

ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

**Piper PA-28R Series 200, Cherokee
Arrow G—AYPW. Report on the accident
at Six Ashes Road, Halfpenny Green,
Staffordshire on 28 August 1972**

List of Civil Aircraft Accident Reports issued by AIB in 1973

<i>No.</i>	<i>Short title</i>	<i>Date of publication</i>
1/73	Douglas DC3 PH-MOA at Southend Airport, June 1971	February 1973
2/73	Bolkow BO 208C Junior G-ATVB near Hambledon, Surrey, January 1972	February 1973
3/73	Beagle 206 Series 2 G-AVAL at Chouppes (Vienne) near Poitiers, France, March 1971	May 1973
4/73	Trident I G-ARPI near Staines, June 1972. Report of the Public Inquiry	May 1973
5/73	Jodel DR 1050 Ambassadeur G-AYEA in Bridgwater Bay, Somerset, March 1972	May 1973
6/73	Fournier RF 4D G-AXJS in the sea about ¼ mile northeast of Skateraw, Kincardine, October 1972	June 1973
7/73	Piper PA-28R Series 200, Cherokee Arrow G-AYPW at Six Ashes Road, Halfpenny Green, Staffordshire, August 1972	September 1973

Department of Trade and Industry
Accidents Investigation Branch
Shell Mex House
Strand
London WC2R 0DP

12 June 1973

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

Sir,

I have the honour to submit my report on the circumstances of the accident to Piper PA-28R Series 200, Cherokee Arrow G-AYPW which occurred at Six Ashes Road, Halfpenny Green, Staffordshire on 28 August 1972.

I have the honour to be
Sir
Your obedient Servant

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch
Civil Aircraft Accident Report No 7/73
(EW/C 421)

Aircraft: Piper PA-28R Series 200, Cherokee Arrow
G-AYPW

Engine: Lycoming 10-360-C1C

Owner and Operator: His Royal Highness Prince William of Gloucester

Pilot: His Royal Highness Prince William of Gloucester
– Killed

Passenger: Mr V B Mitchell – Killed

Place of Accident: Six Ashes Road, Halfpenny Green, Staffordshire

Date and Time: 28 August 1972 at 1434 hrs

All times in this report are GMT

Summary

At the start of the 1972 Goodyear International Trophy Air Race the aircraft made a 'paired' take-off with another of the same type and handicap rating. Very shortly after take-off G-AYPW made a steep and very low level turn to the left round a marker pylon at the up-wind end of the take-off runway, during which, after the angle of bank had increased to about 80°, there was an abrupt and very considerable increase in the rate of turn.

The abrupt increase in the rate of turn may well have been a last-second attempt to prevent the port wing hitting houses which lay in the immediate flight path. This manoeuvre led to an inevitable loss of height during which the aircraft struck a tree severing its left wing tip and aileron after which it rolled over and crashed inverted to the ground. The aircraft was destroyed by impact with the ground and a subsequent fire, both occupants being killed.

The scatter-point marker for a take-off on Runway 04 was sited with insufficient regard for the welfare of local residents near the up-wind end of that runway. The Civil Aviation Authority and the Royal Aero Club have since agreed revised requirements for the siting of scatter-points which should prevent any recurrence of this unsatisfactory situation.

1. Investigation

1.1 History of the flight

G-AYPW, piloted by HRH Prince William of Gloucester was one of 35 aircraft taking part in the 1972 Goodyear International Trophy Race which was flown over five laps of a four legged 18 mile circuit starting and finishing at Halfpenny Green Aerodrome. The runway used for take-off was 04. After take-off competitors had to pass a pylon known as the 'scatter-point', located on the left hand corner of the up-wind end of the runway, before turning left through about 120° on to a westerly heading towards the first mark of the course.

Prince William had flown the aircraft to Halfpenny Green during the morning of the day of the race and then, with another competitor who was familiar with the course in the right hand seat, and with Mr and Mrs Vyrell Mitchell in the rear seats, he made one take-off on Runway 04 followed by two practice circuits of the course. After landing from this flight the aircraft was refuelled and was then prepared for the race.

A full briefing starting at 1130 hrs and lasting about 50 minutes was given to all competing pilots, passengers, and racing officials on all the aspects of race procedure covered by the Royal Aero Club briefing sheet. In this type of race, when two aircraft have the same handicap rating, it is standard procedure for them to start by taking-off in a side by side formation on the runway; this is known as a 'paired' take-off. There were seven paired take-offs in all during this race. G-AYPW was paired with another Arrow aircraft, EI-AVH, and took off after 23 other aircraft including five pairs had started in the race.

