TRANSPORT ACCIDENT INVESTIGATION COMMISSION TE KOMIHANA TIROTIRO AITUA WAKA

AIRCRAFT ACCIDENT REPORT

No. 89-066

BRITTEN NORMAN BN2A-26 ISLANDER, ZK-EVK

NEAR BLUE DUCK GLACIER, UPPER DART VALLEY

8 August 1989

Transport Accident Investigation Commission
Wellington • New Zealand

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Transport Accident Investigation Commission
Wellington

Chief Commissioner
Transport Accident Investigation Commission

The attached report summarises the circumstances surrounding the accident involving Britten Norman BN2A-26 Islander aircraft ZK-EVK at Blue Duck Glacier, Upper Dart Valley on 8 August 1989 and includes suggested findings and safety recommendations.

This report is submitted pursuant to Section 8(2) of the Transport Accident Investigation Commission Act 1990 for the Commission to review the facts and endorse or amend the findings and recommendations as to the contributing factors and causes of the accident.

4 December 1991

R CHIPPINDALE
Acting Chief Executive

APPROVED FOR RELEASE AS A PUBLIC DOCUMENT

9 December 1991

M F DUNPHY
Chief Commissioner

AIRCRAFT:	Britten Norman BN2A-26 Islander	**OPERATOR:**	Aspiring Air Limited
REGISTRATION:	ZK-EVK	**PILOT:**	Mr P W Campbell
PLACE OF ACCIDENT:	Near Blue Duck Glacier, Upper Dart Valley	**OTHER CREW:**	Nil
DATE AND TIME:	8 August 1989 Approximately 1035 hours	**PASSENGERS:**	Nine

SYNOPSIS:

The Office of Air Accidents Investigation was notified of the accident at 1320 hours. Mr D.G. Graham was appointed Investigator in Charge and commenced the investigation later that afternoon. ZK-EVK departed from Wanaka on a VFR scenic flight to Milford Sound but failed to arrive. Wreckage from the aircraft was subsequently located on steep snow covered mountainous terrain at elevations up to 5400 feet. Following initial impact, major portions of the aircraft, including the fuselage, had fallen over precipitous bluffs. The pilot and the nine overseas tourists on board all received fatal injuries in the accident.

1.1 HISTORY OF THE FLIGHT:
See page 4.

1.2 INJURIES TO PERSONS:
Pilot: 1 Fatal
Pax: 9 Fatal

1.3 DAMAGE TO AIRCRAFT:
The aircraft was destroyed

1.4 OTHER DAMAGE
Nil

1.5 PERSONNEL INFORMATION:
See page 6.

	Flight Times	
	Last 90 days	Total
All Types	152	1063
On Type	12	12

1.6 AIRCRAFT INFORMATION:
See page 7.

1.7 METEOROLOGICAL INFORMATION:
See page 9.

1.8 AIDS TO NAVIGATION:
Not Applicable.

1.9 COMMUNICATIONS:
See page 13.

1.10 AERODROME: INFORMATION:
Not Applicable

1.11 FLIGHT RECORDERS:
See page 14.

1.12 WRECKAGE AND IMPACT INFORMATION:
See page 14.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION:
See page 20.

1.14 FIRE:
No fire occurred.

1.15 SURVIVAL ASPECTS:
See page 20.

1.16 TESTS AND RESEARCH:
See Page 21.

1.17 ADDITIONAL INFORMATION:
See page 22.

1.18 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES:
Nil

2. ANALYSIS:
See page 24.

3. FINDINGS:
See page 30.

OBSERVATIONS:
Nil

4. SAFETY RECOMMENDATIONS:
See Page 31.

5. REGULATORY:
See Page 32.

* All times in this report are NZST (UTC + 12 hours)

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 On the morning of the accident the pilot, who was in regular employment with Aspiring Air Limited, had flown the Company's Britten Norman Islander aircraft ZK-EVK from Wanaka to Queenstown with a load of eight passengers. He had left Wanaka at approximately 0820 hours and landed at Queenstown at 0843 hours. During the period of some 25 minutes spent on the ground at Queenstown, the pilot exchanged courtesies with several staff working in various capacities at the airport before leaving to return to Wanaka. ZK-EVK departed the Queenstown area at 0916 hours and arrived back at Wanaka at approximately 0940 hours. Both flights proceeded uneventfully.

1.1.2 Eighteen members of an organised ski-tour group travelling through various areas of South island had elected to fly to Milford Sound as a part of their sight-seeing activities. Accordingly Aspiring Air Limited had arranged for the two Islander aircraft of their fleet (ZK-EVK and ZK-EVO) to be available for the flight, each aircraft to carry a full complement of nine passengers. The passenger load in ZK-EVK included four Canadian men and one Canadian woman and four men from the United States of America.

1.1.3 The group members were already at Wanaka Aerodrome when ZK-EVK returned from Queenstown. After taxiing to the apron and shutting down both engines the pilot went to the Aspiring Air office where he completed and signed the load sheet which had been prepared for the flight to Milford Sound. A short time later the pilot returned to ZK-EVK, started the engines and taxiied the aircraft to the fuel bowser located adjacent to the hangar. He parked the aircraft and after obtaining the ladder kept nearby for the purpose, the pilot began the refuelling task.

1.1.4 The quantity of fuel uplifted at this time was not recorded and it was not established which of the two wing tanks was filled first. However, after one wing tank had been replenished to the pilot's satisfaction a pulley on the supply pump of the fuel bowser malfunctioned while he was refuelling the tank on the other wing. This brought the refuelling operation to a halt.

1.1.5 As a result of this occurrence, the pilot of ZK-EVK asked the pilot of ZK-EVO (the other Islander aircraft) for some assistance. After explaining that he had an asymmetric fuel load of 200 litres in one wing tank, and 80 litres in the other, the pilot requested confirmation regarding the Islander engine crossfeed procedure. He indicated that he had been shown the procedure during his recent conversion training on the aircraft type but wanted to confirm the necessary actions. The pilot of ZK-EVO reviewed the required procedure with him. He later stated "(the procedure) is pretty foolproof and Paul knew that. He just wanted to confirm it. ... There was no problem there whatsoever as far as I'm concerned". He reported that the pilot of ZK-EVK was in his normal good spirits despite the interruption to the refuelling process.

1.1.6 Following these events, the waiting passengers boarded their respective aircraft. The passengers chose their own seating positions. Which of the nine passengers on board ZK-EVK occupied the right front (co-pilot's seat) was not established. No significant baggage was carried on board either aircraft.

1.1.7 The pilot of ZK-EVK started the engines of his aircraft first and taxiied out, backtracking the sealed runway and turning at the eastern end for a take-off to the west. The subsequent take-off and climb appeared normal. When ZK-EVK had departed, the pilot of ZK-EVO taxiied out and also took off to the west, following approximately the same initial route as ZK-EVK, climbing out over Lake Wanaka, but some two to three minutes behind that aircraft.

1.1.8 The pilot of ZK-EVK contacted Queenstown Flight Service Station by radio at about 1015 hours and in accordance with standard Company procedure transmitted airborne flight details on behalf of both his own aircraft and ZK-EVO (See Section 1.9). ZK-EVK was several miles ahead of ZK-EVO. The pilot of ZK-EVO last saw ZK-EVK when it was approximately overhead Phoebe Creek, a tributary of the Matukituki River, some 35 km to the north-west of Wanaka Aerodrome. Radio communication had been established between the two aircraft and in the last known transmission from the aircraft, the pilot of ZK-EVK indicated he was "Five miles down the Dart River, from the Dart Glacier".

1.1.9 The pilot of ZK-EVO climbed his aircraft to a height of about 9000 feet over the upper reaches of the Shotover River then followed a route which passed close to, but to the west of, Mt Earnslaw. He then proceeded virtually direct to Milford Sound, flying to the north of Mt Tutoko and descending in Milford Sound. He experienced no difficulty with the weather conditions along this route. ZK-EVO landed at Milford Sound at 1055 hours.

1.1.10 The pilot of ZK-EVO was concerned that there had been no response from ZK-EVK during his attempts to continue radio communication with that aircraft over the latter part of the flight, despite calls on several different frequencies. On landing at Milford Sound he expressed his concern to the Flight Service Station (FSS) Officer on duty who initiated preliminary action for the commencement of full scale Search and Rescue operations, if the aircraft proved to be 30 minutes overdue.

1.1.11 ZK-EVK failed to arrive at Milford Sound and at 1128 hours, INCERFA action concerning the flight was commenced by Milford FSS. The Pilot of ZK-EVO took off at 1146 hours and flew back over the route he had followed. However he observed no sign of ZK-EVK and heard no emergency transmission on RTF frequency 121.5 mHz, before being obliged to return to Milford Sound.

1.1.12 The Rescue Coordination Centre (RCC) in Wellington had been advised that ZK-EVK was missing and the RCC was declared open at 1140 hours. An RNZAF F27 aircraft, based in Christchurch, was tasked to carry out an electronic search at high level covering the area from Milford Sound to the Dart River. At the same time an Aerospatiale AS350B Squirrel helicopter ZK-HMY, was tasked to undertake a low level electronic search over the same area. Arrangements were also put in hand for an RNZAF Iroquois helicopter to proceed from Christchurch to the search area with medical and support personnel.

1.1.13 Queenstown and Milford FSS officers requested various aircraft about to depart, or already airborne and operating within the surrounding area, to listen out on 121.5 mHz. At 1153 hours, a scenic operator advised that he

had received a strong emergency locator transmission signal while flying in the vicinity of the head of the Rees Valley. The emergency signal was subsequently picked up by the helicopter engaged on the low level search and at 1312 hours the wreckage of ZK-EVK was sighted on snow slopes and steep bluffs close to the Blue Duck Glacier on the side of a confined valley adjoining the upper reaches of the Dart River.

1.1.14 Initial observations from ZK-HMY suggested that all the occupants of ZK-EVK had perished at the time of the accident. A subsequent survey by Police and medical personnel on board another helicopter which reached the accident site at approximately 1356 hours confirmed that there were no survivors.

1.1.15 The accident took place in daylight at about 1035 hours. The accident site was on the steep snow covered slopes on the western side of the Blue Duck Valley in Mount Aspiring National Park at an elevation of approximately 5400 feet. Grid reference 378344 NZMS 1 Sheet S114 "Earnslaw". Latitude 44°30'S, longitude 168°29'E.

1.5 Personnel information

1.5.1 The pilot in command, Paul William Campbell, 21, had grown up near Wanaka. He commenced flying training at Wanaka in December 1984 and had obtained a Private Pilot Licence — Aeroplane in January 1986. Continuing his flying training in the Wanaka area, he had passed the flight test for a Commercial Pilot Licence — Aeroplane (CPL A) on 24 March 1987. Shortly afterwards he had commenced employment as a pilot with Aspiring Air Limited, based at Wanaka Aerodrome. He held CPL A number 4961, first issued on 16 April 1987.

