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NATIONAL TRANSPORTATION SAFETY BOARD

AIRCRAFT ACCIDENT REPORT

ALLEGHENY AIRLINES, INC.
CONVAIR 580, N5802
NEAR THE BRADFORD REGIONAL AIRPORT
DECEMBER 24, 1968

NATIONAL TRANSPORTATION SAFETY BOARD
Bureau of Aviation Safety
Washington, D. C. 20591

SA-410 FILE NO. 1-0033

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ADOPTED: JANUARY 28, 1970

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TABLE OF CONTENTS

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DEPARTMENT OF TRANSPORTATION
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ALLEGHENY AIRLINES, INC., CONVAIR 580, N5802
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SYNOPSIS

On December 24, 1968, Allegheny Airlines Flight 736, a Convair 580, N5802, crashed at approximately 2012 e.s.t., while executing an instrument approach to Runway 32 at the Bradford Regional Airport, Bradford, Pennsylvania. There were 20 fatalities among the 47 persons on board the aircraft.

The aircraft made initial contact with trees approximately 2.5 nautical miles from the end of Runway 32 at an altitude of 2,081 feet m.s.l. (€6 feet above ground level). The aircraft thereaffer struck a tree at 33 feet above ground level and rolled to an inverted position before striking the ground.

The weather observation in effect for Bradford Airport at the time of the accident shoved an estimated ceiling 2,000 feet broken and visibility of 1 mile in very light snow showers and blowing snow. An observation recorded 2 minutes after the accident showed an indefinite ceiling 800 feet obscuration and visibility 1 mile variable in light snow showers and blowing snow, with visibility variable between 1/2 and 1-1/2 miles.

The Board determines that the probable cause of this accident was the continuation of the descent from the final approach fix through the Minimum Descent Altitude and into obstructing terrain at a time when both flight crewmembers were looking outside the aircraft in an attempt to establish visual reference to the ground. Contributing factors were the minimal visual references available at night on the approaches to the Bradford Regional. Airport; a small but critical navigational error during the later stages of the approach; and a rapid change in visibility conditions that was not known to the crew.

1. INVESTIGATION

1.1 History of the Flight

Allegheny Airlines Flight 736 (AL 736) of December 24, 1968, was a regularly scheduled passenger flight originating in Detroit., Michigan, and destined for Washington, D. C., with en route stops at Erie, Bradford, and Harrisburg, Pennsylvania. The aircraft utilized was a Convair 580, N5802. 1/

Flight 736 was approximately 50 minutes behind schedule leaving Detroit due primarily to delays caused by the loading of cargo and mail and by the late arrival at Detroit of N5802 on its previous flight. Flight 736 operated routinely through Erie, departing from there at approximately 1946 e.s.t., 2/ on an Instrument Flight Rules (IFR) flight plan to Bradford via airway Victor 116 at an altitude of 5,000 feet.

In compliance with instructions from Pie Approach Control, AL 736 reported passing a position 40 DME 3/ miles east of Erie at 1957. The flight was then instructed to descend to 4,000 feet, cleared for an approach to Bradford, and directed to "report the VOR 4/ starting your approach." At the same time, AL 736 was informed that—the Bradford weather, based on the previous hourly observation, was "ceiling estimated two thousand one hundred broken, one mile, light snow showers, blowing snow, wind three hundred degrees, thirteen, gusting twenty-two, altimeter is two nine seven seven."

The flight repeated the altimeter setting, reported leaving 5,000 feet for 4,000 feet, and stated that "we'll check the VOR outbound." At 1959:15, AL 736 reported "level at four thousand," and again was requested to report when the approach to Bradford was started.

At 2005:10, Pie Approach Control transmitted the following Bradford weather to AL 736: "Estimated two thousand broken, 1 mile, light snow, blowing snow, wind three ten, fifteen to twenty five, altimeter two nine seven seven." The flight acknowledged this message and, in responso to a request for their position, reported "four and one half (miles) from the VOR."

1/ Although the technically correct designation for N5802 is Allison Prop Jet Convair 440, this type of aircraft is most commonly referred to as a Convsir 580, which is the terminology used throughout this report.

2/ All times herein are eastern standard, based on the 24-hour clock.

3/ Distance Measuring Equipment--an electronic means of measuring slant distance between the aircraft and a ground-based transmitter.

4/ Very High Frequency OMNI Directional Radio Range.

At 2006:25, AL 736 reported over the VOR outbound at the beginning of the instrument approach procedure. 5/ At that time, Erie Approach Control instructed the flight to contact Bradford Flight Service Station (FSS) and to report back to Pie Approach Control when on the ground at Eradford. AL 736 then called Bradford FSS and, at 2006:35, received the following response:

"Roger Allegheny seven thirty six. Understand over the VOR outbound, wind check three ten degrees, fifteen to twenty, altimeter two nine seven sever., you'll have the high intensity lights up on thirty two, you might just want them down. Give us a call whenever you do. Fourteen and thirty-two is covered with hard packed snow and rough ice, braking poor by a Convair, sir."

At 2008:47, AL 736 reported "procedure turn inbound" and was informed by Bradford FSS that the wind was from 290° at 15 knots. This message was the last known communication with AL 736. The accident occurred at 2011:51.

The Bradford FSS specialist on duty recorded a special weather observation at 2014 and immediately transnitted this report to AI, 736, but received no acknowledgment. At approximately 2019, Erie Approach Control attempted to contact AL 736 and, when unable to do so, called Bradford FSS in order to determine if the flight had landed. Bradford FSS advise3 Erie Approach Control that AL 736 was not on the ground and thereafter both facilities attempted, unsuccessfully, to establish radio contact with the flight. At approximately 2030, search end rescue procedures were initiated on the assumption that an accident had occurred.

Allegheny Airlines Flight 734 (AL 734), inbound from Jamestown, New York, arrived over the Bradford VOR at approximately X17 and was instructed to hold pending completion of the approach by AI, 736. After a period of delay of about 30 minutes, AL 734 eventually was able to execute an approach to Bradford Airport, during whicn the crew sighted a fire on the ground approximately 1-1/2 miles southeast of the Bradford VOR. This information was transmitted by AL 734 to Erie Approach Control at 2050, and thence relayed to Bradford FSS, which in turn advised the parties involved in searching for the crash site. The wreckage was subsequently located approximately 2-1/8 nautical miles southeast of the approach end of Runway 32 and 2,000 feet to the southwest of the extended centerline of that runway. The geographic coordinates of the crash site were: longitude 78°36'W., and latitude 41°45'56"N.

The investigation did not disclose any witnesses located on the ground who had observed the aircraft during the approach, up to and including impact.

5/ The approach chart utilized on the approach for which Flight 736 was cleared is set forth in Attachment 1.

Almost all of the survivors of AL 736 recalled that the stewardess had announced that the flight was approaching Bradford Airport and that the passengers should observe the "Seatbelt" and "No Smoking" signs. The survivor!. Generally described the descent as smooth and normal, with no forewarning of the impending impact. Most of tnem either were dozing or had their attention focused inside the cabin.

Most of the passengers who were looking outside the aircraft observed moderate to heavy snow. One passenger, who was seated next to a window just aft of the trailing edge of the left wing, glanced out the window and noticed a beam of light coming from under the wing shining down and forward on the treetops. In addition, the on-duty stewardess, who was seated in the rear, right aisle seat, observed the right landing light shining directly downward toward the ground. The passenger and the stewardess estimated that they first observed these lights about 4 to 7 seconds prior to impact..

Several survivors stated that the first sign that anything was wrong was the sound of tree branches scraping against the aircraft, while others described the first contact as a "bump" or a hard landing. A number of survivors also observed flashes of light both inside and outside the aircraft.

Of three survivors seated in the right rear of the passenger compartment, one Stated that "at impact the wings tore off," another saw "the wing and the engine go by," while t5e third stated that "the right engine burst into flames." A number of survivors reported that ths aircraft appeared to bounce into the air, after which it rolled or turned over to the right, and then slid to a stop in an inverted position.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	2	17	1 (Nonrevenue, additional crew-member)
Nonfatal	1	24	2 (Nonrevenue, additional crew-members)
None	0	0	

Postmortem and toxicological examinations of the fatally injured flight crewmembers did not reveal any evidence of either pre-existing disease or physical impairment that would have adversely affected their performan-e of duties associated with the operation of the aircraft.

1.3 Damage to Aircraft

The aircraft was destroyed by ground-impact forces.

1.4 Other Damage

The impact was on sloping terrain partially covered with trees, several of which were destroyed or damaged along the swath cut by the aircraft.

1.5 Crew Information

The crew of Flight 736 was properly certificated and qualified to conduct the flight. (For detailed information concerning the crew, see Appendix B.)

1.6 Aircraft Information

The aircraft was properly certificated and had been maintained in accordance with existing requirements. The actual weight of the aircraft on departure from Erie was 50,941 pounds, as compared with the maximum certificated takeoff weight of 54,600 pounds and the permissible takeoff weight fron Erie (the sum of the maximum landing weight at Bradford plus fuel burn-off) of 53,153 pounds. The center of gravity was calculated to be 28 percent MAC (Mean Aerodynamic Chord), well within the approved limits of 22.1 percent MAC (forward) and 34.0 percent MAC (aft). The aircraft had been serviced with Jet A turbine fuel. (For detailed information concerning the aircraft, see Appendix C.)

1.7 Meteorological Information

The weather in the Bradford, Pennsylvania, area at the time cf the accident was characterized by low clouds, snow showers, blowing snow, and strong northwesterly winds. The 1900 and 2200 surface weather charts prepared by the National Meteorolcgical Center showed a northwesterly flow of air with no fronts or low pressure centers located near the Bradford area. The 1900 650 millibar chart (approximately 5,000 feet m.s.l.) showed a strong northwesterly flow of cold, moist air over the area.

The following surface weather observations were taken at Bradford Airport near the time of the accident:

1857 Estimated ceiling 2,100 feet broken, visibility 1 milt?, very light snow showers, blowing snow, temperature 11° F., dew point 8" F., wind 300° 13 knots, gusts 22 knots, altimeter setting 29.77 inches.

1959 Estimated ceiling 2,000 feet broken, visibility 1 mile, very light snow showers, blowing snow, temperature 11° F., dew point 8° F., wind 300° 15 knots, gusts 25 knots, altimeter setting 29.77 inches.

X14 Special, indefinite ceiling 800 feet obscuration, visibility 1 mile variable, light snow showers, blowing snow, wind 320° 12 knots, gusts 20 knots, altimeter setting 29.78 inches, visibility 1/2 variable to 1-1/2 miles.

2029 Special, indefinite ceiling 600 feet obscuration, visibility 1 mile variable, light snow showers, blowing snow, wind 320° 10 knots, gusts 30 knots, altimeter setting 29.78 inches, visibility 1/2 variable to 1-1/2 miles.

A number of the survivors on AI, 736 reported that snow was falling with moderate intensity after they exited the aircraft subsequent to impact. In addition, the captain of AL 734 noticed that when making his approach to Bradford some 35 minutes after the accident, he was able to sight the airport at a distance of about 1 mile. The captain also stated that light to moderate icing was encountered when AL 734 was descending through the cloud? over Bradford. With respect to the possibility of icing, it should be noted that the temperature in the Eradford area ranged from 11° F. at the surface to -4° F. at 5,000 feet, well below the temperature regime most conducive to icing (28° F. to 32° F.), However, the Weather Bureau duty forecaster stated that despite the low temperatures, he did not rule out icing and therefore retained it in the forecast.

