

ACCIDENTS INVESTIGATION BRANCH  
Department of Trade and Industry

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Viscount 802 G-AOHI  
Report on the accident at Ben More,  
Perthshire, Scotland, on 19 January 1973

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LONDON: HER MAJESTY'S STATIONERY OFFICE  
1974

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Department of Trade and Industry  
Accidents Investigation Branch  
Shell Mex House  
Strand  
London WC2

19 December 1973

*The Rt Honourable Peter Walker MBE MP*  
*Secretary of State for Trade and Industry*

Sir,

I have the honour to submit the report by Mr R D Westlake, an Inspector of Accidents, on the circumstances of the accident to Viscount 802 G-AOHI which occurred at Ben More, Perthshire, Scotland on 19 January 1973.

I have the honour to be  
Sir  
Your obedient Servant

V A M Hunt  
*Chief Inspector of Accidents*

Accidents Investigation Branch  
Civil Aircraft Accident Report No 4/74  
(EW/C435)

*Aircraft:* Viscount 802 G-AOHI  
*Engines:* 4 Rolls-Royce Dart 510 Turbo Propeller  
*Registered Owner and Operator:* British European Airways Corporation  
*Crew:* Commander Captain W Durward — Killed  
Co-Pilot Second Officer S E R Kemp — Killed  
*Passengers:* Two — Killed  
*Place of Accident:* Ben More, Perthshire, Scotland  
*Date and Time:* 19 January 1973 at 1431.30 hrs

All times in this report are GMT

### Summary

The aircraft took off from Glasgow on a visual flight rules (VFR) flight plan for an air test and flew north at flight level (FL) 40 for approximately seven and a half minutes before the captain asked for clearance back into the Glasgow Control Zone. This was the last message received. About two minutes later the aircraft struck the summit of Ben More (3,852 feet) and was totally destroyed. There were no survivors.

The report concludes that the pilot did not maintain a safe altitude and gave insufficient attention to navigation when flying VFR into an area of snow covered high ground in marginal weather conditions.

# 1. Investigation

## 1.1 History of the flight

The day prior to the accident the aircraft had been scheduled to fly a normal passenger service from Birmingham to Edinburgh but because of bad weather at Edinburgh and also at Glasgow, the nominated diversion, it had landed at Prestwick. During this flight the autopilot had malfunctioned and the aileron trim was seen to run away to starboard; also, during manual flight, the aileron control appeared unusually heavy. After landing at Prestwick these defects were entered in the technical log.

A BEA ground engineer checked the aileron controls and trim and found nothing amiss. Consequent on this check the captain agreed to take the aircraft to Glasgow on an engineering flight with the autopilot still unserviceable (an allowable deficiency), in order that a full investigation of the defects could be made. During this positioning flight, which was flown manually, the first officer found the aircraft still flew a little left wing heavy. The ground engineer, who had previously checked the aircraft, flew on this flight as an observer.

The following morning, that is the day of the accident, the aircraft was given a full ground check using test equipment and no defects were found in the aileron trim mechanism or the autopilot. However, the two engineers concerned with the tests wished to satisfy themselves that there was no intermittent fault which might only show up in the air, and asked for the aircraft to be given an air test; this was arranged for the early afternoon.

Captain Durward and Second Officer Kemp (the standby crew) were detailed for the test flight and an Air Traffic Control (ATC) flight plan was filed for a 15 minute VFR local flight. It was established that after reporting at BEA Operations, the captain visited the meteorological office but did not speak to the Duty Forecaster apart from saying he was going on a local test flight. He later proceeded to the aircraft and was heard discussing the reported defects with the two engineers who were to accompany him on the flight.

At 1416 hrs the aircraft was cleared to taxi to Runway 06. The captain informed ATC that he would fly in a northerly direction for about ten minutes climbing to FL 40 and then return for an instrument landing system (ILS) approach. This message was acknowledged by ATC who later cleared the aircraft to leave the Glasgow Zone to the northwest climbing to FL 40.

