



Department of Transport
Australia

ACCIDENT INVESTIGATION REPORT

Air Safety Investigation Branch

**Piper PA32-300 Aircraft VH-PGC
near Merimbula, New South Wales,
on 29 February 1976**



Special Investigation Report 77-2

AIR SAFETY INVESTIGATION BRANCH

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The Secretary to the Department of Transport authorised the investigation of this accident and the publication of this report pursuant to the powers conferred by Air Navigation Regulations 278 and 283 respectively.

Prepared by Air Safety Investigation Branch

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Note 1: All times are Eastern Summer Time except where otherwise stated. Times are based on the 24-hour clock and, where applicable, seconds are shown using a six-figure group.

Note 2: Metric units are used except for airspeed and wind speed which are given in knots; and for elevation, height and altitude which are given in feet.

THE ACCIDENT

At approximately 1121 hours Eastern Summer Time on 29 February 1976, Piper PA32-300 Cherokee Six aircraft registered VH-PGC crashed at a position 5 kilometres west of Merimbula Aerodrome, New South Wales, following structural disintegration in flight. The aircraft was engaged on a private flight from Cooma and was descending en route to Merimbula when the accident occurred. The aircraft was destroyed by aerodynamic and impact forces and the six occupants were killed.

1 FACTUAL INFORMATION

1.1 HISTORY OF THE FLIGHT

1.1.1 Description of the Flight

The flight originated at Essendon Airport, Victoria, as a result of arrangements made between the six people who were the occupants of the aircraft. It was intended that the party would fly to Cooma, New South Wales, on 27 February 1976 and remain in the area until 29 February before returning to Essendon Airport via Merimbula. The Piper PA32-300 aircraft VH-PGC was hired through Discover Flying Australia, Essendon Airport, from SAS Southern Air Services, Moorabbin Airport, who acted as agents for the holder of the certificate of registration, W. L. Lewington of Brighton, Victoria. The flight was to be conducted under the command of Gregory Alfred Williams and he took delivery of the aircraft at Moorabbin Airport, from SAS Southern Air Services, on the afternoon of 26 February. He then flew VH-PGC to Essendon Airport to prepare for the flight to Cooma.

On 27 February, the pilot submitted a flight plan to the Airways Operations Unit at Essendon Airport for a private flight to Cooma. The aircraft departed Essendon Airport at 1658 hours and the flight to Cooma, where the aircraft arrived at 1902 hours, was without recorded incident. The aircraft was parked at Cooma Aerodrome and it remained there until the morning of 29 February. The six occupants proceeded to a location at Lake Eucumbene where they spent the corresponding period. The pilot attended at the Flight Service Unit (FSU) at Cooma on the morning of 29 February and submitted a flight plan for a flight from Cooma to Merimbula, Essendon and Moorabbin. The flight was to be conducted under the Visual Flight Rules and the sector from Cooma to Merimbula was to be flown at an altitude of 5500 feet. The estimated flight time from Cooma to Merimbula was 24 minutes and the fuel endurance on the flight plan was 120 minutes—the aircraft had not been refuelled since departure from Essendon.

At 1049:11 hours VH-PGC reported to Cooma FSU that it was taxiing and the pilot indicated his intention to use Runway 36 for take-off. At this time, VM-NLD, a Mystere aircraft of the Royal Australian Air Force, was operating in the circuit area at Cooma and was making an approach to Runway 36. The FSU co-ordinated the operations of the two aircraft and the Mystere departed Cooma for Merimbula at 1054 hours climbing to cruise at Flight Level 135. VH-PGC departed at 1056 hours and was advised that the altimeter setting appropriate to the flight was 1008 millibars.

The Mystere aircraft arrived over Merimbula Aerodrome at approximately 1105 hours at an altitude of 5600 feet having descended en route; it then continued to seaward preparatory to entering the circuit area at Merimbula Aerodrome from the east. The aircraft subsequently approached the Merimbula circuit area from the east at about 2000 feet, then descended to 1500 feet and made a full right-hand circuit of the aerodrome, culminating in an approach to Runway 02 and a practice overshoot

manoeuvre before departure for Canberra at 1120 hours. The runway heading was maintained whilst climbing to 4000 feet; and at 1121:25 hours, whilst on course for Canberra, the crew reported it was above 7000 feet.

Meanwhile, at 1113:00 hours VH-PGC was advised by the Sydney FSU of the activity of the Mystere in the Merimbula circuit area and was requested to confirm that VH-PGC was a Cherokee Six. The flight acknowledged this transmission with the word 'affirmative'. At 1118:27 hours the flight made a general transmission, 'all stations, Merimbula, this is Papa Golf Charlie one zero miles west on descent from five thousand inbound'. At 1119:37 hours Sydney called VH-PGC to advise of an amendment to the weather forecast for Essendon Airport. There was no response to this call, nor to subsequent calls which were directed to the aircraft during the next 25 minutes.

1.1.2 Final Flight Path

The structural disintegration of VH-PGC, and the subsequent descent of the components, was witnessed by a number of people from different vantage points on the ground. However, despite a comprehensive search and canvassing of the areas adjacent to the probable approach and descent path of the aircraft, only four witnesses were found who saw the aircraft during the period immediately prior to the structural disintegration.

A witness standing outside his home approximately 3.5 kilometres to the south-east of the accident site first saw the aircraft flying towards him from the north-west. He estimated that it would pass a little to the south-west of his position if it did not change direction. He observed that the aircraft was flying with the wings level, and that it was maintaining a virtually constant height above the general terrain which in this area has an average slope of some 3 degrees downwards to the south-east. When the aircraft was about 4 kilometres from his position it made a 'tight' turn to the left. He estimated the height of the aircraft above the ground to be about 400 feet and formed the opinion that the speed of the aircraft was comparable with that of other light aircraft he had seen operating in the area. The aircraft turned through about 90 degrees and he then saw parts of what he believed to be the tail separate from the aircraft and 'shortly afterwards the wing fell off'. The aircraft went into a steep dive and disappeared behind the intervening terrain.

A witness about 3 kilometres to the east of the accident site observed the Mystere aircraft on its approach to the runway at Merimbula and, although he did not recognise the aircraft type, he judged that its approach speed was higher than that of the usual Fokker F27 aircraft which operate into Merimbula (110 knots). About one minute or a minute and a half later he saw an aircraft to the west of his position. The aircraft was in a steady descent of a normal nature, travelling in a south-easterly direction, and it appeared to the witness to be flying slightly slower than the Mystere when on its landing approach (130 knots). His recollection of the flight path was that the aircraft's descent steepened momentarily to perhaps 20 degrees, then the aircraft appeared to either bank or pull up quickly and a white object separated from it. He gained the impression that the aircraft might have been avoiding something in its flight path, but he could see nothing in the area which he could relate to this manoeuvre.