1.5.2 On 17 April 1987 Mr Campbell had flown with an approved instructor and had been checked out in accordance with the Civil Aviation Regulations, for air transport operations at Milford Sound Aerodrome and over the route from Wanaka to Milford Sound and return. The following day he had commenced tourist flights on this route. He had subsequently flown from Wanaka to Milford Sound and return on a regular basis, flying a variety of single engined Cessna passenger aircraft over the route.

1.5.3 Mr Campbell had completed a Regulation 76 check satisfactorily on 11 April 1988, with the Managing Director of Aspiring Air Limited who was the company's approved check pilot. In October 1988 he obtained a category "C" Instructor Rating and subsequently interspersed occasional instructional flights with his regular scenic and charter flying.

1.5.4 During May 1989, Mr Campbell undertook an instrument flight training course and passed the flight test for the issue of a Class 1 Instrument Rating on 23 May 1989. The rating was endorsed "Not valid for multi-engine aeroplanes".

1.5.5 On 20 July 1989 Mr Campbell commenced a multi-engine rating in Britten Norman Islander BN2A-26 ZK-EVK which was owned and operated by Aspiring Air Limited. In the process of completing this rating he flew a total of 5.1 hours dual and 0.3 hours solo in ZK-EVK and 0.3 hours solo in a similar Islander aircraft, ZK-EVO, also owned and operated by Aspiring Air Limited. He had completed the minimum requirements for the initial issue of a multi-engined aeroplane type rating (5 hours) and the required number of take-offs

and landings as pilot in command by 24 July 1989. His first passenger carrying flight was in ZK-EVO on 1 August 1989 and on 4 August, 7 August and during the early morning of 8 August, he flew ZK-EVK on passenger operations. With the exception of one flight in ZK-EVK on 4 August to Christchurch, returning via Cromwell, all his flights in the Islander aircraft were from Wanaka to Queenstown and return. The accident flight comprised the heaviest take-off load of his recorded passenger flights, and was his first flight on the Wanaka-Milford Sound route in the Islander Aircraft.

1.5.7 Mr Campbell's total time on multi-engine aircraft, amounted to a little over 12 hours (including the accident flight), accumulated solely on the BN2A-26 Islander type. About 7 hours had been flown as pilot in command with 6 hours of this time flown on ZK-EVK. All of Mr Campbell's multi-engined experience was obtained within the period of three weeks immediately preceding the day of the accident.

1.5.8 Mr Campbell's total flying hours amounted to 1063 hours. This included 140 hours dual and 908 hours as pilot in command of single engined aircraft by day, with 2.6 hours dual at night. He had recorded 4.6 hours actual, and 44.85 hours simulated instrument flight time. His flying hours as an Instructor amounted to 176 hours.

1.5.9 A review of Mr Campbell's Pilot Logbook showed that from 18 April 1987 to 3 August 1989 (inclusive) he had made 93 flights, direct from Wanaka Aerodrome to Milford Sound and return. Thirteen of these flights were made within the 90 days preceding the accident.

1.5.10 Within this 90 day period Mr Campbell had flown a total of 24.1 hours dual and 127.95 hours as pilot in command. 50.3 hours had been flown on instructional duties. 2.6 hours actual and 17.9 hours simulated instrument flight time had been recorded in this period.

1.5.11 After Mr Campbell's last medical examination for the renewal of his CPL A in February 1989 he was assessed fit for the subsequent 12 month period. The Validity Certificate associated with his CPL A was valid from 19 February 1989 to 18 February 1990.

1.6 Aircraft information

1.6.1 The Britten Norman BN2A series "Islander" was a twin engined, high wing, light transport aircraft of conventional design, fitted with a fixed tricycle undercarriage and capable of seating up to 10 persons including the pilot. ZK-EVK a BN2A-26 version, serial number 583, was manufactured in 1977 and had been formerly operated on the United States Register as N29MN. Designation of the aircraft as a BN2A-26 indicated that it was derived from the basic BN2A-8 Islander type (incorporating 260 horsepower engines, wing leading edge and flap droop) but included additional channel assemblies on the engine firewalls allowing an increase in its maximum operating weight.

1.6.2 Aspiring Air Limited arranged purchase of the N29MN aircraft from the overseas operator in the United States and on 4 March 1988 an Export Certificate of Airworthiness (C of A) was issued by the Federal Aviation Administration of the United States Department of Transportation. The aircraft was subsequently fitted with a ferry fuel tank installation and flown to New Zealand. It had been operated extensively in Alaska and at the time of importation

had accumulated a total airframe time of 8166 hours. The total number of landings was unknown.

1.6.3 Following importation a comprehensive inspection was completed in New Zealand in accordance with the Britten Norman 1000 hour inspection/ major inspection schedule. Various additional modifications and special inspections were carried out to satisfy the requirements for a New Zealand C of A. The aircraft was inspected by an Airworthiness Surveyor of the Civil Aviation Division of the Ministry of Transport in July 1988 and a C of A in the Standard Category was issued, valid from 28 July 1988. This C of A was non-terminating provided that the aircraft was inspected in accordance with the Britten Norman Islander Maintenance Schedule.

1.6.4 ZK-EVK commenced service with Aspiring Air Limited at Wanaka in the latter part of 1988 and was routinely maintained as was required in accordance with the Manufacturer's Schedule. In February 1989, following an in-flight engine failure, the right engine was removed and Lycoming IO-540-E4C5 engine serial number 11742-40 was installed. During April 1989, the left engine was removed and replaced by Lycoming IO-540-E4C5 engine serial number 10284-40. Between 14 April 1989 and 3 August 1989 the vacuum pump on the right engine was replaced three times. A new vacuum pump was installed on the left engine on 3 August 1989. No other significant defects in relation to the operation of the engines were reported during flight, or disclosed in the 50 hourly and 100 hourly inspections carried out in the period preceding the accident.

1.6.5 The most recent inspection of ZK-EVK comprised a combined 50 hour, 100 hour and Annual Inspection completed on 3 August 1989. The aircraft's total airframe time amounted to 8350 hours, of which 184.8 hours had been flown in New Zealand. Respective times on the engines and propellers as at the date of this inspection were:

Left engine:	Total time not known, Time since overhaul 412 hours
Right engine:	Total time 3947 hours Time since overhaul 549 hours

Both propellers were Hartzell HC-C2YR-2CUF:

Left propeller:	Hub serial number AU7264 Time since overhaul 962 hours
Right propeller:	Hub serial number AU6592 Time since overhaul 916 hours

1.6.6 Prior to the inspection a pre-check engine run was carried out. This check included vertification of satisfactory operation of the fuel cock selectors and of fuel crossfeed. The left engine "suction" system was found to be inoperative and was rectified by replacement of the engine driven vacuum pump. No other defects were found and the post check engine run indicated that all systems were operating as required. Due to the staggered times at which the engines had been installed and the respective hours accumulated, the left engine and propeller were inspected in accordance with the 100 hourly inspection schedule while the right engine and propeller were the subject of a 50 hourly inspection. The airframe inspection included replacement of the

right mainwheel brake linings, a required special inspection of the elevator trim tab, and checking of a worn but serviceable aileron balljoint, together with inspection and repair as appropriate of minor cracking noted at the left wingtip and an inspection panel. Minor cowl repairs were also carried out.

1.6.7 Aspiring Air Limited had recently received approval from the Air Transport Division of the Ministry of Transport for the introduction of 4 monthly Maintenance Release periods and this new arrangement was in the process of implementation. A new Maintenance Release had not been issued at the time of the latest inspection on ZK-EVK as it was conducted within the previous 4 month period and some items of the maintenance schedule remained to be completed. Following the inspection an Aircraft Annual Inspection report was forwarded to the Air Transport Division, as required, certifying that ZK-EVK and its instruments and equipment were serviceable and that the aircraft was fit to return to service.

1.6.8 ZK-EVK was returned to service on 4 August 1989 and had flown each day on charter and scenic operations until the accident intervened. In addition to flights carried out by Mr Campbell ZK-EVK was flown during this period by two other pilots, one charter totalling 2.9 hours being conducted by the Chief Pilot of Aspiring Air Limited. There were no reported defects, handling difficulties or unusual characteristics in relation to the operation of the aircraft, its engines or systems. At the time of the accident ZK-EVK had accumulated approximately 10 hours flight time since its last inspection.

1.6.9 The total fuel load on board ZK-EVK prior to take-off was 280 litres. At the time of the accident a total of approximately 70 litres would have been consumed. The Load Sheet indicated the actual take-off mass of ZK-EVK as 2851 kg (Maximum Permitted Take-off Mass 2994 kg). The estimated mass at the time of the accident was 2800 kg with the centre of gravity (CG) approximately 533.5 mm (21.0 inches) aft of the datum. The CG aft limit was defined as 650 mm (25.6 inches) aft of the datum with the forward limit varying from 431.8 mm (17.0 inches) to 533.5 mm (21.0 inches) aft of the datum according to the all-up mass of the aircraft. At 2800 kg the forward limit was approximately 508 mm (20 inches).

1.7 Meteorological information

1.7.1 The General Aviation weather forecast for South Island, valid from 0700 hours to 1800 hours NZST on the day of the accident contained the following information (reproduced in part only):

> ***"Situation:***
> Slow moving front from Southland to west of Buller is expected to weaken during the day. Moist northerly airstream onto the South Island.
>
> ***Forecast Weather***
> Westland Fiordland. Occasional rain/drizzle easing this morning in Fiordland and afternoon in Westland to scattered light showers. Areas broken stratus 600 in rain, broken cumulus/strato cumulus 2000 tops 8000 areas broken alto cirrus/alto stratus above 7000.
>
> ***Visibility***
> 50 km down to 500 m in fog. Visibility reduced to 1000 m at times in rain Westland this morning and 4000 in Fiordland.

Ice
Occasional moderate ice above 8000 about and west of the main divide and about Southland. Clearing slowly during the day.

Turbulence
Occasional moderate turbulence below 10000 feet south of Dunedin to Queenstown . Easing slowly during the day.

Freezing Level
7500.

Winds at 0600 hours (E means estimated)

	3000 feet	5000 feet	7000 feet	9000 feet
Hokitika	340°/15 kts E	340°/20 kts E	340°/20 kts E	330°/25 kts E
Dunedin	330°/24 kts E	340°/20 kts E	330°/20 kts E	320°/25 kts E
Invercargill	330°/14 kts E	330°/11 kts E	320°/24 kts E	320°/33 kts E

Forecast
Little change."