The aircraft was airborne at 1422 hrs and at 1423.30 hrs the pilot reported crossing the GLG non-directional radio beacon (NDB), sited at the ILS outer marker for Runway 24, turning on to a northerly heading and climbing to FL 40. The aircraft was monitored by Glasgow Radar until contact was lost on a bearing of 020°M at 19 nm. Loss of radar contact in this area at this height and range from Glasgow is normal. A few minutes later, at 1429.37 hrs, the pilot called Glasgow Radar and said 'Hotel India would accept a positioning back to the ILS for 06

now'. The aircraft was cleared at FL 40 to the AC NDB, sited at the ILS outer marker for Runway 06; this clearance was acknowledged.

At 1432 hrs Glasgow Approach passed the 1420 hrs Glasgow weather report to the aircraft but there was no reply to this transmission, nor to all subsequent attempts to contact the aircraft on all possible frequencies. At 1439 hrs ATC initiated the Distress Phase of Alerting Action of the Search and Rescue Organisation, and the Rescue Co-ordination Centre at Pitreavie was advised. At 1655 hrs the aircraft's endurance was considered exhausted and since all further attempts to locate or contact the aircraft had proved negative, it was assumed that an aircraft accident had occurred at an unknown location. A search for the missing aircraft was mounted forthwith and on the following day, 20 January 1973, units of the Mountain Rescue Service found the wreckage on Ben More mountain about 31 nm almost due north of Glasgow Airport. The aircraft, whilst flying on a westerly heading, had struck the mountain about 100 feet below the summit which is 3,852 feet above mean sea level (amsl).

## 1.2 Injuries to persons

| <i>Injuries</i> | <i>Crew</i> | <i>Passengers</i> | <i>Others</i> |
|-----------------|-------------|-------------------|---------------|
| Fatal           | 2           | 2                 | —             |
| Non-fatal       | —           | —                 | —             |
| None            | —           | —                 | —             |

## 1.3 Damage to aircraft

The aircraft was destroyed by impact.

## 1.4 Other damage

No other damage was caused.

## 1.5 Crew information

Commander: Captain Walter Durward, aged 42.  
Licence: Airline Transport Pilot's Licence, valid to 12 June 1975.  
Ratings: Aircraft, Part 1; Viscount. Instrument rating valid to 5 October 1973.  
Last medical examination: 18 December 1972, assessed fit.  
Last competency check: 6 September 1972.  
Last route check: 17 November 1972.  
Total pilot hours: 8,346.  
Total flying hours in command of Viscount aircraft: 1,835.  
Total flying hours in last 28 days: 22.  
Rest period: Three days prior to the accident flight.

Captain Durward had extensive experience of flying in Scotland, having operated from Glasgow with BEA for the past 16 years. He was known as a keen student of meteorology and had been commended by the Meteorological Office for his conscientious reporting of weather information.

Co-pilot: Second Officer Stanley Ernest Robert Kemp, aged 40.  
Licence: Commercial Pilot's Licence, valid to 11 March 1976.  
Ratings: Aircraft, Part 1; Viscount. Instrument rating valid to 8 January 1974.  
Last medical examination: 1 May 1972, assessed fit.  
Last competency check: 7 December 1972.  
Total pilot hours: 4,340.  
Total flying hours as co-pilot in Viscount aircraft: 606.  
Total flying hours in last 28 days: 22.  
Rest period: 13 hours 10 minutes rest before commencing duty at 0540 hrs on the day of the accident. During the morning he had flown a return flight from Glasgow to Birmingham.

Second Officer Kemp joined BEA in March 1971 after 20 years service in the Royal Air Force as a pilot; he had been operating from Glasgow since April 1972.

## 1.6 Aircraft information

Viscount 802 G-AOHI was constructed in 1957 and went into service with BEA the same year. The records show that it had been properly maintained and that all mandatory modifications had been embodied. Its certificates of maintenance and airworthiness were valid and it had flown 129 hours since its last Check 1 inspection; its total flying time was 32,677 hours.