Both the Meteorclogist in Ch-rge of the Weather Bureau Airport Station at Detroit and the Station Chief at the Detroit FSS reported there was nothing in their records to indicate any person connected with AL 736 was given a briefing on the day of the accident. However, the dispatch package furnished to AL 736 included pertinent weather documents, some of which were found in the wreckage. In addition, a self-help weather briefing display was available to the flightcrew at the Allegheny Airlines Operations Office in Detroit.

1.8 Aids to Navigation

Instrument approaches to tht Eradford Regional Airport utilize the Bradford VORTAC (a VOR station capable of also providing distance measuring information to appropriately equipped aircraft) and/or the Bradford NDB (nondirectional radio beacon). The Bradford VORTAC is located 0.9 miles from the approach end of Runway 32, and the NDB is located 3.8 miles from the end of this runway. On a VOR Runway 32 approach, 6/ either the NDB or the 2.9 mile DME reading is used as the final approach fix. The minimum altitude at this fix is 2,900 feet m.s.l.; after passing it, a descent to the minimum descent altitude of 2,543 feet m.s.l. may be initiated.

During the time frame of the accident, the Bradford FSS specialist on duty did not observe any activation of the Bradford VORTAC and NDB monitoring system alarms. Following the accident, these two navigation aids were ground- and flight-checked by the Federal Aviation Administration (FAA) and were found to be within the specified tolerances. In addition, the captain of AL 734 did not notice anything unusual with respect to the DME (e.g., power interruptions) during his approach to Bradford shortly after the accident.

1.9 Communications

Erie Approach Control is responsible for providing separation between aircraft operating under IFR at altitudes 5,000 m.s l. and below in an airspace which includes the Bradford Airport. Accordingly, the air traffic control services and attendant communications concerning AL 736 over the route segment between Erie and Bradford were accomplished by Erie Approach Control. When a flight is cleared for an approach to the Bradford Regional Airport, a ciearance which is also the responsibility of Erie Approach Control, communications contact is transferred to Bradford FSS in order for the flight to receive the latest weather conditions, altimeter setting, runway conditions, and other pertinent information.

These communications were routine and in accordance with standard procedures. There was no indication in any of these transmissions that AL 736 was encountering any difficulty. Tho last air-to-pound contact began at 2008:47 when AL 736 reported procedure turn inbound, and Bradford FSS responded with current wind information.

1.10 Aerodrome and Ground Facilities

Runway 32 at the Bradford Regional Airport is 6,500 feet long and 150 feet wide. The published airport elevation is 2,143 feet above sea level. The runway is equipped with high-intensizy runway lights which were operating satisfactorily at the time of the accident. These lights had bren turned up to their highest setting in order to assist the flight in making its approach. The airport is not equipped with approach lights.

On the evening of December 24, 1969, Runway 32 was covered with hard-packed Snow and rough ice, and a Convair aircraft, which landed at Bradford about 2 hours prior to the accident, had experienced poor braking action. This information was given to AL 736 by Bradford FSS at the commencement of

6/ See Attachment 1.

its approach. The captain of *AL* 734, who landed approximately 40 minutes after the accident, reported that he had no trouble stopping the aircraft, despite the runway conditions, due in large part to the strong wind blowing down the runway.

1.11 Flight Recorders

(a) Flight Data Recorder

N5802 was equipped with a United Data Control Model F-542 flight data recorder, S/N 2568, which was recovered from the wreckage completely intact, with no evidence of mechanical damage. The recording medium was readable and all parameters were functioning throughout the flight. Tie appearance of all recorded traces was normal, with the single exception of the altitude trace, which reflected a continuously high reading of approximately 1,150 feet.

In order to determine the cause of the aberration in the altitude trace, the flight data recorder was minutely examined at the manufacturer's headquarters. It was discovered that the altitude stylus had an .063-inch offset, corresponding to an error of approximately 1,000 feet at all altitudes. In order to further refine the specific degree of the error, an examination was made of the altitude trace indications during ground operations at the 21 consecutive stations into which N5802 had operated prior to the crash. These values were then compared with the listed airport elevations. The result was an average high reading of 1,145 feet.

When the error calculated above was applied to the altitude trace recorded between lift-off at E-ie and impact, all altitudes flown by N5802 corresponded closely to the air traffic control assigned altitudes, the procedure turn altitude, the final approach fix altitude, and the elevation of the ground at the accident site. The heading and airspeed traces also were consistent with a normal approach.

king the final minute of flight, the flight recorder indicated an altitude loss of approximately 1,050 feet (from about 3,150 feet m.s.l. to 2,100 feet m.s.l.). The rate of descent during the first 30 seconds of the final minute was a steady 600 feet per minute, and then the rate steepened to a constant 1,500 feet per minute during the final 30 seconds. The indicated airspeed during the final minute decreased gradually from 140 knots to 130 knots, and the vertical acceleration trace indicated *only* minor excursicns. Finally, the heading trace during the last minute fluctuated between 330° and 340°.

(b) Cockpit Voice Recorder

In addition to the flight data recorder, N5802 was also equipped with a United Control cockpit voice recorder (CVR) Model V-557, S/N 1452. There was no visible damage to the CVR as taken from the wreckage. Examination of the recorder tape and the recordings found thereon revealed the CVR was operating at the time of the accident and had functioned normally for a period of approximately 30 minutes prior to the accident.

The last 12 minutes and 21 seconds of the tape was transcribed. Of this portion, the final 7 minutes was considered to contain the information most pertinent to the accident. Accordingly, the conversation and sounds recorded during this period--commencing with the transmission from Erie Approach Control at 2004:51, containing the latest Bradford weather, and terminating with the end of the recording at 2011:51-- is set forth in Appendix D.

The voices of the crewmembers making voice transmissions and conversing in the cockpit were identified by several Allegheny Airlines employees who were sufficiently familiar with the two pilots to recognize their voices as heard on the recording. An effort was also made to ilentify the two "click" sounds recorded at 2011:38 and 2011:40. A spectral analysis of these sounds war made along with comparing them to the recorded sounds of certain known Convair 580 cockpit switches. However, this study did not reveal any significant characteristics upon which a determination could be made of the identity of the switch sounds recorded on the N5802 CVR.

(c) Correlation of the two recorders

Attached hereto is a profile presentation of the final 3 minutes and 15 seconds of flight as depicted by the flight data recorder readout (Attachment 2). Interspersed on this profile are pertinent crew remarks extracted from the cockpit voice recorder.

There is a total of 4 seconds of elapsed tine between the first sounds of impact and the end of the recording on the CVR. In addition, the first evidence of tree contact on the flight data recorder occurs 4 seconds prior to the end of the traces. Since the aircraft would have taken approximately 4 seconds to cover the distance from initial tree impact to ground impact, 7/ it csn be established that both recorders ceased operating at the same time. Accordingly, it was possible in preparing Attachment 2 to accurately correlate the two recorders in terms of time.

1.12 Wreckage

Impact occurred along terrain which had an average upslope of 1.5° and which was partially covered with trees. The first signs of impact

7/ The distance involved is 800 feet, and the aircraft ground speed was approximately 200 feet per second at initial impact and was not slowed appreciably until after the first 700 feet of travel following initial impact.

were broken tree branches 66 feet above the ground. The ground elevation at the base of this tree was 2,015 feet. From this point, the swath cut by the aircraft through the tree branches followed a general heading of 331° magnetic, with a downward slope of 2° for 230 feet. Evidence indicated that at this point, the right wing of the aircraft, outboard of the engine, struck a large tree 38 feet. above its base, the elevation of which was 2,035 feet. The downward slope of the swath cut by the aircraft thereafter increased to 4° until thr first ground impact at a point 800 feet from the initial tree contact. The heading of the swath remained 331° until reaching a point. 715 feet from initial tree impact, after which the heading changed to 342'. The major portion of the aircraft came to rest, inverted, 1,053 feet from the point of initial impact. The elevation at the main wreckage area was 2,040 feet. 8/

The airframe structure and all flight controls were found, in the wreckage area. Examination of the flight control system did not reveal any evidence of failure or malfunction prior to impact.

The Wings were extensively damaged by tree impact. Damage precluded determination of the outboard wing flap settlngs. The right inboard flap was complete and indicated 17° of extension. The flap structure was undamaged in the area of the extension visual indication mark. The left inboard flap also was complete and indicated 15° of extension; however, this flap was wrinkled and distorted in the area of the visual indication mark.

The main landing gcsr was in the extended position but not locked, although the down locks were intact. During the movement of the structure, it was found that the landing gear could be placed in the fully extended position and the down locks would function. Damage to the nose gear precluded determination of its position.

The extend-retract mechanisms of both landing lights were discovered in the extended position. The lamps were missing.

Examination of the engines at the crash site did not reveal any evidence of mechanical fault or failure prior to impact. Examination after disassembly at the manufacturer's facility disclosed blade angles at impact of + 34° for the left engine propeller and + 37' for the right engine propeller. The power corresponding to these blade angles is 1,065 horsepower for the left propeller and 1,775 horsepower for the right propeller.

The barometric pressure setting on the captain's altimeter indicated 29.78 inches. The hands were free to rotate and the hundreds hand had fallen fron its shaft. The first officer's altimeter barometric pressure setting indicated 29.69 inches. The setting knob was broken off and the pointers were free to rotate. Both altimeters were dismantled and examined at the manufacturer's factory. The internal mechanism of the first

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8/ See Attachment 3 for a diagram graphically depicting the swath cut by the aircraft as well as the distribution of the wreckage.

officer's altimeter was broken into many pieces and no useful information was obtained. The captain's altimeter, with the rocking shaft pivots replaced, proved to be operational and tested within the tolerance limits. It was not possible, however, to determine the altitude reading at time of impact.

The only part of the aircraft static system not recover-d was the left "salt shaker" port serving the altitude controller mechanism of the autopilot. Examination of the static system did not reveal the presence of any obstruction, foreign material, or moisture. Examination of the captain's altitude controller servomechanism showed a position equal to an altitude of 2,193 feet m.s.l. No information was obtained fron the first officer's altitude ccntroller.

The Distance Measuring Equipment war. recovered and examined in the Allegheny Airlines instrument shop. The unit was found to be operational and accurate to within 0.1 mile. The distance display in the cockpit showed approximately 1.5 miles. Internal mechanism readings showed 1.4 miles.

The flight director/autopilot controller mode selector switch was found in the "approach" position. Examination of the flight director indicator showed that the command bars associated with the selection of the approach mode were motor-driven from view. The command bars on 'this unit are positioned out of view only when the "gyro" node is selected.

The autopilot electrical power switch was found in the "on" position. The bank and pitch control knobs were functionally free. The autopilot indicators were centered.

The captain's flight director indicator was found intact. The pitch command knob was operational and positioned to a 3" nosedown indication. The symbolic aircraft was centered in the instrument face. The glide slope, gyro, and computer Slags were in view.

The captain's course selector knob shaft was bent. The course selected showed 332°. The compass card indicated 337°. The lateral deviation bar was centered. The glide slope flag and the VOR/LOC flag were in view. The To/From indicator was hidden from view at rest, but rotating the instrument case caused the arrow to appear. The heading marker was on 105°.

With respect to the first officer's flight director indicator, the front glass was smashed, the pitch comand knob was bent approximately 20°, and the selector knob was disconnected internally. The symbolic airplane was centered in the instrument face. The gyro and computer flags were in view, and the glide slope flag was missing.

The first officer's course indicator course knob was bent, the glass face was missing, and the compass flag was in view. The compass card indicated 005°. The course selected showed 318°, the course arrow 318° and the heading marker 335". The case was dented and the lubber line was broken. The lateral deviation bar was deflected 1-1/2 dots to the right.