1.7.2 The General Manager of the New Zealand Meteorological Service in an "aftercast" of the weather situation on the day of the accident, provided the following details:

"At 0600 hours on 8 August 1989 an anticyclone was centred to the south-east of Chatham Islands and a small depression near Campbell Island was moving quickly south-east. A weak cold front associated with this depression lay from near Invercargill to Haast. This front moved steadily eastwards during the day and by 0900 hours lay from near Dunedin to south of Hokitika and was already east of Wanaka.

The front brought a period of heavy rain to Haast prior to 0600 but there were only light falls east of the main divide. Behind the front the airflow was a moderate north-westerly. Undisturbed winds in the range 5000 to 8000 feet amsl would have been from about 300 degrees at between 20 and 25 knots. However, close to the mountains, the wind flow would have been distorted with speeds probably increasing to 30 to 35 knots in places. There would have been some turbulence but I do not expect it would have been more than moderate. As the ridge line was oriented south-west to north-east, i.e. approximately at right angles to the wind flow, it is likely that there were moderate downdraughts also in the lee.

About and west of the main divide there was probably broken cumulus and stratocumulus with main bases between 3000 and 5000 amsl and tops 8000 to 10000 feet. The radiosonde flight done at Invercargill at 1100 hours showed the air was potentially unstable, but was probably too dry to promote widespread cumulonimbus development. However, Invercargill reported a few cumulonimbus tops to the far north-west at 1000 and Hokitika reported one octa cumulonimbus during the afternoon in the post-frontal air. East of the divide only scattered cumulus was likely with bases about 5000 feet amsl. Above there was also some scattered altocumulus at 13000 to 14000 feet which dissipated during the day.

From the Invercargill radiosonde flight the temperature at 5000 feet was about 2.5 degrees Celsius and the dew point about minus 3.5 degrees. At 8000 feet they were about minus 3.5 degrees and minus 15.5 degrees respectively. The temperatures in the vicinity of the crash site in free air should not have been significantly different."

1.7.3 The pilot of Islander aircraft ZK-EVO, which departed from Wanaka shortly after ZK-EVK, subsequently landing uneventfully at Milford Sound, described conditions during the flight as follows:

"It was CAVU (ceiling and visibility unlimited) to the ridge between the Dart and the Rees Valley, because that's where the first lot of clouds started. It was broken cloud from between the Rees Valley and the Main Divide and then there was quite a layer of cloud on the West Coast. To the north of the Hollyford Valley there was quite a lot of cloud although it was broken, I would call it about 6 or 7 octas on that west side. But the Hollyford Valley itself was wide open. Milford was wide open and out to sea was CAVU again. It was totally clear, there was no cloud at all. I would say there was probably about 3 to 4 octas in the Dart Valley. The middle of the valley was wide open but there was cloud on the ridge between the Dart and the Rees and there was cloud pushing over a wee bit from the west ..."

In regard to cloud cover in the particular area of the accident site, the pilot commented:

"... There was cloud on the Main Divide ...It looked as if it was coming down in to those valleys. You could see on to the Dart Glacier, so I can only presume that it was not pushing in there."

The pilot described wind conditions over the route as follows:

"... There was wind there. I could tell that because I could see snow blowing off the tops. There had been snowfalls the night before and it was light fluffy snow. I estimate the wind at only 20 knots maybe at the most at that height ..."

The pilot stated that the wind was westerly. During his flight he experienced no problem with turbulence, nor was there any indication that carburettor icing was likely to have occurred.

1.7.4 A Cessna 172 aircraft was operating in the Dart Valley some 5 to 8 nm downstream of the accident area between 1000 and 1100 hours. The pilot of this aircraft, which was being flown at low level for a Department of Conservation wildlife survey, recalled cloud along the ridges on both sides of the Dart Valley, with "thicker" cloud towards the top end of the valley. He described the cloud as broken "fair weather" cumulus, typical of the clearing conditions and estimated its extent as 3 to 4 octas from the point of view of an observer on the valley floor. Above the area of his operations there was clear blue sky with bright sun and strong shadows. He estimated that the cloud he observed would have extended from about 5000 feet to a height of some 6500 feet, but considered that cloud level and extent in the upper Dart Valley was likely to have differed from this. At the low level at which he was operating he experienced no significant down draughts or turbulence, nor any indication of carburettor icing. An observer on board the aircraft commented that the wind was "north-west" (down valley) at the time.

1.7.5 An observer in the helicopter which first located the wreckage reported that snow was being picked up off the tops and there were strong winds in the area. The wind strength and direction varied considerably at different elevations and rendered a landing impracticable.

1.7.6 Conditions in the accident area at the time of search and rescue activity some three hours after the accident were reported as: Wind approximately 10 to 15 knots from a "northerly" quarter — with some "swirling" in the snow basin. No significant downdraughts. Visibility good. The tops of the adjacent peaks were still in cloud, the lowest cloud base about 6500 feet.

1.7.7 At 0800 hours the weather conditions at Milford Sound were the subject of a special weather report (SPECI) as follows:

Surface Wind:	120°/09 knots
Visibility:	7000 m
Present weather:	Rainshowers
Cloud layers:	1 octa cumulus base 1500
	3 octas cumulus base 4500
	7 octas cumulus base 5000
QNH:	1009.1 Hpa

The special conditions ceased prior to the issue of the 0900 hours METAR.

The 1000 hours METAR for Milford Sound read as follows:

Surface Wind:	Calm
Visibility:	20 km
Present Weather:	Intermittent slight rain
Cloud Layers:	1 octa cumulus base 1500 feet
	3 octas cumulus base 3500 feet
	5 octas cumulus base 5000 feet
QNH:	1010.4 Hpa

Cloud and visibility fluctating from the north-west

The METAR for Queenstown at this time was:

Surface wind:	020°/03 knots
Visibility:	50 km
Cloud:	General dissolving or becoming less developed
	1 octa stratocumulus base 3000 feet
	4 octas altocumulus base 1300 feet
QNH:	1008.2 Hpa

1.7.8 A weather report transmitted from the Milford Sound FSS to Queenstown FSS, at 0957 hours contained the following information:

> "Weather generally okay — light intermittent rain. Just claggy Cu (cumulus cloud) holding visibility down at moment in the Sound and south-west fluctuating blue sky is visible past this in patches. Good big breaks over Lake Ada and the Airfield. Hollyford/Divide/Eglinton all open."

1.7.9 Local reports indicated that mountains above about 5000 feet near Glenorchy and in the surrounding area remained covered in cloud and mist until between 1100 and 1200 hours.

1.9 Communications

1.9.1 ZK-EVK was equipped with a King KX170B very high frequency (VHF) navigation and communication (nav/com) transceiver and a King KX175B VHF nav/com transceiver. At approximately 1015 hours, shortly after departure from Wanaka Aerodrome, the pilot utilised one of these transceivers to establish communications with Queenstown FSS on RTF frequency 128.0 mHz.

1.9.2 The exchange of communication was recorded as follows:

FROM	TO	MESSAGE
EVK	QN FSS	Queenstown Echo Victor Kilo One Twenty Eight
QN	EVK	Echo Victor Kilo go ahead
EVK	QN	Victor Kilo airborne Wanaka with ten will be Milford Sound about five seven
QN	EVK	Echo Victor Kilo copied all (QNH) one zero zero eight
EVK	QN	One zero zero eight and also Echo Victor Oscar with ten also Milford the same time
QN	EVK	Roger

No other RTF transmissions from ZK-EVK were received by Queenstown or Milford Sound FSS, nor was there any report of any further transmission on 128.0 mHz from the aircraft.

1.9.3 During the flight the pilot of ZK-EVK, Mr Campbell, established contact on RTF frequency 119.1 mHz with Islander aircraft ZK-EVO which had taken off from Wanaka Aerodrome approximately two minutes after ZK-EVK. RTF contact was established while both aircraft were climbing, with ZK-EVK several miles ahead of ZK-EVO, who was in the vicinity of Treble Cone ski field.

1.9.4 Later Mr Campbell contacted the pilot of ZK-EVO and asked, in relation to the cloud cover, what route the latter intended to follow to Milford Sound. The pilot of ZK-EVO replied that he would be "going over the top at about 9000 feet". The pilot of ZK-EVO understood from Mr Campbell's response that he also proposed to "go over the top", that is, fly a relatively direct route over the mountains rather than deviate through the various passes.

1.9.5 At the time of this conversation, which was the last known communication from ZK-EVK, Mr Campbell described the position of his aircraft as "down the Dart River, five miles from the Dart Glacier". The pilot of ZK-EVO later tried to establish contact with ZK-EVK on a variety of different RTF frequencies without success.

1.9.6 A Chief Engineer, who was working at Wanaka Aerodrome, reported that the transmissions from ZK-EVK were clearly audible on the loud speaker installed in the hangar. The Chief Engineer heard the pilot of ZK-EVO ask the pilot of ZK-EVK for his position and confirmed Mr Campbell's response that

he was "entering the Dart". He noted no urgency or stress in Mr Campbell's voice. The clarity of reception gave the impression that the aircraft was more likely to have been at altitude than in a valley situation at the time of the transmission.

1.11 Flight recorders

1.11.1 The aircraft was not fitted with a flight data recorder or a cockpit voice recorder nor were these required to be fitted.

1.11.2 Had either of these aids to any investigation been fitted it was likely that they would have provided useful information and materially assisted in the resolution of the circumstances surrounding the accident.

1.12 Wreckage and impact information

1.12.1 The wreckage of ZK-EVK was located on the steep snow covered slopes and mountain ramparts and bluffs which rose to the west above the valley of the Blue Duck River. The valley, some 3.5 km in length and oriented approximately north/south was enclosed on three sides by high mountainous terrain but was open at its southern end, falling steeply to the upper reaches of the Dart River, of which the Blue Duck River was a tributary. ZK-EVK had impacted the western slopes approximately 1 km from the head of the valley. At the elevation of the accident site the valley was some 2 km wide and correspondingly wider at a greater height, but narrowing to less than 400 m at the valley floor.

1.12.2 Towards its northern extremity, the valley floor comprised a confined but relatively level expanse of open shingle riverbed and low rock-strewn tussock flats at an elevation of 3500 feet amsl. Beyond this the valley ended abruptly in a massive cirque, bounded directly to the north by the sheer snow clad slopes of Mt Tiber (7445 feet) and Mt Amundsen (7535 feet), with a col leading to the Snowball Glaciers and the Marion Plateau situated between these two mountains at an elevation of 6800 feet amsl.

1.12.3 The slopes on the western side of the valley and to the north-west, were dominated by the shoulder ridge and peak of Mt Ian (8140 feet). The Blue Duck Glacier, an array of ice-falls and crevasses, covered the east face of the mountain, encircling the north-west slopes at the head of the valley from a few hundred feet below the peaks down to a level of about 5000 feet amsl.

