

No. 30

Britavia Limited, Hermes G-ALDJ, crashed while approaching to land
at Blackbushe Airport on 5 November 1956. Report by Ministry of
Transport and Civil Aviation (UK) C.A.P. 144

Circumstances

The aircraft was flying under charter to the Air Ministry and had flown from Idris Airport, Tripoli with a crew of 6 and 74 passengers, nearly all members of servicemen's families. Shortly before midnight, on landing at Blackbushe in poor visibility, the aircraft undershot the runway, hit a beech tree 3 617 feet short of the threshold, swung sharply to port, came down among pine trees about 3 000 feet from the beech tree and caught fire. Three crew members were killed by the impact and four children lost their lives due to fire.

Investigation and Evidence

The aircraft left Blackbushe at 0130 hours Greenwich Mean Time on 4 November on a flight to Malta, Cyprus and Tripoli. It was expected to return direct from Tripoli to Blackbushe during the afternoon of 5 November. A fresh crew took over the aircraft in Malta and it was planned that this crew should have a 12 hour rest period in Tripoli before returning to Blackbushe. Due to unforeseen delays the aircraft arrived at Tripoli about 5 hours late and the rest period before departure was reduced to about 10 hours. The aircraft took off from Idris (Tripoli) at 1525. The flight to Blackbushe was uneventful until very near the end. There is no direct evidence that the captain or any other member of the crew was exceptionally fatigued. The flight engineer said in evidence that he felt tired and strained but it was hard to say whether he felt more tired than usual after such a trip. The captain spoke to him often in the course of the flight and seemed quite normal and there was nothing to indicate that he was exceptionally tired. The steward said that he spoke to the captain about a quarter of an hour before the accident and the captain seemed perfectly normal though he did look tired and may have remarked that he was tired.

The question arises why the captain elected to leave Idris after a rest period (even assuming that all the time at Idris can be counted as rest) of only 10 hours following the duty period of over 19 hours. There is no evidence that he was in any way pressed to leave, though it is only natural to assume that both he and the R.A.F. authorities were anxious that the evacuation should not be delayed. Moreover, the captain probably took the view, shared by all three survivors who gave evidence, that a longer stay offered little prospect of real rest.

The rules laid down by Britavia in their Operations Manual with regard to the periods of duty and of rest are as follows:-

- "1. No air crew member of the Company's staff shall accumulate more than 120 flying hours in any one period of 30 consecutive days.
2. Normal duty hours will not be scheduled to exceed 16 hours except in cases where a higher fatigue factor would result e.g. unsuitable night stop facilities etc. In these cases only duty hours of up to 20 hours are permissible at Captain's discretion.
3. The minimum rest period following a 16 hour duty is 12 hours. The minimum rest period following a 20 hour duty is 16 hours or pro rata."

The crew had had over 19 hours on duty (including nearly 13-1/2 flying hours) on the 4th/5th November and something between 8 and 12 hours on duty (including about 8 flying hours) on the afternoon and evening of the 5th. The rest between these two periods of duty had been not more than about 10 hours spent in unhappy conditions at Idris. There can be no doubt that the crew were tired, but it does not necessarily follow that this caused the accident.

The flying hours of the crew in the 30 days before the accident did not total more than 80 hours so that provision (1) above was complied with. From details given in evidence it is clear that in the 30 days in question there had been some long periods of duty interspersed with periods of several days rest. There was no suggestion in the evidence that the crew were not quite fresh and in good health on the morning of 4 November. As to (2) duty hours did exceed 16 on 4 and 5 November, but they did not exceed 20. As there were no night stop facilities at Nicosia the long period of duty was within the limit allowed by this paragraph. As to (3) since the duty period had been 19 hours, the rest period required was at least 15. This paragraph unlike paragraph (2) does not expressly leave any discretion to the captain. The Operations Manager and the Air Superintendent of Britavia both said in evidence that under abnormal circumstances they would expect the captain to exercise his discretion under (3) as under (2). This is certainly not made clear by the manual but as this is the view taken by the Company, the captain cannot be blamed for not adhering to the letter of the printed instructions.

