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DEPARTMENT OF CIVIL AVIATION AUSTRALIA





Contents

Trapped Beyond Recall	 	 	1
Deadly Deception	 	 	6
Spatial Disorientation?	 	 	10
The Obvious Overlooked	 	 	14
Dual in the Sun	 	 ••••	18
In Brief	 	 	21
False Alarm!	 	 	27
The Power of Suggestion	 	 	28

FRONT COVER: Undulating timbered country poses a challenging task for this agricultural pilot as he skilfully positions his Pawnee for a spraying run during an operation near Burnie, Tasmania. -"The Advocate" photograph

ABOVE AND REAR COVER: A Really Safe Private Pilot! The most senior licensed pilot in Australia, and probably in the whole British Com-monwealth, Mr. Robey Manuel, D.F.C. and Bar, poses with his Cessna 172B at his farming pro-perty near Kerang, Victoria. Mr. Manuel learnt to fly in the Australian Flying Corps during World War I and served with No. 2 Squadron A.F.C., in France, where he became a flight commander and was credited with a number of victories. After he returned to Australia in 1919, he bought a Boulton Paul P9 two-seat biplane and, except for the years of World War II, when he held a commission in the R.A.A.F., Mr. Manuel has owned an aeroplane ever since. In the rear cover photograph, Aviation Safey Digest artist Norman Clifford discusses a full-colour illustration he has made of the SE-5A single-seat fighter that Mr. Manuel flew while with No. 2 Squadron, A.F.C. The registration letters on the tail of Mr. Manuel's present-day Cessna strike a nostalgic note.

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T Lilydale Aerodrome, 25 miles A north-east of Melbourne, Victoria, a pilot with a restricted private licence had arranged to hire a Beech Musketeer for an hour's flight in the local training area. The pilot was familiar with the locality, having flown over it on several previous occasions, and he had also covered a large proportion of the terrain on foot in the course of bush walking and surveying activities.

The flight was to be the first from Lilydale on this particular day and the pilot arrived at the aerodrome with his three passengers at 0945 hours. The weather on the morning of the flight was showery, with four to five eighths of strato-cumulus cloud, and a base some 3,000 feet above aerodrome level. The wind was from the west-south-west at 10-15 knots, with a general visibility of about 20 miles, except where it was reduced in isolated rain showers.

Before departing, the pilot was given a pre-flight briefing by the chief flying instructor who told him to be alert for heavy rain showers or any other significant deterioration in the weather. Should the weather change for the worse, he was to return immediately to the aerodrome. The CFI then authorised the pilot to operate between 1,500 and 2,000 feet AMSL and reminded him that while

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airborne he would be in a better position to assess the approaching weather. The aircraft subsequently departed at 1015 hours.

Some 15 minutes afterwards, another instructor at the aerodrome happened to be speaking on the telephone to a commercial pilot at Moorabbin Airport who mentioned that the local weather had deteriorated and that it seemed probable that the airport would be closed for a time as a result. When he had finished the telephone call, the instructor saw what appeared to be a heavy rain shower in the distance, in the direction of Moorabbin Airport.

The instructor was then busy preparing two other aircraft for departure, but while doing so he continued to keep an eye on the approaching weather. After about 15 minutes he realised that the squall was advancing much more quickly than he had first thought and that it was a good deal more threatening. At this stage the storm was about two miles away to the south-west, forming a front five to six miles wide. The dark cumuloform cloud extended up to the surrounding strato-cumulus cloud base and beneath it was heavy rain. Until this time there had been little change in the weather at Lilydale since the Musketeer had departed, but now as the storm con-



General view of the accident site, showing the main wreckage as it was found by the ground search party. The surrounding undisturbed vegetation indicates that the aircraft struck the ground at a steep angle.

tinued to approach, light rain began to fall. The instructor cancelled the other two flights which were about to depart and, boarding one of the parked aircraft. called the pilot of the Musketeer to ascertain his position. The pilot answered immediately, stating that he was three miles north-east of the field and inbound. The instructor then told the pilot to make a straight-in approach to land into the south and the pilot acknowledged the call. From the aerodrome at this stage, visibility in an arc from north-west through north to south-east was still at least 15 miles and the instructor then joined the CFI to watch for the approach of the aircraft. By this time the rain and the wind strength on the ground were increasing steadily.