When the pilots of the two aircraft had ascertained their respective starting positions from the race committee, G-AYPW to be on the left side of the runway and EI-AVH on the right, the procedure to be adopted to ensure a safe turn after passing the scatter-point pylon was discussed. It was mutually agreed that EI-AVH should climb after take-off so that at the turning point it would be higher than and also outside the flight path of G-AYPW. It was agreed also that, since with this relationship during the turn only the pilot of EI-AVH would be able to see the other aircraft, it would be his responsibility to keep clear of the flight path of G-AYPW.

When their turn to start came the two aircraft, each with the pilot in the left hand seat and one passenger in the right hand seat, lined up abreast on the runway and when the starter's flag dropped both aircraft commenced accelerating along the runway. During the ground roll EI-AVH gained a slight lead and lifted off first and retracted its undercarriage fractionally before G-AYPW

lifted off and also commenced retracting its undercarriage. The pilot of EI-AVH said subsequently that he could see he was rapidly accelerating away from G-AYPW, but that as he began to climb his aircraft to the pre-arranged higher outside station he lost some of this advantage.

On reaching the scatter-point pylon the pilot of EI-AVH from his position above and to the right of G-AYPW could see it flying apparently very low, and he stated subsequently that he commenced his turn directly after he saw G-AYPW start to turn. Immediately after this he took his eyes off G-AYPW for a few moments to look back into his cockpit and make a rapid scan of his instruments, noting that his speed was about 105 mph, adequate in his opinion to carry out a reasonable turn, but not sufficient for a full rate racing turn. When he looked back he could see G-AYPW below on the inside in a very steep turn, then suddenly it passed underneath his aircraft and disappeared from view.

The consensus of eyewitness evidence particularly of those having professional aviation experience, was that EI-AVH had turned either simultaneously with or possibly fractionally before G-AYPW, but that EI-AVH had not 'crowded' the other aircraft in any way during the turn sequence. According to these witnesses the turn made by EI-AVH had been a normally banked slightly climbing turn whilst G-AYPW, with undercarriage retracted, remained very low and made a turn during which its angle of bank became progressively steeper until it reached an estimated 90°, at which time the aircraft commenced to slip in and lose height.

In this steeply banked attitude the aircraft passed between a group of trees and some houses then, still steeply banked, its left wing cut through the top 20 feet of a 48 foot tree. The impact with the tree broke off several feet of the wing together with the aileron. The aircraft continued, narrowly missing a house as it rolled over and dived inverted to the ground 200 feet beyond the trees; it burst into flames on impact with the ground and both occupants were killed. EI-AVH continued in a climbing turn on to course with its occupants unaware of the accident to G-AYPW.

1.2 Injuries to persons

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

1.3 Damage to aircraft

Destroyed.

1.4 Other damage

None.

1.5 Crew information

The pilot, His Royal Highness Prince William of Gloucester, aged 30, held a valid Private Pilot's Licence endorsed for aeroplanes in groups 'A' and 'B' with both night and instrument meteorological condition (IMC) ratings. He also held a valid restricted radio-telephony operator's licence, and had been assessed fit at a medical examination on 13 October 1970. His total flying experience amounted to about 850 hours, of which about 225 were in Cherokee Arrow 200 type aircraft. Most of his flying had been in Piper aircraft generally similar to the Cherokee. He had flown in six previous air races, four of them in 1972 and had made 'paired' take-offs in three of these. Prince William's licence was endorsed 'Holder to wear spectacles which correct for distant vision and shall have available a second pair whilst exercising the privileges of the licence'. A broken pair of spectacles was found in the wreckage.

1.6 Aircraft information

The aircraft was manufactured by the Piper Aircraft Corporation in the USA in 1970 and shipped to the United Kingdom where it was reassembled by CSE Aviation Ltd. After being test flown it was issued with a certificate of airworthiness in the private category on 4 March 1971; this was valid at the time of the accident. The aircraft had been properly maintained in accordance with a Royal Aero Club maintenance schedule reference R AeC (Issue 2). It had undergone a major inspection (Check 3) on 24 February 1972, and minor inspection (Check 2) on 22 June 1972. Its total flying time amounted to 226 hours. The aircraft was correctly loaded and there was sufficient petrol in its tanks for the intended flight.