Two other persons were standing together at a position some 200 metres south-east of the first witness above, which is to say that they were also some 3.5 kilometres south-east of the accident site, and they were watching the operations of the Mystere aircraft. One of these witnesses watched that aircraft approach the runway at Merimbula and then climb, on the alignment of the runway, until it was 'just a dot' in the distance to the north. He then looked to the north-west and first saw VH-PGC as it came into his line of sight from behind the roof of his house. He thought that the aircraft was below the height at which he had observed other light aircraft flying in the general Merimbula

area. He stated that he watched the aircraft for some 3 to 5 seconds during which time it was flying straight and level on a north-easterly heading. It then appeared to descend on a gradient which he estimated to be about 10 degrees before pulling up smoothly to about 25 degrees of climb. After regaining its original height it levelled momentarily and then pieces came away from it. A white or grey cloud appeared and the aircraft dived steeply, spiralling until it disappeared behind intervening terrain. The evidence suggests that the total time of his sighting prior to disintegration of the aircraft was about 13 seconds.

The other witness at this location said that when he first sighted the aircraft it was on a north-easterly heading and descending on a gradient which he estimated to be about 12 degrees. It was above the skyline and well clear of the terrain. He observed the aircraft descend for about 5 seconds and then it levelled out. Soon afterwards a number of pieces seemed to leave the aircraft individually. After the last and largest piece came away from the aircraft, a white cloud formed, the aircraft then dived and disappeared from his view behind an area of trees. His impression of the speed of the aircraft before the final dive was that it had been about normal for a light aircraft.

Two men on horseback working cattle on a property some 5 kilometres west of Merimbula Aerodrome were watching with interest the operation of the Mystere aircraft. They followed the progress of that aircraft through its approach to Runway 02 and saw it climb away to the north-north-east. A noise then drew their attention to the south of their position, and they saw an aircraft with 'pieces falling from the tail section'. Almost immediately afterwards a wing separated and the aircraft descended in a steep spiral and struck the ground some 300 metres from their position.

1.2 Injuries to Persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Others</i>
Fatal	1	5	—
Non-fatal	—	—	—
None	—	—	—

1.3 Damage to Aircraft

The aircraft was virtually destroyed by aerodynamic and impact forces.

1.4 Other Damage

There was no damage to property other than that which was on board the aircraft.

1.5 Personnel Information

The pilot in command, Gregory Alfred WILLIAMS, aged 22 years, was the holder of a valid private pilot licence appropriately endorsed for the Piper PA32 Cherokee Six aircraft. Since the initial issue to him of a student pilot licence on 24 July 1975 he had flown a total of 132 hours 25 minutes including this flight and, of this total, 8 hours 10 minutes had been flown in the Piper PA32 type of aircraft. He had undergone familiarisation training on the Piper PA32, including a flight at the maximum permissible all-up weight, before assuming command of this type of aircraft. He had flown 56 hours 15 minutes on Piper PA28 Cherokee aircraft, a similar type to the Piper PA32. The remainder of his experience had been gained on Cessna aircraft. His log book does not record any flight in VH-PGC prior to 26 February 1976.

One other person on board had pilot experience; Laurence Bernard BAKEWELL was the holder of a valid student pilot licence and he had flown a total of 33 hours 30 minutes, of which some 5 hours 40 minutes was in command. This flying had been undertaken in Cessna aircraft; his licence was not endorsed for the Piper PA32 or other Piper aircraft. The evidence suggests that he occupied the right-hand front seat of

VH-PGC at which a dual set of flying controls was fitted. There is no evidence to indicate whether or not he manipulated the aircraft controls at any time during the flight.

1.6 AIRCRAFT INFORMATION

1.6.1 History

The aircraft was a PA32-300 Cherokee Six, Serial Number 32-40415, constructed in the United States of America by the Piper Aircraft Corporation and imported new into Australia in 1968. The aircraft was registered VH-PGC and entered in the Register of Australian Aircraft, with Certificates of Airworthiness and Registration current until 31 October 1977. Subsequently, the Certificate of Airworthiness was reissued on 25 November 1975 to remain current until the aircraft should cease to be registered in the Register of Australian Aircraft. At the time of the accident the airframe had flown a total of 3147 hours 30 minutes. The engine had been installed in the aircraft on 18 January 1972 having at that time operated for 2140 hours 42 minutes. A complete overhaul of the engine was carried out at 3101 hours, and at the time of the accident the total operating time of the engine was 3284 hours 54 minutes.

The aircraft was involved in a landing accident on 11 November 1973 in which some damage to the left-hand mainplane and the left-hand stabilator was incurred. The nosewheel leg was broken and the propeller was also damaged. After repairs had been effected the aircraft was returned to service. Additionally, repairs to the stabilator and fuselage tail fairing were effected in August 1974 following storm damage sustained whilst the aircraft was parked. These latter repairs were not recorded in the aircraft log book but records were available within the relevant maintenance organisation.

A major inspection of the aircraft was completed on 8 February 1975 and the aircraft had flown 293 hours 38 minutes since that date. The aircraft log book contained a certification that a 100 hourly periodic inspection had been carried out on 26 February 1976, and an appropriate maintenance release was issued on that date. One item in the inspection was that the engineer be satisfied as to the tension of control cables—this was performed by feel. The last check of cable tension using a tensiometer was during the major inspection in February 1975. The maintenance release form was recovered from the wreckage of VH-PGC and it did not carry any endorsement indicating that items required rectification. The records of the maintenance organisation which had carried out the periodic inspection of the aircraft indicated that the cabin main door seal should be replaced at the next such inspection.

The rudder is not required to be identified with an individual serial number, but the aircraft maintenance records did not indicate that the rudder fitted to VH-PGC had been changed during its service life. There was no evidence that the rudder had been repaired or repainted in a manner likely to affect the control surface static balance.

The aircraft log books were examined for evidence of recurring corrective maintenance or repetitive replacement of specific items. It was found that the bulb of the fin-mounted rotating beacon had not been replaced during the first 2498 hours of operation, but during the 650 hours of operation subsequent to 17 July 1973 it had been replaced on four occasions, the last replacement being on 26 February 1976.