Shortly afterwards at 1045 hours, when there was still no sign of the Musketeer, the instructor called the aircraft again and the pilot reported that he was now heading towards Healesville to remain clear of the approaching weather. Conditions were deteriorating rapidly at Lilydale, but by this time the instructors could see that it was still clear to the north-east towards Healesville, although this was the direction in which the weather was moving.

By 1100 hours the rain had become heavy at the aerodrome and the wind strong with severe gusts, but as conditions were still reasonably clear beyond Healesville, the instructor sought the CFI's permission to take-off in another

aircraft and follow the Musketeer to faintly see the outline of Mount Dandetry and intercept it before the weather nong. In view of this they again called caught up with it, and guide the pilot back to the field. The CFI agreed, so him to turn on to a heading of 180 taking another pilot with him as an observer, the instructor made a hasty take-off and climbed immediately towards Healesville. The weather in the meantime had continued to worsen with very heavy rain beginning to fall and strong, gusty south-west winds developing and, as the aircraft climbed away a heading of 120 degrees at 1,300 feet. from the aerodrome, it almost immediately encountered heavy rain, hail and snow which reduced visibility to about calls to it producing no response. one mile.

As they were climbing the instructor called the Musketeer again to check its position and after some delay the pilot replied that he was five miles north-east. After a number of further exchanges, made very difficult by the fact that there were long delays before any reply was received, it was established that the Musketeer was now at 1,500 feet flying in "zero visibility". Conditions deteriorated further as the instructor continued towards Healesville in the hope that the cloud was patchy, but by the time the aircraft had reached 1,300 feet the precipitation had increased to such an extent that it seemed futile to go on, and the instructor turned back.

But by the time their aircraft had descended again to a height of 700 feet, the crew saw that the weather to the south was improving, and they could

the pilot of the Musketeer and instructed degrees and commence a descent to 1,000 feet, intending that this should bring the aircraft away from the ranges to the north and into a position where the pilot could safely descend and regain visual contact with the ground. After a long delay the pilot replied that he was on This transmission, at 1125 hours, proved to be the last from the Musketeer, further

When it was evident to the instructor that contact with the Musketeer was lost, he returned to Lilydale and landed. By this time the rain was decreasing with the passage of the weather. The CFI, after conferring briefly with the instructor, then telephoned the Melbourne Air Traffic Control Centre to report that the Musketeer was overdue, and Search and Rescue action was initiated immediately.

For the next eight days an intensive air search, using a number of aircraft and helicopters, and supported by police and civilian ground parties, was carried out over the area in which the aircraft was believed likely to have crashed. The search was continually hampered by low cloud and rain and even when the weather on the ranges did improve, it

remained overcast. The lack of sunlight eliminated any possibility of reflection from metallic surfaces of the missing aircraft and also reduced definition of objects on the ground. A further difficulty was posed by the fact that the Musketeer was painted white with a vellow tail, and on numerous occasions during the search, patches of snow, in conjunction with flowering wattle trees on the ranges, were mistaken for the wreckage.

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After eight days, during which 244 hours were flown by the search aircraft, including 70 hours helicopter time, and a total of 116 sighting and hearing reports had been investigated, it was concluded that the likelihood of finding survivors was extremely remote and, in the face of the further poor weather that was developing, the search was abandoned.

Meanwhile, the owner of a privatelyregistered Cessna 172, who had followed the progress of the search with a great deal of interest, felt that his local knowledge of the area might be of some advantage in finding the missing Musketeer. He therefore decided to carry out a further search in his own aircraft.

The owner outlined his ideas to three friends, each of whom held a commercial pilot licence, and the group planned a flight for the following week-end. All available information was studied and early on the Saturday morning, the four pilots departed from Moorabbin Airport in the 172.