Since the last Check 1 inspection the autopilot had operated satisfactorily for 61 hours before a series of unserviceabilities, commencing on 31 December 1972, were reported by flight crews. These reports indicated that during turn demands on the autopilot the aircraft was not responding or was being sluggish or was overbanking. Various checks and replacement of autopilot components were made but the troubles continued intermittently culminating in the report of autopilot malfunction made by the captain of the flight on the day prior to the accident. In this incident, during a turn to port, the aircraft continued to turn through the selected heading and lost 400 feet in height. Later during a further turn with the autopilot engaged the aileron trim was seen to run away. After disengagement of the autopilot and with the aileron trim back at the neutral position the aileron controls were reported to have been unusually heavy during manual flying. Following the report a full ground check was carried out and the autopilot and aileron trim were found satisfactory. However, because of this incident and the previous history of autopilot defects, it was decided to carry out an airtest to check on the autopilot and aileron trim systems. It was during this test flight that the accident occurred.

The weight and centre of gravity of the aircraft were within the prescribed limits and at departure from Glasgow the aircraft's tanks contained 800 gallons of aviation kerosene, sufficient for an endurance of approximately 2 hours 40 minutes.

## 1.7 Meteorological information

The following weather observation was recorded at Glasgow Airport at 1420 hrs:

|               |                                 |
|---------------|---------------------------------|
| Surface wind: | 090°/12 knots.                  |
| Cloud:        | 1/8 4,000 feet, 8/8 5,000 feet. |
| Visibility:   | 6 kilometres.                   |
| Weather:      | rain and snow.                  |
| Temperature:  | +3° centigrade.                 |
| QNH:          | 1006.5.                         |

At Glasgow Meteorological Office the Standard practice was for pre-flight meteorological briefing to be given to pilots by the Duty Forecaster; no official provision is made for self-service briefing. However, on this occasion when the captain visited the meteorological office the Duty Forecaster was busy briefing another pilot and apart from saying 'Just local - an air test' as he left the office, the captain did not speak to the forecaster.

At the time the captain visited the meteorological office, about 1345 hrs, the following information was on display:

- (1) the current hourly synoptic UK charts;
- (2) the 0600 hrs Central Forecast Office analysis;
- (3) the forecast chart for 0600 hrs the following day, 20 January 1973;
- (4) the Sigmet board, containing among other sigmets one for the Scottish FIR valid from 1215 hrs to 1615 hrs warning of severe turbulence below flight level 100;
- (5) a television display which gave the Glasgow current observation. This would have been the 1320 hrs observation which was:

|               |                                 |
|---------------|---------------------------------|
| Surface wind: | 100°/12 knots.                  |
| Visibility:   | 8 kilometres.                   |
| Weather:      | rain and snow.                  |
| Cloud:        | 3/8 4,500 feet, 8/8 6,000 feet. |
| Temperature:  | +4° centigrade.                 |
| QNH:          | 1007.5.                         |

In various trays on the counter within easy reach of visiting pilots, the following documentation was available for inspection and hand-out as necessary:

The forecast spot upper wind chart.

The significant weather chart.

Aerodrome forecasts (Tafs) for various areas.

It has been established that when the captain visited the meteorological office, he looked at the display information and collected a sheet of Tafs - UK 1 Collective. This sheet contained the forecasts for the Scottish aerodromes, including Glasgow, which was as follows:

|                     |                                  |
|---------------------|----------------------------------|
| Period of validity: | 1300 hrs to 2200 hrs.            |
| Surface wind:       | 120°/15 to 25 knots.             |
| Visibility:         | 10 kilometres.                   |
| Cloud:              | 5/8 stratocumulus at 2,000 feet. |

Temporarily 1300 hrs to 2200 hrs:

|             |  |
|-------------|--|
| Visibility: | 5 kilometres.  |
| Weather:    | rain.  |
| Cloud:      | 3/8 stratus at 1,000 feet.<br>6/8 stratus at 1,500 feet. |

Although he did not take copies of the significant weather chart and forecast spot upper wind chart, the captain may well have looked at them.

A post-accident appreciation of the weather conditions in an area within 60 miles north of Glasgow gave the main cloud base as 4,000 feet or above with almost continuous snow. Pilots had reported that they could not detect a cloud base because the snow was heavy enough to merge with the cloud. Witnesses close to the scene of the accident said that at the time there were strong winds with snow and poor visibility.

This weather appreciation gave the wind at 4,000 feet as southerly at 50 knots and indicated that severe turbulence could have been expected in the vicinity of high ground. A plot of the aircraft's air and ground tracks, made from information obtained from the flight recorder, suggests that the actual 4,000 feet wind was 150°/40 knots.

