of rules contained in this part. First, the Visual Flight Rules (VFR) which have been developed on the principle that when weather conditions are above certain minimums pilots will be able to see and avoid other aircraft. The second group of rules governs the operation of aircraft when weather conditions are below these minimums when it is assumed pilots will not be able to see and avoid other aircraft. These rules are known as Instrument Flight Rules (IFR) and under them Air Traffic Control (ATC) guarantees separation from other controlled aircraft.

Generally, if there is a ceiling of less than 1,000 feet or visibility less than three miles in controlled airspace, an aircraft cannot be operated according to VFR. In addition, an aircraft while operating in weather conditions above the minimum may not be flown closer than 2,000 feet horizontally, 500 feet vertically underneath, or 1,000 feet vertically on top of clouds. If the ceiling or visibility is less than these minimums, or these minimum distances from clouds cannot be assured, a pilot must operate in accordance with IFR. In addition, a pilot may elect to conduct his flight in accordance with IFR even though weather conditions are above the minimums. In this event, because the weather is above the minimum, other aircraft can be operated according to VFR without knowledge of ATC. Under these circumstances the pilot operating in accordance with IFR is guaranteed separation only from other aircraft similarly operating according to IFR. He must, therefore, maintain the same degree of vigilance required during VFR operations to see and avoid other aircraft.

The witness defined "positive control" as a traffic control which provides separation between all aircraft notwithstanding weather conditions. After many months of study by the Board the initial step for this control has been taken. The Board has adopted regulations for positive control at high altitudes on certain specified routes. Heretofore, the limiting capabilities of air traffic control facilities have made this infeasible. Expansion of this program will be accomplished as rapidly as increased air traffic control capabilities permit. Elsewhere positive control is not exercised except when the weather conditions are below VFR minimums and then only in controlled airspace. Pilots operating VFR in controlled airspace are required to maintain

cruising altitudes in accordance with those designated for the particular airway they are using. In uncontrolled airspace the altitudes are governed by quadrantal rules, i. e., a certain altitude designated for a particular compass heading. These rules apply only to an aircraft in level cruising flight and do not apply to aircraft climbing or descending.

The witness also testified that the right-of-way rules which are applicable in VFR flight are set out in Part 60. Part 60 of the Civil Air Regulations applies to all types of aircraft operating in the U. S., civil and military. In addition, all Air Force aircraft must be operated in accordance with the provisions of Air Force Regulation 60.16, which is essentially the same as CAR Part 60 but may contain more stringent rules applicable to some operations. The witness said the two regulations are not in conflict but if they were Part 60 would govern.

A witness for the Civil Aeronautics Administration testified that the primary purpose of the Air Traffic Control service is to provide for the safe and efficient operation of aircraft operating according to instrument flight rules. In order for a pilot to avail himself of this service he must first file an instrument flight plan with an ATC facility. His flight must be planned within controlled airspace. He must obtain an air traffic clearance prior to taking off and, finally, he must adhere to the clearance throughout the flight.

The witness said controlled airspace is normally that area within airways structure extending from 700 feet above the ground upward to infinity. In terminal areas controlled airspace extends upward from the ground and is extended laterally beyond the confines of civil airways. In addition, all airspace, exclusive of restricted areas, above 24,000 feet is controlled airspace. Part 60 of the Civil Air Regulations delegates to the Administrator of Civil Aeronautics the responsibility and authority to designate controlled airspace and when the Administrator has determined that IFR traffic density justifies it an airway is designated. Airways are provided with radio facilities making it possible to navigate along the airway by the use of instruments and radio. The airspace over the accident area is such controlled airspace and is defined as Victor Airway 44.

CAA maintains an extensive network of air-ground communications for the purpose of efficiently controlling IFR traffic. Washington Center, which controls all IFR traffic in a designated area around Washington, within which the accident occurred, is equipped with such communication equipment. All IFR traffic, civil and military, is handled with this equipment.

The witness stated that Washington Center is also equipped with radar which is used to augment the basic non-radar system of air traffic control. If the traffic can be seen and identified on the scope, control can be exercised by radar. If the target fades or contact is lost, control reverts to the basic non-radar system. He said radar is used in conjunction with air traffic control services rendered between Martinsburg and Baltimore. Radar-assisted air traffic control also provides pilots with advisories on all observed targets. This service may be limited by the radar coverage and volume of traffic, and workload. In addition, many pilots do not desire the service and request that it be withheld.

