

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

**Rockwell Commander 114 HB - NCM
Report on the accident at Waterloo Farm,
near Dundry, Bristol, on 10 September 1978**

List of Aircraft Accident Reports issued by AIB in 1979

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Department of Trade
Accidents Investigation Branch
Kingsgate House
66-74 Victoria Street
London SW1E 6SJ

16 November 1979

The Rt Honourable John Nott MP
Secretary of State for Trade

Sir

I have the honour to submit the report by Mr J S Owen, an Inspector of Accidents, on the circumstances of the accident to Rockwell Commander 114 HB-NCM which occurred at Waterloo Farm, near Dundry, Bristol, on 10 September 1978.

I have the honour to be
Sir
Your obedient Servant

W H Tench
Chief Inspector of Accidents

Accidents Investigation Branch
Aircraft Accident Report No. 4/79
(EW/C637)

Registered Owner: Industrie-Leasing SA Zurich
Operator: Air Espace SA Switzerland
Aircraft: Type: Rockwell Commander
Model: 114
Nationality: Swiss
Registration: HB-NCM
Place of Accident: Waterloo Farm, near Dundry, Bristol
51° 23' N 02° 35' 33" W
Date and time of Accident: 10 September 1978 at 0830 hrs
All times in this report are GMT

Synopsis

The accident was reported to the Department of Trade Accidents Investigation Branch by Bristol (Lulsgate) Airport Air Traffic Control on 10 September 1978 and an investigation was started the same day. The Swiss Federal Accidents Investigation Bureau participated in the investigation in accordance with Annex 13 of the International Convention on Civil Aviation.

The accident occurred in poor weather during an attempted visual flight rules (VFR) flight from Exeter to Leicester. The aircraft ran into low cloud as it entered a valley which passes through the hills to the south east of Bristol. Whilst in cloud and during a turn to the left, the aircraft descended and struck the edge of a claypit; it then crashed inverted into a pile of timber, killing all four occupants instantly.

It is concluded that the accident was caused by the pilot continuing the flight over hilly terrain at low altitude after encountering adverse weather conditions.

1. Factual Information

1.1 History of the flight

The aircraft with its four occupants, 3 Swiss and 1 British, arrived at Blackbushe Aerodrome from Birrfeld in Switzerland on 8 September where its fuel tanks were replenished with 45 imperial gallons (IG) of 100 LL AVGAS. It then flew to Exeter on 9 September with the same occupants on board and it was their intention to fly from Exeter to Leicester on the morning of Sunday, 10 September. No route forecast was requested but three of the party, including the pilot and his British colleague, went to the aerodrome meteorological office and obtained the 0700 hrs actual weather reports, such as were available, for aerodromes in the Bristol/Gloucester area and for Birmingham Airport. Low cloud was reported in the Bristol/Gloucester area and they were advised by the meteorological officer that the conditions would make the intended flight under VFR difficult. According to the meteorological officer the British member of the party said they would keep to the west of Bristol following the Severn, thus avoiding high ground. He said that it would be "OK as long as there is no cloud below 300 feet" and that they would return to Exeter if the weather was bad. No flight plan was filed but the pilot booked out with Exeter air traffic control (ATC), giving Leicester as the destination with an en route time of 1 hour 10 minutes and an endurance of 3½ hours.

The four occupants boarded the aircraft with the Swiss pilot in the left-hand seat as pilot-in-command and his British colleague seated in the front right-hand seat. According to a relative of the latter he was acting as "navigator" on this flight although he held a Swiss private pilot's licence (PPL). A female passenger and her brother occupied the rear seats. The aircraft took-off from Exeter at 0807 hrs, the Portland altimeter setting given by Exeter Tower was acknowledged and at 0813 hrs radio contact was made with London Flight Information Service (FIS) which was informed that HB-NCM was flying to Leicester by the "direct route, VFR", maintaining 1,000 feet and that the expected time of arrival at Leicester was 0908 hrs. No further radio calls from HB-NCM were received by London FIS or any other station.