1.12.4 Above the slopes on which the wreckage of ZK-EVK was located, the main ridge rose steeply to the west to a height of about 6500 feet with higher ridges, rising to more than 7500 feet and leading to Mt Ian, situated a little further to the north. Directly to the west above the accident site, the slope eased slightly between about 6000 and 6500 feet and opened onto a flatter expanse formed by the Curzon Glacier.

1.12.5 Several major components of ZK-EVK were sighted by the pilot of the searching helicopter which first identified the accident site near to the southern side of the Blue Duck Glacier a little under three hours after the occurrence of the accident. These included a major section of the wing assembly, an outboard section of wing, and the bulk of the aircraft's rear fuselage

assembly. The wing sections were partially buried in snow at an elevation of about 4700 feet amsl and had evidently slid down the steep slope from an impact point higher up, coming to rest close to the edge of precipitous bluffs. However, the fuselage was located in a snow filled gully at the base of the bluffs, some 150 m to the south and approximately 1000 feet below the slope on which the wing sections were lying.

1.12.6 When first observed, it was noted that the large section of wing lay inverted in the snow with the main undercarriage legs and wheel assemblies apparently undamaged and in their normal positions. A separated portion of the left wing was lying in the snow above the level of the main wing section. Portions of interior trim and cabin lining were scattered on the snow at elevations up to 5400 feet amsl, in the vicinity of a large impact crater which matched roughly the shape of the aircraft's wing, suggesting that the separation of the wing from the fuselage had occurred at this point. One of the aircraft's doors from the right side of the fuselage, was lying on the snow adjacent to the impact crater.

1.12.7 At the time of the accident the condition of the snow on the steep slopes above the bluffs was unstable and the impact and subsequent break-up of the aircraft had resulted in numerous minor avalanches originating from "point releases". It was evident that these avalanches had carried quantities of snow and some parts from the aircraft over the bluffs forming piles of debris on the rock and scree fans at the base of the bluffs, more than 1000 feet below and depositing items of wreckage at scattered locations over the mountainside.

1.12.8 To reduce the danger to search and rescue teams at the foot of the bluffs, avalanche control personnel were obliged to induce a further major avalanche late in the afternoon on the day of the accident. A control "bomb" was detonated at a high point up slope from the position in which the wing sections from the aircraft had come to rest. The ensuing avalanche swept these items and other debris over the bluffs up to 1200 feet further down the mountainside, joining the other scattered wreckage in the area.

1.12.9 In the area of the accident the mountainside, which had a snow grass and tussock base, interspersed with scree and rock outcrops, was covered with snow to a depth of one to three metres. The average slope varied between 50° and 70° and the steep snowface was intersected by shallow gullies and runnels which led over the edge of the bluffs below.

1.12.10 Due to the nature of the terrain, surveys of the impact area were carried out by helicopter. Aerial inspection indicated that ZK-EVK had struck the slope between 5300 and 5400 feet amsl on a south-westerly to southerly heading. The impact crater suggested that the aircraft was banked steeply to the left, possibly beyond the vertical, when it struck the snow. It was probable that the severe forces resulted in a cartwheel sequence involving separation of the outboard portion of the left wing, deformation of the right wing and complete separation of the whole wing assembly from the fuselage at the time of the initial impact. Extensive disruption to the cabin area of the fuselage was likely to have occurred during the impact sequence.

1.12.11 As a consequence of the steepness of the mountainside, the angle at which the aircraft had struck the slope and its momentum, both engines together with their propeller assemblies had torn from their mountings and lofted over the slope to fall into a rocky gully, impacting about 300 m to the south and some 500 feet below the initial impact area.

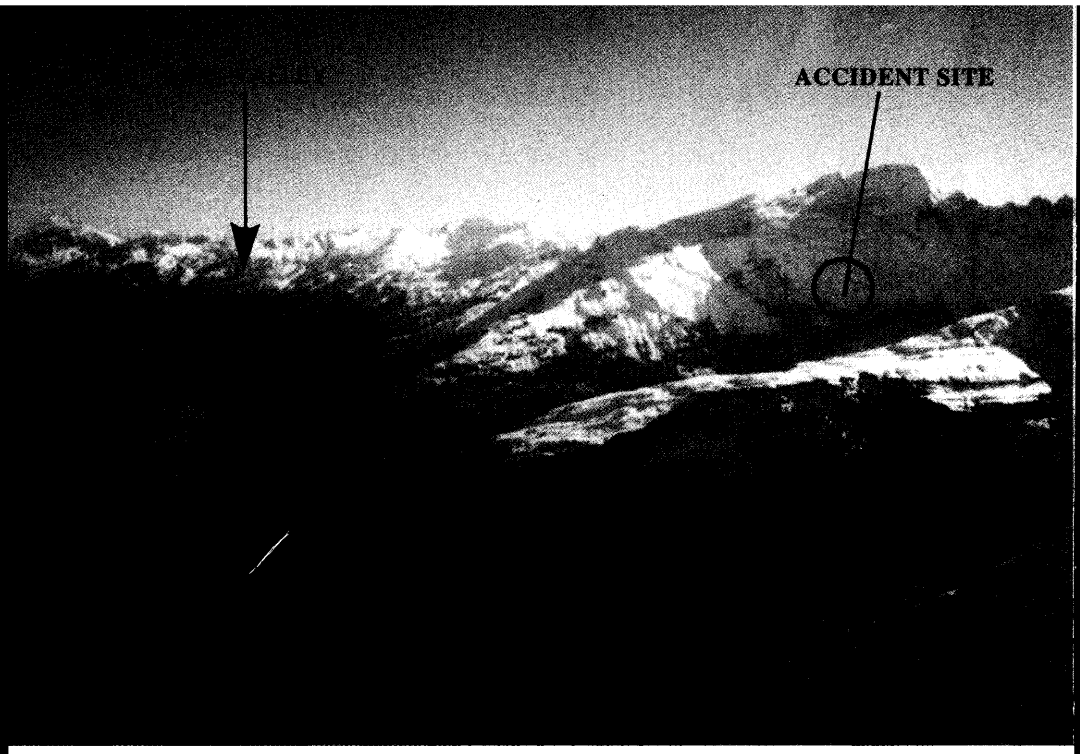
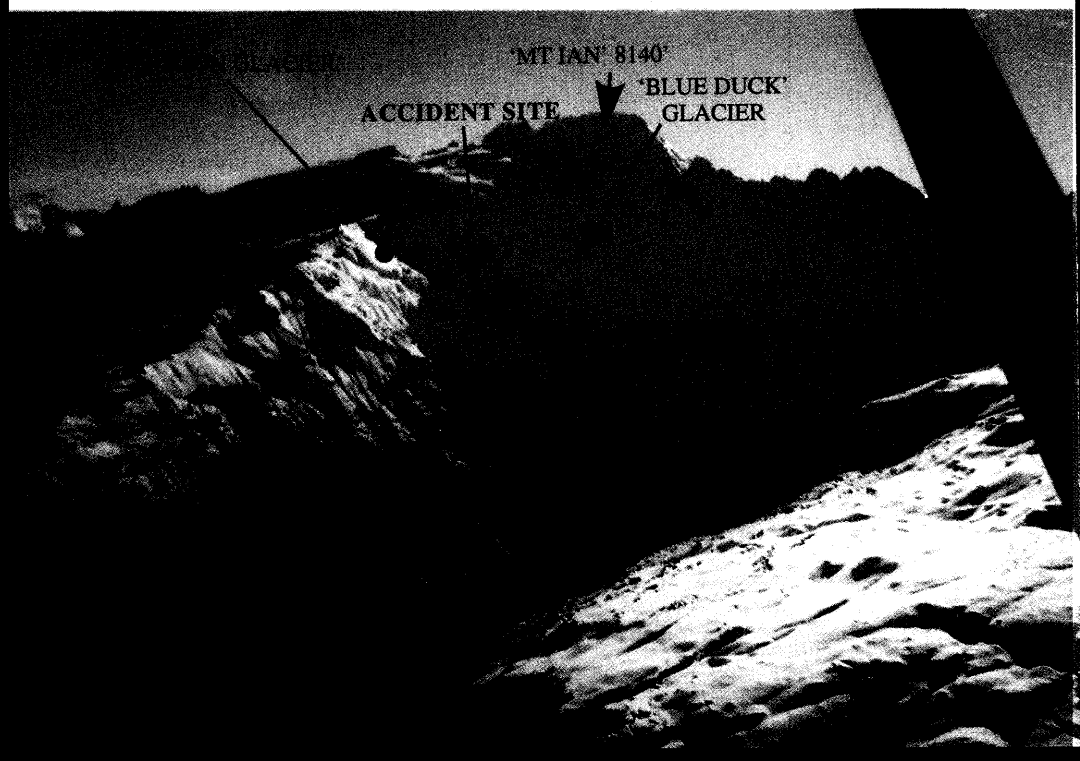