1.13 Fire

Evidence in the wreckage indicated that the aircraft fuel tanks were ruptured at some point prior to terminal impact and that fire occurred at the fracture point of the right wing, adjacent to a severed electrical wire bundle. Flame propogation was noted on the terrain and trees along the wreckage path. Moderate to heavy sooting was evident on the right side of the fuselage. There were soot deposits and small paint blisters on the top of the right horizontal stabilizer. Survivor reports of flashes of light or fire following initial impact generally substantiate the existence of a fire on the right side of the aircraft.

There was no evidence of sustained burning of fuel tanks or associated structure, or that any part of the main wreckage continued to burn after coming to rest. Nor was there any indication of preimpact fire.

1.14 Survival Aspects

The aircraft came to rest in an inverted position with the top portion of the fuselage structure torn away. More specifically, the damage to the upper fuselage began just below the windshield and extended aft in a diagonal plane to the top of the fuselage at the rear cabin door.

Twenty-six of the 27 survivors were seated in the rearmost nine rows of seats (out of a total of 13 rows). The remaining survivor was located in the front row left aisle seat.

Most of tine survivors who remained conscious recalled that when the aircraft came to rest, they were still in their seats with their seatbelts fastened. One stated that he was separated from his seat (next to window, just aft of left wing) and ended up on his back, across the aisle, with his seatbelt hanging around his waist. A number of passengers related that they came to rest with their head or face pressed into or against the snow and dirt.

Many of the survivors were able to unbuckle their seatbelts and fall or ease themselves down onto the ceiling of the inverted aircraft. These persons then began to search for exits from the plane and to help others out of their seats. The primary means of exit utilized were the rear left cabin door, which apparently was torn off at impact, and a hole in the left side of the aircraft near the wing.

Those who were able to exit the aircraft without assistance went back inside and helped evacuate everyone they could. During this period, some of the survivors started a fire at some distance from the aircraft using wood, seat cushion material, and small pieces of baggage. As the survivors were removed from the aircraft, they grouped around the fire to wait for help. It was extremely cold and windy, and moderate to heavy snow was falling.

Several of the survivors recalled observing aircraft overhead while waiting at the fire. After what one survivor estimated to be an hour, rescue personnel arrived and proceeded to extricate the surviving passengers still pinned in the wreckage. The injured survivors who were unable to walk out with or without assistance were evacuated by various means, including stretchers, jeeps and snowmobiles.

1.15 Tests and Research

Following the second Allegheny Airlines Convair 580 approach accident at Bradford Regional Airport (January 6, 1969), the circumstances of which were similar in many respects to those surrounding the December 24, 1968, accident, which is the subject of this report, Allegheny conducted a series of flight tests to explore certain operating characteristics of the Convair 580 static system. The general areas covered by the test program were:

(1) Static system operations with ports partially obstructed.
(2) Static system operations with port surface area irregularities.
(3) Altimeter responses to pressure changes under extreme temperature condition?.
(4) Static system water ingestion characteristics.

The test with ports partially obstructed was conducted in two phases. In phase 1, the aircraft had only one static port of the test system operative, while the other port was taped off. In phase 2, all but one of the holes in each port were taped off. The altimeter and airspeed readings of the test system were compared with a normal system during ordinary descent conditions and rapid descent conditions of 2,000 feet per minute. In each case, it was found that the reading variation between the normal system and the test system was not significant. Even abnormal aircraft maneuvers, such as sideslipping, had little or no effect. Maximum reading variations were 7 knots airspeed and 60 feet altitude.

The test involving static port surface irregularities was conducted by taping a 1/8-inch-diameter cylindrical spoiler to the fuselage in a vertical position, 1/4 inch forward of a static port. The opposite port of the affected system was covered with tape. As in the first test, the test system readings were compared with readings taken from a normal system under identical conditions. During climb and descent maneuvers at 1,400 to 1,500 feet per minute, variations in airspeed readings of zero to 15 knots and variations in altitude readings of 20 to 300 feet were recorded. The maximum altitude variation occurred in climb; in descent, the maximum altitude rariation was 200 feet. This test demonstrated that the system is responsive to surface irregularities in the static port area.

The altimeter response to pressure changes was conducted with an altimeter that had been cold-soaked in an atmosphere of minus 30° F. to minus 38" F. for 21 hours. Reedings of time required for the altimeter to indicate a change of a 1,000-foot increment under constant rate of change conditions were recorded and compared with a room temperature altimeter under identical conditiocs. A descent from 10,000 to 4,000 feet took up to 3 seconds longer per 1,000 feet on the cold-soaked altimeter than on the room temperature instrument. Continuing the descent from 4,000 feet to 1,090 feet, the cold-soaked altimeter took up to 2 seconds per 1,000 feet longer than the room temperature altimeter. The span of readings was between 51–1/2 seconds and 58 seconds per 1,000 feet. The variations recorded were considered negligible.

The static system water ingestion characteristics were tested on aircraft that had the following configurations:

1. One static port of the copilot's system was disconnected and blocked off, leaving one operative port in this system.
2. A plastic tube was installed to the operating port of the test system for viewing the accumulation of water. The water was colored for easy identification.
3. A water discharge device was installed about 1 to 1-1/2 feet in front of the operative static port in the test system. This device was capable of discharging a flood of 4 to 5 gallons of water per minute over a surface area of approximately 15 inches directly in front of the operative static port.
4. The pilot's static system was not disturbed.

As in previous tests, readings were taken from the test system and compared with readings taken from normal systems under identical conditions.

Before the flight test was started, the test system was filled with water in the stand pan area adjacent to the static port in an effort to test the self-purging characteristics of the system. This water contamination caused an altitude error of more than 200 feet on the ground prior to takeoff. During the takeoff roll or slightly after lift-off, the water ran out of the test system and it functicned normally during the subsequent climb.

The aircraft was climbed to 15,000 feet. At this time, the water discharge was turned on and the aircraft was descended at a rate of 1,500 feet per minute, with an airspeed of 125 knots. Water was first observed in the plastic tube at approximately 13,500 feet and was allowed to accumulate until about 8 to 10 inches of water were in the tube. The altitude at this time was 8,500 feet and the water was then turned off.

Descent was continued to an altitude of 3,000 feet. During this descent, a maximum variation of 36 knots airspeed and 660 feet altitude was recorded between the test system and the pilot's instruments. The contaminated system instrument read higher in both cases. At the point of level-off of 3,000 feet, the water ran out of the system, again demonstrating its self-purging characteristics.

The aircraft was climbed back to 15,000 feet and the test system performed normally during this climb. A second descent was made with the water discharge turned on and the rate of descent at 1,500 feet per minute, with tne airspeed increased to 250 knots. During this descent, the test system performed normally and no water was ingested, in spite of efforts to do so.

The tests demonstrated that the static system can be made to ingest water under certain specific conditions, which are:

1. The aircraft must be descending.
2. The airspeed is critical, with ingestion occurring only at slower airspeeds.
3. All holes in the ports of a specific system must be covered with water simultaneously for a sustained period of time. (In the tests, a flood of water equivalent to the quantity being felt by the entire fuselage during a rainstorm was Concentrated in a small area.)
4. Airflow through the static port must be accelerated by removing one static port of the system.

With respect to Convair 580 line operations, Allegheny Airlines reported that it was aware of only one instance in which water was discovered in the static system. This incident involved an aircraft which had a writeup of an airspeed indication of 90 knots on the ground and an altimeter in error by 200 feet. A mechanic drained the system, but his findings were unknown. Within several days, there was a complaint that the copilot's static system was inoperative. Again the system was drained and no moisture was found. The mechanic then applied air pressure to blow out the system and a momentary mist of water was ejected out through the static port. There were no further problems with the system.

1.16 Other Information

The Allegheny Airlines Operatiuns Manual, as constituted st the time of the accident, provided that the duties of the pilot not flying the aircraft during the descent and approach should include the following callout procedures:

"Call out approaching 18,000 feet as a reminder to reset altimeters. Call out 15,000 feet, 10,000 feet, 5,000 feet and 1,000 feet above initial approach altitude or 1,000 feet above field elevation in the case of VFR approaches.

On final approach, upon reaching 500 feet above field elevation, the pilot not flying shall call out altitude, airspeed, and rate of descent. Thereafter, he shall call out specific deviations from programmed airspeed and desired descent rates (this is especially important in turbojet aircraft)."

The nonflying pilot's duties also require him to observe outside conditions to the degree possible throughout the approach and, no later than 100 feet above the minimum altitude, to be alert to spot and call approach lights, runway in sight, or other pertinent information.

The Allegheny Airlines Convair 580 Pilot's Handbook states that "a maximum rate approaching 800-1,000 FPM should not be tolerated during the final stages of the approach."

Subsequent to the accident, the callout procedures quoted above were revised by Allegheny Airlines to read as follows:

"Duties of the pilot not flying the aircraft during the descent and approach: Call out approaching 18,000 feet as a reminder to reset altimeters. Call out 15,000 feet, 10,000 feet, and 5,000 feet. At 1,000 feet above airport elevation call out '1,000 feet'.

VFR

At 500 feet above airport elevation call out '500 feet', then call out airspeed and rate of descent.

IFR

500 feet should be called out as in VFR. In addition - - - 100 feet above minimums call out '100 feet above minimums', then call out airspeed and rate of descent.

At minimums call out the words "AT MINIMUMS" then call out airspeed and rate of descent.

Thereafter, call out any deviations of altitudes, airspeed and rate of descent from normal programmed rates.

During circling approaches call out any altitude, airspeed or descent deviations from normal or as specified by the captain. Deviations defined as:

Altitude - whenever indicated altitude varies from minus 50 feet to plus 100 feet from required altitude for that portion of approach being made, i.e., altitude prior to final fix, MDA, circling, etc.

Glide Slope and Localizer needle - when one dot or more deviation exists after leaving outer marker or final fix inbound, call 'Glide Slope' or 'Localizer', whichever applies.

Airspeed - whenever airspeed varies plus or minus 10 knots from programmed speed. Minus airspeed never to be less than 1.3 V_S (V ref).

Sink Rete - whenever descent rate exceeds 750 feet per minute on final."

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

Based on information derived from the flight data recorder, the flightpath flown by AL 736 during its approach to the Bradford Regional Airport was consistent with the prescribed procedures with the exception of there being no level-off at the MDA. The execution of the approach was flawless up to, and beyond, the 2.9 mile DME fix and until approximately 17 seconds prior to inpact. At that time, the aircraft passed through the MDA in a steady descent of approximately 1,500 feet per minute, which continued without change until contact with the trees occurred. There is no evidence that the crew became aware of the proximity of the aircraft to the ground until initially striking the trees, after which the first officer cried "pull up." It then appears that the crew made an attempt to arrest the descent, 9/ but there was insufficient time to do so since approximately 1 second later, the right wing struck a large tree, resulting in an asymmetrical lift condition which caused the aircraft to roll over to the right to an inverted position.

The entire thrust of the investigation was focused on uncovering the reason behind the apparently unrecognized descent to an altitude not only below the specified MDA, but to one below the Bradford Regional Airport elevation. in the process of attempting to identify the cause of this descent, a number of factors were eliminated from consideration by the known facto. On-scene investigation of the aircraft wreckage, and subsequent detailed examination of the propellers, altimeters, and airborne navigation equipment, did not disclose any evidence of preimpact failure of aircraft structure, control systems, powerplants, propellers, or instruments. Nor was there any indication of these or any other problems of an energency nature in the crew's recorded conversation.

Crew fatigue was not considered a factor since the flight crewmembers had almost 16 hours of rest during the 24-hour period prior to the flight. Crew incapacitation was also ruled out, not only on the basis of post-mortem examination, but also because of the routine nature of the cockpit conversation until 2 seconds before impact. In addition, all persons who came in contact with the crew at the en route stops or during flight stated that both pilots appeared alert and normal.