The accident occurred in daylight.

## 1.8 Aids to navigation

### 1.8.1 *On the ground*

At Glasgow airport all the relevant radio navigational aids were serviceable. These consisted of the ILS for Runway 06, the NDB 'AC', situated 4.74 nm from the threshold of Runway 06, the NDB 'GLG', situated 4 nm from the threshold of Runway 24, Glasgow radar and the very high frequency direction finding (VDF) facility. These were the closest radio-navigational aids to the scene of the accident.

### 1.8.2 *In the aircraft*

The aircraft was equipped with the appropriate radio-navigational aids for operation in controlled airspace including a Decca Mark 10 Navigator and Flight Log; no unserviceabilities had been recorded in the technical log. It was normal BEA procedure for the Decca Navigator to be set up, prior to departure, for all flights. The Decca Flight Log chart gives information on airways, radio aids, reporting points etc, but shows no contours or spot heights and is to a scale which is too small to be of real value for map reading purposes.

## 1.9 Communications

A transcript of the messages between ATC and the aircraft shows that normal VHF communications were established and maintained on the appropriate control frequencies. The last communication to be acknowledged by the pilot was approximately two minutes before the time of the accident when he received a clearance to the AC NDB at FL 40.

### 1.10 Aerodrome and ground facilities

Glasgow Airport is situated 6 nm west of the city of Glasgow and is within the Scottish Control Zone, the northern boundary of which lies approximately 9 nm from the airport.

According to the official ICAO instrument approach and landing charts for Glasgow published formerly by the Department of Trade and Industry and now by the Civil Aviation Authority, the minimum sector altitude in the area 25 nm north of the airport was 4,400 feet (see Appendix 3). BEA also gave the identical information on their own published instrument approach charts.



The definition of minimum sector altitude which is applied, via the Aeronautical Chart (Map) section of the Air Pilot, to United Kingdom legislation is that given in ICAO PANS document 8168-OPS/611, Aircraft Operation, which is as follows:

The minimum sector altitude is the lowest altitude which may be used under emergency conditions which will provide a minimum clearance of 1,000 feet above all obstacles located in an area contained within a sector of a circle of 25 nm radius centred on a radio aid to navigation.

In this case the radio aid was the ILS localiser transmitter for Runway 06.

BEA's minimum safe altitude for that sector of the route from Glasgow to Inverness, which passes 9 nm east of Ben More, is given as 5,000 feet for an area 10 nm either side of track and 6,000 feet for an area 30 nm either side of track; the latter is the one customarily applied by BEA pilots.

### 1.11 Flight recorder

The aircraft was equipped with a Plessey Davall PV 710 flight data recorder system which recorded the mandatory flight path parameters, namely: pressure altitude (to a datum, in this case, of 1013.2 mbs), indicated airspeed, magnetic heading, pitch attitude and normal acceleration. The protected recorded cassette, which was mounted in the starboard side of the tail cone immediately aft of the tailplane mainspar, was recovered undamaged and had functioned correctly throughout the 9½ minutes of flight.

The read-out showed that the aircraft took off on a heading of about 065° and climbed for approximately two minutes to 3,000 feet before turning left on to a northerly course. It continued north for about one minute climbing to 4,000 feet; the speed during the climb slowly increased from 150 to 200 knots. On reaching 4,000 feet the speed stabilised at about 220 knots and the aircraft commenced a series of continuous level turns, two to the left and two to the right, turning approximately 40° to 50° off the northerly heading in each case. Turn rates were approximately 2° per second, which is generally consistent with the turning performance expected of the autopilot. During these manoeuvres both the speed and height show a slow downward drift, which is also reasonably consistent with the autopilot height lock having been engaged. The speed drop was probably caused by insufficient power compensation for the increase in drag experienced during the continuous turning manoeuvres; the speed finally stabilised at about 200 knots. The completion of this series of turns occurred about 7½ minutes from take-off. One minute later the aircraft, at a height of 3,915 feet, commenced a turn to the left from a heading of 030° at about the same rate as before. The record ends during this turn and shows that the heading had reached 262°, the pressure altitude was 3,995 feet (3,795 feet amsl) and the speed was 192 knots. The pitch trace was relatively steady during the flight apart from a slight pitch up commencing 20 seconds before impact; it is considered this was associated with the recovery from a previous loss of about 70 feet in height. The normal acceleration trace was also reasonably steady until the final 30 seconds of flight when excursions of up to plus .6g to minus .2g were experienced. These g readings are of an order which could be associated with moderate turbulence. The flight recorder shows no evidence that an avoiding manoeuvre was initiated before impact. A plot of the flight recorder read-out is at Appendix 1 and a plot of the aircraft's probable air and ground tracks made from information obtained from the read-out is at Appendix 2.

