ACCIDENT

Aircraft Type and Registration:	Socata TB10 Tobago, G-BOIU
No & Type of Engines:	1 Lycoming O-360-A1AD piston engine
Category:	1.3
Year of Manufacture:	1988
Date & Time (UTC):	28 August 2004 at 1056 hrs
Location:	Bournemouth International Airport, Dorset
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - 1 Passengers - 2 (1 Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	1,456 hours (of which 1,310 hours were on type) Last 90 days - 50 hours Last 28 days - 27 hours
Information Source:	AAIB Field Investigation

Synopsis

Shortly after takeoff from Runway 26 at Bournemouth International Airport the pilot radioed to Air Traffic Control (ATC) that he had a problem and was returning to land. The aircraft was seen to enter a left turn at a low height. In the turn, it started to descend and then impacted a fence just outside the airfield boundary. A severe post impact fire started from which only two of the three occupants escaped.

History of the flight

On the morning of the accident the aircraft was flown by the pilot, accompanied by two passengers, from Guernsey to Bournemouth where it landed on Runway 26 at 0933 hrs. After landing the aircraft backtracked on the runway a short distance before turning off onto a taxiway. As it cleared the runway the pilot of another aircraft, a Cherokee Arrow which had just taken off from Runway 26, radioed to ATC that he was returning for an immediate landing on Runway 08 with an engine problem. The aircraft made a successful landing on Runway 08.

The pilot of G-BOIU was then cleared for taxi to a parking area on the south side of the airport where the aircraft was shut down at 0940 hrs. At 1018 hrs having booked out for Henstridge Airfield, the pilot requested clearance to start and taxi to the north side of the airport. At 1025 hrs the aircraft parked on the north side, where

the pilot and his passengers went into a hangar to look at some other aircraft.

At 1046 hrs the pilot requested start once again and then taxi clearance for departure. He was cleared to the holding area on the north side of Runway 26. At 1053 hrs he reported ready for departure and, on receipt of a clearance, lined up and took off from the full length of Runway 26 at 1055 hrs.

The tower controller, having issued the take-off clearance watched the aircraft start to roll and then attended to another task. His attention was drawn back to the aircraft shortly after, by a radio call from the pilot saying "GOLF UNIFORM RETURNING TO FIELD IMMEDIATELY AS WE'RE NOT GAINING AIRSPEED". The controller could see the aircraft had just passed in front of the tower and was now flying along the runway at a height that he estimated at between 100 and 200 ft. He replied to the pilot, advising him that he could put down wherever possible, and then telephoned the Airport Fire Service (AFS) to alert them to the emergency. He continued to watch the aircraft and saw it start a level turn to the left and then while still turning, start to descend. He then saw it crash near the airfield boundary and observed that there was an immediate fire. The aircraft was airborne for a total of some 40 seconds.

The aircraft had initially climbed above the runway then, from a position about two thirds of the way along its length, started a turn to the left which continued until ground impact. The turn was within the airfield boundary at first, but the aircraft then crossed low over the B3073 road to the south of the airport and across an open grass field before hitting wooden fence posts at the entrance to an amusement park. The aircraft slid a short distance across some grass, then tipped up and caught fire as it struck a substantial hedge.

The pilot and the rear seat passenger were able to climb out and get clear of the aircraft. There were several people close to the accident site who went to assist, two men first helping the pilot and then one of the passengers away from the area of the burning aircraft. They were advised of one more person still inside and returned to try to assist him, but were driven back by fierce fire and heat.

A fireman inside the fire station heard the radio call from the pilot of G-BOIU and ran towards his fire vehicle. As he passed through the building he could see the aircraft was about to crash and therefore deployed immediately. He drove out of the station and in a straight line across the grass to the boundary fence where he could see the aircraft on fire. From this position foam was sprayed onto the aircraft across the road outside the airport boundary. Two further fire vehicles left the airport through an access gate and drove along the road to reach the accident site. The fire was quickly suppressed but they were unable to rescue the second passenger in time.

The pilot and passenger who escaped from the aircraft suffered severe burns and were airlifted directly from the accident site by air ambulance to a specialist hospital.

Aircraft information

G-BOIU was a four/five place low wing fixed undercarriage aircraft with a single carburettor equipped engine driving a two blade constant speed propeller. It was fitted with electrically operated flaps which typically take 5 to 7 seconds to fully extend from the up position.