9/ The power setting found on the right engine (1,775 horsepower) was substantially above the setting which would be expected in a descent or even in level flight. The lower power setting on the left engine apparently resulted from a tree strike 500 feet from initial impact. (See Attachment 3.). The right engine, on the other hand, was not appreciably affected until ground impact.

The possibility of erroneous information being presented to the pilot because of a malfunction of ground-based or airhorne navigation equipnent was also ruled out by the evidence. The Bradford VORTAC was both ground- and flight-checked by the FAA following the accident and found to be operating within the prescribed tolerances. Furthermore, the absence of any alarm on the VCRTAC monitoring system, as well as the report of normal operations by the captain of AL 734, which was navigating by means of the VORTAC during and after the approach of AL 736, would also tend to preclude the possibility of a signal interruption or malfunction which might have caused false readings in the cockpit during the approach of AL 736. Finally, the fact that the aircraft was properly positioned on course, and the DME recording in the cockpit at the time of impact was providing proper distance information, substantiate the conclusion that neither the ground-based nor airborne navigation equipnent was a factor in the accident. 10/

Another possibility which was considered was that the altitude hold feature may have been used in connection with either the autopilot or flight director system in order to maintain the MDA once this altitude level had been reached. If this were true, an inadvertent disconnect of the altitude hold or an error in the comand bar computed information could produce an unwanted descent.

With respect to the autopilot, the evenness of the altitude trace throughout the procedure turn, as reflected by the flight data recorder, would indicate that the altitude hold feature was being utilized. Since the aircraft then commenced a descent, the altitude hold switch must then have been turned "OFF". If this switch had been reactivated at the MDA, the autopilot should have leveled the aircraft at that altitude. However, there is no evidence of such a leveling, or even an initiation of such a maneuver, shown on the flight data recorder. Since the altitude hold device apparently was in use and working properly during the procedure turn, it is not likely that it would have failed to operate at the MDA had an attempt to use it been made.

The flight director system command bars are electrically driven through a gear train and were not likely to have Seen moved appreciably at impact. These bars are mechanically positioned out of view only by selecting the gyro mode. Since the command bars were found positioned out of view in the wreckage, the system could not have been selected to any mode except gyro. In this mode, the flight director provides only the basic attitude display, and the altitude hold unit cannot be used in connection with the flight director system.

10/ The aircraft was within 2,000 feet of the extended centerline of the runway, and correcting back to the 326" inbound course, when it Struck the trees. The DME reading was 1.4 nautical miles, which was the actual distance from the crash site to the VORTAC.

In view of the foregoing, it is concluded that neither the automatic pilot nor the command bars of the flight director were being used for the purpose of holding altitude at the MDA and, consequently, the altitude controller was not a factor in the accident.

An incorrect altimeter setting is another possibility which was ruled out as a causal factor. The altimeter setting of 29.77 in. Hg was given to AL 736 by Bradford FSS just 5 minutes before the crash. A subsequent check of the instruments used by the FSS to determine the setting revealed that the information was accurate. The captain's altimeter was found in the wreckage with a setting of 25.78 in. Hg, or within 00.01 in. Hg of the proper setting. The first officer's altimeter was found with a setting of 29.69 in. Hg. Even if this were in fact the setting at impact, the result would be an erroneously high reading of 80 feet. However, it is likely that the first officer's altimeter was correctly set since, when performing the Preliminary Landing Checklist 12 minutes before the crash, the first officer called out "Altimeter Seven Seven" and received a reply from the captain of "OK here."

During the investigation, a considerable degree of attention was focused on the static system in order to determine whether contamination of that system might have caused erroneous altitude and rate of descent indications in the cockpit. If a restriction formed in the lines or ports of a static system, the altimeter reading could lag behind the actual altitude of the aircraft during a descent, thus cuusing the pilot to believe the aircraft was higher than the actual altitude at any point during the descent. At the same time, the rate of descent displayed would be less than the actual rate of descent, an indication which would appear consistent with the apparent loss of altitude measured against a time basis. If the restriction were to progress to the point where complete blockage of the static system occurred, the result would be an appearance in the cockpit of level flight at the altitude indicated, notwithstanding the fact that the aircraft was still descending.

Such a restriction or blockage could occur from the ingestion of moisture frcm the atmosphere through which the aircraft operated, from airframe deicing fluid which may have been previously trapped in the lines, or from ice forming on the airframe and blocking the static ports. The aircraft would have been in the clouds throughout most of the flight from Erie to Bradford, and may have encountered light airframe icing, as was experienced by AL 734. However, no evidence of ice was found on the static ports of N5802 during examination of the wreckage. Had such ice existed, the below freezing conditions prevailing at the crash site would have prevented the ice from melting and some trace thereof would have been found.

With respect to water being ingested into the static system, the tests conducted by Allegheny Airlines subsequent to the accident demonstrated that such a phenomenon could occur only under conditions extremely artificial to normal line operations. Furthermore, there was no moisture found during the physical examination of the static system of N5802. Nonetheless, such evidence does not necessarily preclude the possibility that some liquid, such as water or deicing fluid, may have been present in the system but was lost when the lines ruptured at impact.

On Allegheny Airlines Convair 580 aircraft, there are three separate static systems: One supplies information to the altitude controller on the captain's side, another to the first officer's instruments and to the flight data recorder, and the third to the captain's instruments. Each system has two static ports, one located on each side of the aircraft within several inches of the ports serving the other systems.

The altitude controller converts pressure sensing to an electrical signal that is used by the flight director system and automatic pilot in the altitude hold function. It is possible to determine by tests the pressure being sensed by the aneroid at the time power was removed from the motor generator component of this instrument. Such tests indicated that the altitude controller unit, serving the autopilot altitude hold feature for the captain, was sensing a pressure equivalent to 2,193 feet m.s.l The proximity of such an altitude to the actual altitude at impact indicated there were no significant restrictions in the lines of the altitude controller static system.

The flight data recorder and first officer's instruments are served by the same static system. As noted previously, the corrected flight data recorder showed the aircraft to be at the proper altitudes at Erie, en route to Bradford, during the procedure turn, and over the final approach fix. In addition, the corrected flight data altitude recorded at impact with the first tree (2,100 feet m.s.l.) is within 20 feet of the actual altitude of that point (2,081 feet m.s.l.). In view of the numerous points at which the corrected flight data recorder altitude information is consistent with altitudes which are known, ATC assigned, or prescribed by approach procedures, it must be concluded that the recorder was providing an accurate representation of the actual flight profile. Accordingly, there could not have been any significant restrictions in the static system serving the flight data recorder.

Based on ATC communications and intracockpit conversation between the crewmembers, it is obvious that the captain was flying the aircraft. Consequently, when the aircraft was maintaining ATC assigned altitudes, and while it was being maneuvered at the various altitudes specified in the approach procedure, it was being positioned in space by reference to the captain's instruments. Since the flight data recorder, which is on an entirely separate static system, showed that the altitudes being flown by the captain were the correct altitudes up to at least the final approach fix, it follows that, until that point, there could not have been any significant restriction to the static system serving the captain's instruments.

Although remote, it may be hypothesized that a restriction in the captain's static system occurred after the aircraft passed the final approach fix and while it was descending to the MDA, with the consequence that the altitudes and rates of descent displayed on tte captain's instruments would have lagged behind the actual values. Had such a condition in Sact developed, however, it would have had to occur rapidly enough to create a 500-foot error in altitude during a total descent of 900 feet. 11/ The same condition in a static system which would cause a 500-foot error in the altimeter would also produce an indicated airspeed of 164 knots, as compared with the actual airspeed of 130 knots reflected by the flight data recorder. Such an indicated airspeed would be above approach speeds prescribed in the Allegheny Airlines Convair 580 Flight Operations Training Manual, and above the maximum allowable speed for extending flaps to the landing position. In view of the fact that control of airspeed is essential to the proper execution of an approach, it is highly likely that had any such excessive airspeed been indicated in the cockpit the captain would have taken immediate steps to reduce it to an acceptable level. However, the flight data recorder showed a constant airspeed and constant rate of descent during the last 30 seconds prior to impact, thus demonstrating that no change in power or pitch attitude occurred.

Along with airspeed and altitude, another key indication monitored by the pilot during an instrument approach is pitch attitude. An evaluation of the performance characteristics of the Convair 580 aircraft indicates that, with the landing and Slap configuration, airspeed, rate of descent, and appropriate power settings which would have existed during the final 30 seconds of AL 736, an aircraft body angle of 4° nosedown would have been required. If the static system were to become restricted, the pilot would be confronted not only with the anomaly that the rate of descent was decreesing while the airspeed was increasing, but that this was occurring with the artificial horizon showing a steady 4° nosedown attitude, and without any increase in power or change in pitch on his part. That such a conflict in information wculd go unrecognized by a qualified airline pilot, if, in fact, he was monitoring the instrument panel, is difficult to accept.

11/ The aircraft initially contacteu the trees at an altitude of 462 feet below the MDA, with no indication of any attempt by the crew to level the aircraft prior to that point.

In viev of the foregoing, it is concluded that there is no evidence or other logical basis on which to conclude that any problems with the captain's static system existed.

Turning to the approach procedure itself, it is unlikely that the crew was misled by outdated or incorrect instrument approach charts, inasmuch as current charts were found in the wreckage. Nor is there any evidence indicating that the charts vere misread by the crew. As noted previously, the correct approach procedure, including altitudes, was flown up to and beyond the final approach Fix. The first officer had advised the captain, 2 minutes prior to impact, that the ninimms were "2,643," which is the correct MDA for a circle-to-].and approach and 100 feet higher than the MDA for the straight-in approach being flown by AL 736. ?&her-more, there are no numbers on the approach chart as low as the altitude at which the aircraft struck the ground.

One conceivable explanation for the descent below the MDA is that such descent was intentionally made by the crew in order to proceed by visual means fron the final fix to the runway. In a situation where tne reported ceiling is at or near the MDA, there might be a tendency for a pilot to descend below the prescribed minimum altitude in order to break out of the clouds at an early point in the final approach, and thereby assure having the runway in sight before being so close to it that a straight-in landing would not be possible. In this instance, however, the crew was advised that the ceiling was 2,000 feet broken and the visibility was 1 mile in light snow. The crew conversation reflected on the cockpit voice recorder showed that the aircraft was out of the clouds as it overheaded the airport at the start of the approach, and that ground was visible during the procedure turn. These observations would have tended to confirm in the minds of the pilots that the reported ceiling vas reasonably valid, and that the principal problem in sighting the runway would be the restricted visibility. Under these conditions, there would be little to be gained by a deliberate and substantial descent below the MDA at a distance of over 3 miles from the airport. Accordingly, an intentional descent below MDA is not considered to be plausible causal theory.

The remaining possibility to be considered, and one which is most consistent with the known facts, is that the descent below MDA was unintentional and unrecognized because the attention of both pilots was directed outside the cockpit and neither were observing the instruments. It is believed that this situation developed as a result of the factors discussed below, none of which was individually significant, but all of which, acting in combination, caused the captain and first officer to be looking outside the aircraft at the same time to establish visual reference to the ground at a critical stage in the descent.

One of the primary concerns of the pilots of AL 736 upon passing the final fix would have been to establish visual reference to the ground so that a descent below the MDA could be initiated as soon as possible. This is true for several reasons. If the runway were sighted at the reported visibility of 1 mile, a rate of descent from the MDA of approximately 900 feet per minute would be required to land the aircraft on the first 1,000 feet of runway. If the runway, or the environment associated with it, were not observed until the aircraft was closer than a mile, then an even higher rate of descent would be required. 12/ Such terminal rates of descent would be of particular concern to a pilot who is instructed by his handbook that "a maximum rate approaching 600 to 1,000 feet per minute will not be tolerated during the final stages of the approach." Consequently, it would be natural to expect him to make every effort to initiate his final descent to the runway as early as possible in order to avoid having to descend at an excessive rate prior to landing, or execute a circle-to-land or a missed approach.