## 1.12 Wreckage

Examination of the initial impact area indicated that the aircraft had been in about a 20° left-wing-low and slightly nose-high attitude on a heading of about 270°M when it struck the rocky slope of the mountain at a point about 600 feet to the northeast of, and some 100 feet below the summit. The aircraft then appeared to have cartwheeled and broken up almost instantaneously, the wreckage spreading out fan-wise in the general direction of 270°M.

Pieces of all four engines and the associated propellers were found in the vicinity of the initial impact and all sixteen propeller blades were ultimately accounted for. The entire structure of the aircraft had disintegrated. Pieces of the right and left wings and their control surfaces, the tailplane and fin together with a number of passenger seats and some pieces of the right main landing gear were found between the point of the initial impact and the summit. The majority of the disintegrated forward fuselage and cockpit structure and its equipment had travelled over the summit and had then rolled down the deep gully on the western side, pieces of engine and fuselage structure, together with the nosewheels, being found near the Ben More burn, at the western base of the mountain.

The remains of the aircraft's instrumentation, radio and navigation equipment, was found scattered down the first 2,500 feet of the gully. The disrupted state of the equipment was consistent with the disintegration of the forward fuselage during the initial impact, and apart from the captain's servo altimeter and the remains of the cockpit and the centre control pedestal (showing all trim controls approximately neutral), no other instruments or relatively complete pieces of navigation or radio equipment were identified.

From the damage noted on the remains of the propeller and turbine rotating assemblies, it was evident that they were all rotating at high speed at the time of the crash and although no evidence of any pre-crash fire was noted, there were signs of a considerable 'flash' fire having occurred during the initial impact.

The aileron trim actuator was not found, and although much of the aircraft's lighter structure was not located or identified there was sufficient of the main structure and other evidence to indicate that the aircraft was probably complete, not on fire, maintaining normal speed and was in a 'clean' flight configuration when it struck the mountain.

Inspection of the captain's servo altimeter showed that the height and pressure settings were jammed indicating 4,050 feet and 1012.5 mbs respectively. Inspection of the internal mechanism confirmed that the jamming was due to disruption at impact. No evidence of any pre-crash obstruction or possible malfunctioning of the instrument was found. A brief altitude test of a serviceable instrument of a similar type showed that with a pressure setting of 1006 mbs the instrument indicated 3,850 feet and upon re-setting the pressure subscale to 1012.5 mbs the instrument indicated 4,050 feet. This would appear to suggest that the captain's altimeter was functioning properly prior to the crash.

## 1.13 Medical and pathological information

The extent of the injuries precluded detailed internal post mortem examination but no evidence of disease was discovered in either the pilot or the co-pilot. Tests for ethanol were negative and there was no evidence of cockpit contamination by carbon monoxide before the crash. All the four occupants had died immediately on impact from severe multiple injuries. The accident was not survivable.

#### 1.14 Fire

There was evidence of a 'flash' fire on impact.

#### 1.15 Survival aspects

The Rescue Co-ordination Centre at Pitreavie instructed the RAF Leuchars Mountain Rescue Team to proceed to the Callander area and establish a base, on receipt of the information from Glasgow ATC at 1439 hrs on 19 January 1973 that a Distress Phase had been declared for the missing aircraft. A team of 25 men and five rescue vehicles left immediately and later received further information from Pitreavie that the search area was being extended to include Ben Lawers, the Crianlarich Hills and in particular the Ben More area. The team leader decided to centre his operation on Lochearnhead; the base was established by 1915 hrs. Road parties were then sent out to obtain any witness evidence from houses in the area. A possible contact was established from a witness living at the foot of Ben More, who had heard during the afternoon a rumbling noise, similar to a peal of thunder. All parties returned to base by 2359 hrs except one, which remained out all night checking on another report, which ultimately was shown to have no connection with the accident.

