AMERICAN AIRLINES, INC.
BOEING 727, N1996
NEAR THE GREATER CINCINNATI AIRPORT
CONSTANCE, KENTUCKY
NOVEMBER 8, 1965

TABLE OF CONTENTS

SA-387 **File No.** 1-0031

CIVIL AERONAUTICS BOARD

AIRCRAFT ACCIDENT REPORT

ADOPTED: September 28, 1966 **RELEASED:** October 7, 1966

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SYNOPSIS

American Airlines Flight 383, Boeing 727, N1996, a regularly scheduled passenger flight nonstop from LaGuardia Airport, New York to Cincinnati, Ohio, crashed and burned near the Greater Cincinnati Airport on November 8, 1965, at approximately 1902 e.s.t. Fifty-eight of the 62 persons on board were fatally injured in the accident.

The flight was conducting a visual landing approach to runway 18 when it crashed into a wooded hillside approximately two miles north of the runway. Initial impact occurred at an altitude 225 feet below the published airport elevation of 890 feet m.s.l.

At the time of the approach a line of rain showers and thunderstorms was moving into the Cincinnati area from the northwest. Rain was reported at the field shortly before the accident.

The last communication from the flight, five seconds before impact, indicated no awareness by the crew of the aircraft's low altitude.

The Board determines that the probable cause of this accident was the failure of the crew to properly monitor the altimeters during a visual approach into deteriorating visibility conditions.

1. INVESTIGATION

1.1 History of Flight

American Airlines, Inc., (AA) Flight 383, a Boeing 727, N1996, departed LaGuardia Airport, New York, at 1738 e.s.t.,1/ 2/ on November 8, 1965, as a regularly scheduled passenger flight, nonstop, to the Greater Cincinnati Airport, Covington, Kentucky.

1/ All times herein are eastern standard based on the 24-hour clock.
2/ Scheduled departure time of the flight from New York was 1700; however the departure from the gate was delayed until 1720 because N1996 was being utilized as a standby aircraft for another flight.

There were 56 passengers and six crewmembers on board. The aircraft crashed and burned approximately two miles north of the Greater Cincinnati Airport at 1902 while attempting a visual landing approach to runway 18.

The crew filed an Instrument Flight Rules (IFR) flight plan which called for a standard instrument departure from LaGuardia Airport with transitions to the Philipsburg, New Jersey, VORTAC, thence via Jet Airway (J) 49 to Allegheny, J80 to Dayton, and J43 to Cincinnati. The requested cruising altitude was 35,000 feet with an estimated time en route of 1 hour 23 minutes. The alternate airport was listed as Standiford Airport, Louisville, Kentucky.

After departure from LaGuardia the flight proceeded in accordance with its clearance to the Philipsburg VORTAC. After passing Philipsburg the flight requested and received a change of routing via J78 to Charleston, J24 to Cincinnati. However, when about 100 miles from Charleston the flight requested, and was cleared direct to the York VOR,3/ thence direct to Cincinnati.

At 1845 AA 383 contacted the company radio (ARINC) and reported their estimated time of arrival at Cincinnati as 1905. They were advised at this time that the Covington altimeter setting was 30.01 inches and that the airport barometric pressure setting was 815 feet "above."

At approximately 1855, when the flight was about 27 miles southeast of the Greater Cincinnati Airport, radar traffic control was effected by Cincinnati Approach Control. Subsequent descent clearances were issued to the flight and at 1857:38 American 383 reported: ". . . out of five for four and how about a control VFR, we have the airport." The Approach Controller replied: ". . . continue to the airport and cleared for a visual approach to runway one eight, precip lying just to the west boundary of the airport and its . . . southbound."

The crew acknowledged the clearance and the controller cleared the flight to descend to 2,000 feet at their discretion.

At 1858:41 Approach Control advised the flight that its radar position was six miles southeast of the airport and instructed them to change to the Cincinnati tower radio frequency.

The recorded transmissions4/ between American 383 and the Cincinnati Tower are as follows:

1859:06	AA 383	"Cincinnati Tower its American three eight three, we're six southeast and ah control VFR.
1859:15	Tower	"American three eight three Cincinnati Tower runway one eight, wind two three zero degrees five, altimeter three even.
1859:21	AA 383	"Roger runway one eight.

3/ York VOR - a low altitude navigational aid located approximately 65 miles northwest of the Charleston VORTAC.

4/ Transmissions were obtained from the transcript of recorded conversation and have been converted to e.s.t., and corrected for tape speed lag.

1859:23	Tower	"In sight cleared to land runway one eight American three eighty three.
1859:28	AA 383	"We're cleared to land Roger.
1859:29	AA 383	"How far west is that precip line now?
1859:30	Tower	"Looks like its just about over the field at this time sir, we're not getting any on the field, however.
1859:35	AA 383	"Okay.
1859:40	Tower	"If we have a windshift I'll keep you advised as you turn onto final.
1859:44	AA 383	"Thank you very much we'd appreciate it.
1900:06	Tower	"American three eighty three we are beginning to pickup a little rain right now.
1900:11	AA 383	"Okay.
1901:11	Tower	"American three eighty three you still got the runway Okay?
1901:14	AA 383	"Ah just barely we'll ah pickup the ILS here.
1901:19	Tower	"American three eighty three approach lights, flashers and runway lights are all high intensity.
1901:22	AA 383	"Okay."

The acknowledgement, "Okay" at 1901:22 was the last known radio transmission made by American 383.

Federal Aviation Agency (FAA) tower personnel first observed the aircraft at a point approximately four miles east-southeast of the airport as it proceeded on the downwind leg in a northerly direction. (See Attachment #1.) It was stated that the aircraft's navigation lights were clearly visible and that the flight appeared to be operating at a normal traffic pattern altitude. One of the controllers stated that the aircraft passed about one mile to the east of the WCKY radio towers (located three miles east-northeast of the control tower), then commenced a left turn onto the base leg and started a gradual descent. The controller continued to watch the aircraft as it proceeded west on the base leg; however, at a point between two and three miles northeast of the airport it disappeared from his view. He stated that he believed the aircraft was lost from his view because it, ". . . appeared to fly into or behind weather phenomena."

Weather conditions at the time of initial contact with AA 383 were described by the tower controllers as being clear to the east and northeast with "clouds" and "lightning" observed to the northwest. As the aircraft proceeded on the base leg the clouds had moved over the field with light rain blowing on the west and north quadrants of the tower cab windows.

A number of persons on the ground observed the aircraft during its approach. Their observations placed the aircraft approximately four miles east of the field on a northerly course while on the downwind leg. (See Attachment #1.) The flight was observed as it crossed the Ohio River and turned left to a westerly course. Witnesses stated that the aircraft had its navigation and landing lights on and that its altitude appeared to be low at this point.

Various witnesses located along the base leg stated that: The aircraft was proceeding in a westerly direction at a low altitude, the landing lights were on, the engines sounded loud and that it appeared to be in level flight, or at most, in a gradual descent.

At a point approximately 2-1/2 miles from the end of runway 18 the aircraft was observed to start a turn toward the field. One witness located one-half mile west of the accident site observed the aircraft for approximately the last 10 seconds of flight. He stated that he first saw four bright landing lights coming from the east toward his position. He then observed the aircraft bank rapidly to the left, crash into the hillside and burst into flame. He observed nothing unusual about the aircraft except that its position was too low to clear the terrain.

With regard to the weather, witnesses located along the aircraft's flightpath in the area of the downwind and base legs stated that a light rain was falling with lightning observed in the clouds to the west at the time they saw AA 383. Shortly after the aircraft passed a heavy rain commenced.

Witnesses located near the accident site reported heavy rain in this area at the time of the accident.

None of the witnesses saw lightning strike near or on the aircraft.

The pilot of a light aircraft, inbound to Cincinnati at the time of the accident testified as to his observations that evening. He stated that when he was approximately five miles northeast of the airport at an altitude of 2,000 feet and on a heading of 200 degrees he observed ". . . a streak of light . . .," which he later assumed were the landing lights of the aircraft. He described the light as being below and directly ahead of his position, progressing from left to right. He further stated that the lights diminished in length during this period (3-5 seconds) then went out. Approximately four to five seconds later he saw flames erupt from the ground in that vicinity. He stated that the weather was generally VFR to the north of the field with thunderstorms located to the west and northwest. A line of light precipitation was observed over the Ohio River extending from west of the airport, east to a point between the airport and the WCKY towers with low scud clouds in the same general area. He also noted an area of heavy precipitation just starting in the immediate vicinity of the accident site. Little or no turbulence was experienced.

There were four survivors of this accident, a stewardess, two revenue passengers and a non-revenue AA pilot. The latter survivor was occupying the most forward window seat on the right side of the first-class cabin section. His testimony indicated that the flight en route from LaGuardia was routine, the initial descent into the Cincinnati area seemed rapid and that the lights of Cincinnati were visible to the north after level off. He further stated that the next time he looked out the window, "It seemed like we were very low . . . I, then, sat there unconcerned, and it seems like we were on approach, after I looked out the window, and yet it seemed we had started another left turn and we were in maybe a 10 to 15 degree bank . . . I heard what I thought at the time to be hydraulic flap motors actuating, unwinding toward the rear of the airplane and it was just immediately after this that we made contact with the ground, with quite a large bang, and it seemed like the destruction of the airplane."

He stated that on impact he was thrown to the floor of the cabin with a great deal of debris piling on top of him. Although momentarily stunned he remembered seeing flame coming from the rear of the cabin and after extricating himself from the debris made his way forward and stepped out of the front of the aircraft which was completely missing. A few moments later the aircraft exploded and began to burn intensely.

During the final portion of the approach he remembered seeing strobe light reflections from scud clouds below the aircraft and a little water running horizontally along his window. He stated that when he first left the aircraft it was not raining but that a heavy downpour commenced approximately 30 seconds later.

The surviving stewardess who was occupying a forward jump seat, and the two surviving passengers were thrown from the aircraft at impact and were unable to recall any significant occurrences relating to the flight, final approach, or their egress from the aircraft.

The location of the crash site was approximately two miles north of the approach end of runway 18 and 1/4 mile to the left of the extended centerline.

Initial impact was made by the right wing of the aircraft with a tree at an altitude of 665 feet m.s.l.; 225 feet below the published airport elevation of 890 feet m.s.l.

The accident occurred at 1901:27 during the hours of darkness.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	5	53	
Non-fatal	1	2	1 non-revenue Passenger

Post-mortem examinations of the flight crewmembers revealed no evidence to indicate any pre-existing disease that might have affected the performance of their duties.

1.3 Damage to Aircraft

The aircraft, with the exception of the right outboard wing and tail assembly, was destroyed by ground impact and fire.

