No. 17

KLM, Lockheed Electra L-188C, PH-LLM, accident near Cairo Airport, United Arab Republic on 12 June 1961. This summary is based on a translation of the report, dated 6 March 1963, of the Aircraft Accident Investigation Board The Netherlands.

Circumstances

Flight KL 823 departed Amsterdam at 1850 hours local time (11 June) on a scheduled air service to Cairo via Munich, Germany and Rome, Italy. It was then to continue to Kuala Lumpur via Karachi, Pakistan. Aboard were a crew of 7 and 29 passengers. During the approach to land at Cairo the aircraft crashed at 0411 hours local time (12 June) 4 km southeast of the threshold of runway 34 at a point 60 m above the level of the runway threshold. The aircraft was destroyed. Three crew members and seventeen passengers were killed in the accident, and four additional crew members and twelve passengers sustained injuries.

Investigation and Evidence

The Aircraft

By virtue of an American Certificate of Airworthiness for Export, a Netherlands Certificate of Validation, valid until 13 December 1961, was issued to the aircraft on 14 December 1960. It also had a valid maintenance release.

The Loading of the Aircraft

The take-off weight and centre of gravity of the aircraft were 45 310 kg and 24.8% of the mean aerodynamic chord, respectively. At the time of the accident the aircraft's total weight would have been 39 120 kg, and the centre of gravity at 22%, i.e. they were both well within the limits.

Crew information

The crew consisted of the pilot-in-command, a co-pilot, a flight engineer, a flight navigator/flight radio operator, a purser, steward and stewardess.

The pilot-in-command was acting in this capacity for the first time on the subject flight. He held a valid airline transport pilot's licence on which were entered ratings entitling him to act as pilot-in-command on Convair 340's and on the Electra. His flying experience amounted to 11 489 hours, 4 955 of which were as pilot-in-command. He had about 100 hours experience on the Electra L-188C, i.e. 87 hours as co-pilot, 6 hours of pilot-in-command training and 7 hours as pilot-in-command. Though the pilot-in-command had little experience on this type of aircraft and was acting as pilot-in-command on this type of aircraft for the first time, he should in view of his extensive airline transport piloting experience be considered sufficiently competent to execute the landing at Cairo safely.

The co-pilot had flown 3 821 hours in all, including 747 hours as co-pilot on the Lockheed L-188C.

Weather

The conditions at Cairo Airport at 0411 hours (the time of the accident) were as follows:

surface wind	330°/8 kt
visibility	10 km
clouds	4/8 stratocumulus
base of clouds	600 m
air pressure	1014.4 mb
temperature	20°C
weather conditions	favourable

Runway 34 - Cairo - Landing Chart

KLM Nav.11/5/60 (visual manoeuvring chart) concerns the visual approach procedure for runway 34.

The chart which was on board the aircraft contained the following information:

a) landing runway 34 is not equipped with special landing aids, e.g. ILS; the runway length is 2 500 m, the threshold is situated at an altitude of 333 ft (100 m); the runway has a downslope of 1.6%;

b) during the approach to runway 34 a right-hand circuit must be flown; the visual manoeuvring chart recommends that the downwind leg of the circuit be flown at 1 200 ft (365 m), that the descent be commenced during the right-hand turn and that a glide path of 3° be maintained during the final approach;

c) to the south of the airport the area slopes upwards in a series of sand dunes. On the chart the level is marked by lines indicating differences in height of 100 ft;

d) about 4-1/2 km from the beginning of runway 34, at an altitude of 636 ft (193 m), a red obstruction light has been placed on the ridge of a hill; this light is an occulting light and is of low intensity;

e) the aerodrome has been provided with the usual night lighting; only runway 23 is equipped with approach lighting.

A KLM Notam, dated 9 June 1961, promulgated the following information concerning runway 34 at Cairo:

"Runway 16/34 available length 2 500 m. Threshold runway 34 marked by gooseneck flares on each side and the first 500 m ICAO marked.

Take-off distance 8 200 ft, 1.6% downslope."

The pilot-in-command knew of this data. He also knew that instrument runway 05 was not in use because of repairs.

Reconstruction of the flight

The flight was uneventful until the approach at Cairo. The aircraft contacted Cairo Approach when about 35 NM out and was cleared to continue its descent to 610 m to the radio beacon near the airport. It also received the latest information on the air pressure (QNH 1014.6 mb), the prevailing surface wind (350°/6 kt) and the landing runway to be used (runway 34).