It has not been possible to establish the aircraft's track from Exeter and its approach to the Bristol area was not observed by Lulsgate radar. If the direct route was being followed, as suggested by the last radio transmission to London FIS, the aircraft would have had to cross the Mendip Hills, the tops of which were covered by low cloud. It is likely therefore, that a deviation was made to the left of track in order to remain in visual contact with the ground when approaching Bristol (see Fig. 1). Its subsequent track suggests that the pilot was attempting to circumnavigate the city of Bristol to the south and east. When first sighted by eyewitnesses the aircraft was on an easterly heading, below cloud and crossing the hills which lie to the east of Bristol (Lulsgate) Airport and south of the city. It passed at a low height directly over a farm which is located at 620 feet above mean sea level (amsl), then across North Wick village which is about one mile further to the east at an elevation of 300 feet amsl (see Fig. 2). As it flew into a shallow valley which curves northwards towards the Bristol conurbation it was lost to view when it entered low cloud. At this point visibility at ground level below cloud was less than one kilometre. To the left of the aircraft was a 550 ft ridge (Dundry Hill) with Maes Knoll reaching a height of 653 feet amsl. The ridge, which runs roughly west to east was shrouded in cloud or mist. The aircraft was heard to circle to the left after it entered cloud and witnesses near the northern slopes of the ridge heard the sound of an aircraft, very loud, then its engine noise ceased abruptly. No one saw the final flight path or the impact, but a witness on the southern side of the ridge heard the engine noise rising and falling followed by a "thud".

The aircraft first struck the top of a clay quarry at 300 feet amsl on the southern slopes of the ridge whilst on a heading of 240° (m) down the slope. It then rolled and crashed

inverted about 30 feet lower down on the floor of the quarry, collided with a stack of timber and came to rest inverted and on fire in the bed of a small stream about 140 metres from where it struck the edge of the quarry. All of the occupants were killed by the inverted impact and the aircraft was destroyed by fire.

The accident occurred in daylight in a position 4.5 nautical miles (nm) due east of Bristol (Lulsgate) Airport.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	3	none
Serious	—	—	—
Minor/None	—	—	—

1.3 Damage to aircraft

The aircraft was destroyed by impact forces and post-crash fire.

1.4 Other Damage

Nil.

1.5 Personnel Information

1.5.1 Pilot in command:	Male, aged 33, Swiss national and resident in Switzerland.
Licences:	PPL issued by the Swiss Federal authorities on 23 October 1975, with a Controlled VFR rating (CVFR) and a Radio Telephony Licence. The privileges of his licence permitted him to fly single-engined aircraft up to a maximum authorised weight of 2,500 kg with retractable landing gear, wing flaps and a variable pitch propellor. A restricted professional licence, valid only in Switzerland, was issued by the Swiss authorities in March 1978.
Validity of licence:	The PPL was renewed on 5 March 1978 and was valid until March 1980 subject to continued medical fitness and recency requirements. The pilot's last medical examination was on 16 February 1978 and there were no medical restrictions.
Instrument rating:	None; according to the Swiss authorities the pilot was not qualified to fly on instruments and he had not received any formal instruction in instrument flying.
Experience:	Total flying experience 162 hours of which 107 were in command. Total flying in Rockwell Commander: 20 hours.
Types flown:	Piper Cherokee, Cessna 150, Cherokee Arrow, BO 209 and Rockwell Commander.