1.4 Other Damage

The impact area was a wooded hillside which received damage to trees in the impact swath of the aircraft.

1.5 Crew Information

Captain David J. Teelin, age 46, was employed by American Airlines Inc. on January 6, 1946, and was upgraded to Captain on May 1, 1956. He held airline transport pilot certificate No. 221867 with ratings in the Douglas DC-6/7, Convair 240/340/440, Lockheed L-188, Boeing 727, and BAC 1-11. He satisfactorily passed his last FAA first-class medical examination on May 25, 1965, with no waivers. He had in excess of 24 hours off-duty time preceding this trip.

Captain Teelin satisfactorily completed his type rating requirements in the Boeing 727 on March 1, 1965, and was a company-designated check airman in this type equipment.

He had accumulated a total of 16,387 flying hours including a total of 225 hours in Boeing 727 type aircraft.

On the subject flight Captain Teelin, in accordance with Federal Aviation Regulations (FAR) 121.425(a)(1), 4/ was acting as check airman for Captain O'Neill who had completed 9 hours and 30 minutes of the programmed 25 flight hours as pilot-in-command under the observation of a check airman. As the check airman assigned to this flight Captain Teelin was the designated pilot-in-command of the aircraft.

Captain Teelin was observed to be in the copilot's seat on the aircraft's departure from LaGuardia Airport. It was also determined that Captain Teelin was making all radio transmissions from Flight 383 to the Cincinnati Tower during the approach.

Captain William J. O'Neill, age 39, was employed by American Airlines Inc. on May 1, 1951, and was upgraded to captain on April 8, 1957. He held airline transport certificate No. 351691 with ratings in the Douglas DC-6/7, Convair 240, and Boeing 727. He satisfactorily passed his last FAA first-class medical examination on July 26, 1965, with no waivers. He had in excess of 24 hours off-duty time preceding this trip.

He had accumulated a total of 14,400 flying hours of which 35 were in the Boeing 727.

Captain O'Neill began training in the Boeing 727 on August 16, 1965, and received approximately 21 hours of B-727 flight training prior to taking his initial type rating flight check on October 16, 1965. The records indicate that he failed to

4/ FAR 121.425 Initial Flight Assignments on a Particular Type of Airplane.

(a) Except as provided in paragraph (b) of this section in addition to the ground and flight training specified in the certificate holder's approved training program, no crewmember may serve on a type airplane on which he has not previously served, or in a crew position in which he has not previously served, unless he satisfactorily completes at least the number of programmed hours specified in the certificate holder's approved training program for initial flight assignment (Appendix E. Column V.) In conducting initial flight assignments in each type airplane -

(1) Each pilot-in-command must perform the duties of a pilot-in-command while being observed by an approved check airman.

satisfactorily accomplish the flight portion of this check and it was recommended that he receive "Two hours additional flight training or as necessary to successfully complete" the following maneuvers:

"1. Takeoff with ATC clearance (including holding).

2. Instrument approach procedure. (Dev. /deviation mode/ and auto-coupler approach.)

3. Missed approach procedures.

4. Preflight check."

He received 55 minutes of further flight instruction covering the above maneuver and on October 19, 1965, he satisfactorily accomplished a flight recheck and received a type rating in the Boeing 727.

He was in the final process of being upgraded to captain on Boeing 727 type equipment and as previously stated, had accumulated 9-1/2 flight hours in the B-727 during seven flights under the observation of a check airman in accordance with FAR 121.425. The check airman on all of these flights, including the accident flight, was Captain Teelin. One of these flights was conducted into Cincinnati on November 4, 1965, arriving at 1427 and departing at 1606.

Flight Engineer John T. LaVoie, age 33, was employed by American Airlines Inc. on November 10, 1956, and was designated as a flight engineer on May 22, 1958. He held flight engineer certificate No. 1410784. He had accumulated a total of 6,047 hours as flight engineer of which 307 hours were in the Boeing 727. Flight Engineer LaVoie satisfactorily completed his last line check in the Boeing 727 on June 2, 1965. His FAA first-class medical certificate was issued on July 26, 1965, without limitations. He had 16 hours off-duty time prior to assuming duties for this flight.

Stewardess Toni F. Ketchell,5/ age 25, was employed by American Airlines Inc. on March 9, 1965, and received her last recurrent training on June 21, 1965.

Stewardess Mary E. Campbell, age 22, was employed by American Airlines Inc. on September 8, 1964, and received her last recurrent training on June 4, 1965.

Stewardess Joyce B. Chimel, age 22, was employed by American Airlines Inc. on April 6, 1965, and received her last recurrent training on June 2, 1965.

1.6 Aircraft Information

N1996, a Boeing 727-23, manufacturer's serial No. 18901, was manufactured on June 29, 1965, and had accumulated a total of 938 flying hours.

An examination of the maintenance records for N1996 disclosed that the aircraft and powerplants were maintained in accordance with American Airlines' procedures and FAA approved directives.

5/ Miss Ketchell was the only surviving crewmember.

The aircraft's gross weight at the time of the accident was computed to be 120,980 pounds with a center of gravity (c.g.) of 25.5 percent Mean Aerodynamic Chord (MAC). Both the weight and c.g. were well within the prescribed landing limits.

The aircraft was serviced with 3,358 gallons of kerosene jet fuel at LaGuardia for a total of 38,000 pounds of fuel prior to departure.

1.7 Meteorological Information

The following official United States Weather Bureau (USWB) observations at the Greater Cincinnati Airport were taken prior to and following the accident:

1858, record special, measured ceiling 1,500 feet broken, 4,000 feet overcast, visibility 7 miles, thunderstorm, temperature 58F, dewpoint 53F, wind 220 degrees 8 knots, altimeter setting 30.00 inches, thunderstorm began at 1855, thunderstorm northwest moving southeast, occasional lightning in cloud and cloud to cloud.

1903, special, measured ceiling 1,500 feet broken, 2,500 feet overcast, visibility 2 miles, thunderstorm, moderate rain showers, wind 260 degrees 8 knots, altimeter setting 30.01 inches, thunderstorm northwest moving southeast, occasional lightning in cloud and cloud to cloud.

1911, special, 1,000 feet scattered, measured ceiling 1,500 feet broken, 2,500 feet overcast, visibility 2 miles, thunderstorm, light rain showers, temperature 56F, dewpoint 52F, wind 300 degrees 12 knots, gusts to 17 knots, altimeter setting 30.01 inches, thunderstorm north moving southeast, occasional lightning in cloud and cloud to cloud, windshift 1904, aircraft accident.

Examination of the Cincinnati USWB telautograph record shows that the 1858 and 1903 surface observations were transmitted to appropriate FAA facilities which included the Tower and IFR room.

The following advisory was transmitted immediately preceding the above observations; Weather advisory 1815 E, thunderstorms in the vicinity of Cincinnati 1830-2000, possible surface wind gusts to 40 knots from the northwest.

The Cincinnati arrival radar controller stated that precipitation areas were visible on his radar scope during the time of the approach of AA 383. He stated that the heaviest precipitation area was located to the west of the airport moving generally southward with areas of lighter precipitation located to the north and northeast moving to the southeast. He also stated that at the time of the last AA 383 radar observation, at a position approximately two miles northeast of the field, the aircraft appeared to be at the leading edge of the lighter area of precipitation.

The radar meteorologist on duty at the Cincinnati USWB testified regarding his radar weather observations during the period 1800-1900. He stated that a line of showers and thundershowers approximately 20 miles in width was observed on his radar scope. The line extended from about 80 miles west of the station to 110 miles northeast and was observed to have been moving from the northwest (320°) at a speed of 25 knots. A photograph of the radar scope taken at 1900:30 showed that the line of precipitation had reached the Cincinnati Airport.

Runway 18 at Cincinnati is equipped with a transmissometer adjacent to the ILS touchdown point on the approach end of the runway. Examination of the recorder trace revealed that at approximately 1903 a sharp drop in the transmissivity of the atmosphere occurred which reduced runway visibility to 1-1/8 miles. Almost immediate thereafter the transmissivity increased showing runway visibilities in excess of two miles.

Prior to departure from LaGuardia the captain of Flight 383 was provided with a dispatch packet which included the company forecast for the Cincinnati terminal for the period 1600-2000. This forecast called for 1,200 feet broken, 3,500 feet overcast, visibility 4 miles, light rain, fog, variable to 1,000 feet overcast, visibility 2 miles, thunderstorm, moderate rain showers.

A weather information display board is also installed at the LaGuardia American Airlines Operations office. Company employees observed Captain Teelin briefing himself at this board at approximately 1600.

The American Airlines' Briefing Forecaster on duty in the New York Flight Dispatch office at Kennedy International Airport stated that a "pilot" called at approximately 1610 and advised that he was going to Cincinnati and requested weather information. The caller did not identify himself by name or flight number. The forecaster stated that he briefed the pilot to the effect that 35,000 feet would be a good cruising altitude over the intended route and that the flight should be on top of all weather until descent into the Cincinnati area. He also stated that a route over Charleston, West Virginia, should put the flight south of all thunderstorm activity except for what he would find in the Cincinnati area on arrival.

Following the accident a special study was conducted by the USWB in order to determine the possibility of any vertical and/or horizontal wind shear in the Cincinnati area. The study revealed a maximum recorded gustiness of 16-17 knots and a wind shear of about 0.6 knots per hundred feet in the area.

Additionally, the study indicated a headwind component change on the aircraft of approximately five knots per minute during the last minute of flight.

1.8 Aids to Navigation

All components of the ILS serving runway 18, the Cincinnati VOR, and the facility radar were in operation at the time of the accident. These navaids were flight checked shortly after the accident and were found to be operating within prescribed tolerances.

1.9 Communications

The air traffic services provided to Flight 383 from LaGuardia to Cincinnati were examined and found to be in accordance with standard Air Traffic Control (ATC) practices and procedures.

With respect to the flight's arrival in the Cincinnati area it was noted that AA 383 requested a "control VFR" and was cleared by Approach Control for a "visual approach" to runway 18.

It is to be noted that there is no specific definition of the term "control VFR" in the ATC Manual of Air Traffic Control Procedures.6/ The manual defines "visual approach" as follows: "An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions and having received an Air Traffic Control authorization, may deviate from the prescribed instrument approach procedures and proceed to the airport of destination by visual reference to the surface."

A visual approach clearance does not constitute cancellation of the flight's IFR clearance and ATC is required to provide appropriate minimum aircraft separation standards. In this case cancellation of the clearance was not requested and ATC minimum aircraft separation requirements remained in effect.