The airspeed indicator fitted to the aircraft did not comply with the terms of Airworthiness Directive DCA/GEN/7E in that the airspeed limit markings and warning sectors displayed on the face of the instrument did not correspond with the limit speeds set out in the aircraft flight manual. The instrument was marked with a white arc around the periphery of the face between 62 and 97 knots, indicating what purported to be the speed range in which the flaps could be operated. A green arc had been marked between 72 and 174 knots, indicating what purported to be the speed range for normal operation of the aircraft. An orange arc extended from 174 knots to 210 knots, and that sector marking was terminated with a red line. The speeds thus

marked correspond to speed limitations appropriate to the Douglas DC3 type of aircraft and the face of the airspeed indicator also carried the letters DC3. There was no entry in the aircraft log book relating to the fitment of this instrument, and no relevant entries were found in the records of the organisations which normally maintained the aircraft. There is, however, some evidence to suggest that it had been installed subsequent to the last major inspection in February 1975.

The aircraft Flight Manual was recovered from the wreckage. At section 2.4 under the subheading 'Airspeed Limitations', the manual included the following data:

'Never Exceed Speed	186 Kts. I.A.S.
Normal Operating Limit Speed (Max. Structural Cruise Speed CAR 3) This speed shall not be exceeded intentionally; the limitation is imposed to reduce the probability of excessive loads on the structure being caused by gusts.	149 Kts. I.A.S.
Manoeuvring Speed—Maximum manoeuvres involving an approach to stall conditions, or full application of rudder or aileron control.	132 Kts. I.A.S.
Maximum, Wing Flaps Extended	109 Kts. I.A.S.'

The Flight Manual required that the air speed limitations shown in the manual be displayed in the form of placards or other suitable markings visible to the pilot. A placard on the aircraft instrument panel displayed the rough air or manoeuvring speed as '149 MPH'. This speed is the appropriate unit equivalent of the 132 knots shown in the aircraft Flight Manual as the manoeuvring speed, however mph were not displayed on the face of the air speed indicator.

The front cover of a folder provided by the owner for the use of pilots, and recovered from the wreckage, carried operating information including the entries 'VNE 186 kts' and 'VFE 109 kts'. Flying times applicable to the flight from Moorabbin Airport to Essendon Airport on 26.2.76 and the flight from Essendon Airport to Cooma on 27.2.76 were listed against the name of the pilot on sheets contained in the folder. The aircraft tachometer time at the beginning of the flight from Cooma to Merimbula was entered against the date 29.2.76.

1.6.2 Loading

The maximum permissible weight for take-off or landing in this aircraft, having regard to structural considerations, was 1542 kilograms. There was no documentation found in connection with the loading of the aircraft and none was required to be prepared in respect of this flight. It has been calculated that when VH-PGC took off from Cooma the gross weight was about 1484 kilograms, and at the time of the accident the gross weight was about 1465 kilograms. Material recovered from the forward locker at the accident site weighed 48 kilograms. The maximum permissible load in that locker was 45 kilograms.

It was not possible to establish with absolute certainty the seating arrangement in respect of all the occupants, nor the location of some items of the load which were carried other than in the forward locker. The location of the centre of gravity was calculated for a number of possible load configurations and it is concluded that the centre of gravity would have remained within the designated limits throughout the flight.

1.7 METEOROLOGICAL INFORMATION

When he attended at the Cooma FSU, the pilot received current meteorological information relevant to the flight to Merimbula and the Melbourne area. The area forecast which covered the flight from Cooma to Merimbula predicted that broken stratus cloud between 3000 and 4000 feet above sea level could be expected east of the mountains, with scattered cumulus cloud from 6000 feet to 10 000 feet on the mountain slopes (the elevation of Cooma Aerodrome is 3068 feet). Scattered rain showers and drizzle were predicted from the coast to the mountains with a visibility of 30 kilometres reducing to 10 kilometres in rain showers. Moderate turbulence was expected in cumuliform cloud. The wind in the area of the flight at the heights at which the aircraft intended to operate was predicted to be 10 knots, variable in direction below 5000 feet becoming southerly at 5000 feet.

A weather observation made at 1200 hours at Merimbula Aerodrome, 5 kilometres east of the accident site, indicated that the surface wind was from the north-north-east at 12 knots, the visibility was 35 kilometres and there was no cloud below approximately 10 000 feet. The basic conditions of bright sunlight were subject to very slight obscuration of the sun from middle and high level cloud.

At 1050 hours a Cessna 150 aircraft had departed from Merimbula for Cooma via Lake Wallagoot, thus proceeding on a route in the opposite direction and slightly north of that followed by VH-PGC. The pilot stated that there was no significant cloud on the coast but there was scattered cumulus cloud with a base of about 5000 feet within approximately 35 kilometres of Cooma. He encountered no turbulence in the coastal area but there was slight turbulence associated with the cloud on the inland section of the route.

A post-analysis of the weather situation covering the route from Cooma to Merimbula, and also the local Merimbula area at the time of the accident, was undertaken by the Bureau of Meteorology. This indicated that the upper wind structure between Cooma and Merimbula was north-north-easterly to northerly at 15 to 20 knots, in layers to 3000 feet, turning north-westerly at 15 to 20 knots between 3000 feet and 10 000 feet. The temperature at 3000 feet was 16.5°C. The analysis concluded that no turbulence waves or rotors were present nor were conditions conducive to their presence, and that significant turbulence over the route did not exist. There was no evidence of marked wind shear at altitudes below 10 000 feet.

1.8 AIDS TO NAVIGATION

These were not relevant to this accident.

1.9 COMMUNICATIONS

Cooma FSU maintained satisfactory communication with the aircraft from 1049:11 hours, at which time VH-PGC reported that it was taxiing, until 1107:37 hours when the aircraft advised that it was leaving the Cooma frequency. At 1111:58 hours Sydney FSU contacted VH-PGC on the VHF frequency of 124.1 MHz and at 1113:00 hours advised the flight of known aircraft activity in the vicinity of Merimbula. Further calls from Sydney at 1114:13 hours and 1114:33 hours with details of the estimated time of departure from Merimbula of the Mystere aircraft were not answered by VH-PGC.

A transmission was made from VH-PGC at 1118:27 hours to the effect that the aircraft was 10 miles west of Merimbula on descent from 5000 feet inbound. There was no record of any transmission from VH-PGC after 1118:27 hours.

At 1119:37 hours Sydney called VH-PGC to advise of an amendment to the weather forecast for Essendon Airport. There was no response to this call.

The local Merimbula area is outside the normal estimated coverage of the ground network of VHF communications, including the 124.1 MHz frequency, for aircraft

operating below 5000 feet but Sydney continued to call and, at 1125 hours, arranged for the Mystere aircraft to call VH-PGC. None of these calls was answered.