- Recent experience: During the three months preceding the flight from Birrfeld to Exeter he had flown 9 hours 57 minutes of which 2 hours 12 minutes were within the preceding 28 days.
- 1.5.2 Passengers: The occupant of the right hand front passenger seat, a male aged 35, was a British national resident in Switzerland. He held a Swiss PPL and a restricted professional pilot's licence which was valid only in Switzerland. His PPL was valid and he had approximately 200 hours total flying experience, of which approximately 36 hours were as pilot-in-command of the Rockwell Commander 114. He had learned to fly in Switzerland and according to his personal flying log book he had made two previous flights to Exeter from Switzerland as pilot-in-command; on one of these flights, which was in September 1977 he was accompanied by the pilot referred to in the previous paragraph 1.5.1.
- On the accident flight he was, according to his father, carrying out the duties of 'navigator'.
- The male occupant of the rear passenger seat was a qualified glider pilot and the other passenger, a female, had no flying qualifications.
- 1.5.3 General information: Both the pilot in command and the occupant of the front passenger seat were members of a consortium which had leased HB-NCM since September 1977. According to information provided by the Swiss Federal Accident Investigation Bureau they had flown together on many occasions. It was also reported that the Federal German aviation authorities had filed an airspace violation report against an aircraft, crewed by these two pilots, for low flying through controlled airspace in bad weather 16 months before the accident; a warning was issued on that occasion.
- 1.6 Aircraft Information
- Aircraft type: Rockwell Commander 114
- Constructor: Rockwell International, Bethany, Oklahoma, USA.
- Year of Manufacture: 1977
- Certificate of Airworthiness: No. 5749/6/1 issued by the Federal Air Office, Switzerland, on 20 September 1977 and valid provided terms of issue and maintenance schedule are complied with.
- Operating permit: No. 5749/C/1 issued by the Federal Air Office, Switzerland, and valid until March 1980.
- Scope of Utilisation: Certificate No. 5749/d/1, issued by the Federal Air Office, Switzerland, showed its Scope of Utilisation in Private Operation: "VFR by day and VFR by night." (A limitation imposed due to its scale of radio navigation equipment).

Certificate of Registration: No. 5749/a/1 issued by the Federal Air Office, Switzerland, showed the Registered Owner as "Industrie-Leasing" SA and the Operator as Air Espace SA.

Engine: Manufacturer and Type: Avco Lycoming IO 540 T4B5D

Year of manufacture: 1977

Propeller: Manufacturer and Type: Hartzell HC C2YR 1BF variable pitch, constant speed two bladed.

Year of manufacture: 1977

A 100 hour inspection had been carried out on the aircraft on 29 July 1978 at which time it had flown 300 hours 51 minutes. Since that inspection it had flown at least 8 hours 12 minutes in 10 flights, not including the flights from Birrfield to Blackbushe and Exeter. No significant defects were recorded in the aircraft, engine or propeller log books.

1.6.3 *Weight and balance*

Maximum weight authorised for take off and landing 3140 lb

Estimated weight at take off from Exeter 2903 lb

Estimated weight at impact 2860 lb

The aircraft's centre of gravity was calculated as having been within the prescribed limits.

1.6.4 *Fuel*

Type: AVGAS 100 LL

Quantity at take off from Exeter: 46 IG (estimated).

1.7 **Meteorological Information**

1.7.1 *Pre-flight briefing*

As no route forecast had been requested by the pilot and since the Exeter meteorological office did not issue forecasts the duty meteorological officer could only provide the pilot with the information contained in the Area Forecast for Southwest England which was issued by the Plymouth meteorological office and a limited number of weather observations made at 0700 hrs by stations astride the intended route.

Area forecast

The area forecast for SW England and adjacent waters, valid for the period 0600 hrs to 1800 hrs on 10 September contained the following pertinent information:

Meteorological situation: Moist westerly airstream, trailing cold front soon moving southeast into Ireland probably reaching South Wales later before returning a little north.