1.10 Aerodrome and Ground Facilities

Runway 18, 8,600 feet long and 150 feet wide, is equipped with high intensity runway lights and a standard configuration type "A" approach lighting system with sequenced flashing condenser (strobe) lights. All lights were on their highest intensity setting and operating satisfactorily at the time of the accident. The published airport elevation is 890 feet above sea level.

1.11 Flight Recorder

The aircraft was equipped with a United Data Control model F-542 series flight recorder which scribes traces of inflight pressure altitude, indicated airspeed, magnetic heading and vertical acceleration as a function of time. Examination of the flight recorder record for that portion of the flight from takeoff at LaGuardia to the initial descent into Cincinnati area revealed no abnormalities or unusual occurrences. In order to more closely examine the final portion of the flight, a large scale plot of the recorded parameters was prepared for the descent from 7,000 feet m.s.l. to impact, encompassing the last six minutes of flight (see Attachment#2). The plot shows that a continued descent from 7,000 feet to 2,000 feet was maintained on a heading of approximately 305 degrees with a brief level off at 5,000 feet m.s.l. During this descent the airspeed was reduced from 350 knots to 250 knots with descent rates ranging from 2,800 to 3,000 feet per minute. Level off was made at 2,000 feet (1,110 feet a.f.l.)7/ and the aircraft remained at this approximate altitude for 1 minute 20 seconds while the airspeed was further decreased to 190 knots. While maintaining this altitude the aircraft turned to a northerly heading on the downwind leg and subsequently initiated a left turn toward the base leg. At 1859:57 a descent from 2,000 feet (1,110 feet a.f.l.) commenced. It was noted that a relatively steady descent averaging about 800 feet per minute was maintained for approximately 70 seconds and that the airspeed was further reduced to 160 knots. At this point the aircraft was holding a west-northwesterly heading on the base leg. The readout shows that at 1900:53 a left turn was initiated toward the final approach course for runway 18 and at 1901:07, (20 seconds before impact) at an altitude of 1,100 feet (210 feet a.f.l.), the descent rate increased to approximately 2,100 feet per minute. This rate of descent was maintained for about 10 seconds to an altitude of approximately 725 feet (165 feel below published field elevation) with the airspeed holding at 160 knots. The descent rate then decreased to about 625 feet per minute for approximately the last 10 seconds of flight with the airspeed decreasing to 147 knots at impact. The last readable heading point obtainable from the recorder was 270 degrees at time 1901:12. However, an individual engraved mark of the heading trace was found

6/ ATP 7110.1B.
7/ The aircraft's altitude above the published field elevation (a.f.l.).

at the coordinate time point of 83 minutes 14 seconds corresponding to a heading of 238 degrees. This mark was not plotted because verification of this prior engraved mark over the last 15 seconds was considered impossible due to foil aberration.

The acceleration excursions noted throughout the readout were consistent with the maneuvers being performed and, except for the last 50 seconds of flight, no significant turbulence activity was noted. During the last 50 seconds of flight the G trace activity was suggestive of light turbulence computed to be less than 14 feet per second.

In an effort to derive additional information from the flight recorder readout, the recorder data was utilized to develop an envelope of possible engine power/aircraft configuration combinations during the last six minutes of flight. Aerodynamic and mathematical techniques were employed to compute the various thrust and aircraft configuration combination possibilities that would be consistent with the flight recorder parameters of specific time points in the descent. It was possible to establish that for the descent from 5,000 feet to 2,000 feet, the only compatible aircraft configuration was; flaps retracted, gear up, spoilers extended, and thrust at idle. For other time intervals during the approach many combinations of these variables would have been consistent with the flight recorder data, and the actual configuration of N1996 for these time intervals could not be conclusively established. However, the study did indicate that with the exception of the level off at 2,000 feet where some thrust would have been required to correlate with the recorder data, the entire descent, 7,000 feet to impact, could have been made at or near idle thrust, gear up and with wing flap extension at or near the AA normal operating flap extension speed schedule.8/

1.12 Aircraft Wreckage

Examination of the aircraft wreckage at the crash site indicated the first impact was made by the right wing with a tree at an altitude of 665 feet m.s.l. which is approximately 225 feet below the published field elevation. Evidence based on tree damage in the swath path substantiates that the aircraft was in a level attitude on a heading of 235 degrees at the point of initial impact. The aircraft attitude at nose impact was determined to be five degrees noseup; the measured terrain up-slope angle at this point was 9.6 degrees. The aircraft slid a distance of 340 feet relatively intact through scrub trees and ground foilage before impacting and coming to rest amidst a group of larger trees.

The major airframe structure and all flight control surfaces were found in the wreckage area. There was no evidence of any inflight separation of the aircraft structure or components.

Examination of the flight control system revealed no evidence of failure or malfunction prior to impact. The horizontal stabilizer was found at a setting of

8/

Flap Position	AA Normal Operating Flap Extension Speed Schedule	Maximum Flap Extension (Placard) Speed
2 Degrees	200K	230K
5 "	180	215
15 "	160	205
25 "	150	185
30 "	140	180
40 "	140	170

5-1/2 degrees airplane noseup which is in the normal range. No reliable trim setting could be obtained for the aileron and rudder controls due to extensive impact damage to these components. The nose gear, two main landing gears and tail skid were found in the retracted and locked position.

The trailing edge flaps were in the 25-degree extended and locked position at impact as determined from the aileron lockout actuator and flap jackscrew measurements. All of the leading edge devices were found in the full extended position. All inflight and ground spoilers were retracted.

The hydraulic and electrical systems were examined thoroughly and no evidence was found to indicate any pre-impact failure or malfunctions. No determination could be made as to the operating condition of the pitot static or autopilot systems due to severe impact and ground fire damage. Both air-condition pack shutoff valves were found in the open position.

All three engines were recovered from the wreckage. The Nos. 1 and 3 engines had separated from the fuselage during the final impact sequence while the No. 2 engine remained attached to its engine mount in its proper location.

Subsequent disassembly and inspection revealed that the three engines had ingested tree wood, mud, and twigs during the impact sequence. This debris was distributed from the air inlet section through the turbine sections of each engine. The No. 1 engine high compressor assembly was damaged extensively with the seventh, eight, and ninth stage blades all broken off at the blade platform. Blades were also broken in the tenth, eleventh, and thirteenth compressors stages and all blades not broken were bent in a direction opposite to rotation. The No. 3 engine compressor section was damaged extensively with stator vanes and fan blades bent or broken. Those blades not broken were bent in a direction opposite to rotation. Evidence of rotation on the No. 2 engine was established by mud and debris which was wiped in the track of the first stage fan blades. There was no significant damage to the compressor or turbine assemblies and the engine was free to rotate.

Metal impingement was noted on the combustion chamber heads, nozzle guide vanes and turbine sections of all three engines. Impingement was heaviest on the first stage turbine blades and diminished progressively through the remaining stages.

The engine pressure ratio (EPR) transmitters, one for each engine, were recovered completely undamaged. Testing of these units indicated that all were within calibration tolerance; however, no valid information could be obtained as to engine power settings at impact.

The complete examination of all three engines revealed no evidence of any failure, malfunction, or operating distress prior to impact.

All of the flight and engine instruments located in the cockpit were either damaged severely or destroyed by impact forces or fire. None of the recovered instruments could be functionally tested due to the severity of the damage incurred.

The two VHF navigational receivers installed on the aircraft were recovered but because of damage, the selected frequencies could not be obtained. Only one badly distorted radio frequency selector control panel was recovered. Positions of the two control heads showed frequencies of 118.30 mcs. (Cincinnati Tower frequency) and 110.95 mcs. (ILS frequency for runway 18 is 110.90 mcs.).

The copilot's course deviation indicator (CDI) was found with a course setting of 18 - (the third character was unreadable) and a compass card reading of 240 degrees. No reliable readings could be obtained from the copilot's remote magnetic directional indicator (RMDI) because of damage to the instrument.

The RMDI and the CDI located on the captain's panel were not completely recovered and no information was obtained from these instruments. Examination of the No. 1 vertical gyro and both directional gyros revealed evidence of rotation at impact. No information could be obtained from either of the two remaining vertical gyros installed in the aircraft.

The three Kollsman altimeters 9/ installed in the aircraft were recovered from the wreckage and were examined at the manufacturer's facility. The captain's (No. 1) altimeter was found at a barometric setting of 29.06 inches with the index marker set on 800 feet. A valid drum position could not be obtained because of internal mechanism disruption. The copilot's (No. 2) altimeter was found at a barometric scale setting of 29.03 inches with the index marker positioned at 815 feet. Only portions of the center instrument panel (No. 3) altimeter were recovered and no barometric, index marker, or drum position information could be obtained. A discussion of the American Airlines procedures for altimeter utilization and related procedures will be found in section 1.15 under the heading of AA altimeter procedures.

1.13 Fire

Following impact an intense ground fire erupted which completely destroyed the aircraft cabin forward of the tail section. Firefighting personnel and equipment arrived in the vicinity approximately 15 minutes after the accident occurred but the inaccessibility of the accident site precluded utilization of this equipment.

1.14 Survival Aspects

There were 58 persons fatally injured in this accident. These fatalities were attributable to severe trauma, fire, or both. Three of the four survivors were thrown clear of the aircraft during the deceleration and breakup. The fourth survivor managed to crawl out of the wreckage through a hole in the front end of the fuselage.

1.15 Tests and Research

Examination of the AA 727 flight training curriculum disclosed that the normal VFR (training) pattern for Boeing 727 type aircraft (see Attachment #3) calls for the downwind leg to be flown at a distance of 1-1/2 miles out from the runway. Since the flight recorder, ATC observations, and witness observed flightpaths all indicate that the downwind leg on this flight was flown at a distance of 4-1/2 miles from runway 18, this aspect of the approach was explored in detail. Testimony from AA training and operations representatives at the public hearing indicated that although the VFR training pattern taught to pilots in the training syllabus serves as the standard or desired VFR approach, many variances of this pattern can be, and are, utilized in actual line operations. It was stated that the variables in the VFR

9/ Drum-pointer type altimeters.

approach profile, such as pattern distances, airspeeds, descent rates, flap and landing gear sequencing, would depend upon the specific operational situation encountered at a particular airport on a given day. It was further stated that regardless of the deviations from the basic pattern it is always recommended that the conditions for a stabilized approach be established when the aircraft is on final approach, and that upon entering the "slot"10/ the aircraft should be in the final landing configuration, and that only small adjustments to the glide path, approach speed, and trim should be performed.

It is also recommended in the operating manual that pilots utilize the ILS glide slope or visual approach slope indicator (VASI), if available, during VFR approaches as an aid in establishing and maintaining the proper approach flightpath.