The captain's concern about the excessive rate of descent problem resulting from low visibility conditions would have been heightened by the reported adverse runway conditions. Indeed, it is apparent that he was more concerned about the poor braking action than being able to see the runway at minimums, as demonstrated by his comment "I think we'll see it, but that's not the problem. It just means getting stopped." It is therefore likely that the pilot would be particularly careful not to be high or fast when the runway was sighted, and would be planning his approach with these concerns in mind.

Approximately 37 seconds before initial impact, the first officer commented "you're about two and one half miles from the end of the runway, Gary." In fact, the aircraft was then nearly 3-1/2 miles from the runway. In all probability, this call was derived from the DME, 13/ %:,?

12/ That the captain was concerned about the validity of the reported visibility is implicit in his comment "How ... can they have light snow and now they got a mile?" In fact, the weather conditions in the final approach area may have been as low as the variable 800 foot obscuration and 1/2 mile visibility reflected in the weather observation made 2 minutes after the crash.

13/ Considering the darkness and reduced visibility in snow, it is extremely unlikely that the 2-1/2-mile figure was derived from ground reference. The DME, on the other hand, would have been indicating exactly such a distance at that point in the approach.

the first officer inadvertently miscalled it as the distance to the runway instead of the VORTAC. In any event, the result would have been to cause the captain, if he did not recognize the error, to expect that in the next 30 to 45 seconds he would have the end of the runway in sight. 14/ It is also noteworthy that immediately following this call, at a point 30 seconds prior to impact, the rate of descent of the aircraft was increased from 600 to 1,500 feet per minute, which may be an indication that the captain expected the runway to come into view momentarily and, in the process of searching for the runway lights, inadvertently exceeded the maximum allowable sink rate.

Two "click" sounds were recorded by the cockpit voice recorder 9 and 7 seconds prior to the sounds of initial impact. Although these sounds could not be positively identified by means of a spectral analysis, there is a considerable amount of evidence supporting the conclusion that the first "click" was the activation of the landing light "ON" switch, while the second "click" represented the activation of the landing light '"TENDED" switch. A passenger and the surviving stewardess, each looking out a different side of the aircraft, observed lights shining downward from under the wings approximately 4 to 7 seconds prior to impact. The lights they described could only have been the landing lights in the "Retracted" position. In fact, the stewardess, based on her familiarity with the aircraft, specifically referred to what she saw as the "landing lights."

The landing lights take 7 seconds to extend, a duration of time exactly equal to the period between the second click and initial impact. Accordingly, there was sufficient time for the lights to become fully extended prior to impact, which is the position in which they were found in the wreckage. The conclusion that tne lights were in the process of being extended seconds before impact also accords with the passenger's description that the lights were shining downward but at a slightly forward angle at one point when he observed them.

The most logical reason for the landing lights being turned on and extended is because the captain, based upon the 2-1/2-mile call by the first officer some 30 seconds previously, would be mentally positioning the aircraft at a mile and a half from the runway and thus was anticipating landing. 15/ Concurrent with turning on the lights, there would

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14/ The fact that runway lights were turned up to high intensity would have meant they would become visible at a distance 1/4 mile greater than the reported prevailing ground visibility.

15/ Allegheny Airlines winter procedures specify that the lights should be turned on prior to cxtcnsion in order to warn up the gear drive mechanism.

be a natural tendency on the part of a pilot to look outside to see vhether *any* ground reference could be established by the downward shining lights. That this in fact happened is substantiated by the captain's comment, 4 seconds after turning on the lights, "If it'll help to see it, I don't know." In this connection, it should be noted that in snow, vertical visibility can be quite good and ground objects observable if directly beneath an aircraft, whereas forward or horizontal visibility will be poor. If, at the time the captain turned on the landing lights and before they were extended, he iooked downward out his side window, he would have been looking at a ground level of approximately 1,800 feet m.s.l., or 340 feet below airport elevation and 550 feet below the level of his aircraft. This in turn would have created a mental impression of being high on the approach at a point when he believed the aircraft was within a nile and a half or less from the end of the runway. Accordingly, he would not be overly concerned about continuing the descent for several more seconds while he attempted to sight the runway lights he expected to come into view at any moment.

Allegheny Airlines procedures in effect ai: the time of the accident specified that the pilot not flying the aircraft during the approach, in this instance the first officer, should call out altitude, airspeed, and rate of descent upon reaching 500 feet above field elevation. The cockpit voice recorder indicated that such a callout, which would undoubtedly have prompted the captain to arrest the descent, was not made. The reasons for this omission by the first officer are not entirely clear. It is interesting to note, however, that the Allegheny procedures also require the first officer to be observing outside conditions and to be alert to spot and call ground reference no later than 100 feet above the MDA. In this particular approach, the latest point at which the first officer was supposed to call out ground reference coincided with the point. at which he was to call out 500 above field elevation. It is possible, therefore, that his attention was focused outside the cockpit in an attempt to comply with the former duty, with the result that he overlooked the latter.

The above line of reasoning is not inconsistent with the first officer's callout of "two and one half miles from the end of the runway" at a point 37 seconds prior to impact. Although this callout was undoubtedly based on the DME, thus indicating the first officer's attention was directed inside the cockpit at that point, it is likely that thereafter his attention shifted outside the aircraft in order to sight the momentarily expected runway lights and remained there through the point (X, seconds before impact) when the 500 feet-above-field-elevation callout should have been made. When the landing lights were turned on by the captain 9 seconds prior to impact, the first officer would have presumed that the captain was preparing to land and therefore was aware of the altitude. There is no doubt that at this stage the first officer was in fact looking outside, as evidenced by his remark 2 seconds before impact, "I don't see a thing."

Finally, even if either or both of the pilots had redirected their ettention back inside the cockpit after glancing outside in an attempt to establish ground reference, the combination of the landing lights and the snow would have made it difficult to focus on the instruments during the remaining few seconds of flight. This adverse effect on the pilots' ability to see the instruments would have manifested itself in two ways. After a pilot's eyes have been exposed, even momentarily, to the brilliance of the reflection of the landing lights in the snow when looking outside, it would take several seconds for his eyes to readjust to the darkened environment of the cockpit. In addition, the flashback effect created in front of the aircraft as tte landing lights revolved to a forward position would have presented a substantial distraction to a pilot who was looking st the instrument panel.

During the course of the public hearing held by the Board in connection with this accident (see Appendix A), there was a considerable amount of testimony concerning approach light systems, which basically consist of a series of light cars extending out from the end of the runway. The United States Standard for Terminal instrument Rocedures describes such systems as devices which "can 'reach out' to the approaching pilot and make the runway environment apparent with less visibility than when such lighting is not available." The Terminal Instrument Procedures also state in effect that high intensity approach lights can be seen at a distance of 1/2 mile greater than the objects used to determine prevailing visibility. The approach light system commonly in use is 3,000 feet in length and generally is installed only in connection with an Instrument Landing System (ILS). Neither an approach light system nor an ILS were installed at the Bradford Airport at the time of the accident. Even if an approach light system had been installed, it probably would not have been seen by the crew of AL 736 because of the 1-mile prevailing visibility (which would be increased to 1-1/2 miles by the penstration effect of the approach lights) coupled with the fact that the aircraft crashed 2-1/2 miles from the end of the runway. However, had an approach light system been available, it is also possible that the pilot would not have used the aircraft landing lights to establish ground reference in advance of the runway threshold, but rather would have waited for the approach lights to Identify the ground environment leading to the runway.

2.2 Conclusions

(a) Findings

1. The aircraft was properly certificated and in an airworthy condition.

2. There was no evidence of any failure or malfunction of the aircraft or any of its systems or components prior to impact.

3. The flight, crewmembers were properly certificated and qualified to conduct the flight.

4. Crew incapacitation or fatigue was not a factor in the accident..

5. Both the ground-based navigation aids and the airborne navigation equipment were functioning properly.

6. The correct barometric pressure was set on both altimeters.

7. There was no evidence that any part of the static systems on the aircraft was restricted or blocked to the point where the associated instruments would have been substantially affected.

8. The reported ceiling and visibility at Bradford Airport were 2,000 feet broken and 1 mile in very light snow showers and blowing snow; however, it is possible that variable conditions as low as 800 feet obscuration and 1/2-mile visibility prevailed in the final approach area at the time of the accident.

9. The appropriate approach charts were in the aircraft and were being utilized by the crew.

10. The approach was in compliance with the prescribed procedures up to and beyond passage of the final approach fix.

11. The first officer did not call out 500 feet above field elevation as required by Allegheny Airlines procedures.

12. The aircraft passed through the Minimum Descent Altitude in a steady descent of 1,500 fcet per minute, which continued until initial impact with the trees occurred.

13. The attention of both pilots was primarily directed outside the aircraft during the final 30 seconds of flight in an ettempt to establish visual reference to the ground.

14. The pilots were unaware of the vertical proximity of the aircraft to the ground until initial impact with the trees occurred.

(b) Probable Cause

The Board determines that the probable cause of this accident was the continuation of the descent from the final approach fix through the Minimum Descent Altitude and into obstructing terrain at a time when both flight crewmembers were looking outside the aircraft in an attempt to establish visual reference to the ground. Contributing factors were the minimal visual references available at night on the approaches to the Bradford Regional Airport; a small but critical navigational error during the later stages of the approach; and a rapid change in visibility conditions that was not known to the crew.

3. RECOMMENDATIONS AND CORRECTIVE MEASURES

On January 17, 1969, the Chairman of the Safety Board sent a letter to the Administrator of the FAA dealing with aircraft accidents which occur during the approach and landing phase of flight. It was therein noted that this type of accident continued to be among the most numerous, as highlighted by some of the events of the month preceding the date of the letter. After discussing the numerous and varied factors which might be involved in landing and approach accidents, the letter went on to state:

> "In this light, and with the number and frequency of approach and landing accidents under similar weather and operating environments, we believe that certain immediate accident prevention measures need to be taken. We believe that preliminary to the successful completion of our investigations into the factors and causes of the recent rash of accidents, renewed attention to, and emphasis on recognized good practices will tend to reduce the possibility of future accidents."

The Safety Board's letter thereafter listed a number of specific recommendations. On February 6, 1969, the Administrator responded to these recommendations. Each Safety Board recommendation is set forth below, followed by the FAA response.

1. NTSB Pilots, operators and regulatory agencies should renew emphasis on, and improve wherever possible, cockpit procedures, crew discipline and flight management.

   FAA Expressed concern and has initiated followup action directed to the areas of adherence to established procedures, altitude awareness, winter operating procedures, and cockpit discipline and vigilance.

2. NTSB Both the air carrier industry and the FAA should review policies, procedures, practices, and training toward increasing crew efficiency and reducing distractions and nonessential crew functions during the approach and landing phase of a flight.

   FAA Inspectors have been instructed to review cockpit checklist and procedures on a continuing basis to assure that minimum checking will be done during the more critical periods of flight such as departures, approaches, and landings.

3. NTSB Crew functions not directly related to the approach and landing should be reduced or eliminated, especially during the last 1 , 0 feet of descent.

FAA Although it is believed the airlines require all cockpit check proceaures, particularly the in-range checklist, to be completed well before the final 1,000 feet of descent, inspectors will be requested to doublecheck and take action where warranted.

4. NTSB During the final approach, one pilot should maintain continuous vigilance of flight instruments inside the cockpit until positive visual reference is established.