Winds:	Surface: 210° to 250° (T), 12 to 25 knots, locally 30 knots. 1,000 ft: 250°/28 knots Temperature + 17° C 2,000 ft: 260°/35 knots Temperature + 16° C 5,000 ft: 270°/38 knots Temperature + 13° C
Cloud:	Low Extensive stratus often base surface to 500 feet and covering all high ground, locally 2/8 to 5/8 base 500-1,000 ft in well sheltered areas. 8/8 stratocumulus base 1,000 to 2,000 feet tops 5,000 feet to 6,000 feet. Medium: Little or none. High: 4/8 to 7/8 Cirrus 25,000 feet to 40,000 feet.
Surface visibility:	1,500 to 5,000 metres. 500 metres or less in fog, locally 500 metres to 10 kilometres in sheltered areas.
Weather:	Mist or fog in many places with drizzle at times.
Remarks, Warnings, Turbulence, etc:	Warnings: Low cloud, fog. Turbulence: Moderate to severe.
Exeter Aerodrome Forecast 0700 hrs to 1600 hrs:	Surface wind 220°/13 knots, visibility 10 kilometres or more. 7/8 stratocumulus 1,500 feet, visibility intermittent 6 kilometres, drizzle, cloud 6/8 stratus 700 feet, 8/8 stratocumulus 1,200 feet.
0700 hrs observations:	The following reports were made available to the pilot at the Exeter meteorological office: Lyneham: visibility 14 kilometres, cloud 8/8 at 500 feet. Staverton (Gloucester): visibility 15 kilometres, cloud 3/8 at 1,700 feet, 3/8 at 4,500 feet. Brize Norton: visibility 14 kilometres, 6/8 cloud at 800 feet, 7/8 at 4,000 feet.

1.7.2 *Aftercast*

The following is an appraisal by the Meteorological Office of the weather conditions which existed for the route Exeter to Leicester between 0800 hrs and 0900 hrs on 10 September:

“A very moist westerly or WSW’ly airstream, gradient speed 35 to 40 knots covered the area. An important feature of the situation was the shelter from fog and very low cloud afforded by high ground. Widespread very low cloud with extensive hill fog and some sea fog in the Bristol Channel became lifted and broken to the lees of high ground and notably so to the lee of Dartmoor and the Welsh Hills. It is perhaps significant that Exeter lay in this shelter with comparatively good weather.

The Bristol Channel gap allowed some very low cloud to funnel into the Bristol region. In addition to the very marked spatial variability of low flying weather there were temporal variations and it is apparent that about the time of the accident there had been a deterioration.

Weather observations in the area best describe the picture:

Time	Place	Surface Visibility Wind	Weather	Cloud (oktas/feet)
0750	Lulsgate	260°/17 More than 10 km knots	nil	7/8 stratus 600 feet
	Cardiff	270°/19 7 km knots	Mist	7/8 " 400 feet
	Birmingham	230°/13 More than 10 km knots	nil	5/8 stratocumulus 1400 feet
0820	Lulsgate	260°/17 More than 10 km knots	Drizzle	7/8 stratus 600 feet
	Cardiff	260°/20 7 km knots	Mist	7/8 " 300 feet
	Birmingham	230°/17 More than 10 km knots	nil	7/8 stratocumulus 1400 feet
0850	Lulsgate	270°/15 5000 metres knots	Rain	5/8 stratus 200 feet
	Cardiff	260°/19 7 km knots	Mist	8/8 " 300 feet 3/8 " 200 feet 7/8 " 300 feet 8/8 stratocumulus 200 feet
	Birmingham	260°/16 More than 10 km knots Max 27 knots	nil	7/8 stratocumulus 1500 feet

The Birmingham observations are given as typical of the improved low-flying weather further north along the route towards Leicester."

1.7.3 *Special Study*

The Meteorological Office also considered the possibility of mountain wave formation, the existence of turbulence, and to what extent the existing weather conditions would have been affected by the hills to the east of Bristol (Lulsgate) Airport. This study showed that the synoptic conditions were suitable for the formation of mountain waves but there was no suitable topographic feature to initiate them over the crash site; such features as Exmoor and the Welsh Hills would have been too far to the north or south and, in the case of the Mendip Hills, unfavourably orientated. However, the strong westerly winds blowing up the Bristol Channel would have given rise to moderate to severe turbulence within the lowest few hundred feet above ground and would have funnelled the stratus cloud over the Bristol Channel directly into the Bristol area. The forced ascent of the stratus over the high ground to the east of Lulsgate would cause the cloud to thicken and the cloud base to descend somewhat lower over this area.