AA Altimeter Procedures

Three Kollsman drum-pointer type altimeters were installed in N1996. This type altimeter has a range of from plus 50,000 feet to minus 1,500 feet. Hundreds of feet are indicated by a radial pointer; thousands of feet are indicated on a rotating drum visible through a slot in the face of this instrument. A cross-hatched marking is printed on the drum adjacent to the numbers from plus 1,000 feet to minus 1,500 feet to increase the conspicuity of these lower altitude values. (See Attachment #4.)

A conventional barometric scale (in inches or mercury) is provided for setting the altimeter. The scale is adjusted by a knob in the lower left corner of the altimeter. The knob also positions an index on the periphery of the instrument face which is used for setting field pressure altitude (QFE).11/ The procedures for setting altimeters, as applicable in this case, are set forth in the AA Flight Manual as follows:

"(3) Descent Approach:

"(a) Aircraft descending through FL 180 (15,500' in Mexico) shall have the No. 1 and 2 altimeters changed to appropriate QNH12/ settings. Once again, all three altimeters will be set to the same setting and the No. 1 altimeter becomes the master.

"(b) When making "in range" or "changeover" report, both the No. 1 and the No. 2 altimeters shall be set to local station pressure (QFE) setting. The third altimeter shall continue to be set to the local station QNH setting. After the No. 1 and 2 altimeters have been reset to the QFE setting, ATC specified altitudes will be maintained by reference to the third altimeter.

"(c) After setting the three altimeters per (b) above, the following check for accuracy shall be made by the Captain and First Officer. Subtract the altitude

10/ Desirable flight corridor extending from approximately the middle marker position (3/4 mile from the touchdown point and 250 feet a.f.l.) to the touchdown point and signifies a zone wherein the aircraft should be in the final landing configuration, properly aligned with the runway, in a steady state thrust condition, and maintaining proper airspeed and rate of descent.

11/ QFE - Station barometric pressure which when set in the altimeter allows for an altimeter reading of zero feet at the airport elevation.

12/ QNH - Local atmospheric pressure which when set in the altimeter allows for the appropriate mean sea level altitude reading at the airport elevation.

shown on the No. 1 altimeter from that shown on No. 3; then substract the altitude shown on the No. 2 altimeter from that shown on No. 3. In each instance the difference shall equal the published elevation (ASL) of the airport of intended landing. Each pilot will call out the difference derived from his altimeter check for verification by the other pilot.

"(d) Care shall be exercised throughout the approach to monitor the barometric changes and to correct the altimeters accordingly, particularly where significant barometric changes are taking place.

"(e) During the final approach the pilot not making the landing, using the instruments of his own flight panel, will call out the altitude and airspeed checks that are currently specified in the respective aircraft Equipment Operating Manuals. The pilot making the landing will check the announced airspeed and altitude readings with those being displayed on his instruments. This cross check shall also include checking that the No. 3 altimeter is indicating the appropriate value. Any discrepancies of readings between instruments shall immediately be called to the attention of the pilot making the approach.

"(f) QFE settings may be obtained, upon request, from FAA operated control towers when Company facilities are not available.

"(g) All aircraft altimeters have both the adjusted field pressure markers and the barometric scales. If an Instrument should fail or be suspected of error during flight, the other instruments may be used with QFE or QNH settings if desired."

The investigation revealed that the crew of N1996 was provided with a local station pressure altitude (QFE) of "815 above." This setting will result in a barometric scale position of 29.05 inches of mercury. The local station (QNH) setting provided to the crew was 30.00 inches of mercury. As was previously discussed, the captain's altimeter was found at a barometric setting of 29.06 inches with the index marker on 800 feet and the copilot's altimeter was found at a barometric setting of 29.03 inches with the index marker positioned at 815 feet.

The AA standard operating procedures for monitoring altimeters and rates of descent are outlined in the AA B-727 Operating Manual as follows:

"Monitoring Instruments

Localizer and Glide Slope Indications:

The pilot not making the landing and the Flight Engineer shall monitor CDI and HDI indications and shall call out any discrepancy, between the two panels, in glide slope or localizer indications.

Airspeed, Altitude, and Rate of Sink:

During all (VFR and IFR) approaches, the pilot not making the landing shall call out:

- Airspeed - any time it is below reference or above reference plus 10 knots after extending full flaps.

- Airspeed, Altitude, and Rate of Sink - at 500 feet AFL (primarily for instrument cross-check).

- Rate of Sink - any time it exceeds 700 feet per minute when altitude is below 500 feet AFL and always from runway threshold to point of touchdown. Additionally, during the instrument approaches, call out:

- Altitude - when minimum authorized altitude is reached. The F/E will monitor instruments, and assist pilots in maintaining a "watch" for traffic or other factors that could adversely affect safety."

N1996 was equipped with a rain repellent system designed to keep the windshield free of water distortion and provide forward visibility from the cockpit during in-flight rain conditions. This system utilizes nozzles located in the lower center corner of the pilot's and copilot's windshield which, when activated, directs repellent fluid over the selected windshield. The repellent is spread over the windshield by the windshield wipers and by airstream and water flow outside of the wiper areas. Because the water flow over the windshield acts as an aid in spreading the repellent and in eliminating the possibility of fluid residue obscuration on the windshield, it is recommended that the system be utilized only in moderate to heavy rain conditions. This system is designed for use, with the same effectiveness, during either day or night operations. American Airlines operating procedures recommend that the repellent be used on only one windshield at a time, normally on the windshield of the pilot not flying the aircraft. It is also recommended that the repellent be used in conjunction with the wipers and not used in light rain conditions.

1.16 Boeing 727 Flight Control and Performance Characteristics Study

During the investigation of this accident a Flight Control and Performance Characteristics Group was organized: (1) to review the flight recorder data and derive the maximum technical information available from the readout (see Section 1.11 Flight Recorder), (2) to review the basic airworthiness requirements and low speed performance and flight characteristics of B-727, (3) to examine and/or develop all applicable aerodynamic-type data which would be useful in the investigation, and (4) to review the B-727 flight crew training programs with regard to information disseminated to the crews relating to flight characteristics of the aircraft.

This group was formed in light of another recent and generally similar Boeing 727 accident and following the suggestion that there might be some inherent design characteristic of the aircraft that might be in some way related to the cause of these accidents. This group was later expanded to encompass a subsequent Boeing 727 accident.

The entire study disclosed no evidence of any design or performance deficiency and substantiated that the FAA and the Boeing Company had conducted extensive tests and research to validate and insure that the Boeing 727 complied with all applicable Federal Aviation regulations.

Examination of the Boeing 727 technical data revealed that the two design features which serve to distinguish it from other jet transports were its three-engine configuration and sophisticated wing flap or high lift system. These unique features of the 727 design were explored thoroughly by the FAA during type certification and it was found that the performance and flight characteristics were in conformance with the design criteria and all applicable certification requirements.

However, it was also determined that the high lift/drag ratio obtained in the 727 with full flaps extended requires the use of a comparatively higher percentage of thrust output than other models, in order to maintain desired landing speeds and rates of descent. At idle thrust and 40 degrees of flap the Boeing 727 descent flightpath at the minimum approach speed was about two degrees steeper than the average descent paths for the other models in the full flap landing configuration. It is recognized that the approach speed is lower for the B-727 than the other models with full flaps and idle power and that steeper descent paths in this configuration should, therefore, be expected. It was also found that the 727, with its hydraulically powered flight control system, has lighter control forces and is more responsive to control input than the other models.

Another aspect of this phase of the investigation was a survey conducted among pilots of the Allied Pilots Association (APA) and the Air Line Pilots Association (ALPA) who represent most of the U. S. Air Carrier pilots involved in day-to-day operation of the Boeing 727. It was thought that these associations, more than perhaps any other one organization, would be aware of any hazardous or undesirable features and unusual or marginal performance/flight characteristics relating to actual line operations in the B-727. The results of this poll revealed that the pilots were generally pleased with the flight characteristics and features of the 727 and that they had experienced no major difficulties in the operation of this aircraft. Similarly, the report of an ALPA evaluating committee, relating to the design and flight characteristics of the B-727, geared primarily to the "line pilot" viewpoint, was made available to the Board for examination. A review of this report revealed a favorable evaluation of the B-727 by the committee with one of the conclusions being that the aircraft constituted a major advance in aircraft design which would significantly enhance air carrier operations. This report also noted that high descent rate characteristics with the flaps in 40-degree position required the use of a greater percentage of thrust to maintain desired speeds and recommended against steep approaches with high descent rates.

The National Aeronautics and Space Agency (NASA) was requested to review their Boeing 727 VGH13/ data for any evidence of unusual operating practices or occurrences. Their review of the VGH records indicated that high descent rates close to the ground and non-stabilized close-in approaches occur at a somewhat higher frequency in B-727 operations than in operations involving other jet transports. The frequency of occurrence varied from airline to airline.

Another facet of this part of the investigation was a review of the Boeing 727 flight crew training programs as conducted by the major air carriers utilizing this type aircraft. Because the several major 727 accidents which were reviewed occurred during the descent or landing position of the flight the examination of the various training programs was concentrated on the descent, approach, landing, and landing abort flight regimes. It was found that the standards and procedures used in establishing the criteria for the 727 training programs were essentially the same as those utilized in developing the 707/720 training programs and were in compliance with FAA requirements. In general, it was noted that the average pilot transition time and training failure rate in the Boeing 727 were approximately the same, or perhaps slightly less than those in the Boeing 707/720 aircraft. It was also found that there was no specific maneuver, required or incorporated, in the

13/ The NASA VGH program is a continuing research project whereby recorded airspeed - acceleration - altitude data is collected for many different aircraft models and for different types of operation.

air carrier training programs for demonstrating high-sink rate close to the ground. However, all of the air carrier training and operations manuals reviewed stressed that high sink rates in this flight regime should be avoided.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The investigation of this accident disclosed no evidence of any failure or malfunction of the aircraft, its systems or components. All applicable aids to navigation, and runway/approach lighting aids were operating satisfactorily during the approach and at the time of the accident. The aircraft and crew were properly certificated and the flight was properly dispatched. All communications during the approach were considered to be normal and revealed nothing to suggest any aircraft or flight crew distress. The last radio transmission, five seconds before impact, indicated that the crew was unaware that they had descended to an altitude below the level of the airport.

After an exhaustive review and evaluation of all available evidence, the Board has become convinced that the cause of the accident is directly related to the manner in which the crew operated the flight and indirectly related to certain specific factors that may have influenced or affected the crew during the landing approach.