The witness said that because of the poor return from a T-33 type aircraft, it would present a poor target for radar in the Brunswick area below about 8,000 feet. The Viscount under the same conditions, however, being a larger aircraft, presents a good return and would be readily identifiable. Because of this uncertain return from the jet fighter, he doubted that the faint target seen by the controller was from the T-33. The enlarged "blip" seen on the screen may have been but was not necessarily the collision.

A representative of the Air National Guard testified at the public hearing. He said that Martin Airport is located in an area completely surrounded by controlled airspace or restricted areas. An area roughly 100 miles square has been designated around the airport as a local flying area. In it, acrobatic and engineering flights are conducted off airways but because of the concentration of airways in the area all other types of training flights are of necessity flown in controlled airspace. Various congested areas, restricted areas, and Air Defense Identification Zones (ADIZ) within the area are avoided. The establishment of the local flying area was coordinated with the Aberdeen Proving Ground as the ANG is allowed to use part of this restricted area for training. Departure and arrival corridors have been set up through this area to avoid congested areas and reduce conflict with other traffic as much as possible. It was not considered necessary to issue NOTAMS describing the ANG activity because of the relatively small amount of traffic generated at the base - about 100 flights per week. The squadron training procedures stress the necessity and importance of pilot vigilance and that Civil Air Regulations place the responsibility on the pilot to avoid collision under VFR conditions.

The witness testified that certain Standing Operating Procedures (SOP) have been established in the squadron. These are operating rules for the squadron and do not carry the same weight as Air Force Regulations in that they are written at squadron level. SOP's covering operational phases in the squadron are constantly monitored by the operations officer and if it is determined one has been violated disciplinary measures are taken.

The witness stated that subsequent to this accident the Air Force accepted certain voluntary flight restrictions. The resulting directives are voluminous but basically the effect is to preclude nontactical flying in jet aircraft below 20,000 feet under visual flight rules. They also direct other similar action be taken to reduce as much as possible any conflict with other traffic. These directives again caution pilots about the provisions of regulations requiring a constant vigilance to prevent the recurrence of similar collisions.

The Capital Airlines training curriculum was described by a company official at the public hearing. All new pilots are given a three-week course of instructions in Civil Air Regulations, company policy, and operations, as well as flight and simulator training. Each pilot is given and required to study two manuals which include the pertinent Civil Air Regulations. In addition, all captains are required, twice yearly, to demonstrate proficiency in flying as well as knowledge of Civil Air Regulations, company policies, and the aircraft in which they are qualified. In all copilot instruction and/or upgrading, knowledge of Civil Air Regulations must be demonstrated. The company also constantly publishes operational bulletins concerning, among other things, air traffic control and cockpit vigilance.

The witness said that all CAP flights in the "Golden Triangle" (an area bounded by an imaginary line drawn between New York City, Chicago, Washington, and back to New York) are operated according to IFR above 9,500 feet. Pilots will not accept VFR climbs or descents above this altitude, nor will they accept VFR on top in this area, except in emergency. In addition, CAP, since the accident, has applied this "Golden Triangle" rule to all its flights. VFR climbs and descents and VFR flight may be conducted below 9,500 feet but not above this altitude. It is company policy that all scheduled flights be conducted on airways or on approved off-airways routes. Below 12,500 feet on approved off-airways routes flight may be planned and flown according to either IFR or VFR, except when weather conditions permit only instrument flight. Above 12,500 feet, on approved off-airways routes, pilots must file an IFR flight plan but must operate according to VFR.

The witness said that clearing "S" turns during climbs and descents are not required by Civil Air Regulations, but the pilots are constantly reminded of the need for keeping alert and vigilant to see other traffic. In addition, there is contemplated a policy revision requiring clearing maneuvers during descent. The V_{no} (velocity normal operation) of the Viscount is 238 knots indicated and this is the maximum operating speed permitted in descent except for emergency. A company rule states that logbook notations will not be made during climb or descent or in congested areas. CAP continuously conducts flight checks to ensure compliance with all regulations and to ensure cockpit discipline to further safety and efficiency of flight.

During the investigation it was learned that the T-33 pilot had been involved in two previous collisions and one major landing accident. Also, the copilot of the Viscount had been involved in a collision and one other incident.

The first of Captain McCoy's collisions occurred when another airplane on an aerial gunnery mission made a simulated firing pass on his aircraft. The pilot misjudged and collided with Captain McCoy. The second collision occurred when Captain McCoy, in a close formation acrobatic maneuver, was unable to effect control and slid into the lead aircraft. In the other accident, Captain McCoy made a hard landing and damaged the aircraft so that a major component had to be replaced. The copilot of the Viscount had, while on active duty with the U. S. Navy, collided with a towed aerial target while on an aerial gunnery mission. On another occasion he had experienced an engine flameout in a jet aircraft and was forced to "bail out."