1.7.4 *Horizontal Visibility*

Although an accurate assessment of visibility at or near the scene of the accident could not be provided by the Meteorological Office it was pointed out that experience has shown there is always a shallow layer close to the condensation level where visibility is considerably reduced and it is difficult for a pilot to decide whether or not he has actually entered cloud. With the cloud base at Lulsgate reported as 200 feet agl near the time of the accident and forced ascent of the moist air occurring over the hills to the east of Lulsgate, any such layer of reduced visibility would probably have lowered on to, or very close to, the surface.

1.7.5 *Eyewitnesses*

Weather and visibility assessments by eyewitnesses varied according to their location and line of observation. The westernmost observation, which was made at 600 feet amsl about three nm east of Lulsgate, gave the cloud base as "very low" with good visibility underneath. An eyewitness located one mile further to the east (and 300 feet lower) observed a low cloud base with wisps of cloud below the aircraft; in the case of this witness, however, his observation towards the east was obstructed. A third witness, located about one mile further to the east than the latter, had a fleeting glimpse of the aircraft as it came towards him: he said it was very misty with low clouds and that horizontal visibility across the valley towards North Wick village (to the west) was poor, less than one kilometre. Another witness, located in the valley which runs through a ridge of hills overlooking the southern part of Bristol, said that the ridge (about one mile to the north) and the Mendip Hills (about five miles distant to the southwest) were covered in low rain clouds.

1.8 **Aids to Navigation**

The flight was being conducted under visual flight rules and the primary means of navigation would have been by visual observation of ground features, ie map reading, supplemented if needed by point-source radio navigation aids such as medium frequency non-directional beacons (NDB) and/or very high frequency omni-range (VOR) beacons. Navigational assistance would also have been available on request from civil and military air traffic services in the form of true bearings by very high frequency direction finding (VDF), courses to steer and radar fixing. Sufficient maps and charts, which were packed in containers and recovered from the wreckage, would have enabled the pilot to navigate visually or by reference to radio beacons; any other maps and navigation logs in use would have been consumed by fire. The following aids to navigation were available:

(a) In the aircraft:

- (i) Topographical map for Southwest England and Wales covering the route Exeter to Leicester; this was an ICAO Aeronautical Chart, scale 1:500,000.
- (ii) Radio navigation and airways charts.
- (iii) Two "Botlang" airfield and route manuals.
- (iv) Two VHF communications transceivers.
- (v) One VOR navigation receiver with indicator instrument.
- (vi) One automatic direction finder (ADF) receiver and relative bearing indicator.
- (vii) An instrument panel for flight on instruments on the left of the instrument panel and an automatic pilot with a navigation coupling facility.

(b) On the ground:

- (i) Medium frequency NDBs located at Exeter, Lulsgate, Staverton and Rhoose (Glamorgan).
- (ii) Radar and VDF available at Rhoose and Lulsgate.
- (iii) Civil and military radar and VDF on request through London Flight Information Service (FIS) and Military Air Traffic Zones (MATZ).

1.9 Communications

Radio communications with Exeter ATC and London FIS West were satisfactory and there were no language difficulties. Radio messages on 119.8 Mhz and 124.75 Mhz were recorded and transcribed. It was established that the aircraft's radio was being operated by the British passenger whose recorded voice was identified by a person familiar with the voices of the Swiss pilot and his British colleague.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Not fitted nor required.

1.12 Wreckage and impact information

1.12.1 *Impact information*

The initial impact was on the lip of a claypit about 300 feet amsl. The aircraft had descended into the ground when flying slightly left wing low on a heading of 240° magnetic; when it made contact the aircraft was travelling down the slope of a 550 feet ridge of hills, the crest of which was 700 metres astern. This first impact removed the left wing tip fairing and the pitot head, damaging the structure sufficiently to fracture one of the cabin side windows. The outboard underside of the wing, including the aileron and the flap hinge brackets and the main landing gear doors scraped and gouged the earth.