Communications checks and efforts to establish the whereabouts of VH-PGC continued until 1145 hours, at which time Sydney received a telephoned report to the effect that an aircraft had crashed in the vicinity of Pambula near Merimbula.

1.10 AERODROME AND GROUND FACILITIES

These were not a factor in the accident.

The elevation of Merimbula Aerodrome is 5 feet a.m.s.l. Right-hand circuits are specified for approaches to Runway 02.

1.11 FLIGHT RECORDERS

No flight recorders were carried in this aircraft, nor was there any requirement for it to be so equipped.

1.12 WRECKAGE AND IMPACT INFORMATION

The area in the general vicinity of the accident site comprises a series of ridges rising from the coastal plain to a height of about 800 feet above sea level and consists of developed rural grazing country, interspersed with areas of heavy timber and rain forest. The general character of the terrain is consistent throughout the area over which VH-PGC would have descended from cruising height; the highest point of terrain in the area concerned is some 16 kilometres west-north-west of Merimbula Aerodrome at an elevation of 2539 feet.

The wreckage of VH-PGC was located some 5 kilometres west of the southern end of Runway 02, Merimbula Aerodrome, and was scattered over an area of some 920 metres by 250 metres on a mean alignment of 018 degrees (M), across and almost at right angles to a ridge. The first item in the wreckage trail was a piece of perspex from the centre of the left-hand windscreen; other items on the southern slope of the ridge included light fragments of metal and fibreglass. The right-hand stabilator was towards the top of the ridge, with the left-hand wing flap to the right and slightly closer to the main wreckage. The next major item, the left-hand stabilator with portion of the rear fuselage and the lower section of the rudder attached, fell beyond the ridge line on the northern slope some 625 metres from the position of the main wreckage: 10 metres beyond and 40 metres to the right of the left-hand stabilator, the fin and the top section of the rudder landed in an area of trees. The left-hand wing and its attached main landing wheel were in the same timbered area, 575 metres from the main wreckage. The outer section of the right-hand wing together with the wing tip tank were to the left of the general wreckage trail, about 425 metres from the main wreckage. The main wreckage of the aircraft, comprising the fuselage, the engine and propeller, and the major portion of the right-hand wing, struck the ground on a grassy slope about 390 feet above sea level and excavated a moderately deep trough for about 4 metres on a heading of 320 degrees (M). Initial impact occurred on the side of the fuselage while the aircraft was slightly nose down and banked almost vertically to the left. The fuselage came to rest inverted on a heading of approximately 090 degrees (M).

The nature of the locality and patches of heavy undergrowth made search in some areas extremely difficult and a few small components of the aircraft's structure were not recovered. These included the rudder mass balance weight and the left-hand aileron mass balance weight. Marks on the right-hand stabilator and on the right-hand element of an antenna fixed to the top of the fin established that the rudder mass balance weight, which was built into the fibreglass tip fairing, had been in place at the top of the rudder at the time of the disintegration. The portion of the fibreglass tip fairing still attached to the rudder was imprinted with sufficient of the manufacturer's

part number to identify the component as being appropriate to the aircraft type and model. Examination of the left-hand aileron mass balance weight mounting bracket established that it had fractured in a manner consistent with this having occurred as a result of the structural disintegration of the aircraft. Other items not recovered were minor and are considered not to have been significant.

There was no indication that the aircraft had struck any obstruction prior to the main impact. Some 80 per cent of the perspex was recovered and reassembled; no evidence of a bird strike was found. There were no signs that fire or explosion occurred in flight. The main wreckage contained a number of firearms and a quantity of ammunition, but it was determined that the weapons had not been discharged in or immediately prior to the accident and all ammunition recovered was intact.

The cabin heater muffler was dismantled and found to be in good condition. The cabin main door seal and frame were extensively damaged in the accident. It was not possible to establish the effectiveness of the door seal in relation to the exclusion of engine exhaust gases whilst in flight.

A detailed examination of the wreckage did not detect any defect of material, pre-existing damage, significant corrosion or metal fatigue. The examination did not reveal indications of any loss of structural stiffness in the rear fuselage. Sections of the stabilator which were repaired following the landing accident in November 1973 and the storm damage to the aircraft in August 1974 were examined after removal of skin panels. No defects were found. The extent of the destruction of the aircraft precluded the measurement of control cable tensions and the determination of the general rigging state of the aircraft prior to the accident. It was however established that all flying controls had been properly connected to the appropriate cables and capable of normal operation.

The fin had collapsed to the right following a bending failure of the rear spar just above its fuselage attachment fitting. The forward fin attachment fitting had pulled from the rivets which secured it to the fuselage structure. There was evidence that prior to the final fin collapse the rear spar had partially failed by bending to the left and that there had also been large deflections of the forward attachment to both left and right. In addition the fin structure had sustained bending failures along a line joining the approximate mid-point of the leading edge and the base of the rear spar. These buckling-type failures showed evidence of repeated reversed bending deflections of increasing amplitude.

When the fin broke away to the right, the stabilator tab drive mechanism was disrupted by the rudder actuating horn assembly, and the top of the fin struck the leading edge of the right-hand stabilator some 65 centimetres from the stabilator tip. The stabilator had been subjected to a leading-edge-down rotation to the full extent of its normal travel, striking the stabilator stops with sufficient force to distort them, and the right-hand stabilator broke from the aircraft in a downwards and backwards direction.

The left-hand wing spar lower cap failed in tension just outboard of the wing attach doubler and the fore and aft wing attachment bolts were torn from their attendant fittings. The spar fracture progressed upwards through the spar web to a lightening hole and then inboard along the lower face of the upper spar cap which broke in bending as the wing separated in an upwards direction. The inboard leading edge panel assembly broke away from both the wing structure and the forward wing attachment bracket and in so doing heavily contacted the left-hand side of the fuselage, including the left windscreen and the left front window. The wing made no further contact with the aircraft.

The rear fuselage broke just forward of the stabilator by a combination of downward bending and anticlockwise torsion, and separated from the main structure of the aircraft taking with it the left-hand stabilator.

The left-hand wing tip tank tore away from its attachment screws in a manner consistent with its having broken away under inertia loads arising from fuel within the tank. Any such fuel would have been lost at that time. Witness evidence that a small cloud of matter formed above the aircraft during the breakup sequence supports the probability that the left-hand wing tip tank contained fuel. The left-hand wing main tank was found to contain about 20–25 litres of fuel when examined at the accident site.