FAA Inspectors have been instructed to assure that cockpit check procedures are arranged so that the pilot flying devotes full attention to flight instruments. 16/

5. NTSB During approaches where less than full precision facilities exist, there should be a requirement that during the last 1,000 feet of final approach, the pilot not flying call out altitude in 100-foot increments above airport elevation.

FAA Instructions have been issued to inspectors to assure airlines emphasize in training and include in training manuals altitude awareness procedures to be used during climbs, descents, and instrument approaches. The FAA-recommended procedures require callouts at 500 feet above field elevations, 100 feet nbove minimums, and minimums. Such a procedure keeps cockpit conversation at a minimum and reduces pilot workload, while at the same time assuring pilot altitude awareness.

6. NTSB There should be a requirement to report indicated altitudes to Air Traffic Control at various points in the approach procedure, such as the outbound procedure turn and at the outer marker position.

FAA Such a requirement would significantly increase frequency congestion and increase crew and controller workload. Efforts in the areas of pilot training and education will prove to be the most beneficial course of action.

16/ Crew vigilance and cockpit discipline was one of the areas stressed in a telegram sent by the FAA Administrator to all airline presidents on December 30, 1968, expressing concern with the rash of accidents.

7. NTSB The aviation cornunity should consider expediting development and installation of audible and visible altitude warning devices and the implementation of procedures for their use.

FAA A rule became effective on September 28, 1968, which will require by February 28, 1971, both visual and aural altitude alerting signals to warn pilots of jet aircraft when approaching selected altitudes during climbs, descents, and instrument upproaches.

8. NTSB Altimetry systems should be reassessed with particular regard to their susceptibility to insidious interference by forms of precipitation.

FAA FAA plans to participate with NASA and the aviation industry in an assessment of possible failure modes of altimeter static systems. At this time, FAA is unaware of any practical replacement for the barometric altimeter.

9. NTSB The possibility of development of additional altitude warning systems, external to the aircraft, should be explored. One possibility is a high-intensity visual warning red light beam, projected up along and slightly below the desired approach glide slope, to warn of flight below the desired path.

FAA The suggested device would not provide complete information concerning the optimum glidepath as does the Visual Approach Slope Indicator (VASI) system, which are or will be installed at many runways throughout the country.

10. NTSB Development is needed in the fields of radio/radar, and inertial altimetry and CRT/microwave pictorial display approach aids as possible improved replacements for tie barometric altimetry System in the near future.

FAA The use of inertial altimetry must be considered as a long-range research and development program. CRT/microwave pictorial display has been evaluated by the military, and the FAA rill look into this matter further when it gets additional information.

11. NTSB Modified use of existing approach radar should be further studied with regard to its adaptability as a surveillance (accident prevention) tool for nonprecision instrument approaches (e.g., to monitor automatically and warn against the descent below desired glidepath of any aircraft in the final descent mode).

FAA A more effective and less expensive alternative to the use of radar as a monitor for nonprecision approaches is the installation of Instrument Landing Systems. 17/

12. NTSB There should be increased ourveillance and more frequent and more rigorous inspection and maintenance of altimetry system by both the air carriers and the FAA.

FAA FAA has met with the Air Transport Association (ATP.) to review and discuss altimetry problems. Although few altimetry troubles are being experienced by flightcrews, ATA has agreed to further explore this area.

13. NTSB Certification requirements and procedures should be re-examined to determine if there is a possibility of a single failure mode of nominally dual systems which, when combined with an already existent passive failure or inadequate cockpit procedures, can invalidate dual failure protection features.

FAA A Notice of Proposed Rule Making was issued on August 16, 1968, proposing to require in systems design means to assure continued safe operation following any single failure or combination of failures not shown to be extremely improbable. Industry comments are now being reviewed end analyzed. 18/

The FAA has also reported that an Instrument Landing System (ILS) was installed at the Bradford Regional Airport in the fall of 1969. Bradford Airport met the criteria necessary to qualify for the installation of such a system for several years prior to its installation. However, budgetary rectrictions have limited the rate at which ILS's can be installed even at those airports which qualify therefor.

ILS is a precision instrument approach and landing system which allows aircraft to operate into airports under weather conditions which are more adverse than the minimums established for nonprecision approaches. In other words, since the ILS provides a greater degree of precision, a lower obstruction clearance and visibility are approved than those associated with nonprecision approaches, such as a VOR.

17/ The Safety Board's recommendation on this matter, and the Administrator's response theretc, are more fully set forth in letters dated June 19, 1969, (NTSB) and July 28, 1969, (FAA).

18/ Copies of the letters summarized above are contained in the Public Docket of Recommendations, which is maintained in the Safety Board's office in Washington, D. C.

It can thus be seen that one of the intents of requiring different sets of minimums for precision and nonprecision approaches is to afford equivalent levels of safety. Accordingly, it might be said that the installation of an ILS is not a "corrective measure" in terms of safety. Nevertheless, the Board believes that a precision approach system such as an ILS provides a significant addition to safety by affording the pilots of an aircraft making an approach not only vertical guidance, but also a valuable and reliable cross-check of the aircraft altimetry down to an altitude close to the ground. Accordingly, the Board urges that the FAA expedite, to the extent possible within the limits of available resources, the installation of ILS at qualified fields currently equipped only with nonprecision approaches.

As noted in the Analysis section, it is our understanding that approach light systems are usually installed only in conjunction with an ILS. We believe, however, that approach light systems provides a significant safety feature, even apart from an ILS, by increasing the conspicuity of the runway environment during low visibility conditions. We are also informed that new approach light systems are becoming available, including systems 1,500 feet in length, which might be appropriate for use without an ILS. In view of the foregoing, the Board recommends that the FAA consider, again within the limits of the available resources and equipment, the installation of approach lights to improve the safety of non-precision instrument approaches at those airports where the installation of a full ILS is not feasible.

Finally, with respect to landing and approach accidents in general, the Board wishes to reiterate its concern with the problem and to re-emphasize our interest in the progress of the various remedial measures that are currently underway. To this end, the Board held a series of meetings with other segments of the aviation community in the early part of 1969 in which particular attention was devoted to the subject of altimetry. Measures initiated by these meetings included the collection and assimilation of statistical information necessary to provide a sound basis for corrective action. We will continue to work in close cooperation with these groups in order to explore to the fullest extent all appropriate steps which might prove useful in reducing the rate of this type of accident.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED, Chairman

/s/ OSCAR M. LAUREL, Member

/s/ FRANCIS H. McADAMS, Member

/s/ LOUIS M. THAYER, Member

/s/ Isabel A. Burgess, Member

January 28, 1970

INVESTIGATION AND HEARING

1. INVESTIGATION

The Board received official notification of the accident at approximately 2230 e.s.t., on December 24, 1968, from the Federal Aviation Administration. In view of the prevailing weather conditions in the accident area, the dispatch of the investigating team from Washington, D. C., was delayed until 0830 e.s.t., on December 25, 1968. Upon arrival, working groups were established for Structures, Powerplants, Systems, Maintenance Records, Human Factors, Air Traffic Control, Weather, Witness, Operations, Flight Recorder and Cockpit Voice Recorder. Parties of interest participating in the investigation included Allegheny Airlines, Air Line Pilots Association, Allison Division of General Motors, Federal Aviation Administration, and the Keene County Coroner. The on scene investigation was completed on Decenber 30, 1968.

2. Hearing

A public hearing was held at the Holiday Inn Motel in Bradford, Pennsylvania, on June 3 to 5, 1969.

3. Preliminary Reports

A preliminary aircraft accident report summarizing the facts disclosed by the investigation was published by the Board on April 15, 1969. A summary of the testinony which was taken at the public hearing was published on June 24, 1969.

Crew Information

Captain Gary Lee Mull, aged 33, was employed by Allegheny Airlines on May 21, 1964. He was promoted to captain on October 12, 1967. He held Airline Transport Pilot Certificate No. 1412777, with ratings in the Convair 580 and the Fairchild-Hiller F27/227 aircraft.

He passed his last examination for a Federal Aviation Administration First-class Medical Certificate on October 10, 1968, without limitations. He had flown 6701:00 hours, of which 1477:39 hours were in Convair 580 aircraft. His instrument time during the past 6 months was 81:05, of which 8:30 hours had been acquired in the 30 days preceding the accident. His last proficiency check in the Convair 580 aircraft was accomplished on September 5, 1968, and his last line check was completed on August 29, 1968. During the preceding 6 months, he made 10 landings at the Bradford Regional Airport.

First Officer Richard Bruce Gardner, aged 30, was employed by Allegheny Airlines on April 12, 1966. He held Commercial Pilot Certificate No. 1605034, with aircraft single-engine land and sea, multiengine land, and instrument ratings. He passed an examination for a Federal Aviation Administration First-class Medical Certificate, without limitations, on April 22, 1968. According to FAA Medical Records, he had flown 4330:16 hours. According to Allegheny Airlines records, 928:03 hours were-in Convair 580 aircraft.

Both flight crewmembers had a rest period of 15:51 hours in the 24 hours prior to this flight.

Stewardess Rita Boylan, aged 23, was employed by Allegheny Airlines on June 1, 1966, and received her last recurrent training in June 1968.

Aircraft Information

N5802, manufacturer's serial number 410, was originally certificated as a Convair 440 on March 4, 1957. It was subsequently modified to permit the icstallation of Allison 501-D13 turbine engines and Aeroproducts A6441FN606A propellers. A Standard Airworthiness Certificate for N5802 dated May 25, 1965, was reissued following the modification.

The total time on the aircraft was 29,173:46 hours. Elapsed times since the last major inspection and the last line maintenance were 2276:00 hours and 406:47 hours, respectively.

Engine and propeller serial numbers and total time (T.T.) and time since overhaul (T.S.O.) were as follows:

No. 1 Engine

S/N	500990
T.T.	15464:02
T.S.O.	3265:16

No. 1 Propeller - S/N 866

Blades - S/N's	
1	B-9319
2	B-9499
3	B-9392
4	B-8912

T.T.	6499:48
T.S.O.	3125:48

No. 2 Engine

S/N	501612
T. T.	3783:03
T.S.O.	3783:03

No. 2 Propeller - S/N 1031

Blades - S/N's	
1	B-9672
2	B-8800
3	B-8874
4	B-8239

T.T.	3870:29
T.S.O.	3870:29

APPENDIX D

TRANSCRIPT OF THE FINAL 7 MINUTES OF THE COCKPIT VOICE RECORDER TAPE FROM ALLEGHENY AIRLINES FLIGHT 736, N5802, A CONVAIR 580, WHICH WAS INVOLVED IN A LANDING APPROACH ACCIDENT AT BRADFORD, PENNSYLVANIA, ON DECEMBER 24, 1968

LEGEND

CAM	- Cockpit Area Microphone circuit
#1	- Voice identified as captain's
#2	- Voice identified as copilot's
#3	- Stewardess
ERI AC	- Radio transmission by Erie Approach Control
RDO	- Radio transmission by Allegheny Flight 736
BFD-FSS	- Radio transmission by Bradford Flight Service Station
*	- Unintelligible voice transmission
#	- Nonpertinent word or phrase
()	- Words enclosed within parentheses are not clearly understood. Those shown represent the best interpretation of what the speaker said.