Blackbushe Airport has a datum level of 329 feet above sea level. The runway with which the report is concerned lies roughly East and West and when approached from the western end is known as runway 08. It is a concrete runway about 6 000 feet long. The main London - Southampton road lies at a small angle with the extended runway, the intersection being about 2 000 feet west of the threshold. The beech tree previously mentioned is on the edge of the extended runway 3 617 feet from the threshold and with its top (before the accident) about 59 feet above the threshold level. (It was well below the 1 in 50 "approach surface" recommended by ICAO). On the north side of the extended runway are plantations of pine trees intersected by fire breaks.

The runway has the ordinary white runway lights along each side. The system consists of alternate high intensity and low intensity lights and these were all on at their full brilliance on the night in question. Across the threshold there is a high intensity

bar and a low intensity bar of green lights, both of which were on. Extending back from the threshold is a line of 5 approach lights 300 feet apart so that the first approach light from the point of view of an approaching aircraft is 1 500 feet from the threshold. These are composite lights made up of a high intensity white light beamed upwards and away from the runway and a low intensity red light. The white lights can be set to full intensity or a reduced intensity. They are usually set to the reduced intensity at night and the evidence was that they were so set on the night in question. There is a sodium light on each side of the runway about 60 yards from the threshold and there are the usual red obstruction lights marking various objects around the airfield. The beech tree was not marked by a light as it did not constitute an obstruction within ICAO recommendations.

The system of approach lights is of a much less elaborate kind than is specified in Annex 14 (ICAO) for an approach lighting system and does not comply with the provision of that Annex in relation to a lead-in lighting system that the lights shall be not more than 200 feet apart. It is clear from the foreword to that Annex that none of these standards is applicable to installations commenced before 1 April 1954 (as Blackbushe was) and it is clear from the supplement to the Annex that the United Kingdom may use a wider spacing than that laid down in the Annex. The Council of ICAO has, however, urged Contracting States to take early action to bring all approach lighting or lead-in lighting systems into conformity with the international standards now adopted.

The weather conditions at Blackbushe at the time of the accident were as follows:-

cloudless, poor visibility, light surface wind of 2 or 3 knots from the west, i.e. a tail wind for an aircraft approaching runway 08, visibility on the ground was 1.1 nautical miles at 2200, 1 500 yards at 2230, 1 000 yards at 2301 and 900 yards at 2330. Immediately after the accident an observation was taken at 2356 and showed a visibility of 900 yards except to the southeast where it was 700 yards. The pilot of another aircraft who made an approach

to Blackbushe only a few minutes behind G-ALDJ saw the airport lights from about 10 miles away and could distinguish the runway lights at 3 or 4 miles. He came down to a height of 600 feet and saw no mist or fog.

Arrangements have been made at Blackbushe for the ascertaining of Runway Visual Range i. e. the distance along the runway that a pilot should be able to see the runway lights at the point of touchdown. The method depends on a line of goose-neck flares situated on the south side of the runway which are observed from an observation point just north of the runway. The observer notes how many flares he can see, multiplies the figure by 100 and so obtains the R. V. R. in yards.

The positions for the flares were computed by the Meteorological Office who were informed that the runway lights at Blackbushe were of the same strength as at Northolt. After the accident, tests were made at Blackbushe which disclosed that the system did not give an accurate result. This was partly due to the flares not having been placed quite accurately in the positions recommended by the Meteorological Office and partly to some other factor which has not been ascertained. Possible explanations put forward in the evidence were that the runway lights at Blackbushe might have recently diminished in intensity because of a reduced power output at the runway lights, or that the beaming of the runway lights might have been altered. At any rate the effect of the discrepancy was that an observer would over-estimate the R. V. R. and the discovery of this since the accident is accepted by the M. T. C. A. as showing the necessity for periodical checks at each aerodrome where the system is in use.

The observer on the night of the accident took observations from about 2325 up to shortly before the accident and found that the number of flares he could see was at first 4, then 5, then 7 and then 12. The number then remained steady at 12. Thus, on his reports to the Control Tower, the R. V. R. at the time when G-ALDJ was making its approach was given as 1 200 yards whereas on account of the discrepancy

mentioned in the last paragraph it should have been 920 yards. The improvement in visibility along the runway observed by this witness finds no parallel in other visibility observations and is an indication that there was probably patchy and shifting mist or fog which made visibility variable and uneven. The error involved in giving the pilot the figure of 1 200 yards instead of 920 yards is of no great significance since the important thing for him was to know that the R. V. R. was above the new company minimum of 800 yards. It should also be made clear that R. V. R. relates to vision along the ground and is no criterion of the distance at which lights can be seen from the air.