At some time during the sequence of breakup the outer panel of the right-hand wing, complete with aileron and wing tip fuel tank, had broken downwards relative to the main wing structure, and separated from the aircraft. There was an area of grass discoloured by fuel spillage where this portion of the wreckage came to rest, indicating that the right-hand wing tip tank had contained fuel when it struck the ground. A small amount of residual fuel was found in the breached right-hand main fuel tank.

The engine sustained substantial damage when the aircraft struck the ground, but a strip examination did not reveal any evidence that the engine was not capable of normal operation prior to the accident.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

There was no evidence that the pilot was in other than good health immediately prior to the accident.

Post mortem examination disclosed that there was no alcohol present in the body of the pilot. Traces of carbon monoxide were found in the bodies of some of the occupants, including that of the pilot who was a non-smoker, but the proportions of carbon monoxide were insignificant and incapacity from that source is not considered to have been a factor in the accident. Some carbon monoxide contamination of the aircraft cabin may have been present (see Sections 1.6.1 and 1.12).

1.14 FIRE

There was no fire.

1.15 SURVIVABILITY ASPECTS

This was not a survivable accident.

1.16 TESTS AND RESEARCH

At the accident site the position of each significant item in the wreckage trail was plotted, using survey equipment, before the wreckage was moved. This provided data for the location of both the horizontal position and the elevation of each item relative to the main wreckage. The location of each item and the wind velocity were taken into account in estimating the aircraft speed, height and direction of flight at breakup.

The analysis indicates that the primary breakup of the aircraft was very rapid, being completed in a period not exceeding half of one second. Breakup commenced at a point approximately 500 metres on a bearing of 198 degrees (M) from the position at which the main wreckage came to rest, and the aircraft was at a height of some 900 feet above the final location of the main wreckage. The indicated airspeed (IAS) at the moment of breakup has been assessed as 170 knots plus or minus 15 knots.

1.17 ADDITIONAL INFORMATION

Pilots who had flown VH-PGC during the six months prior to the accident were canvassed. There was evidence that the aircraft had been flown by some pilots at indicated airspeeds as high as 155 knots. None had flown the aircraft at an indicated airspeed in excess of 155 knots. None had experienced any occurrence with the aircraft which might have indicated a potential fin rudder flutter problem. No evidence was found as to the behaviour of VH-PGC at indicated airspeeds in excess of 155 knots.

The possible effects of any discrepancy in control cable tensions were considered and in this regard a number of aircraft of the same make and model were examined. Some of these aircraft were found to have the rudder cables rigged to settings which were substantially below the tension specified by the manufacturer. In no case was an aircraft reported to have experienced significant control difficulty arising from this source. There was no evidence that any of these aircraft had been operated at indicated airspeeds in excess of 149 knots, the maximum permissible speed in normal operations.

2 ANALYSIS

The fin bending oscillations disclosed by the wreckage examination point to the development of flutter in flight. The precise mode of flutter has not been determined, but it clearly involved the fin and rudder and it culminated in the collapse of the fin to the right. The top of the fin struck the leading edge of the right-hand stabilator, resulting in full leading-edge-down deflection of the stabilator. The nose up pitch which this induced in the aircraft generated aerodynamic loads which caused the left-hand wing to break off in an upwards direction. The right-hand stabilator broke away downwards and rearwards, followed by the remainder of the empennage and portion of the rear fuselage, which separated under the influence of forces arising from the left-hand stabilator. The outer panel of the right-hand wing broke off in a downwards direction probably because of a full aileron deflection induced by loading of the aileron control cable during the separation of the left-hand wing. The significant factor in the disintegration of the aircraft was the onset of flutter in the fin and rudder.

The possibility of flutter is characteristic to aerofoil surfaces. Aircraft design practice provides for the suppression of flutter for any condition of operation within the flight envelope including all speeds up to at least the design dive speed, which is substantially greater than the placarded never-exceed speed. In the case of the PA 32 the design dive speed is 204 knots and the never-exceed speed is 186 knots.

Notwithstanding that the design of an aircraft makes adequate provision for the prevention of flutter, the possibility of flutter may arise if:

- (i) the aircraft is operated outside the performance envelope for which it has been certificated, in particular at an airspeed greater than the design dive speed;
- (ii) modifications are made which significantly change the structural stiffness or mass distribution;
- (iii) the aircraft structure is permitted to deteriorate in service to the extent that structural stiffness is significantly reduced;
- (iv) the control system rigging and balance specifications are not maintained.

The aircraft maintenance records and the technical examination of the wreckage did not provide evidence as to the cause of the fin/rudder flutter. There was no evidence to suggest that the static balance of the rudder had changed since the aircraft was brought into service. The pre-accident tension of the rudder control cables could not be measured since the cables were broken in the accident but the maintenance records indicate that the cable tension was considered to be satisfactory a few days before this

flight. The structural examination revealed no progressive deterioration such as might be expected to affect structural stiffness, nor the existence of any modification or repair which could have affected the flutter characteristics of the aircraft. No significance could be attached to repetitive changes of components, specifically the anti-collision beacon bulbs. This is reportedly a common problem with the aircraft type.

The structure of the PA 32-300 wing is such that the minimum indicated airspeed at which the wing could be broken as a result of positive symmetrical aerodynamic loading from a control input, such as that of the stabilator in this case, would be about 150 knots. As no defect was found in the wing it is reasonable to assume that the aircraft was travelling at an airspeed of not less than 150 knots when the structural disintegration began. The analysis of the distribution of the wreckage indicates that the most likely speed was 170 knots plus or minus 15 knots.

Analysis of the evidence of those witnesses who saw VH-PGC during the period immediately prior to its disintegration suggests that the flight path during that time was:

- (i) descent towards the south-east along a moderate gradient of the order of 3 degrees, followed by a 'tight' turn to the left through about 90 degrees;
- (ii) a level period of approximately 5 seconds on a north-easterly heading followed by a descent along a gradient of about 10–12 degrees for about 5 seconds;
- (iii) a levelling-out or a climb to the original altitude, either manoeuvre occupying about 3 seconds;
- (iv) the onset of disintegration.

Speed throughout this period was comparable to that of other light aircraft which operate in the area.

The witness who saw VH-PGC flying level on a north-north-easterly heading had, immediately beforehand, watched the Mystere climb on the runway heading until it was 'just a dot' in the distance. The Mystere maintained runway heading to 4000 feet which, it is calculated, it reached at 1120:24 hours; it then turned onto a north-westerly heading. The evidence is consistent with the witness having watched the Mystere until that time then looking towards the north-west quarter where he saw VH-PGC come into view. Allowing some three to five seconds for this transfer of attention, the disintegration of VH-PGC occurred at about 1120:42 hours.