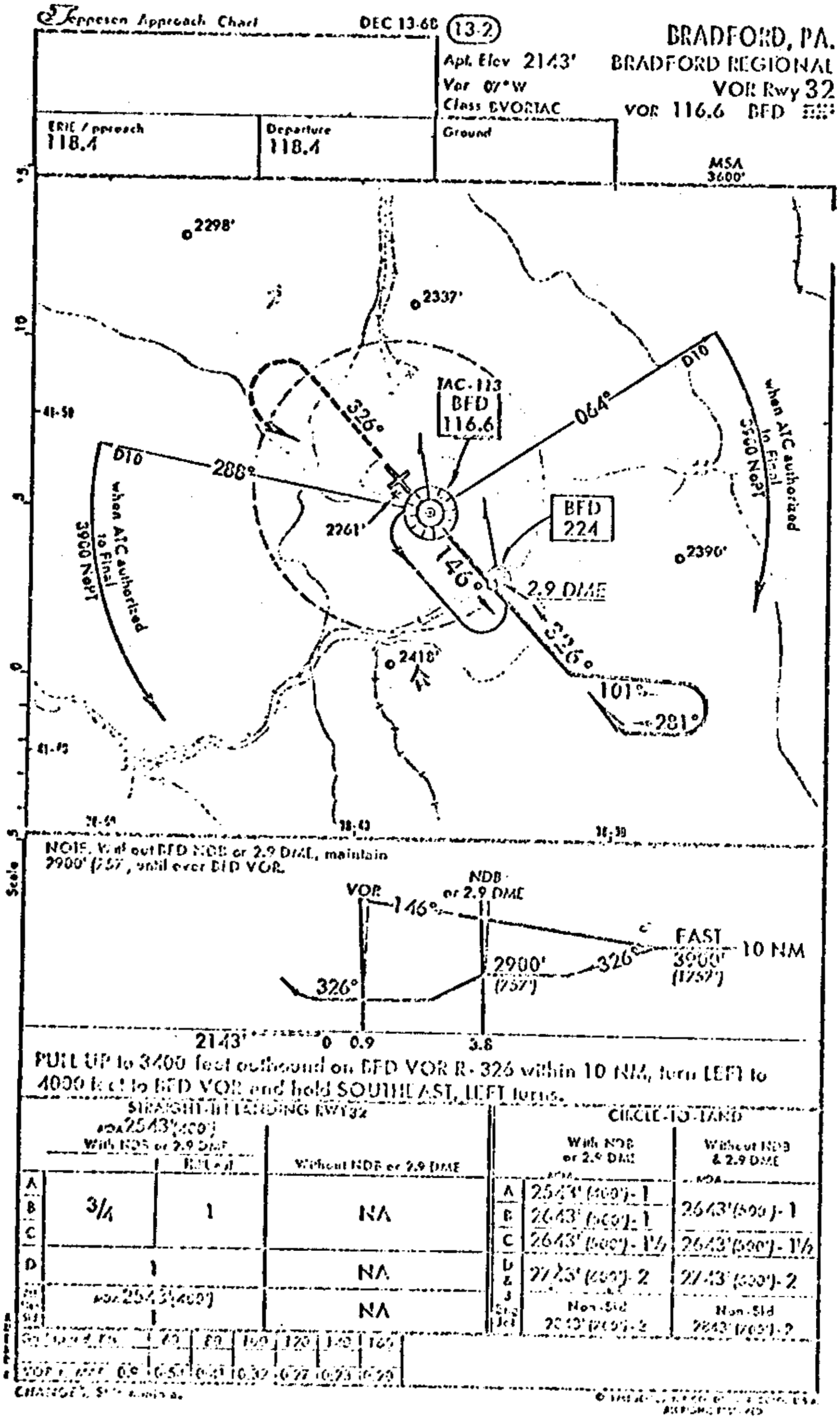
TIME	SOURCE	CONTENT
2004:51	ERI-AC	Seven thirty-six, the-ah-Bradford weather estimated two thousand broken, one mile; light blowing snow, wind three ten, fifteen to twenty-five, altimeter two nine seven seven
2005:00	RDO #2	All righty, thanks a lot, Allegheny seven thirty six
2005:04	ERI-AC	Ah, what is your position right now?
2005:06	RDO #2	Ah, about four and a half from the VOR
2005:16	CAM #2	Two thousand and one
2005:19	#1	How in the # can they have light snow and now they got a mile
	#2	I don't know
2005:51		[Radio transmissions between Allegheny 734 and Erie Approach Control]
2006:10	RDO #2 ERI-AC	and Allegheny seven thirty six VOR outbound Seven thirty-six
2006:17	RDO #2	You want us to go over to the radio now?
2006:20	ERI-AC	Tell you what - - - - go over to them and they can give ya, they'll give ya the lights there. Just report on the ground on this frequency.
2006:26	RW #2	OK, will do, we'll see you then.
2006:32	RW #2	Ah Bradford radio Allegheny seven thirty six
2006:35	BFI-FSS	Roger Allegheny seven thirty six. Understand over the VOR outbound, wind check three ten degrees, fifteen to twenty, altimeter two nine seven seven, you'll have the high intensity lights up on thirty two, you might just want them down. Give us a call whenever you do. Fourteen and thirty two is covered with hard packed snow and rough ice, braking poor by a Convair, sir.
2006:57	RDO #2	Seven thirty six

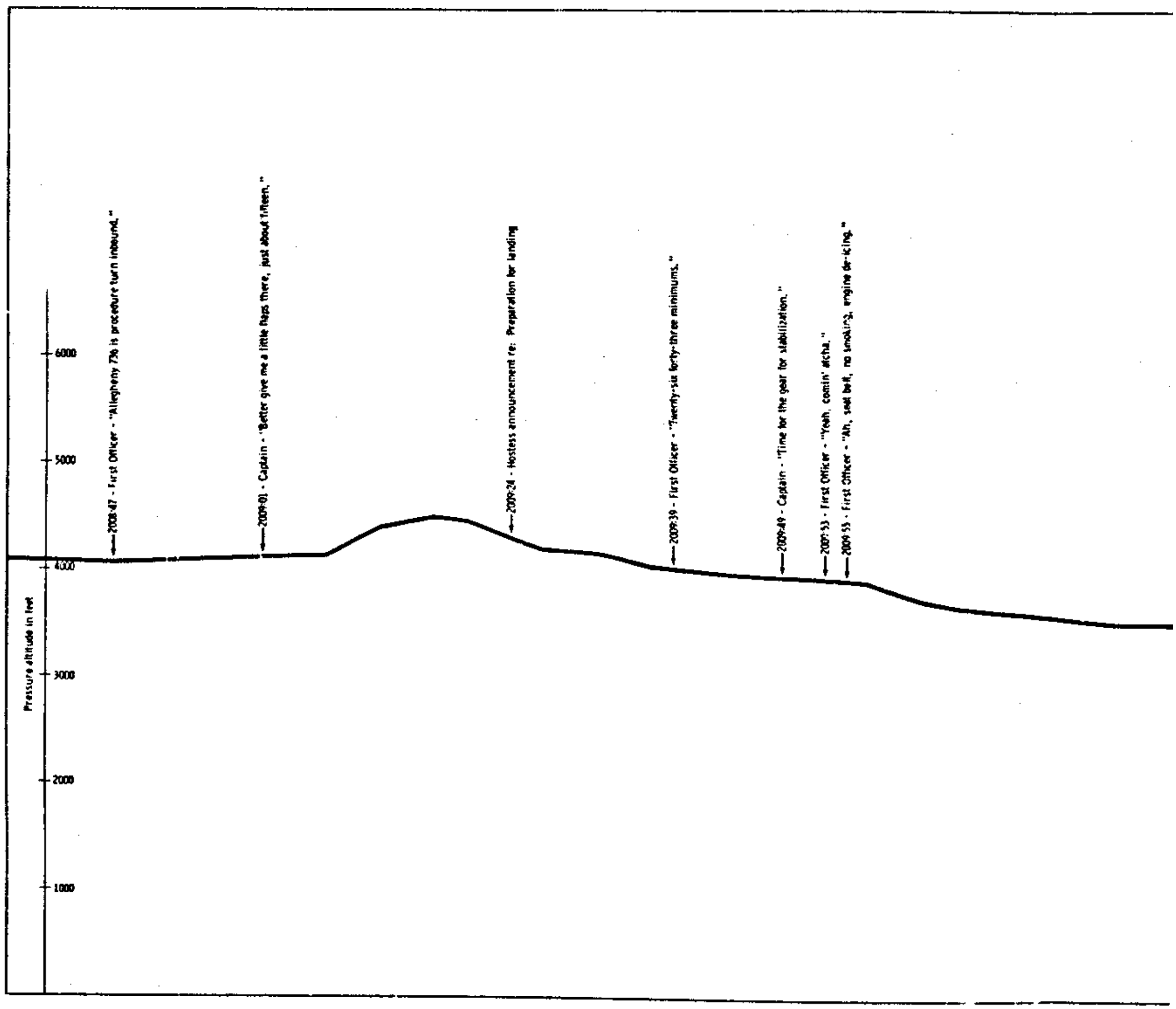
TIME	SOURCE	CONTENT
2006:58	CAM #2	# I called and they didn't have a thing.
	#1	Yeah, I (suppose it wasn't packed too much then.) They had the trucks out on it.
2007:32	CAM	****
2007:47	CAM #2	Got a little bit of ground contact (here)
	#1	Yeah, I saw the runway when we went over it.
2007:53	#2	Oh you did
	#1	Yeah - - - a little fuzzy yet
	#2	(Still) I hope you see it when we get down to minimums.
	#1	I think we'll see it but that's not the problem. It just means getting stopped.
	#2	Yeah, that's it, the # I don't like, especially when they are reported poor.
2008:06	#1	Yeah
2008:24	CAM #2	Ok, the beacon at twenty nine hundred
2008:31	#1	I have probably gone out a little further, I don't know
2008:34	#2	I think you just, we just passed over the beacon there when you turned
ma:39	#1	Yeah, I'm - ah - about a nile beyond it, count of a little bit of tail wind there
2008:47	RDO #2	Allegheny seven thirty six is procedure turn inbound
	BFD-FSS	Allegheny seven thirty six, wind check two nine zero degrees one five
2008:55	CAM #2	Let us know when it's calm
	#1	Yeah

TIME	SOURCE	CONTENT
2009:01	#1	Better give me a little flaps there - - just about fifteen
	#2	Fifteen of em coming at you
2009:15		Just in case, straight ahead on the thirty two thirty four hundred on the three twenty six
	#1	Yeah
2009:22	#1	Hold south east at four thousand
	#2	Yeah
2009:24	#3	[Stewardess announcement terminates at 2009:38] "Ladies and gentlemen on preparation for a landing at Bradford please check to see that you seat belt is securely fastened and observe the no smoking please. At this time we ask that you place all seat backs in their full upright position for landing. Thank you."
2009:29	#1	(you can) pop that wing heat now
	#2	Yeah [sound of control movement audible]
2009:39	CAM #2	Twenty six forty three minimums
2009:49	#1	Time for the gear for stabilization
2009:53	#2	Yeah, comin-atcha
2009:55	#2	Ah, seat belt, no smoking, engine deicing
2009:59	#2	How are you doing over there on yours, Gary?
	#1	I think I'm gonna leave mine on till we're down there
	#2	Yeah, OK
2010:24	CAM #1	(# radio controls still on) this airplane but I don't know which

TIME	SOURCE	CONTENT
2010:32	#1	(put) the flaps seventeen
2011:10	CAM #2	You're about two and ah half miles from the end of the runway Gary
2011:38	CAM	["Click" sound similar to the movement of a switch in the cockpit, is audible on recording.
2311:40	CAM	Another "click" sound similar to first is audible on recording]
2011:42	CAM #1	If it'll help to see it, I don't know.
	#2	I don't see a thing
2011:47	CAM	[First sound of impact of the aircraft with ground object]
2011:48	#?	Pull up
2011:51		[End of recording]

Attachment 1





Pressure altitude in feet
6000
5000
4000
3000
2000
1000
2008:47 - First Officer - "Allegheny 736 is procedure turn inbound."
2009:01 - Captain - "Better give me a little flaps there, just about fifteen."
2009:24 - Hostess announcement re: Preparation for landing
2009:39 - First Officer - "Twenty-six forty-three minimums."
2009:49 - Captain - "Time for the gear for stabilization."
2009:53 - First Officer - "Yeah, comin' atcha."
2009:55 - First Officer - "Ah, seat belt, no smoking, engine de-icing."