1.7 Meteorological information

At the time of the accident the air traffic controllers on duty assessed the weather as follows:

Surface wind	070°/5 to 7 knots
Visibility	8 to 10 kilometres
Cloud	estimated as 2/8 at 1,800 feet and 7/8 at 3,500 feet
Temperature	plus 16°C
Weather	Nil

1.8 Aids to navigation

Not relevant to this accident.

1.9 Communications

The starter's flag was the only form of communication applicable to the race aircraft although some aircraft were maintaining a radio listening watch on the aerodrome frequency.

1.10 Aerodrome and ground facilities

Runway 04 is slightly hump-backed and rises from about 259 feet above mean sea level (amsl) near the starting line of the race to about 278 feet amsl at the hump two-thirds of the way along its length, and then falls away to 267 feet amsl at its up-wind end.

The 'scatter-point' pylon (*see* 1.16) was located at the left hand corner of the up-wind end of the 04 runway 2,421 feet from the starting line of the race and formed the initial navigation mark of the race. After take-off all aircraft were required to pass this mark, leaving it on their left, before turning left through about 120° onto a westerly heading for the first mark of the racing circuit proper.

1.11 Flight recorder

None required and none fitted.

1.12 Wreckage

The aircraft crashed on the grass verge of a public highway running alongside the Halfpenny Green Aerodrome boundary; the general level of ground in this area is about 260 feet amsl. Inspection at the scene of the accident showed that the aircraft was in a steeply banked left hand turn when its left wing had struck a 48 foot high tree. The impact had caused about 3 feet of the left wing tip and the attached aileron to separate from the aircraft, while the top of the tree had been broken off about 30 feet above the ground. The right wing had sustained extensive damage from a secondary impact with another tree as the aircraft rolled over and dived inverted into a grass covered bank about 200 yards from the first impact point. On striking the ground the aircraft had caught fire, and the centre section and cockpit area was almost completely destroyed.

Inspection of the wreckage showed that the undercarriage was locked down, and the flaps were in the up position. The cockpit instruments and controls were too badly damaged by the fire to provide any useful information. The propeller was in fine pitch and damage indicated that it was turning under power on impact. Witnesses in the immediate vicinity of the accident stated that they had heard the engine under considerable power throughout the turn and that there had been no variation in engine noise until ground impact.

A strip examination of the engine, its accessories and the propeller was carried out and a reconstruction was made of the wreckage. No evidence was found to indicate there had been any pre-crash defect or malfunction of the flying controls, the airframe, the engine or propeller, nor any other component which could have been a contributory factor in this accident.

1.13 Fire

The port wing fuel tank was ruptured when the wing broke after hitting the tree and the fuel thus released caught fire at ground impact. A large proportion of the wreckage, a nearby hedge and a large area of grass was burnt in the ensuing fire.

The aerodrome crash rescue land rover reached the scene about two minutes after the accident and the crew were able to reduce the intensity of the fire around the cockpit area. The foam tender from the aerodrome reached the scene shortly after the crash rescue vehicle and extinguished the aircraft fire using foam, and the hedge and grass fire with water. The civil fire brigade arrived just after the fire had been extinguished and took charge of the operation whilst the two aerodrome vehicles returned immediately to the aerodrome. It was estimated that the two vehicles were back at their standby station in front of the ATC tower, with their foam and water systems re-charged within five minutes of returning to the aerodrome.

1.14 Survival aspects

The accident was non-survivable. Both occupants were strapped in using lap straps only and neither was wearing a protective helmet. In this particular case neither the wearing of protective helmets nor the use of shoulder harness could have affected the outcome. Nevertheless the general principle that these safety measures should be used in light aircraft, particularly of the sporting type, remains valid.

1.15 Other information

1.15.1 *The scatter-point pylon*

The essential reason for a scatter-point, which in this case was sited at the left hand side at the up-wind end of the take-off runway, was to ensure that aircraft, which had to maintain take-off heading until passing it, would attain adequate flying speed after take-off before making any turn or other manoeuvre which would gain them an advantage in the race.

The scatter-point at the western end of Runway 29, which had been the intended runway for take-off in the race, would have provided an almost on-course heading towards the first turning point in the race circuit. However, because of the forecast wind, the Race Committee decided that Runway 04 should be used for take-off. The scatter-point in this case was sited at the up-wind end of that runway which resulted in a requirement for competitors very shortly after take-off to make a left turn of approximately 120° onto course for the first turning point. This was brought out during the pre-race briefing and competitors were enjoined to display 'good airmanship' during the turn.