The landing aids provided at runway 08 at Blackbushe are Ground Controlled Approach and Instrument Landing System. GCA was available but not without some delay and was not in fact used. ILS was in operation and there is every reason to believe that the captain was using it.

The ILS system depends on two transmitters of radio energy stationed on the airfield. The first is called a "localiser transmitter" and sends out an indication of the centre line of the runway. The second is called a "glide path transmitter" and sends out an indication of the glide path, a notional path vertically above the line of the runway and sloping down at an angle of 3 degrees with the horizontal to a point 20 feet above the runway and 875 feet along the runway from the threshold. The Hermes is fitted with ILS receivers and indicators. There are two indicators, one for the pilot and one for the copilot. The function of each receiver is to pick up the energy radiated by one of the transmitters and pass an impulse to the indicators. Each indicator then shows by the movements of two needles whether or not the aircraft is on or off the centre line of the runway or the glide path as the case may be.

The glide path transmitter was in working order and in operation at the time of the accident. The receivers and the pilot's indicator were so much damaged by the accident that there is no direct evidence as to their condition but at least there is nothing to suggest that they were not

working properly. Assuming that they were, if the aircraft left the glide path the needle on the indicator would move from a horizontal position, reaching the full extent of its swing ("five dots") when the aircraft was about half a degree off the glide path (measured from the transmitter). If the needle was deflected to its full extent the pilot would know if he looked at the indicator that he was considerably off the glide path. If there were a failure of any part of the equipment in the aircraft or on the ground, a small red flag would appear on

the face of the indicator. Over the beech tree which the aircraft struck the 3 degrees glide path was at a height of about 197 feet above the top of the tree and the maximum divergence of the needle would be obtained when the aircraft was about 100 feet (or allowing for acceptable instrumental error say 120 feet) lower than this.

The ILS transmitters are checked daily and the beacons are checked weekly; all were found to be in order both before and after the accident.

The following are excerpts from the messages recorded between the aircraft and Blackbushe Airport:

| | |
|------------------------|---|
| 2335 from the aircraft | - I am descending to join Blackbushe beacon 2 000 feet E. T. A. Four zero (2340 hours) |
| to | - ... runway visual range now 400 yards |
| to | - G. C. A. on thirty minute call at the moment |
| 2336 to | - ... cleared to the beacon at 2 000 feet. No delay expected to your approach ... London runway visual range just received two eight right 700 yards and two eight left nil ... Blackbushe actual weather for 2330 was 270 2 knots 900 yards in fog with sky clear. |
| 2338 to | - .. runway visual range now 600 yards on zero eight |
| 2339 to | - ... runway visual range now passed as 1 000 yards |
| 2340 from | - Could you give me the QNH please |
| to | - The QFE 1021 millibars |
| to | - .. you will be landing probably if any tail wind at all it'll be about 270 to 290 at about one or two knots |
| 2341 to | - confirm you are westbound now |
| from | - negative, we're doing a racetrack now I'll give you a call westbound over beacon |
| 2342 to | - runway visual range now 1 200 yards |
| 2344 from | - just passed over the beacon at 2 000 feet and westbound |
| to | - clear descend to 1 500 feet on the QFE 1021 advise completion procedure turn |
| 2346 from | - turn complete inbound 1 500 feet |
| to | - advise over the outer marker for information the visibility still holding 1 200 yards range on the runway |

- 2349 from - outer marker
- to - clear to continue descent and clear to land wind indicating 290 about two knots
- 2350 from - we've got the runway lead-in lights in sight (it is calculated that at this time he was a little over two miles from the threshold and therefore about 2 miles or a little less from the outermost approach light).
- to - clear to land wind 290 now almost indicating calm mostly one to two knots
- 2351 from - Juliet
This was the last message from the aircraft. It was clear from the evidence of the Air Traffic Controller that this was merely acknowledgement and not an interrupted message. It will be observed that there is no indication that up to this time the pilot felt himself to be in any difficulty or danger. Other evidence shows that the aircraft had crashed to the ground with a sound of explosion within the next minute and three-quarters.