Although evidence was limited by the fire it was estimated that the aircraft was operating within the required Weight and Balance and performance limitations. The stall speed of the aircraft, as it was loaded and with 10º of bank and 10º of flap, was calculated from data supplied in the Pilot's Operating Handbook (POH) at about 60 kt.

The POH also provided a procedure for engine failure immediately after takeoff. It recommended maintaining an airspeed of 70 kt, mixture to 'full rich', changing fuel tanks and switching the fuel pump on. If no restart, then a procedure to shut the engine down and land straight ahead is provided. It also contained the following warning: *'Never try to turn back'*.

Pilot information

The pilot had owned a half share of the aircraft for many years. He first obtained his Private Pilot's Licence (PPL) in 1993 and had flown regularly since then, including several flights in the week prior to the accident. Although most of his flights originated in Guernsey he had, over the years, visited many different airfields and was familiar with Bournemouth Airport.

Pilot training

There have been many fatal accidents in the past where pilots have attempted to return to an airfield following a loss of power. The extra manoeuvering required to turn further reduces the available performance, therefore only gentle turns towards the most suitable forced landing area ahead are recommended.

The training syllabus for the PPL includes practice in Engine Failure After Take Off (EFATO) procedures and recommends that a forced landing ahead of the aircraft should be carried out with turns being kept to the minimum necessary. During training an engine failure would normally be simulated by the instructor closing the throttle and then the pilot would practice continuing to fly the aircraft while locating a suitable landing area ahead. Once control of the aircraft was established and a landing area selected the exercise would be complete. One limitation with this type of training is that it simulates only the situation where there is a complete loss of power, rather than a partial loss of power, making identification of the problem, and the decision to land more straightforward.

The aircraft's engine was fitted with a constant speed governor regulated propeller, designed to maintain a constant engine/propeller speed over a wide range of manifold pressure (power). This arrangement can disguise some of the symptoms of a loss of power that occur with a fixed pitch propeller[1]. Present licensing regulation requires pilots to undergo 'Differences Training' to convert to an aircraft type with a 'complex' feature, for example, a Variable Pitch/Constant Speed propeller, within the Single Engine Piston (SEP) class rating. Instruction in both theoretical and practical knowledge are required to complete this training. However, this training has only been introduced over the last few years and since the pilot began flying G-BOIU; previously there was no requirement for formal training of this nature. The pilot stated however that he had carried out conversion training with an instructor when he first flew this type of aircraft.

Airport information

Runway 26 at Bournemouth has a Take Off Run Available of 2,026 m (6,645 feet) and a Take Off Distance of 2,086 m (6,842 feet). There are areas of open grass to the south of the runway. The ATC tower is located some 700 m along Runway 26 on the south side.

Meteorological information

The weather observation at Bournemouth taken immediately after the accident was as follows: Surface wind from 200º at 7 kt, visibility 33 kilometres, few cloud

Footnote

[1] With a fixed pitch propeller, any reduction or loss of power is usually most readily detected by the change in the sound of the engine as the propeller slows down. With a constant speed propeller, the governor will maintain the selected engine/propeller speed, particularly if the airspeed is maintained, thereby reducing the cues available to the pilot.

at 3,200 ft, scattered cloud at 5,000 ft, temperature 17ºC, dewpoint 12ºC and QNH 1012 mb. The chart reproduced at Figure 1 below shows that the temperature/dewpoint spread would have put the aircraft in the moderate risk of carburettor icing range.

Symptoms of carburettor icing

The symptoms of carburettor icing for an engine fitted with a constant speed propeller are of a progressive reduction in manifold pressure for a constant throttle setting when flying at a constant altitude. If the icing becomes severe there may be a complete loss of power. The presence of ice may be detected by applying carburettor heat but this, in any case, will cause a small reduction in power, indicated by a drop in manifold pressure. However, if ice is present some rough running may occur as it melts, followed by recovery of the manifold pressure to a value higher than the starting value.

Recorded information

Air Traffic Control (ATC) voice communications with the aircraft were recorded and available for the investigation.