The captain had familiarized himself with the approach procedure as shown in the KLM route manual. He understood from the chart that a right-hand circuit had to be made.

He intended to fly to Cairo Range first and then to approach the airport along the southern leg of this beacon. As soon as the airport was sighted he would change his heading 45° to the left to enter the circuit, and would then carry out a normal right-hand circuit to runway 34 visually. He intended to maintain an altitude of 610 m (2 000 ft) during the flight on the downwind leg and on base leg until he had obtained visual contact with the runway. He would then reduce power and lower his landing gear to carry out a steep approach to the runway. He realized that the approach procedures would have to be carried out over an up-sloping hilly area and that when carrying out this left-hand turn to downwind leg he would, from his position in the left-hand seat, lose sight of the runway. Therefore, he would ask the co-pilot to tell him when the right-hand turn to the runway, following the downwind leg, would have to be started.

At 0409 hours (local time) the pilot reported that the aircraft had passed the range beacon at 610 m (2 000 ft). It probably passed it within one mile. The aircraft was then cleared for the approach procedure. The exact wording of the clearance is not known. The radio log-book entry reads: "you are cleared for a standard beacon approach runway 34". However, the air traffic controller on duty declared that the aircraft was cleared "for a visual contact approach".

At 610 m the aircraft was levelled at a speed of 150 - 160 kt; the engine power being about 1 000 hp per engine. Not until quite close to the airport and nearly over it did the captain see the airport lighting, and changed his heading about 40° to the left to make the right-hand circuit. Prior to passing the range beacon the wing flaps were put in the approach position at an altitude of about 1 830 m (6 000 ft). The aircraft then continued to fly horizontally following the new heading. The co-pilot was requested to "keep the runway in sight".

Applying normal procedure, the aircraft would enter the right-hand turn for the final approach about 30 seconds after passing the runway threshold. Although the captain knew from experience approximately when he would have to initiate the circuit he waited for a sign from his co-pilot.

In the meantime, at 0410 hours local time the co-pilot reported to the Cairo Tower that the aircraft was downwind. The tower gave the surface wind as 330°/8 kt and instructed the flight to report on final.

Shortly thereafter the pilot-in-command commenced the right-hand turn and before he sighted the runway, gave the order for the lowering of the landing gear and reduced the engine power to 100 - 200 hp per engine.

The aircraft struck the ground (at 0411 hours local time) and caught fire.

At the site of the accident

Pieces of wreckage were scattered over a distance of 360 m, over three hills and the valleys in between. The fuselage had fallen into three parts. An attempt was made to establish the positions and indications of the instruments, levers, switches and the controls. The readings of the power indicators and the damage to the propellers led to the conclusion that the engine power was low, i.e. probably less than 170 hp. Examination of the altimeters did not provide any definite conclusion as to their condition prior to impact. It was believed likely that they did function correctly at that time. The airspeed indicator on the left-hand instrument panel was still in good condition after the accident and functioned within the appropriate limits at the examination.

The right-hand circuit

As runway 34 was not equipped with radio navigation aids, a visual approach had to be made. It was a dark night and there were no means of orientation other than the airport lighting and the runway lighting. The red light, 4.5 km southeast of the runway was of too low an intensity to be considered reliable as a means of orientation.

The fact that the runway had to be approached in a right-hand circuit was a disadvantage to the pilot-in-command (in the left seat). The pilot had to rely on instruments until immediately before the end of the right-hand turn, i.e. the moment when he would get sight of the runway.

The pilot had instructed the co-pilot to "keep the runway in sight" and was positive in his statement that the co-pilot had indicated the moment when the right-hand turn should be commenced. This statement was not confirmed by the flight engineer nor by the flight navigator/flight radio operator.

Reconstruction of the flight path
(see Figures 5 and 6)

From the marks on the ground it was inferred that at impact the aircraft was on a 225° heading, the angle of bank was 22° and the ground speed was 159 kt. The flaps were in the approach position, and the landing gear was down. The wind was 330°/8 kt.

This data gives a flying speed and a heading at time of impact of 81 m/sec and 228° respectively. From the angle of bank at this flying speed follows a rate of turn of 2.80° per second, so that the duration of a turn of 180° was 64 seconds, which is in accordance with the duration of the normal

procedure, which takes 60 seconds. From the speed and the bank a radius of 1 650 m in front of the runway and in respect of the air can be inferred. Assuming that speed and bank were kept the same during the turn and taking due account of the wind, it follows from this radius, from the heading at the moment of impact, and from the probable point where the downwind leg of the circuit was commenced that on the track prior to the turn the track was 123° and the heading 122°. This heading differs 40° from the direction of runway 16, the opposite of runway 34, which concurs with the statement of the pilot-in-command that he changed his heading about 45° to the left, after he reached the airport.