One of the factors which undoubtably influenced the conduct of this flight was the weather situation which existed in the Cincinnati area and the specific conditions which were encountered by N1996 during the approach. Based on USWB and witness observations during this time it was reliably ascertained that a line of rain showers and thunderstorms, oriented east-northeast/west-southwest, was moving into the area from the northwest at a speed of 25 knots. Cloud to cloud lightning was reported in the vicinity of the thunderstorms. The surface visibility at the airport was diminishing rapidly due to the precipitation associated with this line. Recorded values showed that between 1902 and 1903 (just after the time of the accident) visibility on runway 18 dropped from between 5-7 miles to 1-1/8 miles, then increased almost immediately to better than two miles. Cloud coverage in the area consisted of an overcast in the process of lowering from approximately 4,000 feet a.f.l. to 2,500 feet a.f.l. with broken clouds based near 1,500 feet a.f.l. A few fracto-stratus or "scud" clouds were located below these layers to the northeast of the field along the Ohio River with light precipitation occurring in this area. Based on surface visibility values it is believed that inflight visibility in the rain showers would have been two miles or less depending on the intensity of the precipitation. Inflight visibility to the east and northeast of the field, along the downwind landing leg, would have been in excess of seven miles.

No inflight turbulence was reported in the area nor was there any significant turbulence indicated on the flight recorder readout. The wind shear of .06 knots per hundred feet and the component headwind change of five knots per minute during the last minute of flight would have had a negligible effect on the flightpath of the aircraft and are not considered to have had any bearing on the cause of this accident.

The weather briefing received by the crew prior to departure from LaGuardia is considered to have been adequate and representative of the conditions existing in the area at the time of their arrival.

The recorder determined ground track was in agreement with the ATC and witness determined tracks and the recorder derived flight profile correlated in all essential elements with the ATC and witness data. A brief review of the flight profile shows that N1996 entered a downwind approach leg approximately four miles east of runway 18 at approximately 2,000 feet m.s.l. (1,110 a.f.l.) and that an approximate 800 feet per minute rate of descent was commenced during the turn onto the base leg. This descent was continued to an altitude of 210 feet a.f.l. at which point a gradual turn toward the final approach course was initiated. Coincident with this turn (20 seconds before impact) the descent rate increased to about 2,100 feet per minute for 10 seconds, during which time the aircraft descended into the valley formed by the Ohio River, below the elevation of the airport. The final 10 seconds of flight showed a decrease in descent rate to approximately 625 per minute until impact.

Analytical studies of the flight recorder data relating to the aircraft's approach configuration were carefully reviewed and evaluated. As was previously stated, only during the descent from 5,000 feet m.s.l. to 2,000 feet m.s.l. could the aircraft's configuration be positively identified; i.e., spoilers extended and engines at idle thrust. However, based on the recorder data and AA operational procedures the other probable configuration sequences were determined relative to the flight profile. This analysis showed that traffic pattern entry was made at an airspeed of approximately 210 knots; that the spoilers were retracted and two degrees of flaps were extended at that time; that airspeed diminished as the aircraft turned toward the base leg; that just prior to the completion of this turn, at an airspeed of 170 knots, flaps were lowered to five degrees; that near the midpoint of the base leg at an airspeed of 160 knots flaps were extended to 15 degrees; and that the final flap extension to 25 degrees was made during the turn toward the final approach course approximately 20 seconds before impact.

Although the increase in the rate of descent to approximately 2,100 feet per minute appears to correlate with the extension of flaps from 15 degrees to 25 degrees the Board find it extremely difficult to suggest a proper rationale for the pilot permitting such high descent rates to develop at this point in the approach. It would appear, however, that the increased drag and nosedown pitch mode accompanying the 25-degree flap extension was not initially checked either through the use of longitudinal control forces or increased thrust and that the high rate of descent was inadvertently developed. However, airspeed bleed-off from 160 knots to 145 knots coupled with a decrease in the rate of descent to approximately 625 feet per minute indicates that the pilot subsequently utilized the longitudinal control system to arrest the high descent rate. Because of the relatively high airspeed at this point in the approach it would appear that this action was consistent with an attempt to further reduce airspeed. Had added thrust alone been used to decrease the high rate of descent it would not have achieved the apparent desired results of slowing the aircraft.

The traffic pattern airspeeds and aircraft configuration sequences utilized by N1996 were compared to appropriate airspeeds and recommended configuration sequences outlined in the VFR training pattern. From this study it was indicated that the various flap extensions during the approach conformed with the AA normal operating extension speeds. However, because of the comparatively higher airspeeds maintained by the flight throughout the approach, these flap extensions were concentrated or "bunched-up" on the base leg.

Based on an evaluation of airspeed bleed-off and descent rates, as well as the metal impingement pattern found in the engine turbines, the Board concludes that, except for the brief level period at 2,000 feet m.s.l., the entire descent was probably conducted at or near idle thrust. In this case, the only logical explanation for conducting the approach at such low engine power settings would have been an attempt by the pilot to expedite airspeed reduction to the appropriate approach/flap extension speeds. However, it can be seen that if the downwind leg altitude had been maintained or if a considerably lesser descent rate had been used while extending flaps in conformance with normal flap extension speeds, airspeed bleed-off would have been more rapid and the appropriate flap extensions could have been achieved further back on the base leg. Thus, with the aircraft slowed down and approach flaps extended, utilization of higher more desirable thurst settings would have been possible earlier in the approach. As it was, a number of aircraft configuration changes and landing checklist items remained to be completed as N1996 was turned onto the final approach course.

The Board recognizes that the VFR landing approach profile can and will vary depending upon the specific operational situation encountered. Since a rather wide downwind leg was flown by N1996 (4-1/2 miles from the runway) as compared to the training pattern downwind leg of 1-1/2 miles, proper technique would have dictated either: (1) remaining at or near the downwind leg altitude (1,100 feet a.f.l.) until much further along the base leg before starting the final descent, or (2) utilizing a considerably lower descent rate throughout the base leg, or (3) leveling off at and maintaining the circling minimum altitude of 600 feet a.f.l. until the aircraft had been turned onto final and a visual landing was assured, or (4) some combination of the single alternatives that would have assured proper terrain clearance. Because none of the above was accomplished and a descent was continued below field elevation it can only be concluded that the crew, possibly distracted by or preoccupied with the exigencies associated with continuing the visual approach into deteriorating weather conditions, did not give proper or sufficient attention to the primary altitude reference instruments during the approach.

It is difficult to reconcile how two experienced captains could spend almost two minutes descending below 1,200 feet a.f.l., at night, under adverse weather conditions and not properly monitor altitude. Even if both pilots were primarily concerned with maintaining visual contact with the airport it would be logical to assume that an occasional cross-check of the flight instruments would be conducted by one or both pilots.

It is therefore not reasonable to believe that the failure to properly monitor the altimeters and the continued unchecked descent can be attributed to one or two factors, but is more properly enveloped within a number of significant, complex, and highly inter-related conditions. The following are considered to be the most prominent, consequential areas and although discussed individually must be evaluated within the frame work of their total effect upon the crew's conduct of the approach:

Deteriorating Visibility Conditions

Prior to commencing the turn onto the base leg better than VFR conditions existed along the aircraft's flightpath. After the turn onto the base leg the flight began to encounter light rain showers and scud clouds which rapidly reduced inflight visibility. In order to maintain VFR conditions and remain clear of these clouds it may have been necessary for the flight to initiate a descent from the downwind leg altitude. As the flight progressed along the base leg rain shower activity became increasingly heavy with inflight visibilities dropping to two miles or less. Towards the latter part of the base leg most probably the only airport lights visible to the crew would have been the sequenced "flashers" associated with the approach lighting system. In view of the rapidly deteriorating visibility as well as the rain being reported at the airport it is likely that the pilots were concerned with and perhaps principally occupied in maintaining visual contact with the airport.

Terrain Features

It is noted that the particular terrain (see Attachment #1) in the vicinity of the aircraft's flightpath may well have provided the crew with an illusion of proper altitude or adequate terrain clearance. The Ohio River basin directly to the left of the flightpath is approximately 400 feet lower than the terrain directly under or to the right of the aircraft's flightpath. Also the terrain south of the river in the direction of the airport is featured by a wooded unlighted hillside which rises steeply from the river to the approximate elevation of the airport. Except for the lights of residences located near the riverbank there are no lights which would provide terrain definition. At night under poor visibility conditions it is quite conceivable that the elevation of the lights in the river valley could be associated with the elevation of the terrain in the vicinity of the airport.

It should be remembered that at all times after turning onto the base leg, and throughout the descent, the airport remained well to the left side of the aircraft. In order to keep the airport in sight all observations by the pilots would have been to the left of the aircraft through the left side cockpit windshield or left side window. Then, the only lights visible to them would have been the ground lights along the riverbank which could have provided the pilots with a sensory illusion of adequate altitude over the immediate terrain.

It is realized that both pilots should have been familiar with all aspects of the terrain having flown into and out of the Greater Cincinnati Airport many times previously. However, at night in limited visibility conditions it is possible that the terrain, as viewed by the pilots, would not have triggered any immediate awareness of low altitude. Conversely, it is believed if the ground lights directly under or to the right of the aircraft's base leg flightpath had been observed an immediate low altitude situation would have become apparent to the pilots.

Misreading/Misinterpretation of Altimeter Presentations

Examination of the pilot's and copilot's altimeters revealed no evidence of any pre-impact failure or malfunction and both were set properly to indicate altitude above field elevation. The functional capabilities of the No. 3 altimeter could not be determined because of extensive impact damage to this instrument. However, based on the fact that the last ATC clearance altitude of 2,000 feet m.s.l. was maintained for approximately two minutes on the downwind leg prior to the initiation of the descent, it is believed that this altimeter was properly set and functioning normally throughout the approach.

All events leading up to impact, including the final radio transmissions from the flight, indicate that the crew was not concerned with and totally unaware of a dangerously low altitude situation. In examining the many potential ramifications involved in the aircraft's deviation from the desired altitude profile one obvious possibility is a misinterpretation or misreading of the information being presented on the altimeters. It is noted that the drum altimeter has been in operation for many years and is considered by all segments of the industry to be an accurate, highly reliable instrument. While the Board has no reason to believe the drum altimeter is deficient in any way whatsoever, it does believe that improper monitoring of the instrument could possibly result in a misinterpretation, and this in turn could help to explain the inappropriate descent involved in this accident.

