No: 10/84 **Ref: EW/G84/07/05**

Aircraft type and registration:	Piper PA36-375 Brave G-BIPJ (single engine light aircraft — crop sprayer)
Year of Manufacture:	1978
Date and time (GMT):	6 July 1984 at 0900 hrs
Location:	On farm near East Dean, Sussex
Type of flight:	Aerial application (positioning flight)
Persons on board:	Crew — 1 Passengers — N/A
Injuries:	Crew — Nil Passengers — N/A
Nature of damage:	Damage to left undercarriage, left wing and lower fuselage
Commander's Licence:	Commercial (FAA), Private Pilot's Licence (UK)
Commander's Age:	25 years
Commander's total flying experience:	722 hours (of which 58 were on type)
Information Source:	Accident Report Pro-forma and Metallurgical Reports.

The aircraft was being positioned to a farm prior to starting crop spraying for the day when during the landing run, after an apparently normal three-point touchdown, the left undercarriage failed. The aircraft swung to the left, collided with an adjacent wire and post fence and ground looped though approximately 180° before coming to rest. There was no fire and the pilot was uninjured apart from upper torso restraint friction burns to his shoulders.

Each main undercarriage on this aircraft is a single leaf steel spring, 0.9" thick and tapering from 6.5" in width at its upper end to 2.5" at the wheel axle mounting position. It is manufactured from rectangular section steel bar cut to the appropriate shape and formed through two approximately 45° bends, such that one is situated just above the wheel, the other just outboard of the fuselage. The left undercarriage had failed across the section at a position approximately half way round the upper bend, ref figure (1). Metallurgical examination of the fracture surfaces revealed that failure had occurred predominantly by fast fracture from a number or origins along the lower surface. Overall rupture features were indicative of low ductility over the major part of the fracture, as evidenced by the very small shear decohesion lips extending along the lower surface, either side of these origins, ref figure (2).

The origins themselves were characterised by a smooth semi-circular region of fatigue growth ranging in size from 1.2 mm to 3.8 mm in diameter and were each centered on a pit of surface corrosion. Adjacent to the fracture were numerous similar pits, the majority of these being filled with paint and with small cracks emanating from many of them. A number of these were detected beneath the largely intact layer of paint, ref figure (3). Microscopic examination of the origins did not reveal any data relating to rate of crack growth.

Examination of the material microstructure revealed the steel to be in a hardened and tempered condition with a hardness value of 500 (HV), equivalent to a tensile strength of 106 TSI. This conformed to the material specification required by the aircraft manufacturer.

In 1983 G-BIPJ had been involved in a previous accident, ref AIB Bulletin No. 9/83 in which the left undercarriage was torn from the fuselage structure. Subsequently, after reportedly being stripped for examination and repainted with no cracks being detected, the same undercarriage was re-fitted to the repaired aircraft and returned to service. It completed approximately 200 further landings before the failure. The Piper service manual for this aircraft recommends that the main undercarriage be examined for any sign of corrosion with a minimum periodicity of 100 flying hours. Section 7.7 of the Manual states only that "If corrosion exists, clean and Magnaflux, inspect the area for signs of cracks". Since the accident the aircraft manufacturer has emphasised that 'corrosion pits are very critical in this area'.

It was evident that two metallurgical factors influenced the failure; the high strength of the steel combined with the presence of corrosion pitting on the tensile surface of the leg. The presence of these pits and the subsequent development of small fatigue cracks have been sufficient, given the low ductility of the steel at the high strength, to cause the leg to fail in a predominantly brittle manner.

The fact that pits and some associated fatigue cracks were discovered beneath the intact layer of paint indicated that both were present at the last occasion on which the leg was stripped and repainted. However, whereas the pits at which cracks initiated are likely to have been readily detectable at that time, the cracks themselves would have been difficult to detect as distinct features beyond the pits.