ACCIDENT SITE

LILYDALE AFRODROME

Two areas to be searched had been chosen, but once again unfavourable weather dictated a change in plan and the group at first had to be content with covering what they believed was the less likely area. The weather eventually began to clear however, and after some four hours flying, including a refuelling stop at Lilydale Aerodrome, one of the observers glimpsed a flash of reflected sunlight amongst heavy timber immediately beneath the aircraft. A closer look proved it to be the wreckage of the missing aircraft. So dense was the forest growth at the site, that the wreckage could be seen only from one particular angle and even then it was visible only by virtue of the sunlight reflecting from the white painted metal. Although the area had been searched unsuccessfully from the air on nine previous occasions, this was probably the first time an aircraft had flown over the crash site when the sun was shining.

The site of the accident was $13\frac{1}{2}$ miles north-north-east of Lilydale Aerodrome and 1,600 feet AMSL on the southern slopes of an east-west ridge that forms part of the Great Dividing Range.

Examination at the accident site showed that the aircraft's initial impact had been made with the top of a tree 95 feet above



Map showing accident site and approximate position of advancing front at about the time the instructor made his first radio call to the Musketeer. The aircraft became trapped between the front and the high terrain to the north-east.

ground level. From this point the aircraft had descended into the trees at an angle of about 30 degrees below the horizontal and on a heading of 127 degrees magnetic. During this descent it had sustained other severe impacts with large trees, which dislodged the port undercarriage, the starboard wing, the starboard tailplane and other minor components. Towards the end of its descent path, the aircraft struck a large tree, breaking off a heavy limb, and finally dropped to the ground at low forward speed, where the main section of the fuselage was consumed by an intense fire. The fire had evidently begun during the descent through the trees when the starboard wing was torn off, rupturing the starboard fuel tank.

Impact damage to the propeller indicated that the engine was delivering only moderate power when the aircraft struck the ground, but as examination of the engine indicated that no defect had developed before the accident, it was apparent that the pilot had probably reduced power when instructed to descend, or alternatively the throttle had been retarded intentionally or otherwise, when the aircraft struck the first tree.

The final flight path as derived from the damage to the trees and the condition of the wreckage itself was not consistent with the characteristic loss of control which is so frequently the outcome of an inexperienced pilot, untrained in instrument flying, becoming caught in

Rather, it was evident that the aircraft was descending to the south-east as stated by the pilot in his last radio transmission. The aircraft's altimeter was found set to the Lilydale QFE current at the time and examination of the altimeter itself showed that it was probably reading 1,450 feet when the accident occurred, an indication consistent with the elevation of the impact point.

The pilot held a restricted private licence and had a little over 50 hours total flying experience. He was familiar with the local training area, and in view of the relatively fine conditions which prevailed at Lilydale when the pilot was preparing for departure, the CFI had no reservations about authorising the flight, particularly as the pilot was regarded as a person who took his responsibilities seriously.

The terrain for several miles around Lilvdale Aerodrome is flat but to the north-west, through north to the southeast, a wide semi-circle of mountainous terrain rises steeply from the plain towards the main ridge of the Great Dividing Range. Several miles directly to the south of the aerodrome, the Dandenong Ranges rise steeply to about 2,000 feet.

Evidence obtained from a number of persons who witnessed the passage of the storm through the area, indicated that the front was aligned approximately north-west, south-east and that it extended south-east at least as far as the northern boundary of the Dandenong Ranges. There was thus no possibility of an air-

instrument meteorological conditions. craft in the Lilydale area being able to further he would be trapped between divert around the storm to the south. To the north, ahead of the storm, the higher peaks of the ranges were enshrouded in the overlying stratocumulus cloud and although it is possible that there would have been escape routes to the north, via the narrow gaps in the ranges at Glenburn and to the east of Healesville, this might not have been evident to an inexperienced pilot who had never before flown beyond the boundaries of the Lilydale training area.