The change of heading between the beginning of the circuit until the moment of the crash was 228° - 122° = 106°, at the rate of turn as reconstructed, reached in 38 seconds.

If the aircraft had not lost height, it would have come right in front of the runway when continuing the circuit. This shows that the pilot-in-command flew the circuit correctly.

The intended approach procedure

When planning the landing the pilot consulted KLM visual manoeuvring chart No. 11/5-60 which gives the following procedure as an example:

> "Downwind leg at an altitude of 1 200 ft (365 m) during 30 seconds after passing the runway threshold at a speed of 150 kt; descend to 700 ft (213 m) during the right-hand turn at a rate of descent of 152:60= 2.5 m per second; approach to the runway under an angle of 3°, at a rate of descent of 4 m/sec."

The pilot of PH-LLM intended to deviate from this example, because with the up-sloping area south of the runway, he preferred to fly at a greater altitude on the downwind leg. He intended to maintain an altitude of 2 000 ft (610 m) on the downwind leg and not to commence the descent before he had the runway in sight when turning and to then approach the runway in a steep descent. In the turn he would not be able to see the runway through the side windows because of the bank of the aircraft. He would only be able to have the runway in sight through the front windows when his heading would be about 280°; the runway would then be about 55° to the right of his heading.

Reconstruction of the flight path showed that at that time the aircraft would have been about 3.4 km from the runway threshold. Reckoning with the wind, it would have taken about 45 seconds to reach the runway threshold.

The pilot stated, during the investigation, that he had calculated that decreasing his engine power to between 100 and 200 hp per engine, he would have a speed descent of 2 000 fpm (10m/sec). Over the runway threshold, therefore, he would have lost about 450 m of height, and his altitude would then have been reduced to a good 150 m. The runway threshold is at an altitude of 333 ft (about 100 m). Also due to the fact that the steep flight path for the landing had to be completed it follows that a rate of descent higher than 10 m/sec would have been required during the first part of the final approach to be able to fly the aircraft over the runway threshold at an appropriate altitude.

This could have been achieved by fully lowering the wing flaps. A final approach thus executed, with a rate of descent of about 10 m/sec, deviated greatly from normal practice and also from the rate of descent of about 4 m/sec as recommended by the KLM manoeuvring chart. The Board wondered whether the pilot had realized that his intended procedure had to lead to a rate of descent which would be considerably higher than that which is usual for landings.

Actual final approach procedure

The pilot carried out the procedure in another way to that planned. At the time the aircraft contacted the ground it was at an altitude of 520 ft (158 m). It should

have been at an altitude of 2 000 ft (610 m). The landing gear had already been lowered, and the engine power had been reduced. From the statement of the flight engineer it appeared that before impact the pilot had reduced the engine power from 1 000 hp to between 100 and 200 hp per engine. The flight engineer was positive on this point because he had for some time been expecting to have to suppress a possible negative power. The aircraft's loss of height and the flight engineer's statement prove, undoubtedly, that the pilot deviated from his plan not to lower the landing gear nor to reduce power until he was in sight of the runway.

Trials were made with the Lockheed Electra at Schiphol Airport on 12 July 1961. The aircraft was loaded the same as the subject aircraft. The trials showed that with flaps in the approach position and the landing gear lowered, the rate of descent at an engine power of 100 hp and a designated speed of 160 kt in a right-hand turn and banks of 15°, 20° and 30° was 10.6 m/sec (between 2 000 and 2 200 fpm). This is a similar situation to that in which PH-LLM was at the time of the accident.

The difference in height between the aircraft's altitude on the downwind leg (2 000 ft) and that at the point of the crash (520 ft) is 450 m, so that it must have been descending for 42 seconds. As the turn took 38 seconds, it can be concluded that the power reduction and the lowering of the landing gear must have taken place about simultaneously with the initiating of the right-hand turn.

The pilot appears to have initiated *the steep descent about one minute before* the time he intended. He initiated the descent in accordance with the recommended procedure of the KLM manoeuvring chart but at a rate of descent in accord with his planned procedure which was 2.5 to 4 times the rate of descent of the procedure of the manoeuvring chart.