A

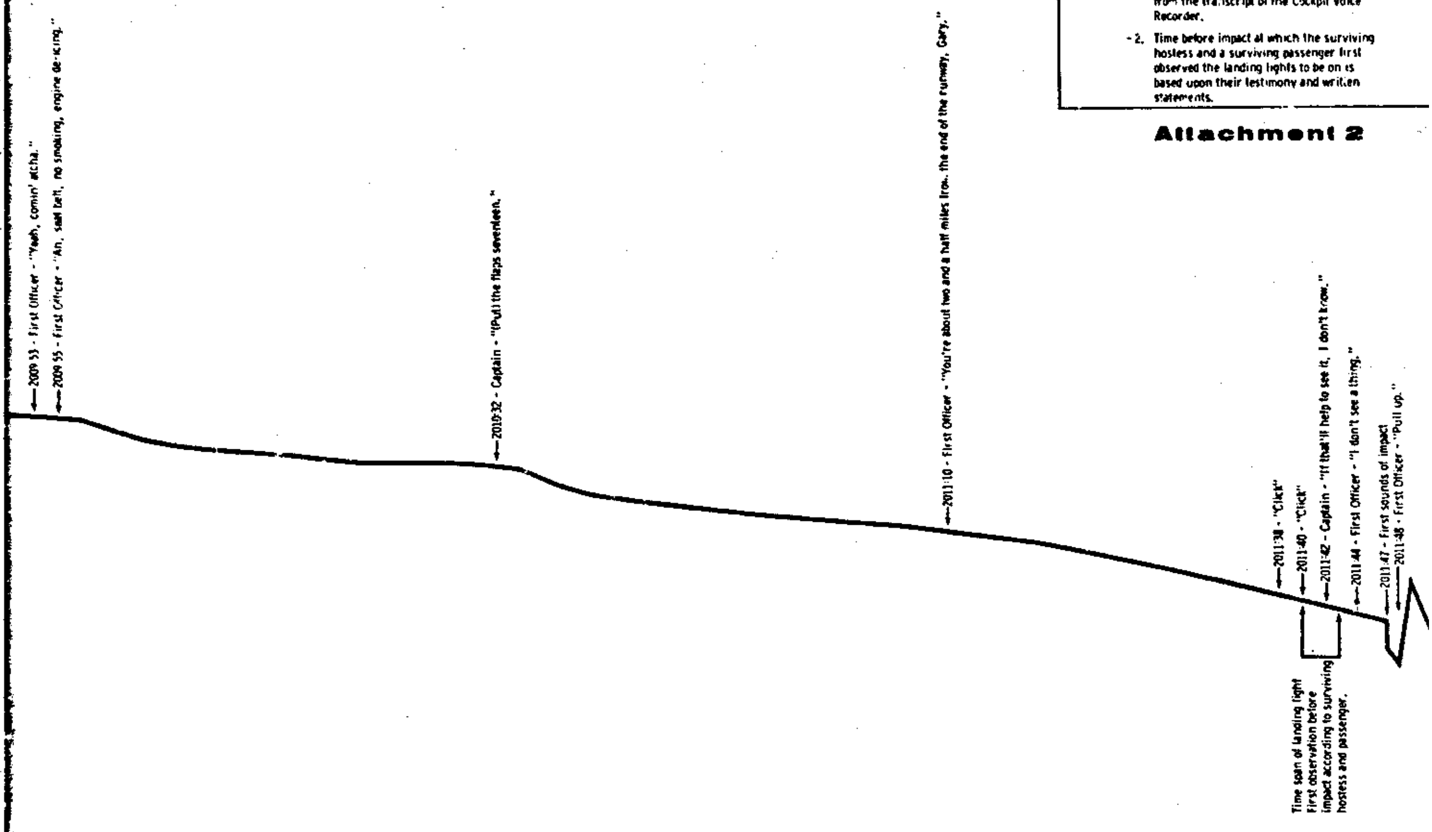
NATIONAL TRANSPORTATION SAFETY BOARD
BUREAU OF AVIATION SAFETY
Washington, D.C.

ALLEGHENY AIRLINES, INC. E FLIGHT 736
ALLISON PROP JET CONVAIR 440-N5802
BRADFORD, PENNSYLVANIA, DEC. 24, 1968

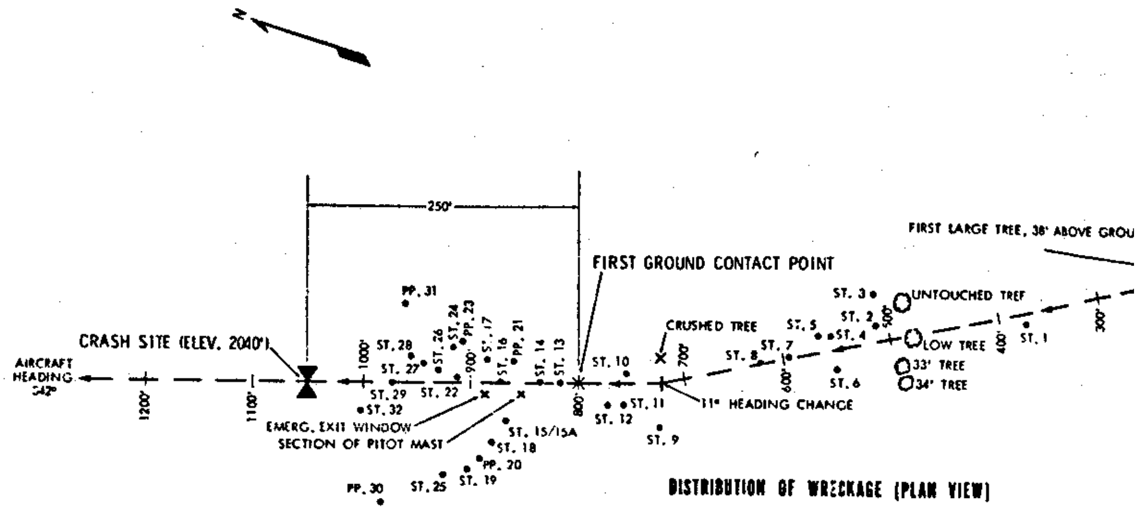
PROFILE OF LAST 3 MINUTES OF FLIGHT
BASED UPON THE FLIGHT DATA RECORDER

- 1. Communications here were extracted from the transcript of the Cockpit Voice Recorder.
- 2. Time before impact at which the surviving hostess and a surviving passenger first observed the landing lights to be on is based upon their testimony and written statements.

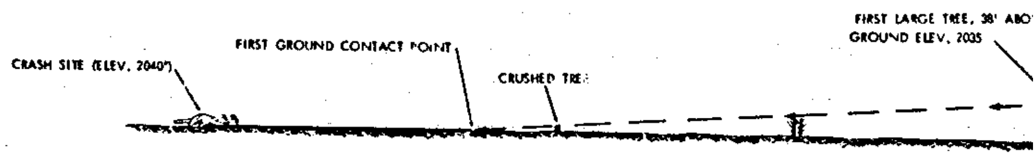
Attachment 2



B

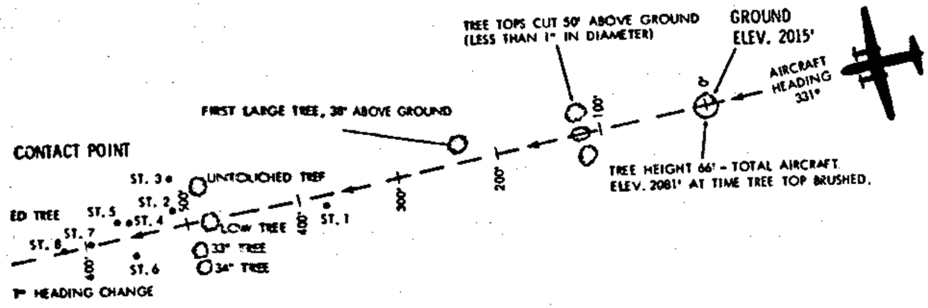


DISTRIBUTION OF WRECKAGE (PLAN VIEW)



DISTRIBUTION OF WRECKAGE (ELEVATION)

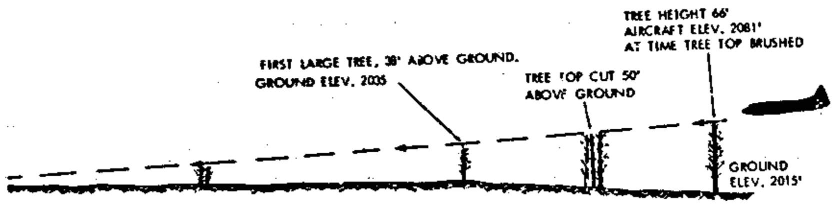
A



IBUTION OF WRECKAGE (PLAN VIEW)

WRECKAGE DISTRIBUTION LIST

ST. 0 TREE FIRST HIT, 65' ABOVE GROUND
ST. 1 RIGHT OUTER WING PANEL (AILERON OUTBOARD)
ST. 2 LEFT ELEVATOR TIP
ST. 3 WING LEADING EDGE PIECE
ST. 4 FRONT SPAR SECTION
ST. 5 FLAP ASSEMBLY SECTION
ST. 6 AILERON SECTION
ST. 7 WING SECTION
ST. 8 SECONDARY WING STRUCTURE
ST. 9 FLAP STRUCTURE
ST. 10 VERTICAL STABILIZER TIP
ST. 11 FLAP SECTION
ST. 12 WING FUEL TANK SECTION
ST. 13 VHF ANTENNA (HORN)
ST. 14 PIECES OF VERTICAL STABILIZER
ST. 15 WING SPAR WEB STRUCTURE
15A SECONDARY WING STRUCTURE
ST. 16 VERTICAL STABILIZER STRUCTURE
ST. 17 LEFT OUTBOARD WING AND AILERON
ST. 18 RUDDER ASSEMBLY SECTION
ST. 19 FLAP SECTION
PP. 20 PROP AFTER BODY
PP. 21 PROP BLADE NO. B 9499
ST. 22 WING TOP SKIN FLAPGAP STRUCTURE
PP. 23 FRONT OF GEAR BOX, PROP HUB, 3 BLADES, NO. P 1031
ST. 24 2 PIECES MAIN WING STRUCTURE
ST. 25 AFT PORTION OF VERTICAL STABILIZER AND TRIM DRIVE ACC
ST. 26 UPPER FUSELAGE SECTION
ST. 27 REAR SPAR, OUTBOARD FLAP AND UPPER GAP STRUCTURE
ST. 28 SECTION OF FLAP ASSEMBLY AND REAR SPAR
ST. 29 LEADING EDGE, SPAR AND BOTTOM WING SPAR WEB
PP. 30 PROP BLADE NO. B 8912
PP. 31. PROP SPINNER NO. S 478-7
ST. 32 PIECE OF VERTICAL FIN



TRIBUTION OF WRECKAGE (ELEVATION)

Attachmen

NATIONAL TRANSPORTATION SAFETY B
DEPARTMENT OF TRANSPORTATION
Washington, D.C.

WRECKAGE DISTRIBUTION MAP
ALLEGHENY AIRLINES CV580, N53

BRADFORD REGIONAL AIRPORT

DECEMBER 24, 1968

B