DESCENT INTO THE VALLEY OF DEATH

It is 25 years since investigators reported on the crash of American Airlines Flight 383. Macarthur Job reviews the accident's significance.

American Airlines' Flight 383 from New York to Cincinnati on the evening of November 8, 1965, was to be one more step in the acting captain's upgrade to jet command.

At their planned cruising level of 35,000 ft, the flight crew expected to be on top of the weather until descent into Cincinnati. The terminal forecast was for: "Ceiling 1,200 ft broken, 3,500 ft overcast, visibility four miles, light rain, fog. Variable to 1,000 ft overcast, visibility 2 miles, thunderstorms, moderate rain".

After a 20-minute delay, Boeing 727-123 N1996 taxied out. With the trainee captain in nominal command, the check captain was carrying out the duties of first officer.

The flight at 35,000 ft was uneventful, and at 6.45pm, the crew called Cincinnati to report their ETA was 1905 hours. They were told that the QNH was 30.01 inches, with the airport barometric setting (QFE) 815 ft "above". (American Airlines set both pilots' altimeters to the airport QFE, while leaving the centre altimeter on the QNH.) Ten minutes later, communication was transferred to Cincinnati approach. The weather was clear to the east and north-east of the airport, but cloud, with some lightning, lay to the north-west.

Shortly afterwards the crew reported: "Out of 5,000 for 4,000 [ft], how about a control VFR? We have the airport in sight."

Approach Controller: "Cleared for a visual approach to Runway 18, precip lying just to the west of the airport and it's southbound."

Three minutes later, when the Boeing was 6 nautical miles out, the approach controller instructed the aircraft crew to contact Cincinnati Tower.

Tower: "Runway 18, wind 230 degrees, 5 kt, altimeter 30."

Aircraft: "Roger, Runway 18."

Tower: "Have you in sight — cleared to land."

Aircraft: "We're cleared to land, roger. How far west is that precip line now?"

Tower: "Looks like it's just about over field at this time, sir. We're not getting anything on the field however. If we have a windshift, I'll keep you advised as you turn on to final."

Aircraft: "Thank you — we'd appreciate it."

Tower (10 seconds later): "We're beginning to pick up a little rain right now."

Aircraft: "OK".

Tower (one minute later): "Have you still got the runway OK?"

Aircraft: "Ah ... just barely ... we'll pick up the ILS here."

Tower: "Approach lights, flashers and runway lights are all on high intensity."

Aircraft: "OK."

Five seconds later, apparently under full control, the Boeing flew into the wooded slopes of the Ohio River valley, 3 km north of the runway threshold.

Cutting a swathe through foliage and scrub, it collided violently with a stand of trees, exploded into flame and burnt to destruction. One stewardess and three passengers – one a pilot – were the only survivors of the 62 on board.

Investigation: Examination of the wreckage established that the aircraft was on a heading of 235 degrees in a level attitude, but 225 ft below the level of the airport it hit the side of the Ohio River valley.

There was no evidence of any mechanical malfunction.

Of the four survivors, only the company pilot could recall any details of the accident. Seated at the front on the starboard side, he believed the flight from LaGuardia was normal in every way.

But the descent into Cincinnati seemed fast, with the lights of the city visible to the north after the aircraft levelled out. He could also see reflections from the airport approach lighting on scud clouds below the aircraft. The next time he looked out, "it seemed like we were very low ... we had started another left turn and we were in a 10 to 15 degree bank."

Next he heard the flaps being actuated again; immediately afterwards they crashed.

The approach controller said areas of rain were visible on his radar screen as the Boeing was approaching the airport. The heaviest was to the west, moving southwards, with lighter areas to the north and north-west. When he last observed the Boeing on radar it was 2 nm to the north-east, at the leading edge of the lighter area of rain.

A witness in the river valley watched the Boeing's last 10 seconds of flight. He saw its landing lights coming towards him, before it banked to the left and crashed violently into the valley's southern slopes.

The Boeing was not equipped with a cockpit voice recorder, but a read-out its four-trace flight data recorder (FDR) produced a ground track and rapid descent profile consistent with the witness evidence.

The FDR showed a continuous descent from 7,000 to 2,000 ft, with the airspeed progressively reducing from 350 to 250 kt and a descent rate of around 3000 ft per minute. At 2,000 ft (1,100 ft above airport elevation), the Boeing levelled off, turned on to a downwind leg, and remained at this altitude while the airspeed bled off to 190 kt. It then entered a gentle left turn on to base leg and began descending again at about 800 fpm, with the airspeed gradually decreasing to 160 kt.