FIG 1. VIEW OF DART VALLEY — LOOKING WEST

FIG 2. BLUE DUCK VALLEY — LOOKING NORTHWEST



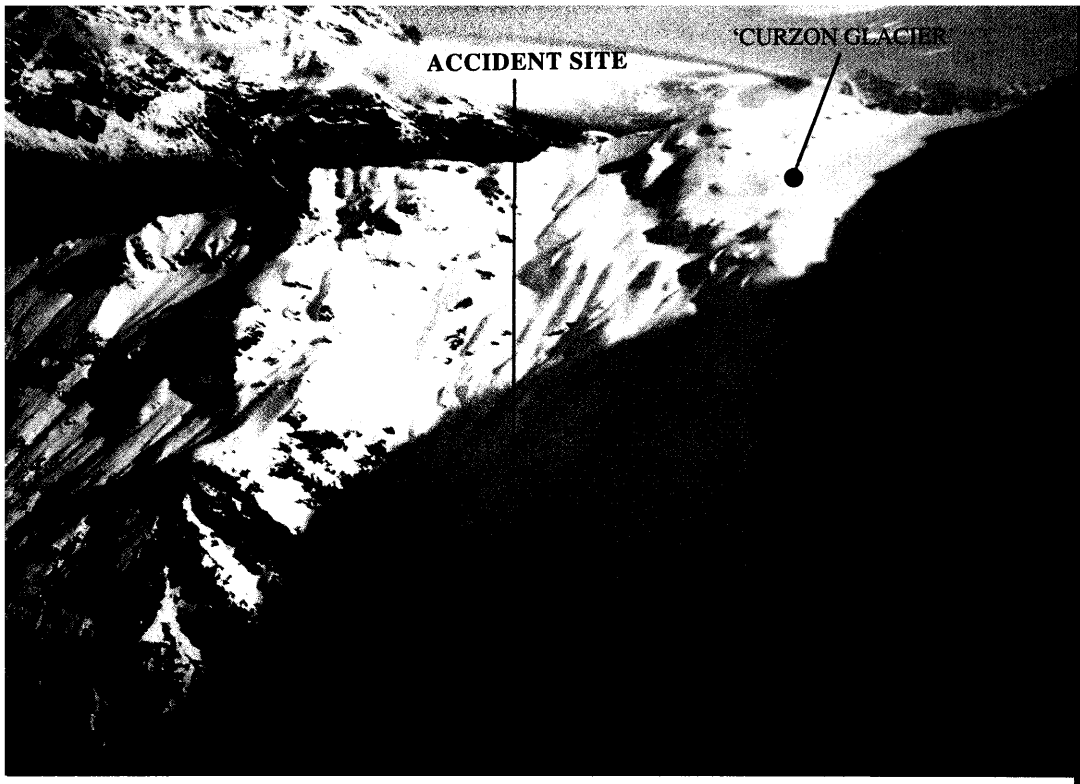
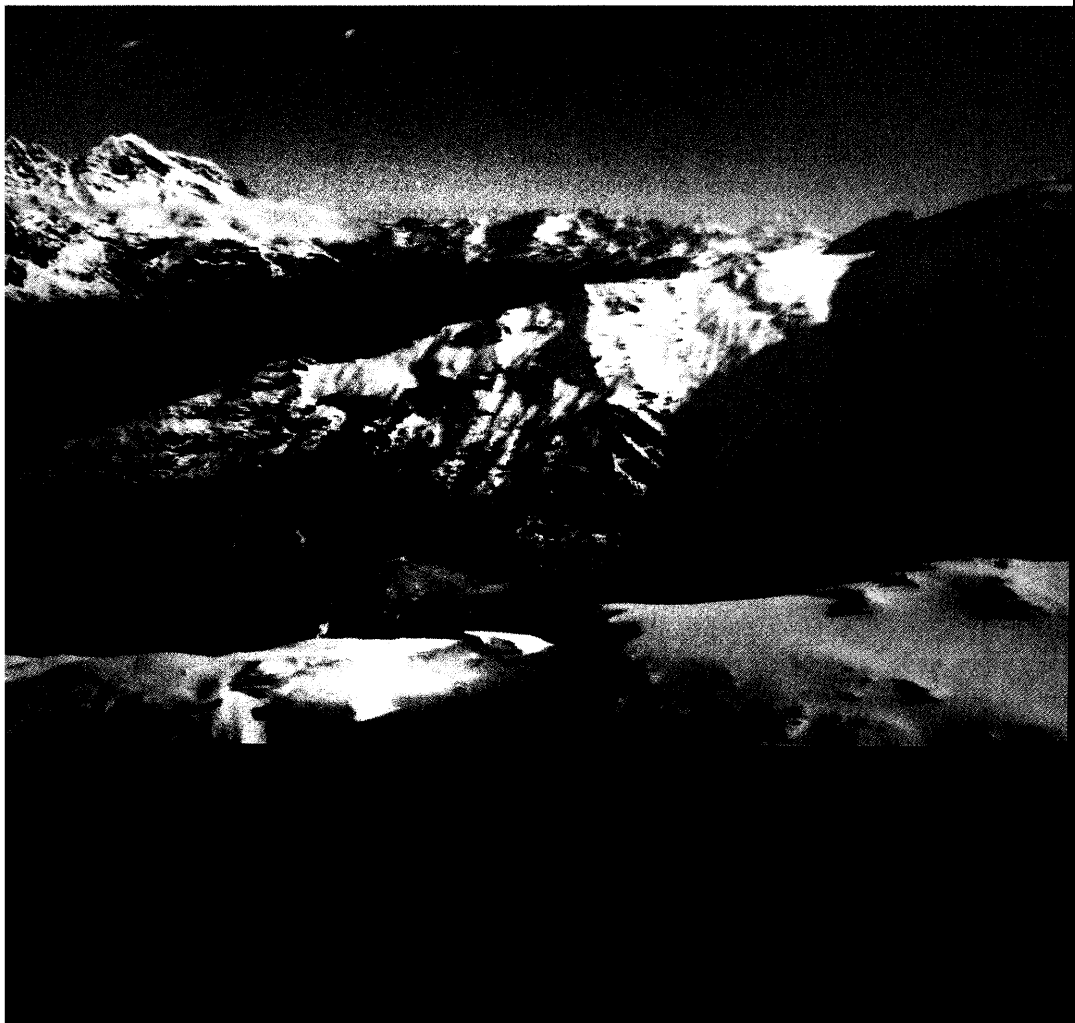


FIG 3. THE ACCIDENT AREA — VIEWED FROM THE EAST

FIG 4. APPROACHING BLUE DUCK VALLEY FROM THE EAST



1.12.12 Following separation of the wing assembly, the damaged fuselage had also lofted over the slope and struck the snow heavily about 150 m south of the wing impact crater. The fuselage had then slid down a snow runnel and had fallen over the edge of the bluffs, plunging some 1000 feet before coming to rest amidst avalanche debris at the base of a snow filled gully.

1.12.13 At the time of initial search and rescue operations the major sections of ZK-EVK were recovered by helicopter and examined as far as practicable on site, later being transported by helicopter and ground transport to a maintenance facility where further inspection was carried out. While most of the large components of the aircraft were accounted for and either recovered or observed, the extensive snow cover and difficult terrain prevented the identification or retrieval of many smaller components during the period immediately following the accident.

1.12.14 The engines and propellers had tumbled in a narrow rocky couloir and had progressively broken up during their subsequent fall down the near vertical rock faces. Portions of the engine accessories were observed scattered in various parts of the gully but it was not practicable for these items to be retrieved. The engines themselves, with parts of their exhaust systems and propeller blades were lifted out by helicopter three months after the accident. One propeller blade and a portion of hub which remained attached to it was observed in the gully and photographed but was not recovered. The recovered portions of the engines and propellers were later subjected to detailed engineering examination.

1.12.15 Two further surveys of the accident area were carried out. The first took place towards the end of September 1989 when the snow had receded sufficiently to enable location and recovery of the remaining passenger's body. Opportunity was taken at this time to locate and observe parts from ZK-EVK which had not been visible earlier. A further survey and search of the area was made at the end of January 1990 when snow levels were low. Various small parts and components were found including portions of the tailplane structure. Part of the elevator and trim tab assembly which had previously been inaccessible was retrieved and examined. Damage to the trim tab and elevator was consistent with the severe damage sustained by both sides of the horizontal tailplane during the impact sequence.

1.12.16 Although the components of ZK-EVK were recovered from scattered locations and most parts were severely damaged, a proportion of the damage occurred as a result of the steep terrain and consequent secondary impacts as the wreckage tumbled and fell over rocky outcrops and bluffs before coming to rest on the scree and tussock slopes rising from the valley floor. All major sections of the aircraft were accounted for and the positions from which they were retrieved were consistent with the probable break-up sequence. Nevertheless the non-recovery of some significant smaller components including one aileron mass balance assembly, one elevator mass balance assembly, the elevator rear bellcrank assembly and push-pull rod segments rendered it impossible to state categorically that ZK-EVK was intact before impact with the slope.

1.12.17 Examination of the outboard section of the left wing showed that the leading edge was curled downwards 90° and had been subject to severe compression. The nature of compression damage to unsupported panels in the

structure was indicative of impact with the snow. Rearwards and downwards bending suggested that initial impact was taken on the left wingtip.

1.12.18 The remains of the main wing section comprised basically the centre section and inboard structure including the left and right engine bays. It exhibited severe damage due to its fall down the mountainside but photographs taken before it was dislodged confirmed the reported position and the evidently undamaged state of both main undercarriage legs. The left wingtip was recovered at an elevation of 5300 feet and part of the right wingtip was found down the mountainside with the right navigation light assembly still intact. Failure of the wing to fuselage structural attachments showed that the wing assembly had twisted prior to separation from the fuselage and had torn out the upper fuselage longeron on the left side. The attachment fittings were torn out on the right side. The engine mounts had remained attached to the wing structure but both mounts had been significantly distorted to the right and forward (viewed from the trailing edge). This had probably occurred just prior to the separation of the engines from the mountings.

1.12.19 The flap actuator assembly was recovered essentially undamaged from the wing centre section. Its extension corresponded with the flaps "UP" normal cruising setting (6° droop) for the BN2A-26 aircraft. The actuator extension was unlikely to have been affected by impact forces and it was concluded that the flaps were "UP" when the accident occurred.

1.12.20 The aircraft's instrument panel had been destroyed by impact forces. Throttle, mixture, and pitch control positions and most switch selections were inconclusive due to the disruption that had occurred. The following observations and readings were considered as probably representative of positions/selections immediately prior to the accident.

EGT Monitor:	Left
ELT (Instrument Panel Switch):	Armed
Pitot and Stall Warning Heaters:	"OFF"
Strobe:	"ON"
Cabin Lights:	"OFF"
Electrics:	Set to "PORT" Generator
VHF No. 1:	"ON"
VHF No. 2:	Inconclusive
HF NO. 1:	"ON"
Altimeter:	Subscale set to 1007 Hpa

1.12.21 A quantity of fuel remainded in the "gascolator" for the right engine but no fuel was found in the left "gascolator". The three way fuel cock in the left wing was in the detent in the "OFF" position while the corresponding three way cock in the right wing was in the detent required to cross-feed the right engine from the left tank. The rudder trim actuator was wound to full travel. Its extension corresponded to substantial "NOSE LEFT" trim. The elevator trim was in a "NEUTRAL" setting. The elevator and rudder trims, and the positions of the three way fuel cocks were operated by a system of cables and chains. Due to the extreme disruption of the wing and fuselage structure in the accident, and the consequent tension loads on the various cables, little reliance could be placed upon the post impact positions of the trim actuators and fuel cocks as representative of their positions immediately prior to the accident.

1.13 Medical and pathological information

1.13.1 Post mortem and toxicology examination did not reveal any medical condition which was likely to have affected significantly the ability of the pilot in command to control the aircraft.

1.13.2 He was reported to be in normal health and good spirits at the time the accident flight was undertaken.

1.13.3 Pathological evidence suggested that the pilot was holding the control column and his feet were on the rudder pedals at the time of initial impact.

1.13.4 The pilot, who had been a smoker but had relinquished the habit, had a carbon monoxide blood saturation level of 8%. The passengers' levels of carbon monoxide blood saturation was approximately 5%.

1.13.5 Pathological examination showed that all occupants of the aircraft sustained essentially similar major injuries, indicative of the severity of initial impact.