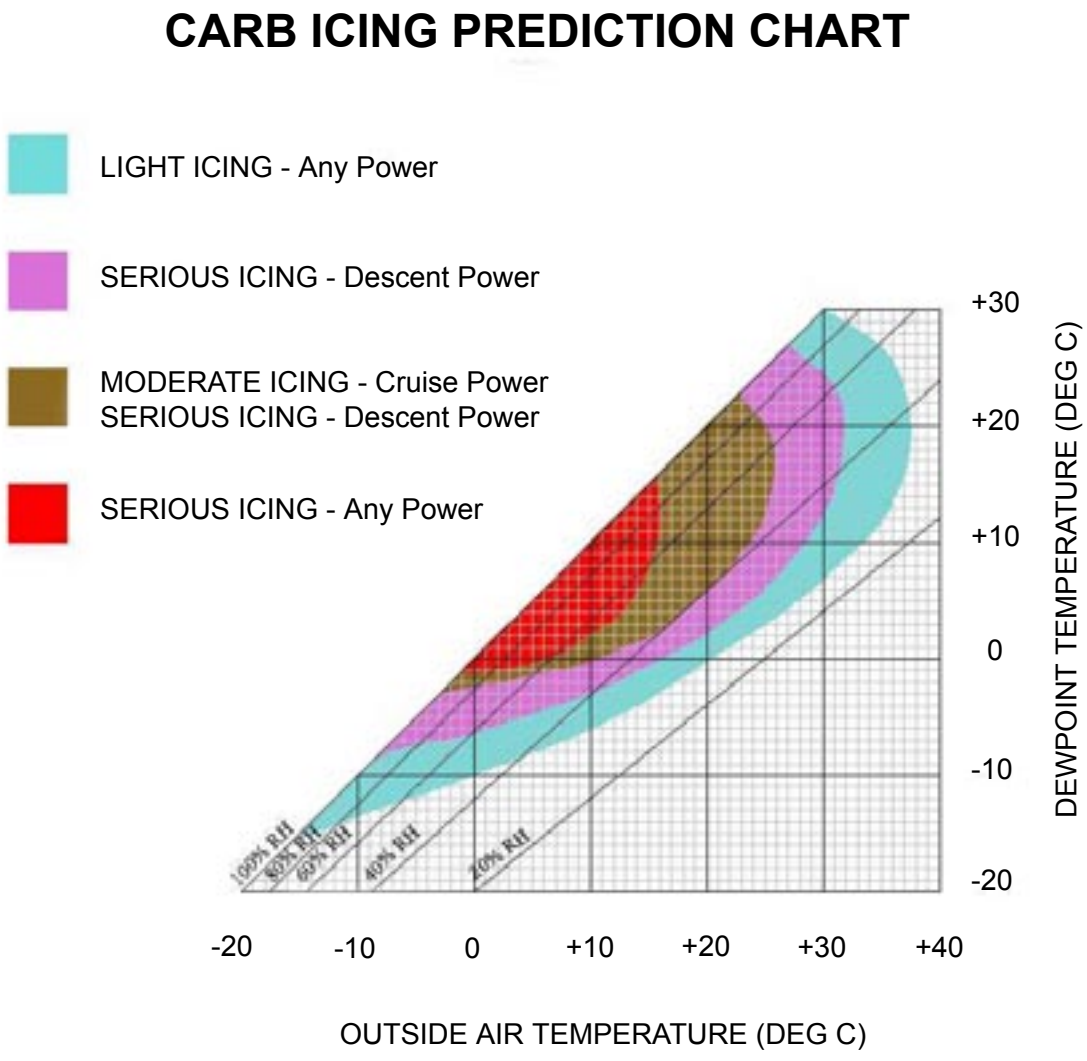

Figure 1

The transmissions from the aircraft on both the inbound flight from Guernsey and the accident flight were analysed to determine whether there was any detectable sound signal that might help to identify the cause of the loss of performance, but none was apparent.

Examination of the wreckage

Wreckage and impact information

The distribution of wreckage and pattern of ground marks showed that the aircraft's left wing initially struck the top of a wooden fence bounding the entrance road to an amusement park just to the south of the airfield. At this stage, it was in a shallow descent, banked approximately 10º to the left, and tracking approximately 085º. The fence caused extensive damage to the wing leading edge and disruption of the integral fuel tank, and yawed the aircraft to the left. The aircraft touched down a short distance beyond the fence, still with a low rate of descent but by that stage sideslipping to the right. Thereafter, it travelled at a shallow angle towards a line of substantial hedging with embedded small trees and chain-link fencing, running along the southern edge of a road which adjoins the airfield's southern boundary. Some 35 m beyond the point of initial impact with the wooden fence, the aircraft slid partially sideways into the hedge, with its speed substantially undiminished, causing the engine to be torn partially from the airframe. Concrete posts supporting the chain-link fencing caused additional extensive damage to both wing leading edges and fuel tanks. More significantly, the right side of the fuselage impacted a small tree with sufficient force to uproot it, bringing the aircraft abruptly to rest on its right side with fuel leaking from both wings and from the disrupted engine pipework.