Following this initial impact the aircraft rolled over to an inverted attitude before striking the ground about 30 feet lower down in the claypit and approximately 73 metres further along its track. The inverted aircraft slid along the ground and struck a large pile of logs before continuing across a road and coming to rest in a brook about 125 metres from its first point of impact. The aircraft caught fire on striking the logs and a fierce fire, which continued to burn in the brook, consumed the cabin and much of the airframe. At impact the landing gear and wing flaps were retracted and the air-speed was assessed as being consistent with cruising flight. Propeller slash marks on the ground and damage to the propeller blades indicated that the engine was developing power at impact. The intensity of the post impact fire was indicative of an appreciable quantity of fuel remaining.

1.12.2 *Wreckage*

1.12.2.1 *General*

On site examination and post salvage detailed inspection of the wreckage did not reveal any evidence of pre-crash mechanical failure or defect. Sufficient of the airframe extremities were recovered to preclude any pre-crash airborne detachment.

1.12.2.2 *Cockpit area*

The cockpit area was severely disrupted during the impact sequence and suffered further damage during the ground fire. Radio, avionic equipment and electrical switches were also severely damaged or destroyed; the following summarises the only useful and relevant information which was retrieved from this area:

Radios

VHF Comm	“Comm A”: 124.75 Mhz set and selected. “Comm B”: 118.57 Mhz set King KX 175B Single channel Comm and single channel NAV switched ‘on’. Comm frequency selected: 124.75 Mhz NAV selected: 114.4 Mhz
M.F. Nav	King KR 85 Automatic Direction Finding (ADF) Switched to “OFF”
Engine Ignition:	Switched to “Both”
Gyroscopic instruments:	The suction driven artificial horizon and the electrically driven turn coordinator instrument rotors were turning at impact
Fuel selector:	“Left tank”
Flying controls:	The left hand control wheel right hand grip had fractured and the fore and aft torque tube had fractured 15 cm forward of the right hand wheel. The left hand limb of the main fore and aft pivoting “T” assembly had broken off at its attachment to the central member. The right hand control wheel and its fore and aft torque tube were intact although the tube had become detached from the “T” assembly at the universal joint.
Elevator trim:	It was not possible to establish the elevator trim position.

1.12.2.3 *Power plant and propeller*

The propeller had separated from the engine during the impact sequence. The nature of the damage to the blades and the slash marks on the ground were indicative of it being driven under a degree of power at impact. A partial strip examination of the engine and its accessories did not reveal any evidence of mechanical failure. The engine control settings as found were considered unreliable as indications of pre-impact settings because all were of the direct mechanical cable type and would probably have moved during engine-fuselage separation.

1.12.2.4 *Fuel and fuel system*

A fuel sample could not be recovered from the wreckage but a sample was obtained from the point of last fuel uplift, Blackbushe, where 45 imperial gallons (IG) of 100LL AVGAS were supplied on the day before the accident. Analysis of this sample showed it complied with specification requirements. The total fuel capacity of the Rockwell Commander 114 is 58 IG of which 56 IG are useable. On the basis of the quantity uplifted at Blackbushe it is estimated that the tanks had been fully replenished before proceeding to Exeter. The aircraft was not refueled at Exeter.

The fuel tanks ruptured at impact and the fuel selector valve was found set to the left tank. The mechanical fuel pump drive was still intact and the pump was found to be still capable of pumping fuel.

1.13 Medical and pathological information

Post mortem examination indicated that in all cases death was instantaneous and caused by gross multiple injuries when the inverted aircraft struck the logs. Tests for alcohol, drugs and carbon monoxide were negative and there was no evidence of pre-crash incapacity or pre-existing disease. There was, however, pathological evidence that the occupant of the front right hand seat sustained a fractured thigh bone a brief period before the immediately fatal injuries. Medical opinion suggests that it could have occurred when the aircraft struck the lip of the claypit a few seconds before the final impact.