1.15 Survival aspects

1.15.1 The impact marks on the snow slope, the damage to the fuselage and distribution of items from the fuselage over the slope, indicated initial impact forces involved in the accident were severe. In addition to the destruction of the nose section and cockpit area, the structural integrity of the main cabin had been compromised once the centre section of the wing had torn away and it was evident that the lower fuselage structure had deformed in compression and bending, reducing the occupiable volume of the cabin area during the impact sequence.

1.15.2 Pathological evidence confirmed that the fuselage struck the slope in a forwards direction with significant downwards velocity and suggested that all occupants sustained incapacitating or fatal injury at the time of the primary impact. The subsequent descent of the separated, damaged fuselage through a vertical distance of more than 1000 feet over rocky and precipitous bluffs was unsurvivable.

1.15.3 The impact forces involved and the extreme disruption of the fuselage structure, exceeded the capability of the installed seat belts and seat attachment structure to provide effective restraint. The occupants, however, remained within the fuselage until the latter stages of its descent over the bluffs.

1.15.4 Despite the difficult and inhospitable nature of the mountainous terrain and the potential for a large search area to be involved, effective signals from the emergency locator transmitter enabled the wreckage of ZK-EVK to be located within three hours of the occurrence of the accident. Medical and rescue personnel were flown to the scene with a minimum of delay but in the circumstances of the accident those on board the aircraft were beyond assistance.

1.15.5 Subsequent search and recovery action by the New Zealand Police was co-ordinated from the Mt Aspiring National Park headquarters at Glenorchy. Appropriately qualified personnel from the Police, RNZAF and Department of Conservation were assembled early on the afternoon of the day of the accident

with helicopter support provided by a local operator and the RNZAF Iroquois crew. An operational base was established close to the accident site, at the head of the Blue Duck Valley, the next morning.

1.15.6 During the two days following the accident, the bodies of nine of the occupants of ZK-EVK, including that of the pilot, were recovered from the bluffs below the accident site and from amongst avalanche debris at the foot of the bluffs. Avalanche control personnel monitored the condition of the unstable snow slopes above the bluffs during the recovery operations. The effects of avalanches rendered it necessary to use trained dogs to locate two of the bodies which were buried in snow and ice debris. The body of the remaining passenger was not recovered until 22 September 1989, some six weeks after the accident.

1.16 Tests and research

1.16.1 The remains of both engines from ZK-EVK were transported to an approved aircraft engineering facility and subject to detailed strip examination. Extensive impact damage had occurred to the cylinders and crankcase assemblies, particularly of the left engine, as a result of an initial unrestrained fall and subsequent tumble down a narrow rock couloir. No evidence was found, however, to indicate any internal pre-impact mechanical malfunction or anomaly in either engine.

1.16.2 The recovered propeller blades and hub portions, together with the propeller governors from each engine were forwarded to the United States for examination at the manufacturers' facilities. The following summary reflects the result of a comprehensive report received from Hartzell Propeller Incorporated regarding the noted damage to the propellers:

"(a) Neither propeller was feathered at impact.

(b) The 'first impact' blade angle could not be determined for either propeller. (This difficulty may have related to initial blade impact into relatively deep snow).

(c) Failure of the components of the propeller pitch change mechanisms was impact related. There was no indication of any pre-impact hub failure.

(d) No conclusion could be drawn with certainty regarding the amount of thrust being developed by either propeller at the time of impact."

The general impression obtained during the examination was that both propellers exhibited "power on" indications. However, it was not practicable to estimate the extent of power.

1.16.3 The Woodward Governor Company stripped and examined the propeller governors. Their report indicated that both governors were capable of operating satisfactorily and that all damage had occurred as a result of impact.

1.16.4 An analysis of fuel samples drawn from the supply tank from which ZK-EVK was refuelled prior to the accident flight showed that the Avgas 100 fuel met all requirements and specifications.

1.16.5 In an attempt to determine whether there was any significant difference in exhaust temperatures between the right and left engines of

ZK-EVK at the time of impact, portions recovered from the exhaust systems of both engines were submitted to the Department of Scientific and Industrial Research/Southern Industrial Development Division (DSIR/SIDD). The Director reported as follows:

> "The impact damage to the exhaust system of the engines identified as L-10284-40C and L-11742-40, occurred below the temperature required to reduce the residual stress incurred at the time of aircraft impact. The temperature of the exhaust pipe adjacent to the manifold at the time of the air accident was below 700°C."

1.16.6 This information indicated that the temperature of the exhaust assemblies of both engines had cooled to below 700°C by the time that deformation of the pipes occurred.

1.17 Additional information

1.17.1 The Britten Norman Islander, Air Registration Board (ARB) approved, Flight Manual contained a graph indicating the two engines operating Gross Pressure Rate of Climb applicable to the BN2A-26 aircraft at varying altitudes, temperature and aircraft mass. Using the estimated aircraft mass and likely air temperature in the locality at the time of the accident the following Gross Pressure Rates of Climb for ZK-EVK were obtained:

At 5000 feet amsl	690 feet/min
At 8000 feet amsl	480 feet/min

The associated conditions required to achieve these rates of climb were:

Engines:	Both operating at maximum continuous power (2700 rpm and full throttle)
Carburettor heating:	OFF
Wing flaps:	Retracted
Airspeed:	65 knots IAS

Operation of the aircraft at other than these conditions (e.g. at a higher airspeed) was likely to result in a reduced gross rate of climb.

1.17.2 Any "downflow" effect in the area would adversely affect the anticipated rate of climb. Downflows experienced on occasion by pilots of light aircraft operating in the vicinity of typical New Zealand mountainous terrain have resulted in rates of descent in excess of 2000 to 3000 feet per minute.

1.17.3 Normal operation of the BN2A-26 Islander fuel system involved fuel drawn from a sump beneath the left or right wing fuel tank, being fed via two electrically operated auxiliary fuel pumps, a three-way cock, a line filter (gascolator) and the engine driven fuel pump, to the carburettor of the engine adjacent to the respective fuel tank. (During normal flight conditions the engine driven pump was capable of supplying an adequate quantity of fuel to the carburettor and it was recommended that the auxiliary fuel pumps should be switched off).

1.17.4 Two manually operated fuel system selector knobs, were mounted on a sub-panel in the cockpit roof structure and were connected by cables and sprocket driven chains to the three-way cocks located in the wings. The fuel feed pipelines from the tanks were interconnected with the three-way cocks enabling "cross feed" selections to be made from either tank to either engine. The left selector (red) was marked "PORT ENG" and could be moved to one of three positions, "OFF", "ON", (the normal position in which the left engine was fed from the left fuel tank), and "STBD TANK". The right selector (green) could be positioned similarly to "OFF" (in which the fuel supply to the right engine was cut off), "ON", or "PORT TANK". "Crossfeed" operation was uncomplicated, requiring only that the fuel selector appropriate to the engine be positioned to the opposite wing tank.

1.17.5 Pilot reports indicated that the handling characteristics of the Islander were not significantly affected if the aircraft was flown with substantially differing quantities of fuel in the left and right main fuel tanks (located in the wings outboard of each engine).

1.17.6 The manufacturer provided the following data in regard to the aircraft's stall characteristics, obtained during tests using a BN2A-8 aircraft loaded to 6600 pounds (2993 kg) with a CG position 533 mm (21 inches) aft of datum (Flaps "UP").

CONDITION	POWER	STALL SPEED	REMARKS
Wings level	Power off	47 knots IAS	Stick full back on stall
Wings level	75%	39 knots IAS	Straight stall
30° left	Power off	50 knots	IAS Stick full back
30° right	Power off	51 knots IAS	Slow roll in
30° left	75%	40 knots IAS	Slow roll out
30° right	75%	45 knots IAS	Slow roll out

1.17.7 While the aircraft used for the tests differed slightly from the BN2A-26, the flight test reports indicated that stall handling was similar to that experienced on the standard aircraft. The Islander ARB approved Flight Manual indicated that for the BN2A-26 with flaps "UP" at a mass of 6300 pounds (2857 kg) the "Power off" stalling speed in level flight was 49 knots IAS (indicated airspeed). Calculation showed that the theoretical radius of turn at an angle of bank of 30° and an airspeed of 120 knots was 687 m. At 100 knots the theoretical radius was 477 m, reducing to 200 m at 65 knots, and 120 m at 50 knots. The stall speeds obtained in flight tests using 75% power at a 30° angle of bank, indicated that it would have been feasible for the pilot to have safely turned ZK-EVK within a radius of about 200 m had he been obliged to do so. Flight test data was not available to substantiate the minimum radius of turn which was likely to be achieved in ZK-EVK under the existing conditions, in an emergency situation.

1.17.8 Following the accident, aerial searches were carried out in the vicinity of the clearly defined impact zones and also over a wide area of the surrounding snow slopes, in an endeavour to discover whether any part of the aircraft had contacted the terrain, or any component had separated from the aircraft, before the major catastrophic impact occurred. Despite extensive

searching no evidence was observed to suggest that either of these events had occurred.

1.17.9 During the first stage of wreckage recovery, soon after the accident, the remains of two cameras were found, but both had broken open due to impact and no film was recovered. In late January 1990, at the time of a further survey, a Fuji Quickshot disposable type camera was located on the mountainside. Two photographs (Frames 20 and 19) had been taken on this camera during the accident flight, by a passenger seated on the right of the aircraft. The first photograph was a view in a northerly direction, from above the headwaters of the Polnoon Burn approximately 20 km east of the accident site, as the aircraft flew toward the north-west at an altitude of 5500 to 6000 feet. The photograph showed extensive cloud cover (estimated to be about 7 octas of stratocumulus and cumulus) to the north and west. Patches of sunlight on the snow slopes indicated, however, that the cloud was broken in isolated areas. The base of the cloud cover was ragged but was estimated to vary from 6000 feet to 6500 feet amsl. The photograph showed that although the surrounding peaks were covered, a gap, clear of cloud, existed above one of the snow covered ridges at a height of about 6500 feet and a steep sided saddle at an elevation of some 5700 feet gave the impression of being "open".