The only survivor from the aircraft who had any knowledge about the management of the aircraft during the approach was the flight engineer. He had head-phones on and could hear the radio telephone communications and also the inter-com. His story was as follows:-

"We had made a routine descent and the captain called for a field approach check, that is a routine check which I performed and it was satisfactory. I heard the captain tell control that he wanted a GCA approach. I believe he said it would take half an hour before GCA could be available. He said he was going to make his approach on the ILS system. All the necessary checks had been carried out quite some time before reaching the outer marker. We made a descent at 1 800 r.p.m. and 30 inches of boost and he then called for 2 100 r.p.m. and subsequently he called for 2 400 r.p.m. 2 400 r.p.m. is the normal r.p.m. to make an approach. Then he asked for 35 inches of boost, that is also quite normal. He subsequently asked me for 25 inches of boost and then he called for his throttles. Up to that point I was operating the throttles and when he called for his throttles it meant he took over command of them. As soon as he called for his throttles he increased the boost to 30 inches and a few seconds later to 37 inches. A few seconds later I felt the first bump." This bump was the impact with the beech tree. After it the captain turned the control column hard over to raise the port wing and raised the power.

There was bumping and crashing and very soon the aircraft came to rest and caught fire

It was not possible to discover from the flight engineer how the various calls upon him fitted in with the R. T. log. The most he could say was that the descent from 4 000 feet to the airfield was at 1 800 r.p.m. and 30 inches of boost. It appears from the R. T. log that this was between 2325 and 2343. The investigator was advised by his assessors that the r.p.m. and boost called for indicate nothing exceptional, except that 25 inches of boost is rather a low figure and would result in a steeper descent than is usual when using ILS. They also advised that the higher rates of boost called for later are not such as to indicate that any emergency action was being taken. The flight engineer said that the captain made no remark during the descent to indicate that he thought anything was wrong with the ILS equipment or with the way that things were going and from his previous experience of the captain he thought that if anything had been wrong the captain would have said so.

It is evident that the aircraft must have been well below the glide path for some appreciable time before striking the tree and no satisfactory explanation was put forward as to why the captain failed to realize this, or if he did realize it why he took no action to gain height. A theory was put forward that the ILS receiver might have failed shortly before the accident. It was, however, clear

from evidence that if this occurred the flag would come up on the indicator unless by an extraordinary coincidence the indicator had failed too - and even if it had "the needle would look dead" and the pilot would know that the system was not working properly. The investigator considered this theory and rejected it.

Examination of the beech tree showed that a considerable amount of the top, about 10 feet, was broken off the tree, so that the impact with it must have been quite severe. The initial damage to the port wing was sufficient to cause the aircraft to bank and turn sharply to port and lose height. The engines, propeller, landing gear and flaps were in such a condition and in such positions as to suggest no mechanical failure before the impact. The captain's altimeter was too much damaged for any conclusion to be drawn from it. The first officer's was set to 1023 millibars; the navigator's to 1022 and the engineer officer's to 1023. The fact that all the settings were so close to each other suggests that they were set before the accident at something very close to the figures mentioned. Examination of these altimeters and of the captain's air speed indicator and climb and descent indicator revealed no evidence of failure before the accident in any of these instruments. As to the ILS equipment, again the captain's indicator was damaged beyond useful testing but the first officer's indicator and the control unit were still able to work satisfactorily.

The evidence of the flight engineer as to the engine settings and behaviour of the aircraft point to its having come considerably below the glide path for some appreciable time before the accident rather than to a sudden dive. Either the captain did not realize this or realized it but was not perturbed. Because of the slight tail wind the captain might decide to come in a little lower than usual in order to touch down near the threshold and give himself a longer run along the runway but this could not account for the very low level reached so early. The magnitude of the eventual departure from the glide path was such that if he had realized it he could hardly have been indifferent to it, and the strong probability is, therefore, that he was unaware

of it. If he was watching the ILS indicator or the altimeter and if these were working properly (and the altimeter was properly set) they must have given him warning. The same applies to the copilot. What arrangements may have been made between the two for a division of duties is not known. Another pilot who made an approach to Blackbushe only a few minutes behind G-ALDJ said in evidence, "I think it is desirable to have one pilot looking at his instruments solely and the other pilot looking out visually for the runway lights, and that in fact is normal practice in the Airline for which I work". The investigator was informed by his Assessors that other Airlines give instructions that the copilot in addition to maintaining a lookout for the lights should make periodical checks on his altimeter and call out the height shown by it. There was no evidence that Britavia had any such practice and nothing to show to what extent the captain was relying on his first officer for assistance.