The discord between intention and execution did not make the collision unavoidable because the pilot, who was flying mainly IFR, should have been warned of the dangerous situation which was developing by reading the rate-of-descent indicator and more particularly the altimeter, so that he could have taken corrective action. The fact that he did not notice this warning indicates that he did not pay adequate attention to these instrument readings for more than half a minute and during a flight which he had to carry out mainly on instruments.

Considering the accuracy with which the circuit was flown, he would have paid due attention to the airspeed indicator and *the turn indicator.*

The neglect of the altimeter and the rate-of-descent indicator gives the impression that not only after the accident but also during the approach, the pilot was unaware that he had commenced the descent that steeply.

The fact that the descent was made over an up-sloping area cannot be considered as the direct cause of the accident.

If the accident area had been at the same altitude as the runway threshold the collision would have occurred 6 seconds later, the difference in altitude only being 187 ft (i.e. 57 m). The heading of the aircraft would then have been 245° so that the pilot-in-command would not have had sight of the runway either, and would not have had occasion to take corrective action during these six seconds.

Conclusions

The pilot-in-command deviated *without known reason from his intended approach* procedure, which included a steep descent. He actually commenced this descent one minute earlier than intended.

His intended approach procedure meant that a rate of descent of more than 10 m/sec had to be applied, which rate of descent is considerably higher than the usual one under normal circumstances and than the rate of descent recommended for

Cairo Airport on the KLM manoeuvring chart. The Board did not believe that a right-hand circuit carried out by a pilot in the left-hand seat was dangerous. This accident was not caused by this circumstance.

Probable Cause

The accident was caused by the pilot-in-command's inattention to his instruments.

Follow-up disciplinary action

The pilot-in-command sustained such injuries in this accident that it is assumed that he will not be able to act as a commercial pilot again. The seriousness of the mistake which was made and the grave consequences thereof have the inevitable result, however, that the pilot-in-command had to be punished disciplinarily. Therefore, his licence (entitling him to act as pilot-in-command of an aircraft) was withdrawn for a period of three months.

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KLM, ELECTRA, PH-LLM, 12/6/61