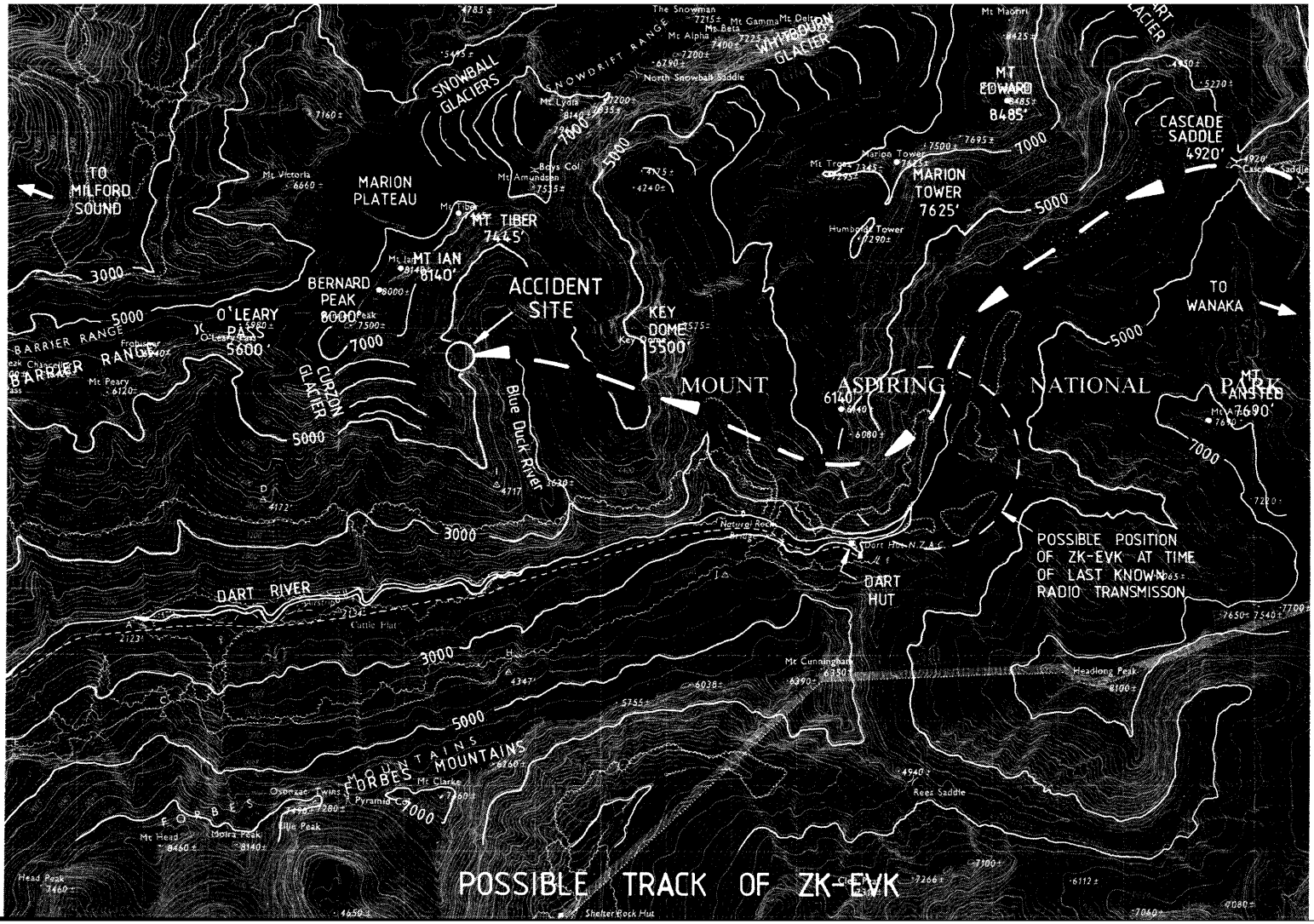
1.17.10 The second photograph was much less distinct, but appeared to show the middle "ice fall" of the Dart Glacier. Mist and cloud obstructed any view of the mountains to the west and north but an area of sunlight indicated that conditions were gradually breaking. The photograph was taken probably about 1 to 1.5 km south of the "ice fall" as ZK-EVK maintained a westerly heading at an altitude of some 5500 feet. The location of the photograph suggested that in the prevailing conditions the pilot had reached the Dart Glacier region via the Cascade Saddle. This was a likely route if he had proceeded from the location of the previous photograph to the head of the Matukituki Valley.

1.17.11 The time at which the accident to ZK-EVK occurred was not established. The available evidence suggested that it occurred soon after the pilot's last known radio transmission. Calculations taking into account the probable flight route and aircraft groundspeed indicated 1035 hours as a likely time. The "combined" nature of the flight involving two aircraft carrying members of the same tour group to Milford Sound where both groups were to embark on a launch cruise shortly after arrival, rendered it unlikely that the pilot of ZK-EVK would have considered making any major diversion.

1.17.12 The planned flights from Wanaka to Milford Sound by Aspiring Air Limited aircraft ZK-EVO and ZK-EVK were the first flights by any operator to Milford Sound on the day of the accident. Weather conditions at Milford Sound and enroute, had been unsuitable for tourist flight operations but improved rapidly during the course of the morning.

2. ANALYSIS

2.1 The pilot in command had learned to fly in the Wanaka area and had held a CPL A since April 1987. On obtaining this qualification he had commenced employment with Aspiring Air Limited and for more than two


TO MILFORD SOUND
MARION PLATEAU
SNOWBALL GLACIERS
SNOWDRIFT RANGE
WHYBOURN GLACIER
MT EDWARD 8485'
CASCADE SADDLE 4920'
MARION TOWER 7625'
MT TIBER 7445'
MT IAN 8140'
BERNARD PEAK 8000
O'LEARY PASS 5600'
ACCIDENT SITE
KEY DOME 5500'
TO WANAKA
BARRIER RANGE
CURZON GLACIER
Blue Duck River
MOUNT ASPIRING NATIONAL PARK
MT ANSTEM 7690'
POSSIBLE POSITION OF ZK-EVK AT TIME OF LAST KNOWN RADIO TRANSMISSON
DART HUT
DART RIVER
Cattle Hut
FORBES MOUNTAINS
Mt Clarke
Pyramid Col
Mt Head 8460±
Idora Peak 8140±
Lilly Peak
Reed Saddle
Headlong Peak 8100±
Mt Cunningham 6350
Shelter Rock Hut
POSSIBLE TRACK OF ZK-EVK

years had flown tourist passengers regularly over the route from Wanaka to Milford Sound and return, in the company's single engined aircraft. He had also carried out instructional flights from Wanaka Aerodrome and recently had been issued with a Class I Instrument Rating on single engined aircraft. He was therefore in current flying practice and could be expected to be familiar with local and extended weather patterns between Wanaka and Milford Sound and accustomed to flying over the varied terrain on the route.

2.2 The pilot's experience on multi-engined aircraft was limited to the Islander aircraft type which he had first flown some three weeks before the occurrence of the accident. He had completed the necessary minimum conversion instruction flight time and had commenced passenger flights in the Islander type on 1 August 1989. At the time of the accident the pilot had accumulated a total of about 12 hours multi-engined flying of which 6 hours had been flown as pilot in command of ZK-EVK. Although the pilot had already flown ZK-EVK on several passenger flights, in comparison to his total flying time on single engine aircraft he was newly qualified and inexperienced on the multi-engined Islander aircraft. The accident flight was the first occasion on which the pilot had flown the Islander type on the Wanaka-Milford Sound route. The aircraft was carrying a heavier load at take-off on this flight than on his previous passenger flights but at the time of the accident was likely to have been some 200 kg below the maximum permitted take-off mass.

2.3 On 3 August 1989 ZK-EVK had completed a maintenance check. Subsequently the aircraft had been flown for about 10 hours without incident or reported defect. The pilot had carried out an apparently uneventful flight from Wanaka to Queenstown and return on the morning of the accident. During the accident flight itself the pilot was in radio contact with the pilot of the following Islander aircraft ZK-EVO. He made no mention of any malfunction, defect or unusual development with regard to the performance or operation of ZK-EVK either in earlier conversation, or when reporting his position at the time of the last transmission received from the aircraft. It was reasonable to conclude that, as far as the pilot was aware, ZK-EVK was in an airworthy condition at the time of this transmission.

2.4 The exact route followed by the pilot of ZK-EVK after departure from Wanaka could not be determined but the pilot's radio transmissions and two photographs taken by one of the passengers suggested that the flight progressed without significant event to a point beyond the Dart Glacier. The last position given by the pilot indicated that ZK-EVK was "down the Dart River, five miles from the Dart Glacier". While both of the photographs emphasised the extent of cloud cover over the mountains and the second photograph showed that most of the Dart Glacier and the surrounding terrain was obscured by cloud or mist there was no reason to suppose that ZK-EVK's position at the time of the transmission was other than that given by the pilot. He had flown the route many times and was unlikely to have mis-identified the Dart Glacier, even in clouded conditions, as it was a prominent enroute feature to which passengers' attention was frequently drawn as an area of special interest. The terminal moraine and river leading from the glacier to the head of the Dart Valley was also well defined and in the prevailing conditions (with the slopes to the west cloud covered) would have been a logical flight path to follow. The height of the mountains and ridges lying immediately to the west of Dart Glacier and the extent of cloud were likely to have encouraged the pilot at that stage of the

flight to remain in the apparently clear conditions, further to the south and east. However, despite the foregoing considerations, the position given by the pilot of ZK-EVK in his last transmission may have been erroneous.

2.5 The altitude of ZK-EVK when the pilot gave his position could not be established. The clarity with which the transmission was heard at Wanaka Aerodrome suggested that the aircraft was still flying at a relatively high level at this stage and had not been obliged to descend for some reason, (e.g. to avoid a cloud build-up), into a low level or confined valley situation.

2.6 The accident site was approximately 4 nm west-north-west of the last reported position of ZK-EVK. If the given position was accurate, the accident was likely to have occurred only 2 to $2^1/_2$ minutes after the pilot had indicated that he intended to follow a reasonably direct track over the mountains to Milford Sound.

2.7 While the pilot of ZK-EVK gave no indication of any specific problem or difficulty regarding the progress of the flight, the nature of his last communication with the pilot of ZK-EVO implied that it was the general weather conditions along his route and at the height at which he was flying (probably the extensive cloud to the west) that required him to make a decision at that time as to the most suitable course to follow, rather than any other factor. If the route ahead of him had been "wide open", it was unlikely that he would have asked the pilot of ZK-EVO, in relation to the cloud cover, what route the latter proposed to take to Milford Sound.

2.8 No maps or navigation documents were recovered from the wreckage of ZK-EVK. Whether the pilot maintained any form of navigation "log" during the accident flight was not established. It was reasonable to conclude however, that irrespective of whether any maps or charts were used for navigation over the route, or a flight "log" kept the pilot would have been aware from his local knowledge and previous experience that the mountains to the north of the Dart Valley rose to a considerable height. However, while there was likely to have been a significant amount of cloud in this region and the peaks were likely to have been hidden, the meteorological evidence suggested that there were some areas of broken cloud with gaps above the ridges which could have indicated to the pilot that a route over these mountains maintaining visual reference was feasible.

2.9 The location of the accident was on the side of a confined valley and the aircraft had struck the snow slope at an elevation of about 5400 feet. Evidence at the accident site, including the nature and extent of damage to the wings and fuselage, the probable impact sequence and the distribution of the wreckage across the slope suggested that the aircraft was steeply banked, possibly beyond the vertical, when initial impact occurred. The attitude could not be determined with certainty, but it was clear that ZK-EVK did not strike the slope in a wings-level attitude, whether in climb, cruise, or descent.