Calculations based on correlation of all the available evidence relating to the descent of VH-PGC from its cruising altitude suggest that the minimum distance to be travelled by the aircraft from the position reported at 1118:27 hours to the point at which it broke up was approximately 12 kilometres. The ground speed required to cover this distance in the period of 135 seconds between 1118:27 hours and 1120:42 hours is 173 knots. The mean tailwind component for the descent, as determined from the meteorological post-analysis was 10 knots. It can be deduced, therefore, that in the prevailing temperature conditions the average indicated airspeed throughout the descent was approximately 155 knots. Nevertheless, having regard to the range of variability possible in such calculations, it cannot be concluded with confidence that this was, in fact, the air speed flown; but it is considered that the calculations correctly indicate the order of the airspeed.

The witness evidence suggests that, subsequent to turning to a north-easterly heading, the aircraft made a descent on a gradient of about 10–12 degrees for some 5 seconds. Such a descent could have resulted in the air speed increasing, in the short term, by a further 10–12 knots approximately.

Typically, 65 per cent of engine power is used for normal cruise flight and the evidence as to the estimated flight time from Cooma to Merimbula suggests that the pilot intended to use such a power setting on this occasion. The calculated airspeed for

the cruise during this section of the flight was 130 knots. If 65 per cent of engine power had been retained during the descent of VH-PGC, and this is a not uncommon practice, the descent gradient of VH-PGC would have been approximately 3.6 degrees for an indicated airspeed of 155 knots.

The mode of operation of VH-PGC during the en route descent is not known with precision but the evidence of the witness who described the aircraft as descending parallel to the terrain, that is on a descent gradient of about 3 degrees, and various hypotheses based on the available evidence—such as the foregoing—do not suggest that the descent path of the aircraft, to that point at which the 'tight' turn occurred, was abnormal.

The evidence suggests, however, that the indicated airspeed was in excess of the normal operating limit of 149 knots, but that it was not grossly in excess of this limit. Certainly the evidence does not support a hypothesis that the aircraft exceeded the certificated never-exceed speed of 186 knots. A sustained descent on a significant gradient would have been required to achieve an indicated airspeed of 186 knots, and deliberate operation in the cautionary sector marked on the airspeed indicator fitted to the aircraft would have been involved. In the event that the aircraft had achieved such a speed, there should nevertheless have been no development of flutter and little likelihood of structural damage in the turbulence-free conditions which existed. The possibility of some damage to the structure of the aircraft, arising from the execution of a steeply banked turn at a speed significantly above the aircraft manoeuvre speed of 132 knots, cannot be completely excluded. However, the wreckage examination did not reveal any damage which might have been incurred prior to the actual onset of flutter.

There is no evidence as to whether the pilot operated the aircraft at an indicated airspeed in excess of the appropriate normal operating limit of 149 knots in deliberate disregard of the airspeed limitations prescribed in the Flight Manual for VH-PGC, or whether he was misled by reference to the markings on the face of the airspeed indicator which incorrectly showed that the normal operating limit was 174 knots. There is no evidence to suggest that the aircraft was being flown outside the 'green' range displayed on the airspeed indicator. The weight of evidence suggests that, at the time of the structural disintegration, the aircraft was flying at an indicated airspeed of approximately 165–170 knots and that the airspeed had probably been slightly less than this figure a few seconds prior to the accident. It might be significant that during this descent the aircraft was probably flown at or about the maximum speed at which it had been flown during its recent service (155 knots indicated airspeed) and that it then exceeded this speed for a few seconds.

The possibility that the pilot of VH-PGC may have encountered a control difficulty arising from turbulence generated by the operation of the Mystere aircraft in the area was considered. The flight path of the Mystere aircraft was reconstructed from the evidence available and this indicated that it had flown in the vicinity of the position in space at which the structural disintegration occurred, but some 200 feet higher and some 5.5 minutes prior to the arrival of VH-PGC at the position at which it broke up.

Specific information as to the wake turbulence pattern of the Mystere aircraft is not available but the intensity of such turbulence is related to the size and speed of the aircraft concerned. A study conducted in respect of the wake turbulence of a larger and heavier type of aircraft was consulted. The study indicated that the turbulence generated by that type of aircraft dissipated with a half life of the order of 20 seconds, and the residual turbulence after 5.5 minutes would be virtually undetectable. It is considered therefore that VH-PGC was not affected by wake turbulence created by the Mystere, and certainly any residual turbulence from that source was not of a severity to have been of significance in this accident.

The Piper PA32-300 aircraft was type certificated in 1966 by the United States of America, in particular the Federal Aviation Administration of the Department of Transportation, in accordance with the then Civil Air Regulations Part 3 of the U.S.A. Subject to the terms of the Australian Air Navigation Order 101.22, Australia accepts aircraft certified under CAR Part 3 and does not necessarily hold all detailed information relating to the justification of various aspects of the design. In the course of the investigation, inquiries relating to the flutter justification of the PA32 were directed to the United States as the State of Manufacture and the State issuing the type certification. A review of the flutter characteristics of the design was carried out in the United States by the Department of Transportation and no deficiencies were found in the design or the certification procedures which would account for the circumstances of this accident as determined by the accident investigation.

As at December 1976, some 3084 aircraft had been built to this design. There is no record of any other accident investigation or past problems in service which indicate an inadequacy in the provisions for flutter prevention in the aircraft type. The information available indicates that, provided the aircraft is maintained in a manner which ensures that it complies with the specifications to which the aircraft was designed and manufactured, and is operated in accordance with the approved flight manual for the type, control surface flutter should not be encountered.