It can be seen that in reading this altimeter the pilot must first look at the number below the index on the "drum" to identify the thousand-foot level, and then to the radial pointer to determine the hundred feet indication. Two separate readings are required to assess altitude. At stabilized altitudes, or at low rates of climb/descent where the drum is moving slowly or not at all, the pilot must be certain to associate the proper thousand feet indication in relationship to the hundred feet reading. For example, an altimeter presentation of 900 feet would show the "1" (thousand feet) slightly above the thousand feet (drum) index and the "zero" below the index. The radial pointer would be pointing to the nine on the outside dial. A misinterpretation could occur if a pilot mistakenly associates the radial pointer reading with the "1" slightly above the index rather than the "zero" below the index for the thousand feet indication. The result would be a reading of 1,900 feet rather than the 900 feet actually portrayed - or, an error of 1,000 feet. It was also noted that AA altimeters have a crosshatched band adjacent to the numbers from plus 1,000 feet to minus 1,500 feet as a means of emphasizing these lower altitude values. In a descending situation to below zero elevation the radial pointer, rotating counterclockwise, does not point to the actual hundreds of feet below zero. For instance, 100 feet below zero elevation would be portrayed with the radial pointer on the outside dial nine and with the zero on the drum slightly above the index. This requires the pilot to interpret the nine hundred feet indicator as actually meaning 100 feet below zero. Additionally, when reading negative values the number above the drum index rather than the number below the index gives the correct thousand feet determination. In other words the drum presentation and reading reverses at below zero altitudes.

It is realized that in these cases or in any altitude presentation a pilot knowledgeable in the altimeter should have no problem whatsoever in quickly determining the correct altitude reading. However, it can also be seen that under certain conditions compounded by infrequent, fragmented, or distracted monitoring, a misreading/misinterpretation of altitude could occur.

Cockpit Workload

Another factor which must be considered in completely evaluating the apparent improper monitoring of altitude is the cockpit workload and crew coordination involved in this approach. It was shown that higher than normal airspeeds were maintained by the aircraft throughout most of the approach and that flap extension sequencing was concentrated on the base leg. As late as the turn to the final approach course, 2-1/2 miles from the runway, only 25 degrees (approach) flaps had been extended. In accordance with recommended operating procedures, the completion of this turn to final would have required the aircraft to be in a landing configuration, with airspeed and rate of descent stabilized at or near appropriate values. However, it can be seen that even in the later phases of the turn the airspeed was still above 40-degree (landing) flap extension speed, the landing gear had not been extended, and the landing checklist obviously was not completed. Because of the number of essential landing items still incomplete this late in the approach there can be little doubt that the cockpit crew would have been extremely busy at this time and more than likely throughout most of the base leg.

Consideration must be given to the fact that these two qualified B-727 captains had flown together on seven previous flights, knew each other well, and most probably had established a high degree of reliance on one another's operational capabilities.

It is possible that the check captain, confident in the other pilot's ability to operate the aircraft safely, would assume that the altimeters and other flight instruments were being monitored and could therefore concentrate on maintaining visual contact with the airport. Moreover, it is possible that the captain being observed was secure in the knowledge that a well qualified check captain was in the right seat performing copilot duties. He could therefore in view of the rapidly decreasing visibility, concentrate on keeping the airport in sight, depending upon visual reference to ground lights for altitude guidance, with the assurance that the check captain was monitoring the flight instruments and would alert him to any unusual contingency.

American Airlines operational procedures require that the pilot not making the landing call out the airspeed, altitude, and rate of descent at 500 feet a.f.l., and also the rate of descent any time it exceeds 700 feet per minute below an altitude of 500 feet a.f.l. The flight recorder readout shows that at 1900:45, about 42 seconds before ground impact, the aircraft was descending through 500 feet a.f.l. near the midpoint of the base leg and that the rates of descent remained in excess of 700 feet per minute throughout the remainder of the approach. It is evident that either the AA altimeter monitoring procedures were not being followed or that a misreading/misinterpretation of the altimeter occurred which indicated higher values to the check captain (pilot not making the landing). It should be noted that if the check captain was concentrating on maintaining visual contact with the airport the limits of his line of vision would have been between 80 and 45 degrees left of dead ahead. It can be seen that with his heavy workload; extending flaps, performing the landing checklist, making all radio transmissions, and trying to keep the field in sight, he would have had little time to swing his gaze back to his own instrument panel on the right side of the cockpit. It would be more probable that with the captain's altimeter almost in his line of vision with the field and set at a corresponding QFE value as his own, he would have if at all, used this instrument for altitude reference. Aside from, but compounded with any other altimeter misread/misinterpret possibility, the probability for error is enhanced when reading the instrument from a side angle which in this case would have been approximately 55 degrees left of forward. It is doubtful that the center (No. 3) altimeter would have been used on the approach as it would not have been indicating absolute altitude over the airport as were the Nos. 1 and 2 altimeters.

It is reasonable to assume that the flight engineer would have been engaged in duties attendant to completing the landing checklist and would not have had time to devote his full attention to the monitoring of flight instruments during the descent along the base leg.

With respect to crew coordination it appears significant that the entire flight was conducted in a manner that would expedite the arrival and approach into the Cincinnati Airport. A brief review of the operational phases of the flight shows that; (1) en route clearance changes were obtained which provided direct and shorter routings to Cincinnati, (2) the average ground speed within the terminal area (between 30 miles and 6 miles of the airport) was in excess of 325 knots, a departure from FAR 91.85(c)(1) which restricts terminal area speed to 250 knots IAS within 30 miles of destination below 10,000 feet m.s.l., and (3) despite the forecast for, and observation of approaching adverse weather, the flight elected to conduct a visual approach rather than utilize standard instrument approach procedures.

These phases of the flight do not, nor are they meant to, suggest any hazardous operational practices but they do indicate operational decisions pointed toward arriving at the Cincinnati Airport in the shortest possible time. It is strongly believed that the pilot being observed would normally be more inclined to maintain airway routings, more closely comply with terminal area speed restrictions, and conduct an instrument approach to the field, unless action to the contrary was being suggested or decided upon by the check captain. Further, decisions or suggestions of this nature would tend to indicate to the pilot being observed that all operational aspects of the flight were being closely monitored and would strengthen any possible over reliance situation of one pilot on the other which may have developed in the cockpit. Again, it is realized that this situation alone should not have precluded proper monitoring of aircraft altitude and can only be considered as a possible contributing factor to the apparent inattention to flight instruments.

It was noted that at 1901:14 in response to an inquiry from the tower if they still had the field in sight the flight replied, "just barely we'll pick-up the ILS here." Although one of the control heads on the radio frequency selector control panel was found set at the approximate Cincinnati ILS frequency it could not be determined if the ILS had been tuned in throughout the approach or if it had been selected at the time of the above transmission. In either event, a full "fly-up" indication should have been displayed on the glide slope indicator at this point which if observed by the pilots could have alerted them to the low altitude situation or at least could have provided the stimulus for an altimeter cross-check.

It can not be determined to what extent the lightning flashes associated with the storm would have affected cockpit visibility or otherwise distracted the crew or, if the windshield rain repellent had been initially actuated in the light rain showers and had possibly deterred forward visibility. These and other indeterminable factors may or may not have presented additional distractions to the crew but must be considered in the final evaluation. It is clear, however, that a rapidly deteriorating visibility situation and increasingly heavy cockpit workload compounded with all or any combination of the other influencing conditions may have distracted from the full attentiveness to flight instruments and the proper monitoring of the aircraft's altitude.

Review of B-727 Design as Related to Accident Events

The Board would be remiss if it did not take cognizance of the concern that existed in the minds of many elements of the aviation community and traveling public regarding the three Boeing 727 fatal accidents that occurred within a short period of time. As indicated earlier in the factual portion of the report the B-727 flight characteristics were not a factor in the cause of this accident. Moreover, the pilot groups have indicated that in general the Boeing 727 is a reliable, versatile, and highly responsive aircraft and that no major difficulties are being experienced in actual line operations.

Yet, the Board's investigation did uncover certain aspects of operating practices in the Boeing 727 that warrant industry attention in the interest of preventing future accidents. It was noted in the NASA-VGH studies that close-in, high descent-rate, unstabilized approaches are being conducted more often in the 727 than in any of the other jet transports studied. Why this is true is not evident from the preliminary review and any realistic evaluation will have to await a final NASA report on this matter. However, from an analytical viewpoint it can be seen that the principal application of this aircraft has been geared to a short/medium haul of "up-down" type operation as compared to the longer range (time-at-cruise) type operation of the older and larger jet transports. It may be that the very nature of this (short range) operation is engendering deviations from the hitherto standard jet operating principles. Also, consideration must be given to the fact that the 727 <u>does have</u> highly responsive and versatile flight characteristics and that these favorable characteristics may be misleading to the pilot, or are presenting the impression that greater liberties may be taken with the aircraft in normal operating situations, especially in the approach/landing regimes. It should be stressed that because of the high drag characteristics of the aircraft in the 40-degree flap configuration, high descent rates and airspeed reduction, in response to decreased thrust, can develop more rapidly than in the less sophisticated models and that this flight regime should be avoided close to the ground. It was noted that most of the 727 operators have included in their flight manuals information concerning the avoidance of high descent rates during the landing approach and also, that the FAA has instituted a requirement for the demonstration of a low altitude high descent rate maneuver as part of the air carrier training programs.

The Board does not know which of the above-described factors ("up-down" type operation, sophisticated-responsive aircraft) is causing the results indicated in the NASA-VGH studies, or if some combination of these factors is involved. However, the Board believes it is of sufficient importance to warrant a thorough review by industry to resolve this matter.

2.2 Conclusions

The entire investigation and in particular the specific examination of the Boeing 727 flight performance and characteristics revealed no design deficiencies or unsatisfactory operating characteristics. Furthermore, the latter review of the aircraft design aspects uncovered no factors that would have had a significant effect on the events leading up to this accident.

It is concluded that the 20-minute delay incurred by the flight in departing LaGuardia, combined with the forecast and inflight observations of thunderstorm activity in the Cincinnati area, prompted the crew to conduct the flight in a manner so as to greatly expedite their arrival at the Cincinnati Airport. Once in the Cincinnati area there can be no doubt that the crew was aware of the rapidly deteriorating weather situation both through visual observations and radio communications with the tower as they proceeded on the downwind and base legs. In view of the total weather picture known to the pilots and despite the fact that VFR conditions existed at the airport, it is believed that a more prudent judgment would have been either for the flight to have conducted an instrument approach, or to have delayed the approach until the storm had moved beyond the airport.

It is further concluded that after the flight turned onto the base leg inflight visibility was sharply reduced and that both pilots became preoccupied in maintaining visual contact with the runway, resulting in inattention to, and improper monitoring of, the altitude reference instruments.

The last point at which this accident could have been averted was approximately 13 seconds prior to impact. At this time the aircraft was descending below the level of the airport and any visual contact with the field or approach lights would have been lost immediately. The flight then should have, and could have accomplished a pull-up and go-around within the operating capabilities of the aircraft. However, at that point, as previously stated in the analysis, the accumulation of many factors either delayed or precluded proper recognition of the situation.