It is evident from the nature of these accidents that they in no way indicate a lack of training or patterns of behavior which are of significance to this investigation.

Analysis

It appears probable to the Board that the faint return on the radarscope followed by the enlargement of the Viscount target seen by the center controller working Flight 300 was, in fact, the collision. No other reasonable explanation can be advanced to account for these observations. Allowing 10 seconds (one sweep of the radar antenna) for the controller to verify the target first observed and 8 seconds for evaluation and initiation of his transmission, it was possible to estimate closely the time of the accident. As stated

before, the controller's transmission was made three minutes and three seconds after Flight 300 had reported over Martinsburg at 1126. Subtracting the 18 seconds estimated to have elapsed prior to the call it is determined the accident occurred about 2 minutes and 45 seconds after 1126. As the point of collision, determined from ground witnesses, was 14 miles from Martinsburg, it was calculated that the ground speed of the Viscount was approximately 304 knots. With corrections for altitude, temperature, and wind it was further calculated that the indicated airspeed of the Viscount was about 235 knots. This speed is approximate and may vary slightly but it is within the range of normal operation. Any variation in this speed would not affect this analysis, which is based on damage patterns and which indicates relative motion only between the two aircraft.

From a study of the inflight damage to the two aircraft, it was determined that initial contact between them was when the nose section of the T-33 right tip tank struck the left side of the Viscount fuselage just ahead of station 132 below the floorline. As a result of this impact the nose section of the tank was crushed inward and rearward. Rivet scratches on the tank also running inward and rearward confirm the fact that the damage resulted from loads acting inward and rearward at an angle of approximately 47 degrees. The Viscount fuselage conversely was destroyed by loads acting from left to right with some indication of an upward component at station 132.

Following this initial impact, which separated the nose section from the T-33 tip tank, the main section of tank contacted the Viscount fuselage below the forward entrance door. The next area of impact was between the T-33 wing and the Viscount fuselage, upward and forward of the initial impact area. This destroyed the right wing of the T-33 and shattered the nose structure of the Viscount. The forces which destroyed the wing acted rearward, inboard, and downward as evidenced by the bending of the front spar upper cap and scratches running aft and inboard at angles of 42 degrees to 45 degrees on the top surfaces of wing fragments. Damage to the Viscount nose structure was caused by loads acting predominantly from left to right.

The outer portion of the right horizontal stabilizer of the T-33 was destroyed when it struck the upper left Viscount fuselage between stations 198 and 232. Scratches found on fragments of this structure ran aft and inboard at angles of 35 degrees and 45 degrees. Again the damage to the Viscount was due to forces acting from left to right.

A study of this damage showed best agreement in matching the observed collision damage of the two aircraft when the longitudinal axes were pointed toward each other with an angle of approximately 42 degrees between them and with the aircraft rolled into one another with an angle of approximately 25 degrees between the vertical axes. With this relative attitude constant during the period, there was generally good correlation between the damage from the time the nose section of the tip tank contacted the Viscount fuselage until the T-33 right horizontal tail hit. Because the vertical closure between the two airplanes was obviously small, it was assumed to be negligible as compared to the horizontal closure.

From this study it was determined that the airspeed of the T-33 was approximately 55 knots greater than that of the Viscount at the instant of impact. The rate of closure between them was approximately 195 knots.

It is significant that the eyewitness' descriptions of the collision are entirely consistent with the inflight damage to the two aircraft. The Board believes, from all the evidence, that the Viscount was flying a straight course but descending at a normal rate and at an indicated airspeed of approximately 235 knots; further, that the T-33 was flying a straight course which was parallel and to the left and behind the Viscount. Although in a shallow climb of a few degrees its airspeed was higher and it was overtaking the Viscount. A short interval before colliding the T-33 began a normal right-hand turn and continued in this turn until striking the side of the airliner. Although the T-33 was in a slight climb and the Viscount was in a descent, it is doubtful that the small vertical closure would be perceptible to ground witnesses. (See Attachment B.).