The evidence points towards the instruments having been in such a condition as to work properly and it seems improbable that any of them was at fault. If (as seems not unlikely from the altimeters that could be checked) all the altimeters were set at 1023 millibars instead of 1021, this would lead anybody who took the height from his altimeter to believe that the aircraft was about 60 feet higher than it really was. The investigator was advised that it is not unusual for an error of a millibar or two to be made in setting an altimeter and thinks this may well have occurred, but the departure from the glide path was much more than 60 feet; at the beech tree it reached about 197 feet.

A pilot using ILS should not come below a certain "critical height" unless he then has the airfield lights clearly in sight. The critical height laid down by Britavia in its Operations Manual for a Hermes using ILS at Blackbushe is 400 feet. Once a pilot has the aerodrome lights clearly in his sight it is normal practice for him to rely on his vision of these rather than on the ILS indicator, though he should still check his height from time to time by glancing at his altimeter or getting his copilot to do so. The R. T. log indicates that the captain had, or believed he had, the approach lights in

sight when he was still about two miles from the threshold. It is likely that very soon after this he would see the runway lights and the threshold lights and he may well have believed that he was getting from them a good indication of his height and direction. He might have had a better indication if there had been at Blackbushe an approach lighting system more in accordance with the latest recommendations of ICAO.

Conceivably the captain was misled by the lights of vehicles on the main London - Southampton road, but it is unlikely that at midnight in November there would be much traffic on the road and in any case these lights would be so different from the aerodrome lights that he could hardly mistake them for more than a moment.

The misty weather with variations in visibility in different directions, and in the same direction within short periods, may have led the captain to draw a wrong inference from the view that he had of the lights. The investigator is advised that the meteorological reports spoken to in evidence are consistent with there being a layer of fog or very low cloud, not very dense and not evenly spread, on or near the ground. This might cause the pilot to see the lights as being further away and at a greater distance below him than they really were. This theory receives no support from the evidence of the pilot who was approaching very soon after G-ALDJ but it is not disposed of by that evidence since that pilot never came below 600 feet at Blackbushe.

It is possible that the accident was caused by a misjudgment which no reasonable care, skill and alertness could have avoided, but after considering the whole of the evidence carefully with his Assessors, the investigator formed the opinion that it is much more probable that the captain did make one or more of the following errors:-

1. failing to set his altimeter accurately when given the QFE by R. T.;
2. giving up reference to his ILS indicator before he had a sufficiently clear view of the lights;
3. not checking his height by glancing at his altimeter.

If the captain was relying on the first officer for guidance about altimeter or indicator readings, the error may have been that of the first officer and not of the captain.

If any of these errors was made, it was probably due at least in part to some loss of alertness brought about by fatigue. The investigator was satisfied by the evidence of the survivors that the officers were not suffering from any extreme degree of fatigue, but they were probably tired enough to make their mental reactions a fraction slower and less accurate than they would normally have been.

The long period of duty on the 4th/5th November was due to a magneto failure not caused by any negligence and to military requirements which nobody could control. The poor accommodation at Idris was the inevitable result of the state of emergency in Tripoli. The period of rest taken there was substantially shorter than that laid down by Britavia and was too short to prepare the captain and crew properly for another eight hours' flight; the captain alone was responsible for the decision to take off without further rest and it is impossible to say that he was to be blamed for his decision or even that it was the wrong decision to take in the circumstances.

Probable Cause

The most probable cause of the accident is that in difficult conditions and while suffering from a degree of fatigue above the normal, the captain, relying on his vision of the airport lights to assess his height, judged his height to be higher than it actually was.

Recommendations

The question of what regulations should be laid down for the government of hours of duty and rest of aircraft crews is one of great importance which has been occupying the attention of the proper authorities for some time. Nothing has emerged in this Inquiry which would enable the investigator to make any recommendation as to the form that such regulations should take. He recommends that if any discretion is to be left to the captain this should be clearly stated.

When an ILS approach is being made (and the same may apply when other aids are in use) the pilot has to make a series of

rapid decisions based on a judgment depending on what he has been told by R. T. from the ground, what he can learn from his instruments and what he can see outside the aircraft. He has the assistance of a copilot whose share of the responsibility is such as the pilot thinks fit to give him unless some directions on this matter are given by his

employers. Consideration should be given by all operating companies to the question of whether any definite allocation of duties should be laid down so as to reduce the risk of any possible checks on height, direction and speed being omitted as the approach to land is made.

- - - - -