Half a minute before impact, the Boeing began another left turn on to final approach. Ten seconds afterwards the descent rate increased again to just over 2,000 fpm and the aircraft descended below the level of the airport into the Ohio River valley. During the final 10 seconds, the descent rate decreased to 625 fpm and the airspeed to 147 kt.

The investigators believed the accident was related to the way the crew conducted the approach. The Boeing entered the traffic pattern at 210 kt with the spoilers retracted and 2 degrees of flap extended. The airspeed decreased as it began its turn on to base leg, and the flaps were extended to 5 degrees at 170 kt. Midway along base leg, the crew selected 15 degrees of flap, and as they turned on to final, increased this to 25 degrees.

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The flap extensions, though conforming to company-stipulated speeds, were "bunched up" because of the excessive approach airspeed. Except at the beginning of base leg, the crew succeeded in reducing the airspeed to successive flap extension figures only by conducting the entire descent at or near idle engine thrust.

With the aircraft slowed and the correct degree of flap extended, it would have been possible to use higher thrust settings, allowing the approach to be controlled with greater precision, and the landing checklist completed without haste. As it was, a number of configuration changes, including lowering the undercarriage, still remained when the aircraft was turning on to final.

The investigators found it difficult to understand how two such highly experienced pilots could spend almost 2 minutes descending from only 1,200 ft above the airport at night in adverse weather, while not monitoring their altitude. Perhaps, preoccupied with expediting the approach in the face of deteriorating visibility, neither gave due attention to altimeter readings.

Yet, given the standing of both pilots, this explanation seemed inadequate. Rather, the true cause of the accident appeared to lie with several complex, closely-related factors that developed during the approach.

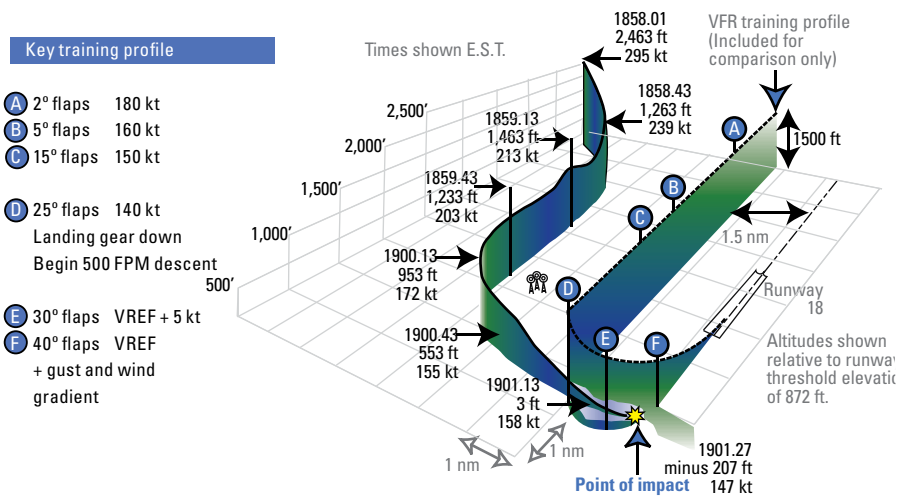
Before the Boeing turned on to base leg, better than VFR conditions existed along the flight path. But after making this left turn, the crew would have encountered light rain and low scud, rapidly reducing visibility. To maintain visual conditions, they might have had to descend from the altitude at which they planned to fly the leg.

Further along base leg, when the rain became heavier, the sequenced "flashes" of the approach lighting system would probably have been the only airport lights still visible and, to keep these in sight, the pilots would have been looking out to the left of the aircraft.

But at this stage of the approach, the Ohio River valley also lay just to their left, and in the poor visibility, the lights of houses on the river bank, 400 ft below the level of the airport, could have conveyed an illusion of adequate height above the runway.

Altimeters: Another possible factor could have been altimeter misinterpretation. On the Kollsman drum-pointer altimeters fitted to the Boeing 727, hundreds of feet are

Kollmans altimeter



Descent into Cincinatti: The sequence of events

indicated by a single radial pointer. But thousands of feet are shown on a rotating drum, the relevant portion of which is viewed, like the barometric subscale, through a "window" in the face of the dial. (a cross-hatched marking on the drum emphasises the significance of indications less than 1000 ft).