Based on the above mentioned evidence, a study was made of the relative opportunities for the various crew members to see the other aircraft during the 60 seconds immediately prior to collision. At the instant of impact the flight path of the Viscount was assumed to be straight while that of the T-33 was assumed to be in a coordinated turn to the right. At an angle of bank of 25 degrees and an airspeed of 290 knots IAS (551 feet per second true), the T-33 would have a radius of turn of about 20,300 feet. To have struck the Viscount at an angle of 42 degrees, the T-33 would have had to have started its turn about 26 seconds before collision from a parallel course about 5,200 feet to the left. The resultant angular relationships of the two aircraft were as follows:

Time to collision in seconds	Angle of T-33 from Viscount in degrees to left of nose	Angle of Viscount from T-33 in degrees to right of nose	Distance between airplanes in feet
5	90	55	1,700
10	93	61	3,150
15	97	65	4,200
20	102	68	5,000
25	107	70	5,450
30	113	67	5,650
45	126	54	6,400
60	136	44	7,450

A comparison of these angles with the cockpit visibility charts for the Viscount shows that the copilot could not have seen the T-33 until at the instant of impact. The pilot could not have seen the T-33 until about 26 seconds prior to collision because of the intervening fuselage aft of his left window.

As for the T-33 pilot, there was no obstruction to his seeing the Viscount for well over a minute before collision.

From a study of weather reports for the area, supported by testimony of ground witnesses, it appears most likely that the cloud coverage below 12,000 feet in the accident area consisted of one- to two-tenths of fair weather cumulus clouds based at approximately 4,500 feet with very little vertical development. One or two eyewitnesses stated that the jet momentarily passed through or behind one of these small clouds, but all witnesses were in general agreement that both aircraft were clearly visible for a considerable period of time prior to the collision.

Civil Air Regulations require that all pilots in VFR weather conditions maintain separation from other traffic visually, irrespective of the type of flight plan or clearance. In addition, these regulations have established right-of-way rules governing the flight of converging aircraft. Here the evidence shows that both aircraft were being operated in VFR weather conditions; also, that the T-33 was behind and overtaking the Viscount. Civil Air Regulations clearly state that an aircraft being overtaken has the right-of-way. The overtaking aircraft, whether climbing, descending, or in horizontal flight shall keep out of the way of the other aircraft by altering its course to the right, and no subsequent change in the relative position of the two aircraft shall absolve the overtaking aircraft from this obligation until it is entirely past and clear.

The evidence is clear that the T-33 pilot had ample opportunity to see the Viscount and avoid it.

With respect to the Viscount, whether the 26-second sighting possibility is adequate is less clear. Numerous studies have been conducted on this subject and the conclusions reached are nearly as numerous. Most of these studies agree that after another aircraft is sighted evasive action can be accomplished in less than 26 seconds. An area of disagreement exists, however, as far as the time required to scan for and detect other aircraft and to determine that a collision course exists.

In this accident it is obvious the Viscount pilot did not see the T-33. It is fundamental that a pilot's primary responsibility is to direct his attention to the most critical area, which is ahead of the aircraft. This is in no way intended to mean pilots should not look around and take any action necessary to avert collisions. It does mean, however, that a greater degree of vigilance is required in the direction the aircraft is flying.

In this collision the T-33 could have been seen about 26 seconds before collision. The Board does not believe that the fact the Viscount pilot did not see the T-33 in this period of time indicates a lack of vigilance. It is believed there may be periods of time considerably longer than this in which a pilot may not have the opportunity to clear behind him. It is not unreasonable therefore to place responsibility for collision avoidance on the aircraft which is behind and overtaking and, in fact, under the Civil Air Regulations, the overtaking aircraft is clearly burdened to see and avoid other aircraft.

As stated before, the Board believes that the collision was observed on the radarscope by the controller. It is tragic that no return was received from the T-33 in time for the controller to take action to alert the crew of the Viscount. As more advanced and sensitive equipment is developed many limitations of radar traffic control will be alleviated and it should be possible to prevent this type of aircraft accident.

Conclusions

From all the available evidence the Board concludes that the weather at the flight altitude was VFR and that both aircraft would have been free from clouds about nine-tenths of the time without taking any action whatsoever.

It is also evident that Captain McCoy, from his overtaking position, had ample opportunity to see the Viscount ahead of him and take evasive action. No unusual cockpit distractions or structural limitations to visibility precluded him from maintaining a lookout for other traffic. The Board believes that Captain McCoy was not exercising the normal lookout for other aircraft required and expected of him. Had he done so this accident might well have been avoided.

Conversely, the Board does not believe the Viscount pilots' failure to see the T-33 in the 26 seconds which it could have been seen is evidence of a failure to maintain a normal vigilance.