The following morning the mountain rescue team from RAF Kinloss joined the Leuchars team and with a number of police and civilian climbers a full scale search was mounted concentrating on the mountain areas of Ben More, Ben Lawers and the hills north of Loch Katrine. At about 1100 hrs the party searching Ben More found parts of an engine and some documents from the missing aircraft. Further parties were sent on to the mountain and further pieces of aircraft wreckage were found; at about 1500 hrs the bodies of the four occupants were discovered. Because of bad weather — continuous snow which gave rise to deep drifts — and failing light, the bodies were left in situ on the mountain. They were recovered the following day when a full scale sweep of the mountain was made with the additional help of a unit from the Army Special Air Service; in all about 100 men were involved. During this search more of the aircraft wreckage was found and the undamaged flight recorder was recovered. A British Executive Air Services helicopter, which happened to be operating in the area, rendered valuable assistance during the search and recovery operations.

#### 1.16 Tests and research

No tests or research were carried out.

#### 1.17 Human factors

It is customary for BEA at Glasgow to maintain morning and afternoon standby crews for the Viscount services. On the day of the accident another captain and S O Kemp had covered the morning duty and had been called out to operate a service from Glasgow to Birmingham and return. As they approached Glasgow on their return they were informed, via the radio, that Viscount G-AOHI would be ready for an air test. However, this captain had an engagement in London which necessitated his catching the BE 5043, Glasgow to London service at 1350 hrs. Mr Kemp also wished to get to London. Nevertheless, as there was no afternoon standby co-pilot, he agreed to stay behind and do the air test with the afternoon standby captain — Captain Durward. His intention was to catch the BE 5047, Glasgow to London service departing at 1540 hrs.

## 2. Analysis and Conclusions

### 2.1 Analysis

#### 2.1.1 *Aircraft integrity*

It was not possible to make an examination of the wreckage in the degree of detail customarily undertaken because of the extent of destruction and scatter of the wreckage over difficult terrain. Nevertheless, from the examination that was possible, and together with evidence from the flight recorder data, it can be said with reasonable confidence that the aircraft struck the mountain in a 20° left banked turn on a heading of about 270°M with a slightly nose-up attitude. At that time it was in a clean configuration, had been maintaining a constant normal airspeed of about 200 knots, and was not on fire.

Although the aileron trim actuator was not found, there is no evidence to suggest that this or the previous troubles with the aileron or the autopilot had any immediate bearing on the accident. No evidence was found in the wreckage nor in the flight recorder data nor the R/T transcript to suggest that there had been any abnormality or untoward event up to the time of impact.

Despite the limitations imposed on the wreckage examination, it is considered that the aircraft's pre-crash integrity was sufficiently established to eliminate it as a significant factor in the accident.

#### 2.1.2 *Operational aspects*

Consideration of all the evidence suggests that Captain Durward intended to conduct this flight as expeditiously as possible consistent presumably with satisfactory completion of the flight engineering test programme. It is a matter of conjecture whether or not he was influenced in this by any wish to ensure that his co-pilot would be able to catch the BEA service to London at 1540 hrs.

The ATC clearance to leave the Glasgow Control Zone climbing to FL 40 was given in response to the pilot's information that he wished to fly on a northerly heading for about 10 minutes climbing to that flight level. The flight recorder data shows that the aircraft climbed to and maintained a height approximating closely to that level on a northerly track. On the existing QNH of 1006.5 mbs FL 40 represented an approximate altitude of 3,800 feet amsl; the value for the QNH had been given to the pilots during the course of taxiing and pre-take-off instructions from the Control Tower.

The flight was being made under a VFR flight plan and therefore the choice of a height to fly to maintain both VFR and a safe terrain clearance after leaving the Control Zone was entirely a matter for Captain Durward to decide. In planning the flight in a northerly direction he had given himself the quickest exit from the Zone, presumably to help expedite the flight. However, it also entailed flight into an area of mountainous terrain for which the minimum sector altitude is 4,400 feet amsl and for which the minimum safe altitude customarily used by BEA pilots would be 6,000 feet.