1.14 Fire

There was no evidence of airborne fire. The ground fire started when the aircraft struck the pile of timber and the released fuel ignited. The fire continued to burn until it was extinguished by a Fire Brigade unit from Bedminster which arrived on the scene approximately 10 minutes after the crash.

1.15 Survival aspects

The accident was non-survivable.

1.16 Tests and research

None.

1.17 Additional information

1.17.1 *Navigational data (see Fig. 1)*

The direct track between Exeter and Leicester 038° (T) crosses the Mendip Hills which lie roughly WNW/ESE with a spot height of over 1,000 feet directly on track; since these hills were covered in low cloud at the time of the flight it would have been necessary to deviate to the west in order to maintain visual contact with the ground. In these circumstances the most plausible track made good from Exeter would have roughly followed the M5 motorway to approximately abeam Clevedon from where the aircraft is thought to have turned eastwards on to its final observed track of about 108° (T) as it approached and passed over North Wick village. The time necessary to fly this route and circle Maes Knoll hill was calculated at 23 minutes, assuming a wind velocity at 1,000 feet of 260/20 knots, temperature +15°C an indicated airspeed using 65% power of 138 knots (Operator's Handbook) and a True Air Speed (TAS) of 140 knots.

The track distance to abeam Clevedon was taken as 50 nm, and the calculated ground speed and time to abeam Clevedon was 155 knots and 19.5 minutes respectively. This left a distance and time to run to the accident site as approximately 10 nm and 3.5 minutes.

The total computed airborne time was taken as 23 minutes; this is in agreement with the total flight derived from the actual departure time and the assumed time of the accident based on emergency telephone calls. The estimated ground speed on an impact heading of 240° (m) was 120 knots (with a 20 knots headwind).

1.17.2 *Interpretation of impact information*

The energy required to move the large stack of timber and severely damage the aircraft structure was clearly indicative of high forward speed at impact. The distance between the propeller slash marks indicate that the ground speed at impact would have been approximately 110 to 120 knots. On the assumption that the flight path from the edge of the quarry to the quarry floor approximated to a ballistic trajectory, bearing in mind that a 180° roll was completed during that time, it is possible to calculate a rate of descent at the time the aircraft struck the edge of the quarry. Since the ground contact area was confined to within 5 feet of the quarry's edge, and that it was a relatively light "brush" contact, it might also be assumed that the first impact did not significantly retard the rate of descent. The rates of descent indicated from these calculations were 1,350 to 1,600 feet per minute.

1.17.3 *Final flight path before initial impact (see Fig. 2)*

Based on meteorological observations at Lulsgate the aircraft would not have flown higher than 800 feet amsl if visual contact was being maintained whilst approaching North Wick village from the west. To have arrived at the initial point of impact with the edge of the quarry at 300 feet amsl on a heading of 240° (M) from where it entered cloud on an easterly heading approximately one mile south of the quarry, the aircraft would have had to cross a ridge approximately 550 feet amsl or Maes Knoll, 650 feet amsl. Assuming that the aircraft was at least 700 feet amsl as it circled to its left, it had to lose about 400 feet of height in a horizontal distance of some 4,900 feet from Maes Knoll or 2,950 feet from the ridge whilst travelling at 120 knots (202 feet per second) in order to have struck the edge of the quarry; this is equivalent to a rate of descent of at least 1,000 feet per minute (fpm) had it cleared Maes Knoll by 50 feet or 1,230 fpm had it cleared the ridge by a similar margin. Had the descent commenced from 800 feet the resulting rates of descent would have been 1,200 and 2,000 fpm respectively.

2. Analysis

- 2.1 There is no evidence that the accident was caused by any defect or malfunction of the aircraft, its engine or any systems during the course of its flight.