The Board is mindful of a current consensus concerning the obsolescence of the visual flight rules. We recognize the fact that these views frequently involve generalizations based upon assumptions of extremely high closure rates. However, prohibitively high aircraft closure rates were not involved in this accident. A requirement still exists for the continuation of visual flight rules substantially as contained in the present Civil Air Regulations for the large majority of aircraft operations such as those with which we are here concerned. With this, all responsible spokesmen for the principal airspace users, including military and civil, are in agreement. Emphasis must again be made, therefore, on the fact that the obligation to see and avoid other aircraft under visual flight rules conditions constitutes a condition precedent to the use of navigable airspace. This responsibility cannot be evaded by allegations that the Civil Air Regulations are inadequate or obsolete or that traffic control procedures which allow visual flight are improper. Accordingly, the air traffic rules clearly establish that failure to maintain a constant vigilance for other air traffic endangers the lives and property of others and, therefore, constitutes a disregard for the safety of other users of the airspace. A corresponding responsibility flows upon the operating agency which must maintain vigorous training and indoctrination programs in which cockpit vigilance is the subject of continuous emphasis and surveillance and in which failure to maintain such vigilance is subject to effective corrective action.

Subsequent to this accident the Air Force published directives requiring that the operation of all aircraft along airways, between 10,000 and 20,000 feet, be according to IFR. However, pilots may accept VFR climb or descent restrictions. In addition, some Air Force commands have imposed further restrictions on locally based jet aircraft which essentially preclude their operation below 20,000 feet under visual flight rules.

Since this accident Capital Airlines has required that all its flights be conducted according to the procedures set out for the "Golden Triangle," i. e., aircraft above 9,500 feet on airways must be operated according to IFR. VFR restrictions on climb and descent will not be accepted above this altitude.

Probable Cause

The Board determines the probable cause of this accident was the failure of the T-33 pilot to exercise a proper and adequate vigilance to see and avoid other traffic.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

SUPPLEMENTAL DATA

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident shortly after it occurred. Investigators were immediately dispatched to the scene and an investigation was initiated and conducted in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and held at the Department of Commerce Auditorium, Washington, D. C., on June 30, July 1, and July 2, 1958.

Air Carrier

Capital Airlines, Inc., is a Delaware corporation and maintains its principal offices in Washington, D. C. The corporation holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property, and mail. It also possesses a valid air carrier operating certificate issued by the Civil Aeronautics Administration.

The Maryland Air National Guard

The Maryland Air National Guard is a reserve component of the USAF. The 104th Fighter Interceptor Squadron (Maryland ANG) is a unit of the 113th Fighter Interceptor Wing. Training for the squadron is conducted to qualify the members of the unit to fulfill a mobilization assignment with the USAF at such times as the national security requires.

Flight Personnel

Captain Kendall J. Brady, age 38, was employed by Capital Airlines June 11, 1945. He held a valid airman certificate with an airline transport rating for airplane, multi-engine land, Douglas DC-3 and DC-4, and Vickers Viscount. Captain Brady had a total of 12,719 flying hours, of which 1,432 were in the Viscount. He passed his last first-class physical examination on April 15, 1958. He received his last semiannual proficiency check on November 25, 1957, and his last line check March 25, 1957.

Mr. Paul F. Meyer, age 26, was employed by Capital Airlines, May 25, 1956. He held a valid airman certificate with a commercial pilot rating for single- and multi-engine land aircraft, and an instrument rating. He had a total of 2,467 flying hours, of which 1,596 were in the Viscount. He passed his latest first-class physical on May 20, 1957. His last copilot proficiency check and semiannual instrument certification was given December 14, 1957.

Captain Julius R. McCoy, age 34, was rated as military pilot August 4, 1944, upon successful completion of the aviation cadet training course. He joined the Maryland Air National Guard in 1952. He had a total of 1,902 flying hours in single- and multi-engine and single-engine jet aircraft. He had a total of 597 hours in single-engine jet aircraft, of which 210 were in the T-33. His latest medical examination was passed January 3, 1958. His latest instrument certification was given December 19, 1957.

The Aircraft

The Viscount. N 7410, a Vickers Viscount, model 745, was manufactured in the United Kingdom January 15, 1956. It was acquired by Capital Airlines on January 24, 1956. Records showed the aircraft was maintained in accordance with applicable regulations. The aircraft was equipped with Rolls Royce Dart engines, model 510, and Rotol propellers, model No. R130/4-20-4/12.

The T-33. AF 35966, a Lockheed T-33, was maintained by the Maryland Air National Guard in accordance with all applicable Air Force maintenance regulations. It was equipped with an Allison engine, model J-33, A-35.