> It seems likely when the pilot was first called from Lilvdale and warned of the approach of the storm, the aircraft was considerably further north than the three miles the pilot estimated in his reply. Had it in fact been in the bility. position reported, the aircraft should have been visible by then to those watching for it from the ground at the aerodrome. From his actual position, it seems possible that the pilot saw the aerodrome overtaken by the advancing front before aircraft and the apprehensive tone of his he could reach it and then, probably in an attempt to keep clear of the higher terrain to the north, he turned southeast towards Healesville, a direction which would take the aircraft towards sky that was still clear of the advancing storm. This meant however, that although the aircraft was flying more or less parallel with the slopes of the higher terrain to the north-east on its port side, it was also flying parallel with the advancing front on its starboard side. It is thus possible that as the pilot continued in this direction, he saw that the front would soon overtake the track he was flying, and that if he went much

the high terrain overlaid by cloud and the advancing storm front. At this stage, with his escape route to the south already blocked, the pilot apparently turned back on to a reciprocal heading towards the north-west, possibly in an attempt to track around the northern edge of the storm, but before he had gone very far in this new direction, the aircraft was overtaken by the advancing front. It was probably at this point, no doubt while experiencing great difficulty in flying the aircraft in severe turbulence with little or no forward visibility, and only very limited visibility directly downwards, that the pilot at length replied to calls from the other aircraft, reporting that he was flying at 1,500 feet in zero visi-

By this time the situation would have been almost beyond the pilot's capacity. The fact that there were long delays before he answered calls from the other voice when he did reply, suggests that he realised his problems were very serious indeed. When instructed to turn on to a southerly heading and descend, the pilot no doubt "clutched at a straw" and grasped this opportunity as the only possible way of escape. But with almost no visual reference remaining, apart from probably an occasional glimpse of the terrain beneath the aircraft from which he was able to maintain some degree of orientation, the pilot probably had extreme difficulty in turning the aircraft in the direction suggested by the instructor. This is borne out by the fact that he later reported that he was on a

General view of the area in which accident occurred, showing probable final flight path and location of wreckage.

heading of 120 degrees and descending. It is unfortunate that at this time, the aircraft was still considerably further north than either he or the instructor in the other aircraft believed, and a descent at this point brought the aircraft into contact with the tops of the trees on the ridge where the accident occurred.

This accident is another classic example of a pilot becoming caught in a situation where a safe alternative course of action was no longer available to him. It is clear from the investigation that, with the advance of the squall line, the aircraft became virtually trapped amid high terrain, with no means of escape because of the overlying cloud cover.

Although in this case the instructor's radioed advice would probably have been effective if the aircraft had been in the position indicated earlier by the pilot, in the circumstances that actually existed it was to no avail. At the same time, the instructor's advice could not be said to have contributed to the accident, because the aircraft was already in such a desperate situation that an accident was almost inevitable. With hindsight, it is evident that from the time that the squall line overtook the aerodrome at Lilydale, the only way in which the accident could have been avoided was for the pilot to have made a precautionary landing in the best available area still ahead of the storm.

Cause

The cause of the accident was that the pilot who was inexperienced, did not take timely action to terminate the flight when weather conditions rapidly deteriorated.





in dense undergrowth.



DEADLY DECEDITION DEADLY DECEDITION DEVDEX DECEDITION



Soon after departing from an airstrip near Wellington, N.S.W. on a return flight to Bankstown Airport, a Cessna 182 was seen descending slowly towards the Burrendong Dam, 13 miles south-east of the town. The gradual descent continued unchecked until the aircraft flew into the surface of the water, which at the time was still and smooth. The aircraft sank immediately and its four occupants were drowned.

6

The aircraft was owned by the pilot and at the time was returning to Sydney after a visit to Wellington where the owner had business interests. Three Sydney employees of the pilot were passengers on the aircraft, accompanying the pilot on the round trip.

The flight from Bankstown to Wellington had been made in fine, clear and calm weather and was entirely uneventful. On landing at about 1230 hours, the party were met at the airstrip and driven into town. After the pilot had completed his business, the party had lunch, in the course of which the pilot mentioned he intended to show his passengers the Burrendong Dam on the return flight. The lake formed by this dam on the Macquarie River, upstream from Wellington, extends for some thirty miles up the river and at its widest point, close to the dam wall, is about five miles across.