The number below the drum index is read for the thousand foot indication, and the radial pointer for hundreds of feet. At constant altitudes or low rates of climb or descent when the drum is almost stationary, care is required to associate the correct thousands reading with the hundreds reading. For example, a reading of 900 ft would show "1" slightly above the drum index (with the "0" below the index), while the radial pointer would indicate "9" on the dial.

But in descending to a "below airport" elevation, as would have occurred on the QFE-set altimeters when the Boeing sank into the river valley, the radial pointer, rotating anticlockwise, would not point to the number of feet below.

Rather, a reading of 225 ft below zero (the level at which the aircraft crashed) would be displayed with the drum zero slightly *above* the index, and the radial pointer indicating immediately *below* the figure "8" (775 ft) on the dial. Thus, at negative values, the number above the drum index rather than the number below the index provides the thousands of ft reading. In other words, the drum presentation reverses at below zero readings.

Flight path of the doomed American Airlines flight 383

Under conditions of infrequent or distracted altitude monitoring, the investigators thought that a misinterpretation of the pilots' altimeter readings could have occurred.

Workload: According to company procedures, when the Boeing turned on to final approach, it should have been in the full landing configuration — undercarriage lowered, 40 degrees of flap extended, and airspeed and rate of descent stabilised.

American Airlines required the pilot not making the landing to call airspeed, altitude, and rate of descent when the aircraft descended to 500 ft above airport elevation. The rate of descent was to be called again if it exceeded 700 fpm.

The FDR showed that the Boeing descended through 500 ft on base leg 42 seconds before impact. The rate of descent remained in excess of 700 fpm throughout the remainder of the approach. So, either altimeter monitoring procedures were not being followed, or the crew misread the altimeters.

If the pilot not making the landing, (in this case the check captain), was concentrating on the approach lights out to the left of the aircraft, his field of view would have spanned 45-80 degrees of straight ahead. Under time pressure to extend the flaps, perform the landing, make radio transmissions, and keep the approach lights in sight, he would have had little opportunity to swing his gaze back to his instruments.

Rather, he would probably have referred to the captain-under-supervision's altimeter because it was in his line of vision and set to the same QFE. However, the possibility of error is increased when an instrument is read from a side angle.

Haste: The entire flight appeared to have been conducted to expedite the Boeing's arrival in the shortest possible time, prompted by the delay in departing New York, and by the crew's anxiety to beat the weather into Cincinnati.

The aircraft's average ground speed in the Cincinnati terminal area (within 30 nm of the airport) was in excess of 325 kt, in contravention of FAA regulations which limit terminal area airspeeds to 250 kt below 10,000 ft. In addition, despite the obviously deteriorating weather, the crew elected to make a visual rather than an instrument approach.

The haste to complete the flight could only be regarded as another factor contributing to the pilots' inattention to their instruments.

In concluding its report, the Civil Aeronautics Board re-emphasised that the responsibility and authority committed to airline captains required continual exercise of sound judgement and strict adherence to prescribed operational procedures. Airline management too, had a heavy responsibility for implementing practices that ensured crews constantly exercised a conservative and prudent approach to their daily work.

Subsequent studies of illusory effects produced by lights on the Ohio River bank, viewed in conjunction with the more distant but 400 ft higher runway lights, demonstrated that pilots approaching to land on this runway in limited visibility could receive visual cues that produced sensations of being much higher than their aircraft's actual altitude.

As a result of these and similar accidents elsewhere, dangerously misleading visual illusions of this type were publicised for the world airline industry in a paper produced by the Boeing Company, entitled *Night Visual Approaches to Lighted Sloping Terrain*.

The accident also drew attention to the danger of allowing high descent rates to develop at low altitudes in the newer, short haul domestic jet transports such as the Boeing 727 which, because of their need to make frequent landings, had more versatile flight characteristics than earlier, longer range jets. These could give pilots the impression that greater liberties could be taken with such aircraft.

However, because of the large amounts of flap available, high descent rates could develop which needed height and time to arrest. With full flap, the Boeing 727 required 47 per cent power simply to maintain a normal 3 degree approach glidepath. With engine power reduced to idle, it descended at more than 2,000 ft per minute, a rate impossible to check quickly.

These findings, together with the newly developed visual approach slope indicator systems (VASIS) being installed at major airports throughout the world, would subsequently do much to overcome the problem of undershoot accidents in heavy jets.

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