Regardless of the possible mitigating circumstances there can be no valid excuse for such a gross deviation from safe operating altitude as was presented in this accident. The approach procedures outlined in the carrier's manuals, the number of cockpit altitude reference instruments and related monitoring procedures, the approach aids available, and the skills expected of airline pilot, are all protective devices designed to prevent the development of such a situation. However, it is apparent that these devices were not fully utilized in the conduct of this approach.

While the circumstances and conditions of this accident are greatly different from those involved in another Boeing 727 accident which occurred at Salt Lake City, Utah, and for which the Board has already issued a report, there are some elements in common relative to pilot/crew judgment. For this reason the Board must re-emphasize that the responsibility and authority committed to an airline captain requires the exercise of sound judgment and strict adherence to prescribed practices and procedures. Any deviation can only result in a compromise of aviation safety. Airline management, too, has a heavy responsibility for devising, developing, and implementing methods and procedures designed to insure that all of their pilot personnel constantly exercise a conservative, prudent, approach to their daily work.

Probable Cause

The Board determines that the probable cause of this accident was the failure of the crew to properly monitor the altimeters during a visual approach into deteriorating visibility conditions.

3. RECOMMENDATIONS

The Board is aware of industry studies now under consideration pertaining to altitude reference instrumentation and cockpit instrument display. Included in these programs is the development of aural and visual low altitude warning features that can be incorporated into the aircraft altimetry system. Although no deficiencies have been found in the instrumentation presently employed in commercial transport operation; the Board believes that continued developments and improvements along these lines will certainly add to a greater margin of aviation safety.

It is also recognized that high performance aircraft operations are becoming increasingly complex especially in the critical flight regimes such as takeoff, approach, and landing. The Board therefore encourages acceleration of the programs designed to improve data presentation.

BY THE CIVIL AERONAUTICS BOARD:

/s/ CHARLES S. MURPHY
Chairman

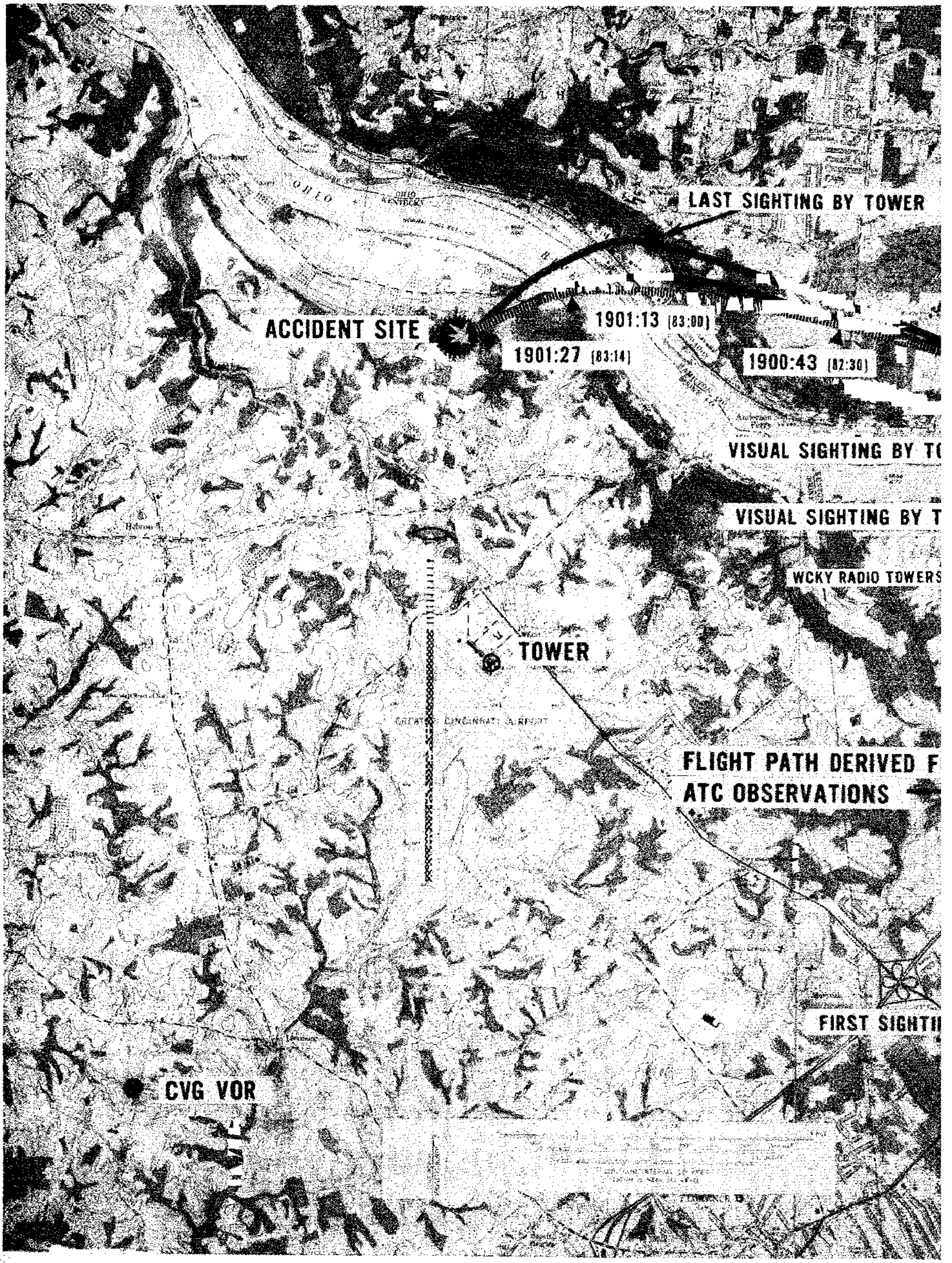
/s/ ROBERT T. MURPHY
Vice Chairman

/s/ G. JOSEPH MINETTI
Member

/s/ WHITNEY GILLILLAND
Member

/s/ JOHN G. ADAMS
Member

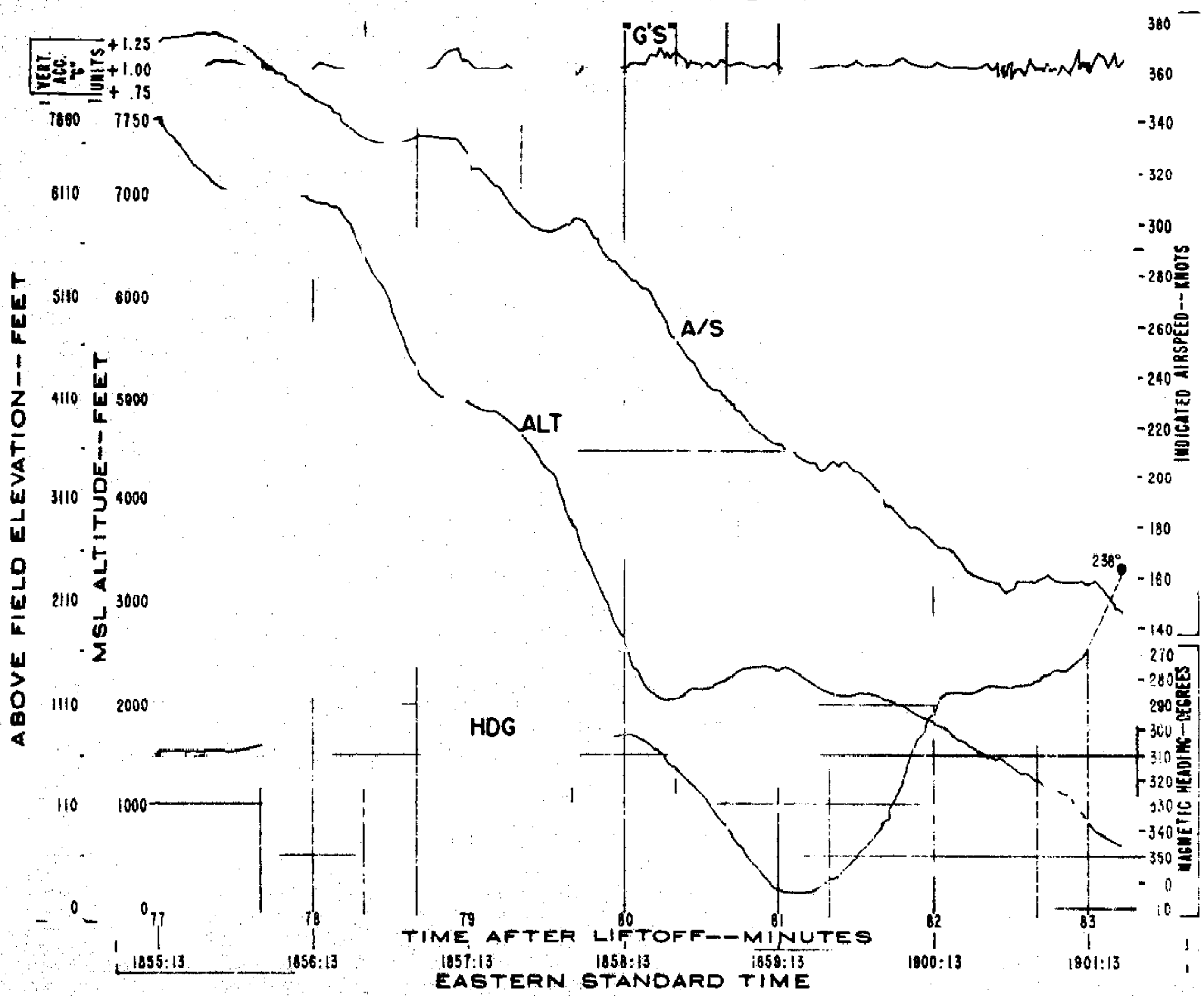

ATTACHMENT 1
COMPOSITE FLIGHT TRACK
AMERICAN AIRLINES
BOEING 727, N1996
NOVEMBER 8, 1965
Civil Aeronautics Board
Bureau of Safety
1900:13
FLIGHT PATH DERIVED FROM
FLIGHT RECORDER READOUT DATA
1859:43
FLIGHT PATH DERIVED FROM
WITNESS OBSERVATIONS
1859:13
TOWER
1858:43



LAST SIGHTING BY TOWER
ACCIDENT SITE
1901:13 (83:00)
1901:27 (83:14)
1900:43 (82:30)
VISUAL SIGHTING BY T
VISUAL SIGHTING BY T
WCKY RADIO TOWERS
TOWER
FLIGHT PATH DERIVED F
ATC OBSERVATIONS
FIRST SIGHTI
CVG VOR

ATTACHMENT 2

FLIGHT RECORDER DATA



CIVIL AERONAUTICS BOARD
BUREAU OF SAFETY
WASHINGTON, D.C.