At about 1330 hours, the party left the town again and were driven back to the airstrip. Boarding the aircraft with his passengers, the pilot started the engine, taxied out and after what appeared to be a normal run-up, took off into the south-west.

After climbing straight ahead to about 1,000 feet, the aircraft was seen to turn on to a south-easterly heading, the approximate track to Bankstown, which would take it over the Burrendong Dam.

Apparently still climbing, the aircraft then passed out of sight to those watching its departure from the airstrip. The weather at the time was still fine and clear with almost no wind.

A few minutes later several witnesses working on properties in hilly terrain immediately to the west of the dam site, saw the aircraft flying a south-easterly heading, apparently following the course of the Macquarie River towards the spillway. When first sighted, the aircraft appeared to be about 1,000 feet above the river, but as it continued over the rising terrain formed by a series of ridges, its ground clearance was progressively reduced and it was seen to clear the highest ridge by only about 100 feet. At this stage of the flight, witnesses on the ground noticed that the engine noise was less than normal, as though throttled back, and that the aircraft was descending steadily in a straight line towards the dam.

Crossing a lower range of hills closer to the dam, the aircraft passed over the spillway, at a height of about 150 feet and continued its steady descent out over the water, the surface of which was smooth and glassy. Closely watched by two men working on the spillway who were becoming increasingly concerned for its safety, the aircraft maintained its flight path and, with no change in engine power or attitude, went on descending until suddenly the engine noise ceased as the aircraft was lost to view in a column of spray. When the disturbance subsided, only a little floating wreckage remained to mark the place where the aircraft had disappeared.

One of the workmen ran at once to a telephone at the end of the spillway to report the accident and to request the nearby dam authority workshops to bring a boat to the area as quickly as possible. He then drove around to the dam authority's launching ramp where, while awaiting arrival of their boat he intercepted a small private motor boat which had just returned from a trip of several miles up the lake. The two men in the boat had seen the aircraft flying in the distance but did not know it had crashed. Taking the workman to direct them, they set out immediately for the point where the aircraft had sunk.

On reaching the area a few minutes later, they found as well as a small amount of floating wreckage, the bodies of two of the four occupants. The floating wreckage consisted only of the pilot's seat, a windscreen sun visor, part of the blind from the aircraft's rear window, and portion of a set of earphones, as well as a number of papers, including the pilot's flight plan and a copy of the area forecast.

A search for the sunken aircraft was begun on the afternoon of the accident and subsequently continued for two weeks. During this period, a "Duck" amphibious vehicle, a number of boats belonging to local authorities and private owners, and a flat-bottomed barge suitable for use as a diving platform were brought into service. While the boats were employed dragging a wide area surrounding the spot where the aircraft had disappeared, an under-water search was begun by a number of police and civilian skin divers, and afterwards continued by an eight-man Navy diving team who brought with them portable sonar equipment.

5

Although at first the search appeared to be a relatively simple task, the real magnitude of the problem became increasingly apparent as the effort continued. The depth of the water (more than 150 feet in the area in which the aircraft crashed) and its muddiness reduced visibility on the bed of the lake to zero, and even a spotlight used under water would illuminate objects no further away than about a foot. The water at this depth was also very cold, and it was necessary to restrict each of the divers to one dive of 20 minutes duration per day. After allowing time for decompression procedures, this meant that each man was able to spend only 11 minutes a day on the lake bed.

The nature of the lake bed itself also made matters extremely difficult. Before



the dam had been built, the river valley had been farming and grazing land and although timber had been cleared from around what was to become the shore of the new lake, the deeper parts were left very much as they were. This quickly became evident during the search when grappling hooks dragged by the boats repeatedly became entangled in submerged fences, telephone wires and drowned trees. Even an old plough, still lying where it had been left before the valley was flooded, provided a further obstruction for the grappling hooks. As well as these obstacles, the fact that the original course of the river was bounded on either side by heavy stands of timber, which had been left undisturbed when the dam filled, rendered the underwater search extremely difficult. If the sunken aircraft had came to rest in these timbered areas, its detection would be virtually impossible. Thus, despite all the effort made, the search for the sunken aircraft proved to be a task beyond the resources and equipment available and, after two weeks, it was reluctantly abandoned.