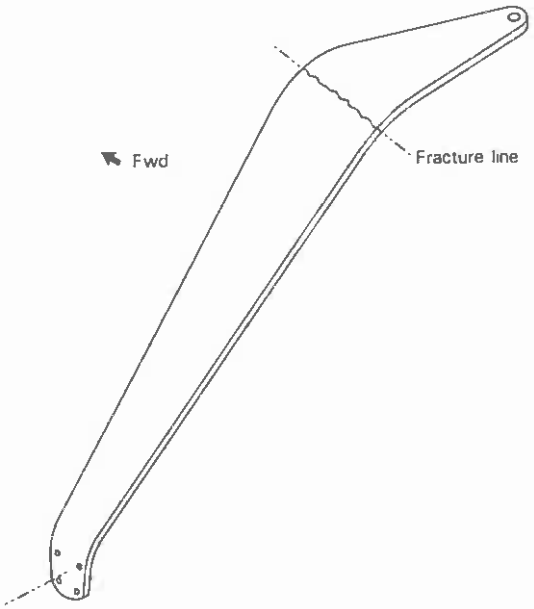

Figure 1

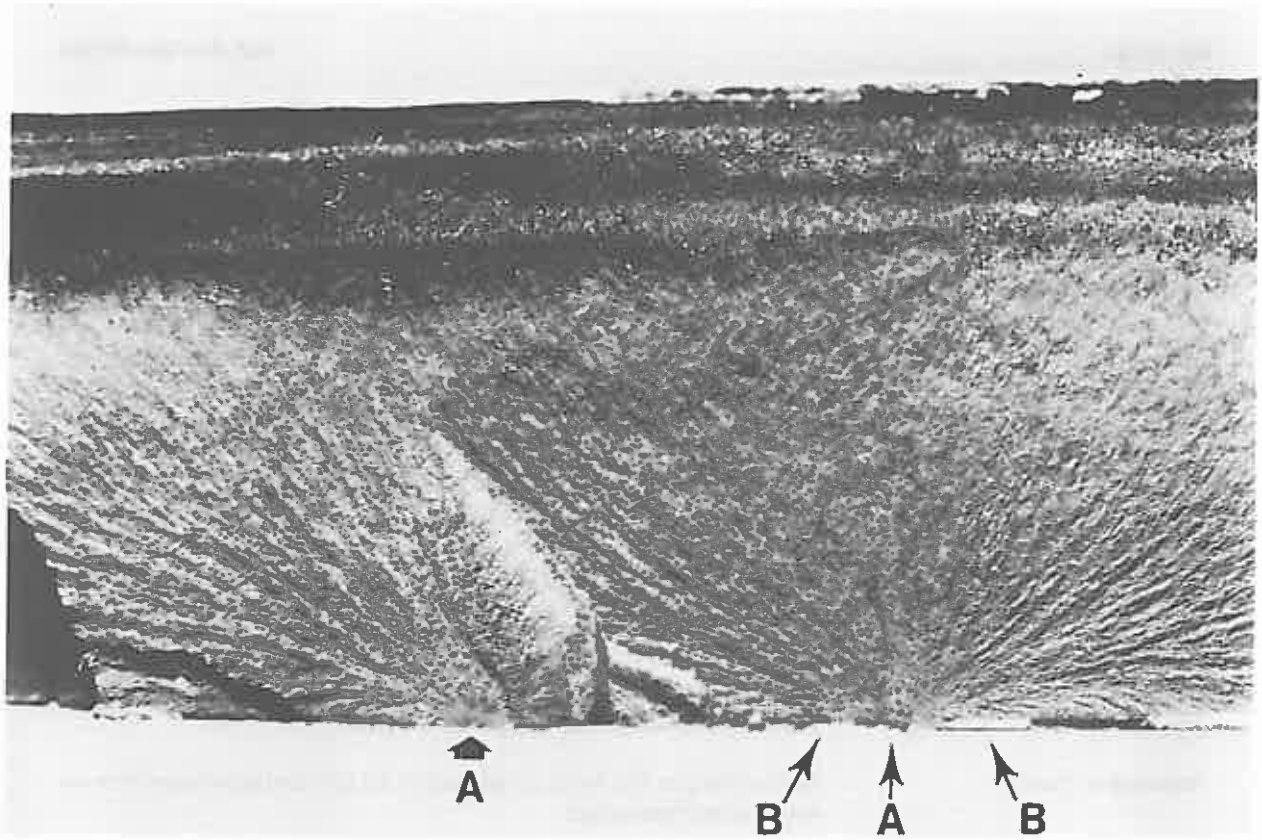

Fig 2 Detail of fracture showing two origins, A, and shear lips, B x3.6

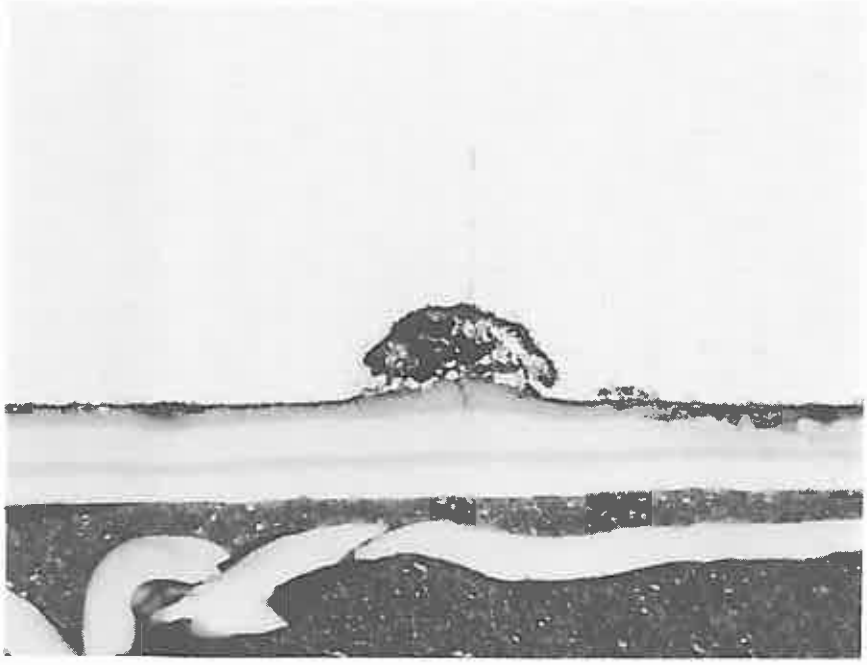

Fig 3 Pit with fatigue crack under paint layer x100