An important consequence of the position of the scatter-point at the up-wind end of Runway 04 was that a group of houses in the village of Halfpenny Green was placed immediately under the turning area and although 34 out of the 35 starters made the turn without incident it is known that a number of them flew very low over these houses during their turns.

1.15.2 *Analysis of BBC news film*

At the request of AIB the Royal Aircraft Establishment, Bedford, made a frame by frame examination of the BBC television news film of the accident. At Appendix 1 is a composite diagram, marked in seconds from the start of take-off containing, together with other relevant data, the essential information derived from this examination.

The position of the camera in relation to the runway was such that in concentrating on G-AYPW the other aircraft passed out of view shortly after the start of the take-off and did not reappear until about halfway through the after take-off turn; it passed out of view again shortly before G-AYPW hit the trees. Because of the limited period in which EI-AVH was visible, and because for some of that time it was at an angle from which it was difficult to make an accurate assessment of speed and heading, this information is less accurate for EI-AVH than for G-AYPW. The initial part of the turn by EI-AVH, shown in Appendix 1 as a dotted line, although certainly not much in error is nevertheless only an estimate.

The elapsed time from start of take-off to impact with the tree was 23.6 seconds and the most significant feature of the information on G-AYPW revealed in the frame by frame analysis of the film is the sudden and radical increase in the rate of turn which took place at about second 21.5. At this point, whilst maintaining an angle of bank of about 80°, the rate of turn was abruptly increased to a value much beyond the aircraft's capability at the existing airspeed, except at the expense of a compensatory height loss. The film confirms that this height loss took place, and resulted in the collision with the trees.

During preparatory work for the above analysis a film sequence was taken from a helicopter flying low and, so far as was possible, following the same flight path as G-AYPW. From this film sequence it became apparent that on this low level flight path the group of houses on Gospel Ash Road is largely screened by trees until about second 20.5. The BBC news film shows that it was just after this point that G-AYPW initiated the sudden increase in its rate of turn. The three photographs at Appendix 2 illustrate the screening effect of the trees.

1.15.3 *Mr Vyrell Baillie Mitchell*

Mr Mitchell was an experienced pilot who had flown regularly with Prince William since 1969 and had accompanied him in a number of other air races. He was listed on the entry form for the race as a passenger, and had been present with other passengers at the briefing and had subsequently taken part in a discussion with the pilot of EI-AVH about the pattern to be flown by each aircraft at the scatter-point.

So far as can be established he took no other part in the events leading up to the accident.

1.16 *Medical aspects*

Full post mortem examinations were made of both occupants of G-AYPW and no medical conditions causative or contributory to the accident were discovered.

2. Analysis and Conclusions

2.1 Analysis

There was no evidence of any defect or malfunction of the aircraft or its engine; post mortem pathological examination did not reveal any medical factor which could have contributed to the accident. Eyewitness evidence confirmed that the undercarriage had been retracted until the aircraft hit the tree. Although found to be down and locked after the accident this is fully explicable in terms of the design of the undercarriage and the final events of the crash sequence. It is not therefore considered relevant to the cause of the accident.

From eyewitness evidence and a preliminary examination of the BBC television news film it was at first thought that the accident had resulted from an error in flying technique stemming possibly from over-enthusiasm on the part of one competitor attempting to beat another during an air race. However, a frame by frame examination of the film shows that at about 21.5 seconds after starting the take-off, and whilst very steeply banked, the aircraft was 'pulled' very sharply in a manner indicative of an abrupt application of full stabilator control. This implies some compelling external influence rather than a simple flying error.

There is no evidence to indicate that the proximity or actions of the other aircraft could have been the reason that G-AYPW made such an abrupt turn. By second 19.5 the occupants of G-AYPW would no longer have been able to see EI-AVH because of their own angle of bank and the relative positions of the two aircraft. Up to that time they would have seen EI-AVH in more or less parallel but climbing flight and thus, since there was no possibility they could have seen any sudden variation in its flight path, the reason for the abrupt turn at about second 21.5 must lie elsewhere than the proximity of EI-AVH.

In the context of air racing the entry into the turn which G-AYPW made at the scatter-point was not initially unduly steep either as to bank angle or rate of turn. However, the aircraft did remain exceedingly low and at second 20.5 the port wing tip was still only about 30 feet above the ground. It was not until well into the turn, by which time the angle of bank had increased to almost 80°, that the aircraft made the abrupt and excessive increase in its rate of turn. Consideration of the three photographs at Appendix 2 suggests a possible explanation for this sudden manoeuvre.