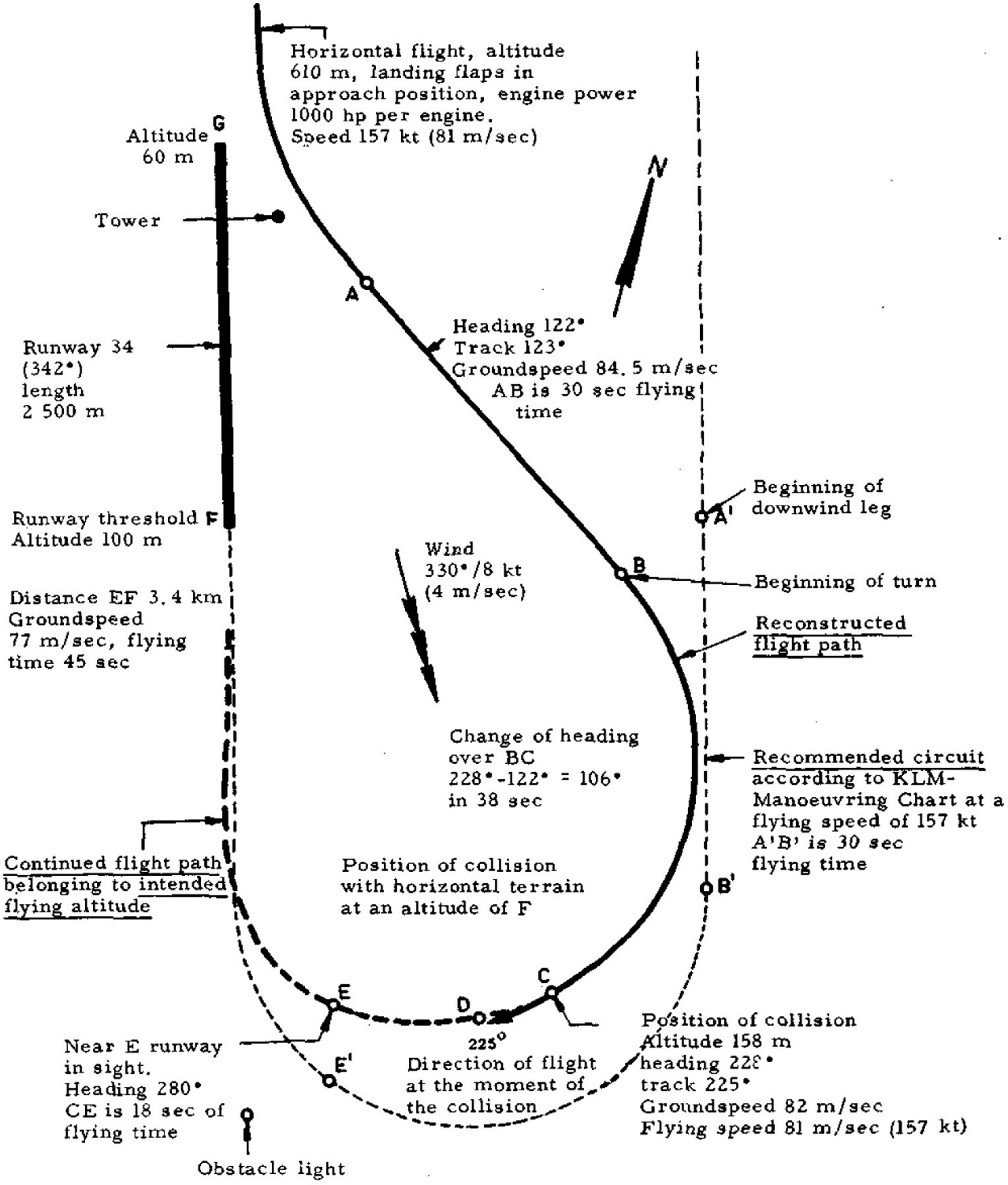

FIGURE 5

KLM, ELECTRA, PH-LLM, 12/6/61

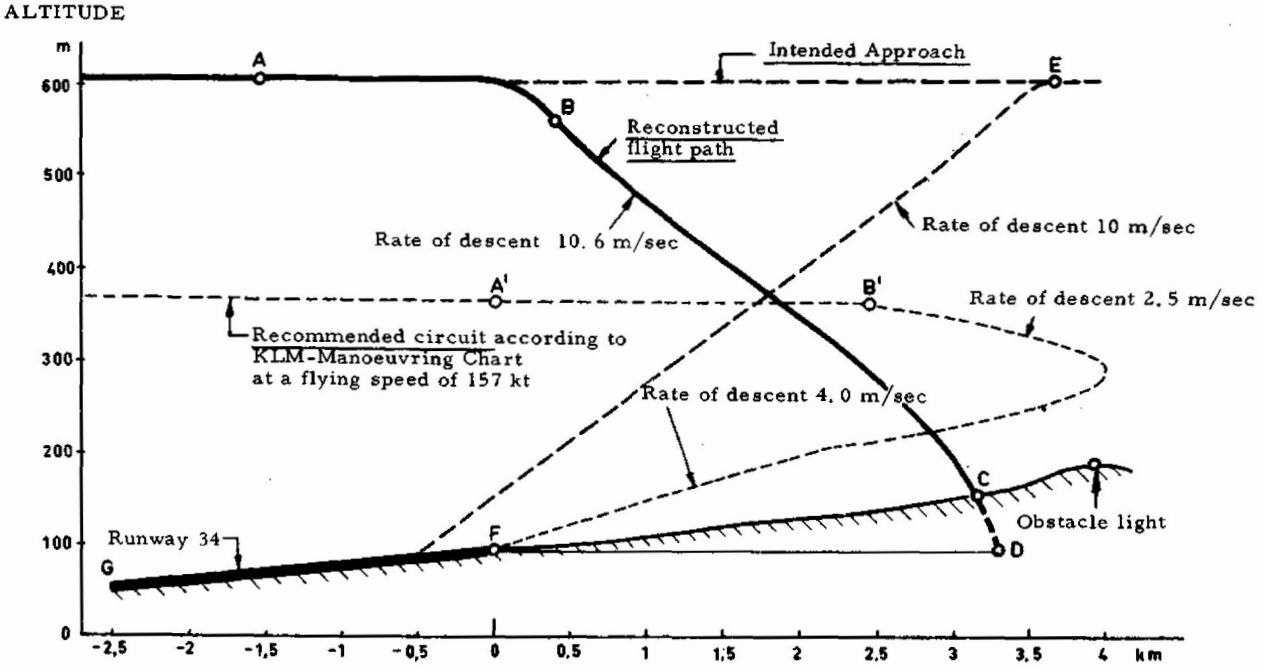

FIGURE 6