The impact sequence overall is consistent with the aircraft having been in controlled flight, in a gentle descending turn to the left at an airspeed slightly above the stall, when it struck the fence. The fuselage survived the impacts substantially intact and there were no significant intrusions into the cabin interior, except in a localised region on the right side, in line with the instrument panel. Here the cockpit side was pushed inwards against the deceased passenger's legs at about the knee position.

With the aircraft lying on its side, the right hand cabin door would have been unusable. 'As found', the left side cabin door was closed and latched but much of its glazing, and that of the windscreen, was missing and the remnants burnt away. Numerous pieces of broken perspex, mainly from the windscreen, lay in and around the wreckage. The front seat passenger harness was burned away, but its buckle (on the left side of the seat) was still engaged.

Fire

An extensive post impact fire consumed much of both wings, particularly in the vicinity of the fuel tanks. It had also involved the forward part of the fuselage and engine, causing major damage in these areas. Additionally, several isolated pockets of ground fire were noted in debris and vegetation immediately forward of the point of impact with the wooden fence.

It was evident from the condition of the surviving parts of the fuel tank structure in both the left and right wings, that fuel would have been released potentially from the left wing during the initial collision with the fence, and from both tanks during the subsequent sequence of impacts. The fuel delivery pipe on the outlet side of the fuel boost pump, mounted on the forward face of the firewall, was torn from the pump casing during the impacts with the hedge and fence, creating a further potential source of released fuel, albeit of small volume.

The ignition source for the post impact fire could not

be positively identified; however, a number of electrical cables were damaged in proximity to the disrupted boost pump pipework. This damage almost certainly was produced concurrently with the latter, providing a potential source of ignition at about the time the aircraft was coming to rest. Whilst it was not possible to exclude totally the possibility that fuel released during the initial impact with the wooden fence ignited immediately, the evidence points more strongly to ignition at a later stage in the impact sequence, or after the aircraft had actually come to rest. The isolated pockets of burning on the ground just forward the wooden fence were most likely caused by the secondary ignition of vapours by the fire at the main wreckage.

Wreckage examination in situ

The examination of the aircraft in situ was necessarily limited. 'As found', the engine and propeller controls were all in the fully forward position. Whilst the possibility of a disturbance of these controls during the impact sequence could not be ruled out entirely, the configuration and routeing of the control runs was such as to make any disturbance tending to cause movement forwards unlikely. The facing of the magneto switch and the plastic parts of the associated ignition key were destroyed by the fire, but the surviving steel part of the key was still inserted in the switch. The orientation of the key was consistent with it having been switched to the LEFT magneto position before the post impact fire had become established; however, there was no way of establishing when it had been moved into this position.

Light circumferential scoring was evident on the forward face of one propeller blade, which was bent rearward through approximately 30° at the mid span position, consistent with this blade striking one of the concrete fence posts whilst still rotating. This blade also exhibited a series of nicks in the leading edge, characteristic of low energy interactions with a steel wire fence. The opposing blade exhibited no significant scoring or leading edge damage. Overall, the character of the damage sustained by the propeller blades was consistent with it being driven under low power at the time of impact.

The remains of the flap actuating mechanism were consistent with a takeoff setting of around 10º, at impact. The elevator trim tab was set to an approximately neutral position.

Detailed examination of wreckage

The wreckage was recovered to the Air Accidents Investigation Branch facility at Farnborough, where it was examined in detail.

The elevator and rudder control systems survived the fire undamaged, but the aileron control circuits in the wings were extensively burned. No evidence of any pre impact abnormality was found in the surviving parts of the flying control system. It was confirmed that the magneto switch 'as found' was selected to the LEFT magneto position.

The fuel system pipework in the vicinity of the fuel tanks was destroyed by fire. In addition, the fuel selector valve located in the wing centre-section, together with fuel pipework forward of the engine bulkhead, was extensively damaged by the post impact fire. Consequently, the pre-impact integrity of the fuel system per se could not be determined. Progressive disassembly of the fuel valve showed that it was selected to the left tank at the time of the crash.

A detailed external inspection of the engine and associated ancillary components did not reveal any evidence of pre-impact abnormality. The carburettor 'hot air' flap was in the cold air (normal) position at impact, and its rubber hinge seal, which is the subject of a Service

Bulletin inspection (SB 10 -086) following instances of its detachment and obstruction of the air inlet path, was securely attached and in good condition.