2.10 The manner in which impact appparently occurred could have resulted from a violent evasive manoeuvre, such as an attempt to turn away from the snow slope had it been obscured and sighted only at the last moment. Alternatively it could have occurred if the aircraft entered a stalled condition as the pilot made a turn in the vicinity of the slope, whether or not he had anticipated making such a turn. These interpretations assumed the aircraft to

have been under the pilot's control until just prior to impact. An additional possibility was that, for unknown reasons, control of the aircraft was lost at some earlier stage and subsequent impact on the snow slope occurred in an unusual attitude either in the absence of suitable control inputs, or despite attempts by the pilot to recover the aircraft.

2.11 No conclusive evidence was found to establish the cause of the accident to ZK-EVK or to account for the location in which it occurred. However a number of deductions were made from the available evidence and the associated circumstances.

2.12 The accident probably occurred within 2 to $2^1/_2$ minutes of the radio conversation between the pilot of ZK-EVK and the pilot of ZK-EVO. ZK-EVO was cruising at a relatively high altitude and was within VHF range throughout this time but no subsequent emergency message, or attempted transmission from ZK-EVK was received. The lack of any radio transmission from ZK-EVK advising an in-flight emergency, or precautionary diversion, climb or descent, suggested that the accident occurred with little warning, allowing no opportunity for an RTF distress message. On the other hand, the pilot may have been occupied with an emergency situation to the extent that he was unable to initiate any radio transmission, particularly if he was attempting to maintain or regain control of ZK-EVK following some unexpected upset or occurrence.

2.13 Analysis of the weather situation and local reports, indicated that although there was considerable cloud cover to the north and west, the Dart Valley was substantially "open". This valley lay less than 2 nm to the south of the accident site and was an area well known to the pilot. Had the pilot of ZK-EVK been faced with an inflight engine malfunction, or for other reasons, been obliged to proceed on one engine while in cruise, climb or descent, at about the time of the accident, the Dart Valley offered a suitable route if the pilot was aware of his position, to enable a lower operating height to be maintained safely. Again, in such an event it was likely that the pilot would have informed ZK-EVO by radio of his situation and intentions. In the event of a more critical in-flight occurrence (in which the aircraft remained at least partially under the pilot's control) necessitating an immediate forced or precautionary landing, the floor of the Blue Duck Valley itself, adjacent to the accident location, offered some confined, but relatively level, areas of tussock flat and riverbed. The evidence suggested, however, that the circumstances of the accident did not afford the pilot of ZK-EVK any opportunity to exercise such options.

2.14 The pilot gave no indication during the progress of the flight of any problem related to the asymmetric fuel load which was known to have existed after ZK-EVK had been refuelled. A significantly unbalanced quantity of fuel in the Islander aircraft's main wing tanks, should not in itself have created any major handling difficulty. The apparently uneventful take-off, climb, and subsequent flight of ZK-EVK to the time of the pilot's last known radio transmission supported such a conclusion.

2.15 In view of the known inbalance of fuel between the left and right main fuel tanks it was logical that the pilot of ZK-EVK should have considered the use of the fuel system crossfeed facility during the flight. Before departure

the pilot of ZK-EVO confirmed with him the required procedure which was straightforward. He was satisfied that the pilot of ZK-EVK understood the correct procedure to employ. Whether the pilot subsequently positioned one fuel selector to the opposite tank at some stage of the flight with the intention of running both engines from the fullest tank for a period of time, thus reducing the overall inbalance, could not be established. While this was likely, it was not essential that such a procedure be employed. The quantity of fuel in the least-filled tank, which was reported to contain 80 litres, before departure, should have been more than adequate to supply one engine throughout the duration of the flight to Milford Sound.

2.16 An alternative possibility was that the pilot decided to use the crossfeed facility but positioned the fuel selectors in error with the result that both engines were being supplied from the least filled tank. In the circumstances this appeared unlikely, but if an erroneous selection had been made soon after take-off and remained undetected, the quantity of fuel consumed by both engines of ZK-EVK may have approached the total usable quantity in the tank close to the probable time of the accident. In such a case the time taken to consume the tank contents would have depended upon the accuracy of the reported quantity and the actual fuel consumption of the engines. Sudden surging followed by stoppage of one engine, with continued but short-lived operation of the other engine would be likely to ensue. If the cause was not immediately recognised, such an event would be, at the least, confusing. If power was not quickly restored probable loss of height, the risk of airspeed decrease and the necessity to prepare for a forced landing and/or terrain avoidance, dependent upon the aircraft's position, would follow.

2.17 Neither propeller was feathered when the accident occurred, but tests and research to determine the likely extent of power on the engines at the time of initial impact were inconclusive. Both engines, with their propellers, departed from their respective mounts in a similar manner, and followed a similar trajectory. The sum of evidence accumulated to date suggested that both engines were delivering some power at the time of the accident but this could not be confirmed. If this was the case it diminished the possibility that engine or propeller malfunction was a significant factor in the accident, or that one or both engines had stopped, or had been shut down either deliberately or inadvertently.

2.18 Whether some medical incapacitation resulted in the sudden collapse of the pilot, or rendered him incapable of controlling the aircraft could not be determined. The passenger who occupied the right front seat was not identified and thus no medical history, or evidence of pilot qualification or experience, in terms of the occupant of this seat could be established. The available evidence, including uneventful earlier progress of the flight and the lack of any indication in the pilot's last known transmission made shortly before the accident that anything was amiss suggested that it was unlikely that major pilot incapacitation contributed to the accident.

2.19 The available evidence indicated that ZK-EVK was essentially intact before it struck the mountainside. Due to the terrain not all components of the aircraft were recovered, but the evidence did not support any catastrophic in-flight structural failure as a cause of the accident. Nevertheless occurrences involving BN2 series Islander aircraft were on record in which the elevator trim had been disconnected resulting in controllability problems. One such

case caused the rapid onset of a steep dive. This incident related to the early type of elevator trimb tab as installed on ZK-EVK. A required special inspection of the elevator trim tab had, however, been carried out on ZK-EVK approximately 10 flight hours prior to the accident with no indication of any existing or impending problem involving the trim tab or its associated control rods or attachments.

2.20 No obvious mechanical or structural defect or abnormality was observed during detailed examination of the recovered wreckage. However, the extent of impact and post impact damage to the basic structure and components of ZK-EVK rendered it impracticable to establish with certainty, the integrity of the primary flight controls and the trim systems prior to impact, or to conclude without qualification that no defect in the aircraft, its engines, propellers, or systems, contributed to the accident.

2.21 The location of the accident site provided conclusive evidence that irrespective of other unknown factors which may have contributed to, or precipitated, the accident, the pilot of ZK-EVK chose to follow a flight route which took the aircraft close to high mountainous terrain.

2.22 It was also evident from the photographs taken by one of the passengers, pilot reports and meteorological analysis of the weather situation that there was likely to have been considerable cloud in the region where the accident occurred, with a probable base between 5500 and 6000 feet.

2.23 The impact sequence and the pattern of subsequent wreckage distribution clearly showed that ZK-EVK was being flown at a height either close to that of the impact area, (approximately 5400 feet), or at some undetermined height above it, when the event(s) leading to the accident occurred.

2.24 On the morning of the accident the prevailing wind was westerly and there was the likelihood of at least moderate turbulence and downdraughts adjacent to lee slopes. The area in which the accident occurred, surrounded by high mountains and ridges to the west may have been particularly susceptible to localised downflow and turbulence. It could not be proven that such conditions existed at the time of the accident to ZK-EVK. Nevertheless instances of sudden upset in turbulence and/or rapid loss of height in severe downflow, under westerly flow in similar terrain, were sufficiently well documented in New Zealand mountain flying experience to render these effects possible contributing factors in the accident.

2.25. Whether one or more of the factors discussed in this analysis contributed in any material way to the accident was not established.

3. FINDINGS

3.1 The pilot held a valid Commercial Pilot Licence - Aeroplane and a Class 1 Instrument Rating and Category "C" Instructor Rating (limited to single-engined aircraft).

3.2 The pilot had completed a multi-engined rating and Type Rating on the BN2A-26 Islander aircraft type.

3.3 The pilot was inexperienced in multi-engine operations.

3.4 The pilot had commenced passenger carrying flights in the Islander aircraft type one week before the accident.

3.5 The pilot had flown single-engined aircraft on tourist flights regularly from Wanaka to Milford Sound over a period of more than two years prior to the accident.

3.6 The accident flight was the first occasion on which the pilot had flown the Islander aircraft type over the route from Wanaka to Milford Sound.

3.7 The aircraft's mass and centre of gravity were within the prescribed limits.

3.8 The aircraft had been maintained to an approved schedule and the required special inspections, including those applicable to the elevator trim tab installation, had been carried out.

3.9 No significant defects or malfunctions in relation to the aircraft's operation or performance had been experienced by other pilots or reported prior to the accident.

3.10 The pilot's communications with another Islander aircraft during the accident flight followed a normal pattern and gave no indication of any emergency aboard the aircraft.

3.11 The pilot had followed a route which positioned the aircraft close to and in the lee of, high mountains and adjacent steep ridges.

3.12 At the time of the accident the weather in the region was cloudy with the likelihood of turbulence and downdraughts.

3.13 Examination of the portions of wreckage which were recovered provided no direct evidence of any inflight structural or mechanical failure or malfunction.

3.14 The pre-impact integrity of the aircraft's primary flight controls and trim systems could not be determined conclusively.

3.15 The lack of direct evidence to account, operationally or structurally, for the manner in which the aircraft struck the mountain slope, the remoteness of the site which provided no witness observation to describe the aircraft's flight path prior to the event and the absence of any survivor, combined to preclude a determination of the accident's probable cause.

4. SAFETY RECOMMENDATIONS

4.1 It was recommended to the General Manager of the Air Transport Division of the Ministry of Transport that he:

Extend the requirement for the carriage of flight data recorders to all multi-engined aircraft used principally for air transport operations.

5. REGULATORY

5.1 Pursuant to Section 14(5) of the Transport Accident Investigation Commission Act 1990 the legal personal representatives of the pilot in command were invited to avail themselves of the opportunities afforded to them thereunder.

5.2 As a result of representations received the report was amended and amplified to clarify some of the points raised.

5.3 The representations made to the undersigned are not to be taken as an admission of liability on the part of the parties concerned and their statements are without prejudice to their right to act in any way they may consider fit in any proceedings or action which may be based on the events to which this report refers.

9 December 1991

M F DUNPHY
Chief Commissioner