These photographs show that during a very low level take-off such as that made by G-AYPW the houses in Gospel Ash Road are partially screened by trees. On the flight path followed by G-AYPW the houses would not be clearly visible until about second 20.5. Although the fact that there were houses close to the up-wind end of Runway 04 had been stressed during the pre-race briefing it is not known whether the pilot was aware of their exact position in relation to his flight path or, if so, whether he had remembered them. In this connection it may be relevant that he had made only one previous take-off on Runway 04 and did not then employ the low-level technique used in the race itself. From second 20.5 a projection of the flight path at the then existing rate of turn predicates a probable collision with these houses and thus the abrupt increase in the rate of turn initiated at second 21.5 may well have been an attempt to avoid this hazard.

If this is correct then it is also possible that because of the proximity of EI-AVH the pilot of G-AYPW made a conscious choice to turn at very low level rather than to climb. However, in the time scale which applied, it appears more probable that the abrupt turn would have been an instinctive reaction rather than a matter of deliberation. The inevitable height loss from the manoeuvre made the collision with the tree equally inevitable and, again because of the time scale, there was nothing the pilot could have done to retrieve the situation or avert the remainder of the accident sequence.

The origins of the accident appear to lie in the decision to stay very low and make a steep turn round the scatter-point. Consideration has therefore been given to whether this decision could have been influenced by the actions or proximity of EI-AVH. The pilots of both aircraft had previous experience of 'paired' starts and had also discussed the procedure they would adopt in this race. Although EI-AVH probably turned very slightly before G-AYPW, the evidence of qualified eyewitnesses together with the film analysis confirms that EI-AVH did maintain a climbing turn of sufficiently greater radius to fulfil the obligation to keep clear of G-AYPW. Since there is no evidence to the contrary it must be assumed that having accepted the lower inside station the decision to stay very low was entirely a matter of personal choice by the pilot of G-AYPW.

The possible influence of the scatter-point as a factor in the accident has also been considered. This marker was sited far enough from the starting line for all aircraft to attain a flying speed adequate for a normal turn but too close for some of them to gain sufficient speed for a full racing turn. However, this point had been drawn to the attention of competitors during the briefing for the race and they had been enjoined to display good airmanship in making the turn; moreover, 34 out of 35 competitors successfully negotiated the turn and consequently it would be unreasonable to consider the scatter-point as a causal factor in the accident.

Another aspect of the siting of the scatter-point for Runway 04 was that it resulted in very low flying activity over the houses in the village of Halfpenny Green. This did not involve any breach of existing UK air legislation, nor of the Royal Aero Club rules for air racing. It nevertheless took insufficient account of the welfare of the occupants of those houses. This unsatisfactory situation could have been avoided by positioning the scatter-point further out in the open country which lies in the extended centreline of Runway 04.

Following the accident the Civil Aviation Authority and the Royal Aero Club have agreed more positive requirements for the positioning of such scatter-points and the unsatisfactory situation which existed on this occasion should not recur.

2.2 Conclusions

(a) Findings

- (i) The aircraft had been properly maintained and its documentation was in order.
- (ii) The aircraft was properly loaded and there was sufficient fuel for the intended flight.
- (iii) The pilot was correctly licensed and sufficiently experienced for the flight.
- (iv) There was no evidence of any pre-crash defect or malfunction of the aircraft, its flying controls, its engine or propeller.
- (v) Post mortem pathological examination did not reveal any evidence of a medical reason for the accident.
- (vi) The aircraft made a very low level turn to the left directly after making a paired take-off with another aircraft of the same type. During the turn there was an abrupt and extreme increase in the rate of turn followed by a loss of height.
- (vii) The aircraft then struck a tree, severing the outer three feet of the left wing and the aileron. It then rolled over and crashed inverted.
- (viii) The evidence indicates that EI--AVH, the other aircraft, did not at any time crowd or interfere with the flight path of G--AYPW.
- (ix) Although it was not a factor in the accident itself, the scatter-point was positioned without sufficient regard for the welfare of the occupants of houses in the village of Halfpenny Green.
- (x) The Royal Aero Club Racing Committee and the Civil Aviation Authority have since agreed requirements which will prevent the unsatisfactory positioning of air race scatter-points in future.

(b) Cause

After making an abrupt and excessively steep turn at a very low level the aircraft lost height and hit a tree.

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry
June 1973