The engine and propeller were taken to an approved overhaul facility where they were subject to bulk disassembly under the direction of the AAIB, sufficient to provide access to all relevant components. Key components were fully disassembled and/or subject to functional testing. With the exception of damage directly attributable to the forces of impact and/or to the post impact fire, no evidence of abnormality was found relating to the core engine. In particular: the crankshaft rotated freely; all rockers and valves operated correctly; the pistons and cylinders were all in good condition, with no visible signs of valve seat damage, excessive coking, or any other indications of abnormality; the camshaft was in good condition; the ancillary drive train was in good condition, and the drive to the engine driven fuel pump was intact. The engine driven fuel pump itself was checked and found to pump effectively.

The carburettor was examined in detail. The throttle-stop housing had fractured as a result of the throttle spindle being driven back against the stop during the impact, and the resulting over travel had caused buckling of the throttle butterfly plate. The mixture control lever had also fractured in the impact. The float level was tested and found to be within the normal range, with no evidence of leakage at the float valve. The carburettor was fully disassembled and found to be in good condition, with no evidence of corrosion, debris, deterioration or damage to the float, seals, or any other component part. All of the jets were clear.

After external cleaning, the propeller governor was installed on a test rig in its 'as found' state and function-tested against the appropriate test schedule. The maximum speed setting was found to be slightly higher, and the relief valve setting slightly lower, than the specified values but the unit operated satisfactorily and its performance was judged to be acceptable for an in-service unit.

The dual magneto and ignition harnesses were inspected and rig tested. Prior to removal from the engine, whilst the drive to the magneto was still intact, its timing was checked and found to be set correctly. Because of fire damage, the pre-accident serviceability of the high-tension harnesses could not be confirmed. Testing of the capacitors revealed that the capacitor for the left side of the magneto was open circuit, but it was considered unlikely that this would have materially affected the ability of the left side of the magneto to deliver an effective spark; rather, its likely effect would have been to increase the probability of radio interference. A visual inspection of the magneto did not reveal any overt signs of abnormality and, after substitution of a serviceable cap and HT harness for the accident damaged items, the unit was installed on a test rig where it performed faultlessly.

A full strip examination of the propeller established that the pitch-change peg on the bent blade (the blade that also exhibited wire damage on its leading edge and circumferential scoring on the forward face) had fractured as a result of gross overload during the impact, allowing this blade to over-travel into a flat pitch position. The propeller appeared to have been in a fully serviceable condition prior to impact.

In summary, detailed examination of the aircraft wreckage failed to identify any significant pre-accident defect or abnormality. No explanation could be found for the apparently low-power output of the engine at the time of the crash. The atmospheric conditions were conducive to carburettor icing, but evidence of such a

condition would not have survived after the crash and consequently no definitive conclusion could be reached as to its possible relevance to this accident.

Survival aspects

Except for the impact with the tree and associated deformation of the right side of the cabin adjacent to the front seat passenger's lower legs, the impact forces were relatively light and the accident would almost certainly have been survivable had the aircraft not caught fire. The post impact fire, however, necessitated a rapid escape from the aircraft.

The aircraft had a door on each side but because it was lying on its right side one of these was not available. The other door was not opened, but it was evidently possible to escape through the broken left side window and/or the windscreen. Bystanders, at some risk to themselves, were able to assist two persons away from the area of the wreckage before the arrival of the emergency services. However, the fire was too severe for them to be able to help the third person, whose legs were almost certainly trapped to some extent by the deformation of the cabin in that area, and whose seat belt was found subsequently to be still fastened. The AFS arrived at the scene rapidly, having been initially alerted by the radio call made by the pilot saying that he was returning to the airfield, but were too late to assist in the escape.

Witness information

There were a large number of witnesses on the ground in the vicinity of the accident and there were also several persons who witnessed the entire flight. The descriptions were generally in agreement and allowed an estimate of the flight track to be constructed. A nose high attitude and slow speed were observed after takeoff, followed by a continuous descending turn which took the aircraft just outside the airfield boundary. There was, however, only limited information as to the sound of the aircraft during its flight but generally people commented that there was little obvious engine noise. Some of the persons who assisted at the accident site spoke with the pilot at the time. They recalled that he had told them that the aircraft had lost power and he was trying to return to the airport.

Pilot's recollection

The pilot, who was seriously injured, was interviewed three months later. He was able to remember many of the events leading up to the accident but some of his recollections did not concur with other factual evidence, probably as the result of the passage of time and the considerable trauma that he had suffered.