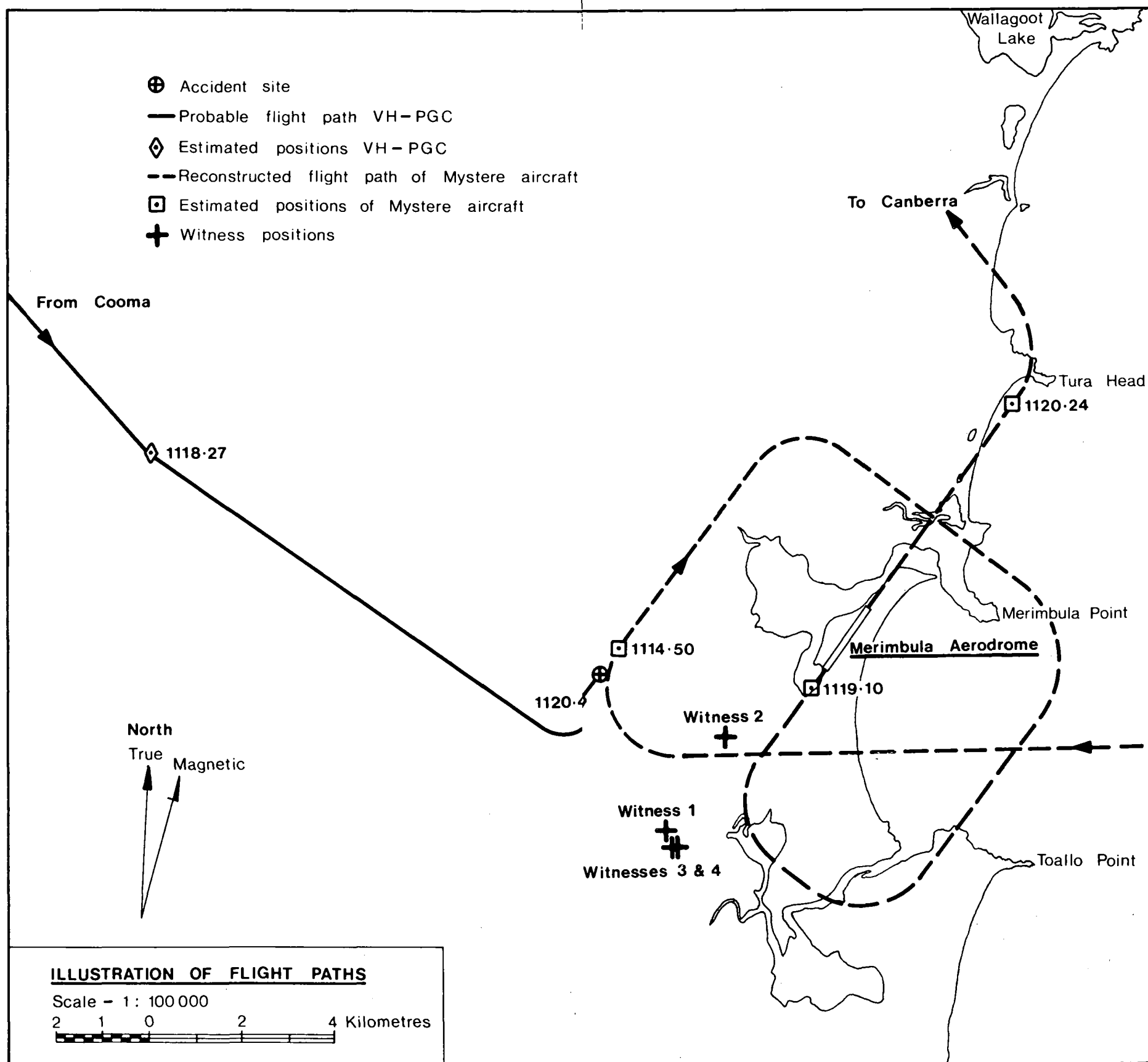
3 CONCLUSIONS

1. The pilot was appropriately qualified and licensed for the duties he was undertaking.
2. The aircraft maintenance records indicated that all appropriate maintenance had been carried out.
3. The airspeed indicator fitted to the aircraft did not comply with the provisions of Airworthiness Directive DCA/GEN/7E.
4. The examination of the wreckage did not reveal the presence of pre-existing damage, material deficiency, metal fatigue or significant corrosion, which may have been a factor in the accident.
5. The all-up weight and the centre of gravity were within the limits applicable to the aircraft type with the exception that the load carried in the forward locker was 3 kilograms more than the maximum permitted in that compartment.
6. Weather was not a factor in the accident.
7. The aircraft was not affected by mechanical turbulence generated by the operation of other aircraft.
8. During the en route descent to Merimbula the onset of fin/rudder flutter led to the collapse of the fin to the right. The fin struck the leading edge of the stabilator, which deflected, generating aerodynamic loads which resulted in the structural disintegration of the aircraft.
9. It is probable that the indicated airspeed of the aircraft at the onset of the control surface flutter was in the order of 165/170 knots.
10. The reason for the development of the fin/rudder flutter has not been determined.

CAUSE

The cause of the accident has not been determined.