AAL BOEING 727 N1996
NEAR GREATER
CINCINNATI AIRPORT
FLT. NO. 383
NOVEMBER 8, 1965

FLIGHT RECORDER DATA GRAPH
UDC MODEL F542 S/N 1395

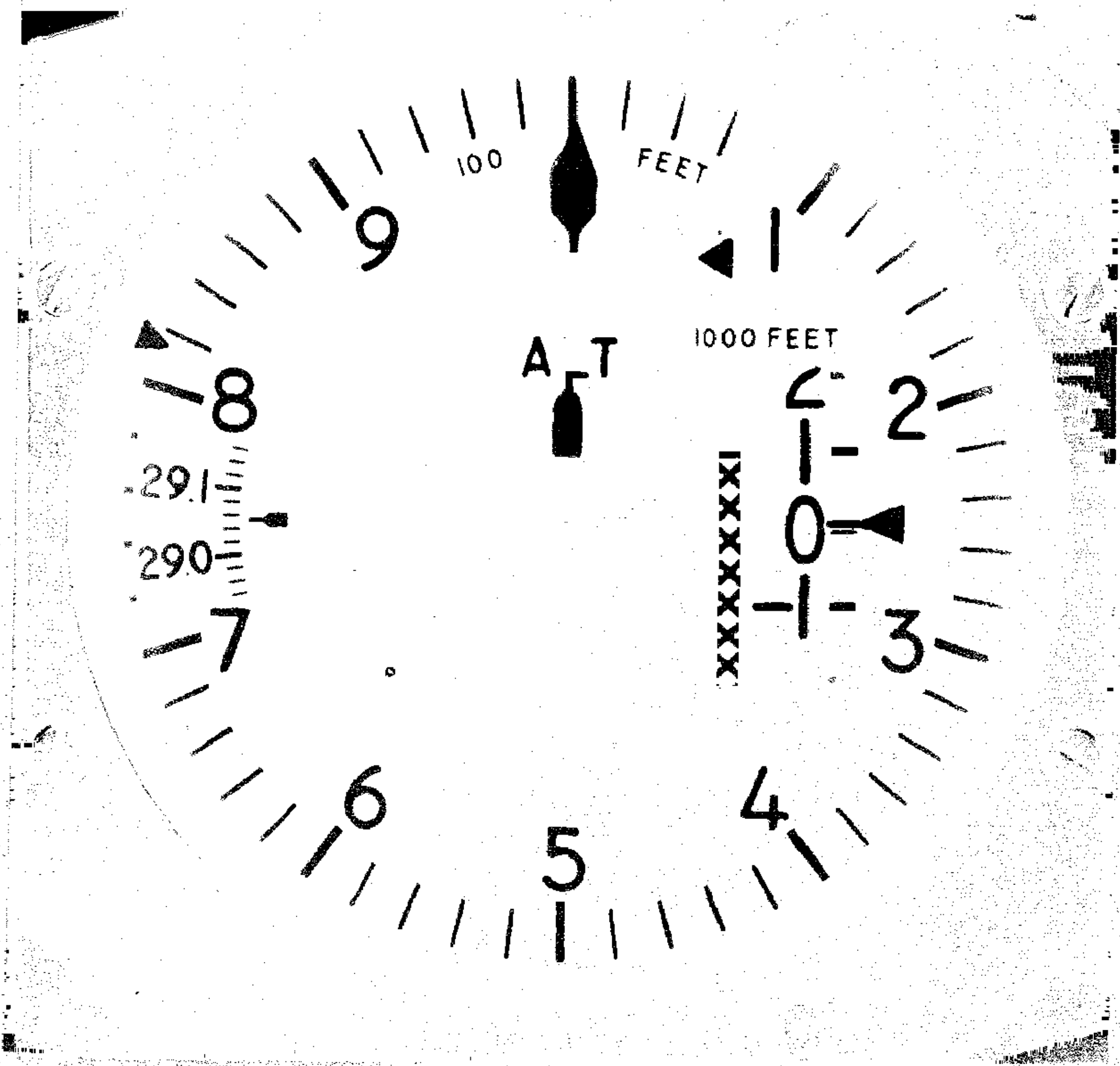
Note. Heading Parameter unreadable beyond 82.59 minutes due to aberrant area on tape except for data point at 83:14. Trace shown dotted between last readable points.

ATTACHMEN

CIVIL AERONAUTICS BOARD

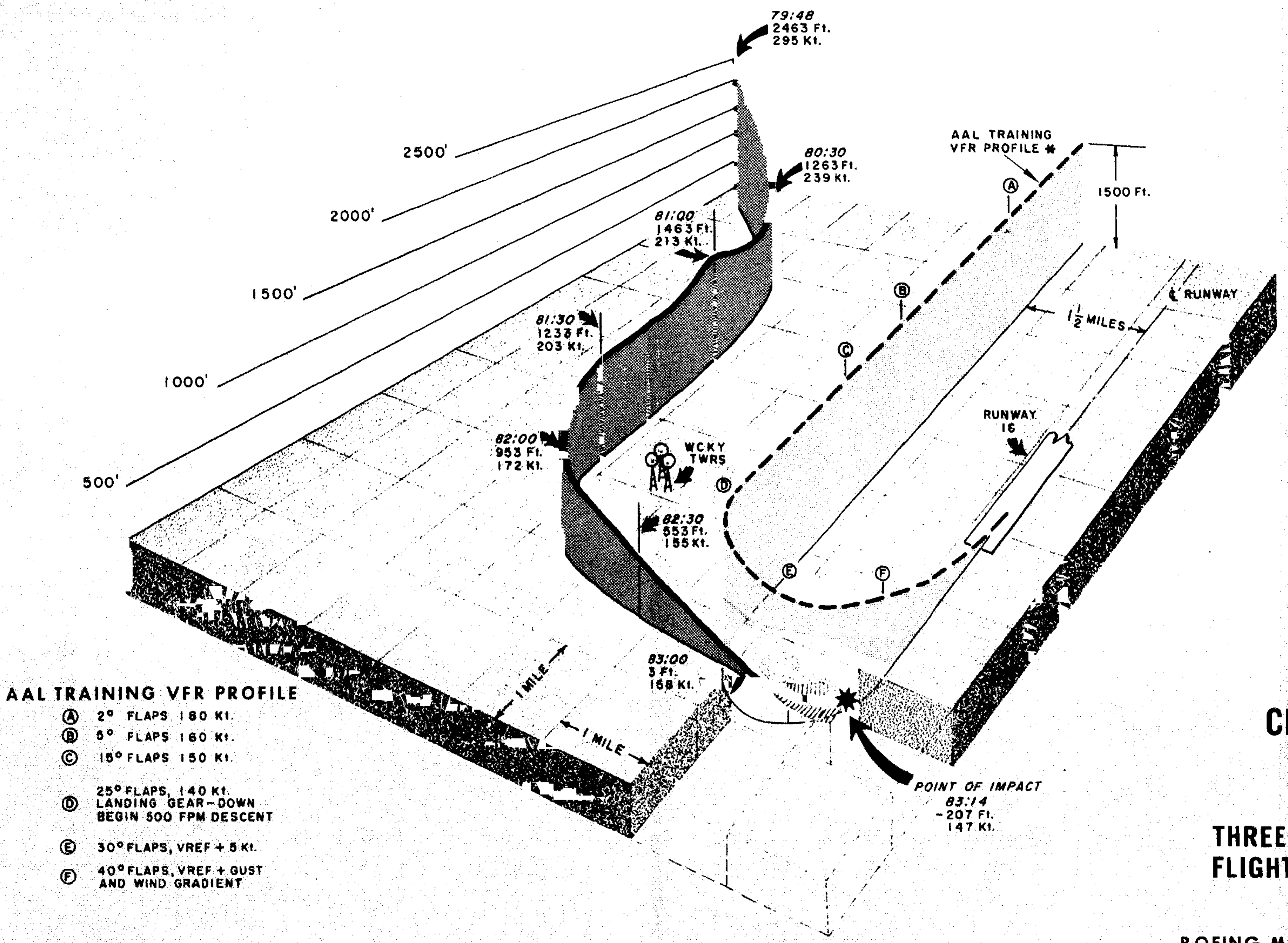
BUREAU OF SAFETY
WASHINGTON, D.C.

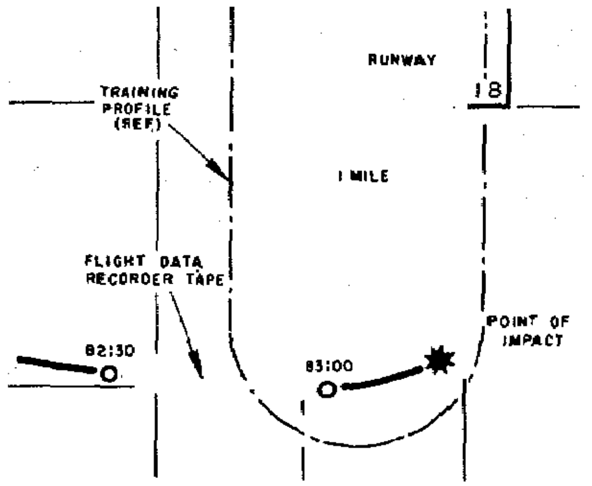
KOLLSMAN ALTIMETER



AAL BOEING 727 N1996
NEAR GREATER CINCINNATI AIRPORT

FLT NO. 383 NOVEMBER 8, 1965





PLAN VIEW OF LAST MINUTES OF FLIGHT

NOTES

- *ALL SCALES APPROXIMATE*
- *ALL ALTITUDES SHOWN RELATIVE TO RUNWAY THRESHOLD ELEVATION OF 872 Ft.*
- *TIMES SHOWN RELATE TO ELAPSED TIME IN MINUTES FROM LAST TAKEOFF*

*AAL TRAINING VFR PROFILE SHOWN FOR REFERENCE ONLY

CIVIL AERONAUTICS BOARD
BUREAU OF SAFETY
Washington, D.C.

THREE DIMENSIONAL CHART OF FLIGHT 383 FLIGHT PATH BASED ON INFORMATION FROM FLIGHT DATA RECORDER

BOEING MODEL 727, N1996, AMERICAN AIRLINES, INC.
GREATER CINCINNATI AIRPORT, NEAR CONSTANCE, KENTUCKY
NOVEMBER 8, 1965

6-1-66