The pilot recalled that prior to departure he had taxied to the holding point where he had completed his pre-takeoff checks according to the checklist. He was then, without any significant delay, cleared for departure.[2] As was his normal practice he ran the engine up to full power on the runway before releasing the brakes. The takeoff appeared normal but, shortly afterwards, he noticed the airspeed was not increasing. This was the first indication to him that there was a problem with the aircraft, he thought that at this time he had attained a height of around 500 ft. He lowered the nose to maintain speed and at the same time made a call to ATC saying that he wasn't gaining airspeed. He turned the aircraft to the left, towards an area to the south where he thought he could land. He stated afterwards that he saw people in the area of the airfield boundary fence at the far end of the runway and he did not want to risk running into them if he landed ahead. He

Footnote

[2] Seven months after the accident the pilot advised that, during his power checks, he always selected left then right fuel selector, then returned to left for take off, all of which he would accomplish before reducing power again.

heard the stall warning sounding (this operates 5 to 10 kt above the stall speed) and was conscious that he needed to maintain speed above the stall.

The pilot described feeling a gentle touchdown before the aircraft tipped over at a fairly slow speed and caught fire. Although he remembered he had unlatched the door prior to landing he was unable to open it, but managed to escape through the front windscreen. Once out of the aircraft, bystanders were able to assist him to a safe area.

Analysis

The pilot flew regularly and was familiar with the aircraft. Shortly after takeoff he recognised that there was a problem and, as evidenced by his radio call, immediately decided to return to the airfield. At this stage he must have considered that there was enough performance available to enable a safe turn and approach to land. At some point thereafter he could no longer maintain height and was forced to descend and, although he may have thought he would just reach the airfield, the aircraft came down short.

The POH does provide a procedure for an attempt to restart the engine but not one for a partial loss of power. In either case any actions that can be completed will necessarily be limited by the time available, the first priority always being to maintain control of the aircraft. It is not known what actions the pilot was able to carry out but the evidence shows that the aircraft was in controlled flight until the point of impact and, but for the obstacles in its path, should have been able to make a successful forced landing.

At the position where the pilot recognised a problem, there were both runway and clearway ahead of the aircraft and open fields beyond the airfield boundary ahead and to the south. The general advice given for an engine failure after takeoff is never to attempt a turnback. Thus it is worth examining some factors which may have influenced the pilot in his decision to attempt to turn back to the airfield.

The pilot recognised a loss of airspeed after takeoff but did not appear to associate it immediately with a loss of engine power. Some of the symptoms of a power loss could have been disguised by the effect of the propeller constant speed unit, as this would attempt to maintain propeller speed, thus eliminating the characteristic sound of a reduction of engine/propeller speed associated with an engine power loss which occurs with a fixed pitch propeller. Other engine instruments might have given an indication but they would be unlikely to have been seen by the pilot during takeoff. Thus, the loss of aircraft performance was the main indication of the problem. This potential for a constant speed propeller to disguise a reduction or complete loss of engine power may not be widely recognised by all pilots. It should however be covered in any course of formal 'Differences Training'.

A decision to attempt a forced landing ahead, with the possibility of damaging the aircraft, may be more difficult where there is only a perceived partial loss of performance, rather than a catastrophic failure, and the aircraft remains under control. Although the principle of not turning back is well established in training, it is possible that some pilots are not sufficiently aware that a loss of power/performance can be insidious in nature and not always as easy to detect as the type of engine failure after takeoff generally practised at training organisations.

In the absence of a clear appreciation of a power loss, the pilot may initially have thought he could complete a turnback to the airfield or even a circuit. On the inbound flight from Guernsey, just after landing, the pilot witnessed another aircraft with an engine problem make a successful return to land on the reciprocal runway.

Although he did not afterwards recollect the details of this event it remains a possibility that at the time it influenced his decision.

After takeoff, with the aircraft in a relatively nose high attitude and at a slow speed, the view ahead and to the right would have been restricted, whereas the pilot's view to his left side would have been good. It would be reasonable for there to have been a natural tendency for the pilot to turn towards an area that could be clearly seen and, in this case, initiate a left turn.

Conclusion

The aircraft crashed just short of the airfield boundary fence while turning back towards the airfield following a loss of power. The reason for the loss of power could not be established from the available evidence but, whilst some failures could be ruled out, it was not possible to eliminate carburettor icing, a fuel supply or an ignition problem.