In view of his long experience in the area it must be assumed that Captain Durward was aware of these height limitations and the reason for their existence. Safe flight in this area at 3,800 feet amsl in VMC is certainly possible but it necessitates a continuous and accurate knowledge of position. Although reference could have been made to the Decca Navigator and Flight Log which gives a continuous map-position presentation, no information on elevation is shown and the scale and format of the map would have precluded its use as a primary navigational aid for this type of flight. Consequently, assuming there would be sufficient visibility and clearly identifiable ground features, it would be essential to use map reading as the basic method of navigation.

The foregoing would be self-evident to a pilot of Captain Durward's experience; nevertheless, from the very nature of the accident, it is also evident that at the time the aircraft was turning to return to Glasgow airport, the aircraft's position was incorrectly assessed. The probable reasons for this mistake are considered in the following paragraphs.

In the prevailing winter conditions of snow covered ground and with snow showers from the cloud base of 4,000 to 5,000 feet, map-reading would have presented obvious difficulties. Given continuity from a known position there would be less probability of a mistake, but if due allowance is made for a probable period of flight-deck preoccupation and interest in the flight-engineering test programme, then it is possible to see that subsequent attempts to identify a ground position could more readily result in a mistake.

An additional factor could have been a wind influence which may not have been appreciated by the pilots. Although Glasgow is not a self-briefing meteorological office, Captain Durward did not wait to receive a personal briefing from the Duty Forecaster. Nevertheless, in view of his long experience of the area, his known great interest in meteorology and the information on display available to him, it would be logical to assume that he had made a reasonably accurate assessment of the weather he was likely to encounter. Whether he had observed the existence of the strong southerly wind at his proposed flight level is perhaps less certain. Although this information could have been obtained from the forecast spot upper wind chart, which was available in the meteorological office, there is insufficient evidence to show whether or not Captain Durward saw it. Although the maximum possible northerly displacement this wind could have produced in the brief period of flight is of the order of 6 nm, it may have been sufficient to produce a mistaken identification of ground position. Because of the initial decision to fly at 3,800 feet amsl a comparatively small error in such an area would be critical given the probable merging effect of the snow covered mountain against the white background of the cloud base and the snow covered surrounding terrain.

Since the accident BEA have made a number of recommendations, one of which is an amendment to the Operations Manual to require that:

'Whenever a test flight is made outside the immediate airfield circuit, the appropriate navigational procedures, including observation of safety heights for the sector, must be followed.'

## 2.2 Conclusions

### (a) Findings

- (i) The aircraft had been maintained in accordance with an approved maintenance schedule and its documentation was in order.

- (ii) The crew were properly licensed and adequately experienced for the flight.
- (iii) There was no evidence that any pre-crash defect or malfunction of the aircraft or its engines was a significant causal factor.
- (iv) The aircraft struck a mountain peak during a local VFR test flight in an area familiar to the Captain who had extensive experience of operations in Scotland.
- (v) Although the Captain obtained some weather information during his visit to the meteorological office he did not seek a briefing from the Duty Forecaster. This may have deprived him of information about the strong winds at his proposed flight level.
- (vi) The minimum sector altitude for the area was 4,400 feet and BEA's minimum safe altitude was 5,000 feet; nevertheless the decision to fly at FL 40 (3,800 feet amsl) was permissible for a VFR flight.
- (vii) The decision to operate under VFR in the prevailing weather conditions was questionable but probably explicable in the light of the nature of the flight.
- (viii) Map reading over snow covered terrain in the prevailing weather conditions would have presented obvious difficulties. The possibility of error may have been increased by temporary distractions resulting from preoccupation with the flight engineering test programme.
- (ix) The exact circumstances of the accident are not known, but it probably occurred whilst the aircraft was flying in 'white out' conditions associated with a snow shower.

(b) *Cause*

The aircraft struck a mountain peak whilst flying over snow covered high terrain in marginal visual meteorological conditions. Failure to maintain a safe altitude and insufficient attention to navigational procedures were contributory factors

R D Westlake  
*Inspector of Accidents*

Accidents Investigation Branch  
Department of Trade and Industry

December 1973