The Swiss pilot-in-command, assisted by his British colleague who had similar flying qualifications, intended to proceed at low altitude, below cloud and avoid the high ground which lay directly on their route to Leicester. Without a detailed route forecast and because of their limited experience of low level navigation in the United Kingdom, they probably underestimated the potential dangers especially since they had some experience of flying in mountainous country. The Area forecast, which was read to them by the duty meteorological officer at Exeter aerodrome, included the information that there was extensive low cloud which covered all high ground. They were also warned that VFR flight to Leicester was “not on” by the same officer who, although not qualified as a pilot, was sufficiently experienced to be aware of the nature of the terrain together with knowing the existing weather conditions. The decision to continue with the flight was probably influenced by the relatively good conditions reported for Birmingham and those which existed at Exeter. Nonetheless, it appears in retrospect, that the prudent course would have been to postpone or cancel the departure.

After becoming airborne the aircraft encountered low cloud covering the Mendip Hills, then increasing cloud cover associated with a lowering base and rain over the Bristol Channel would have made low level navigation hazardous because the Severn Road Bridge was probably at least partially obscured at the time. Instead of returning when these conditions were encountered the evidence suggests that they attempted to circumnavigate the Bristol conurbation to the east at low altitude through a gap in the hills; during this manoeuvre the aircraft, at an altitude of not more than 800 feet amsl, entered cloud with poor visibility beneath whilst flying towards a valley.

The aircraft then turned through about 220° to the left whilst in cloud and struck the ground on the down-slope leading away from a 550 feet high ridge which was covered in cloud. Calculations and operational analysis indicates that the ground speed was approximately 120 knots, the TAS was about 140 knots and the rate of descent was about 1,500 to 1,600 feet per minute when it struck the edge of the claypit.

It is likely that the pilot, on entering cloud, decided to turn back. What is not clear is why the aircraft lost height during the turn to the left and struck the ground. Two possible causes for the relative high rate of descent are suggested; firstly, it is possible that height was deliberately lost in an attempt to regain visual contact with the ground or, alternatively, the height loss was inadvertent because the pilot was not qualified or experienced in instrument flying. There is insufficient evidence to indicate which of these two possibilities would be the most likely reason for the descent, but it is relevant in this context that there would have been moderate to severe turbulence close to the ground in that area. This would have made precision flying difficult in any light aircraft, even in visual flight conditions. To achieve an accurate turn onto a reciprocal heading in the existing conditions would have taxed the skill of a trained and experienced instrument pilot. The pilot of HB-NCM could not be thus described.

3. Conclusions

(a) *Findings*

- (i) The aircraft was airworthy, it was correctly loaded and there were no pre-crash failures or defects.
- (ii) The pilot-in-command was flying the aircraft from the left hand seat, he had a valid licence and he was medically fit.
- (iii) No route forecast for the flight to Leicester was requested or provided but the weather conditions contained in the South Western England Area Forecast were known to the pilot-in-command and the other pilot before take off.
- (iv) The pilot-in-command, assisted by the pilot in the right hand seat was attempting to navigate by map reading at low altitude in poor weather; radio navigational aids were not being used.
- (v) At the time of the accident the weather conditions existing in the Bristol area precluded safe navigation under visual flight rules at low altitude.
- (vi) Low cloud, poor visibility and moderate to severe turbulence existed over the hills near the scene of the accident.
- (vii) Whilst flying towards a valley the aircraft entered cloud, it turned left, descended and struck the ground at a rate of approximately 1,500 to 1,600 feet per minute; existing conditions of cloud cover would have required the turn to be made by reference to flight instruments.
- (viii) The pilot-in-command was neither qualified to fly on instruments nor had he received any formal tuition in instrument flight.

(b) *Cause*

The accident was caused by the pilot continuing the flight over hilly terrain at low altitude after encountering adverse weather conditions.

J S OWEN
Inspector of Accidents

Accidents Investigation Branch
Department of Trade
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