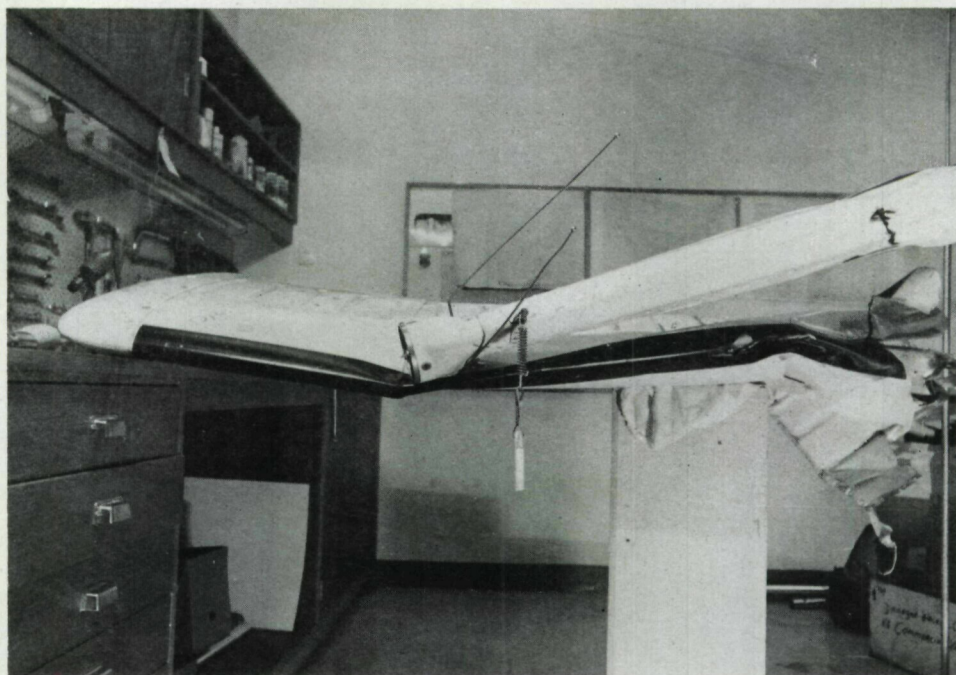
Appendixes



APPENDIX B



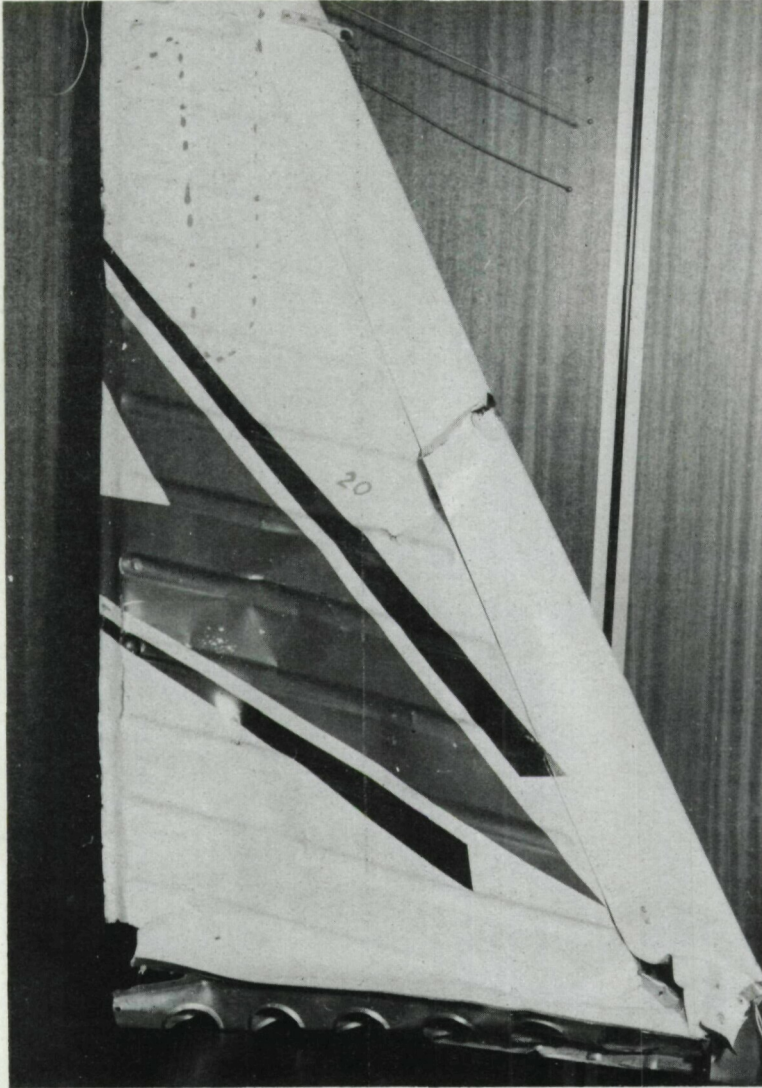
View to south-west showing approach path of VH-PGC. Main wreckage at left.



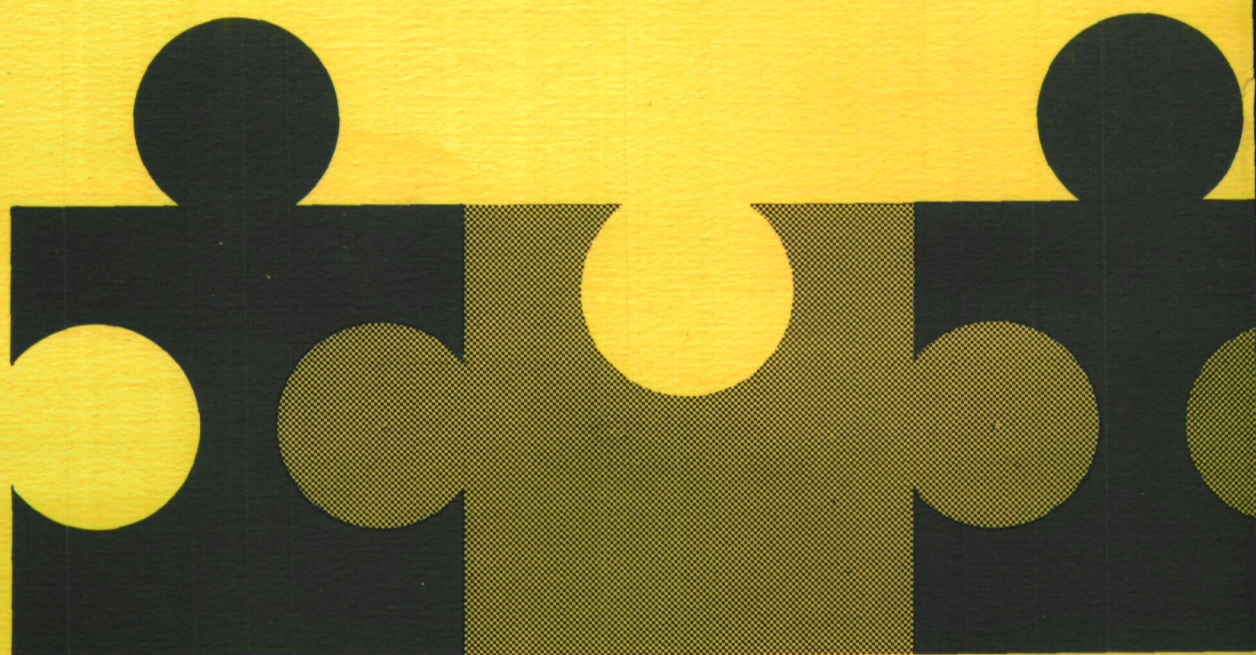
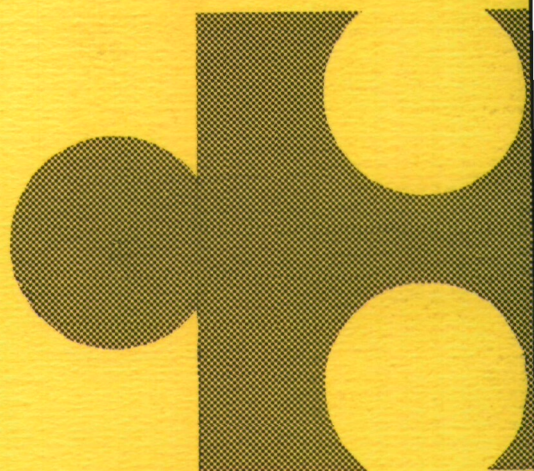
Fin collapse to right. Impact with leading edge of right-hand stabilator.



Right-hand side of fin. Diagonal wrinkling from mid-leading edge to spar fracture point at bottom left.



Right-hand side of fin. Diagonal wrinkling from mid-leading edge to spar fracture point at bottom left.



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