The damage sustained by the pilot's seat and other components found floating near the site of the crash was no more than typical of what could be expected in an accident of this type and gave no hint of any situation which could have caused the aircraft to fly into the water. The possibility of an engine malfunction was considered but could not reasonably be related to the circumstances of the accident. The aircraft had adequate fuel on board for the return flight to Sydney. atmospheric conditions at the time were not conducive to the formation of carburettor ice, and the witness evidence concerning the sound of the engine and the final flight path contained nothing to suggest that the engine was incapable of normal operation. In any case, even if an engine malfunction had occurred during the descent, a change in heading, either to the right or the left could have quickly positioned the aircraft closer to the shore. As it was, the aircraft descended towards the widest expanse of the lake on a long straight approach from a height of some 800 feet and over a distance of almost two miles. The witnesses described this descent as very similar to an approach to land on a runway.

The pilot held a private licence and had accumulated about 140 hours experience. He was in good health and spirits before departing on the return flight to Bankstown and there was nothing to



The damaged pilot's seat recovered from the surface of the lake after the aircraft had sunk.

suggest that he could have become incapacitated in flight before the accident occurred. Inquiries made during the investigation indicated that the pilot was not inclined to indulge in low flying. Although he had overflown the Burrendong Dam on a number of previous occasions in the course of travel flights between Bankstown and Wellington, it was apparent that all these flights had been conducted throughout at a safe height.

On this occasion however, it is clear that the aircraft was flown with substantially less than 500 feet clearance over the hills immediately to the north-west of the Burrendong Dam, and subsequently over the spillway at a height of less than 200 feet. To the pilot overflying the high terrain and approaching the Burrendong Dam from the northwest in this way, the spillway would have come suddenly into view over the crest of a ridge. It seems probable that shortly after sighting the spillway, the pilot reduced power to follow the downslope of the terrain towards the dam, which over this distance averages three and a half degrees. From the evidence obtained during the investigation it is apparent that the aircraft's angle of descent was about four degrees. It is also quite evident, both from

meteorological reports and witness statements, that at the time there was no wind and the surface of the lake was absolutely still and calm. The two witnesses who saw the accident from their position on the spillway, described the surface as "glassy" and "dead, flat and shiny", and one said "there wasn't a ripple". The

Air Navigation Regulation 133 is not witnesses also referred to illusions from designed merely to be restrictive. Nor is reflections in the water, which made it it intended to imply that in every situamost difficult to see the surface itself. tion, 501 feet is safe and 499 feet is not. The situation that existed was thus one Rather, like so many other A.N.R.'s in which a comparatively inexperienced and A.N.O.'s it exists to provide a buffer pilot, with virtually no practice or experifor the unexpected and unforeseen ence in coping with the illusions inherent circumstances that so often occur in in low flying, was making a long shallow aviation. There is an old saving to the approach towards a smooth, glassy effect that "if men were meant to fly, stretch of water. The difficulty in assessthey would have been given wings". ing height above calm water is well Although today, no one could take such known to pilots experienced in over-water a statement in any way seriously, the operations. With no waves or ripples to fact remains that, like so many old give any indication of scale or to provide maxims, it has an element of truth in it. any sensation of relative movement, there Flight is undoubtedly an alien environis nothing to alert the pilot to impending ment for man, and for it to be acceptably danger as the aircraft descends, and if as free from danger, it is necessary that well there are strong reflections, the surit be performed within limitations that face itself becomes virtually invisible. allow for the inevitable errors, misjudgements, and other contingencies that occur In this accident, it is clear that the airfrom time to time, without seriously craft continued its steady descent with no change in flight path until it struck the compromising safety. A margin of safety is thus fundamental to all aspects water. There can be little doubt that of flying and it is this philosophy that the reason why the pilot did not check the descent was simply that he had no is the basis from which ANR 133 and many other Air Navigation Regulations idea the aircraft was so dangerously close have been compiled. Sound pilots are to the surface. The line of flight being followed would not have provided the those whose sense of self-discipline insists that their operations are conducted in pilot with any nearby land mass from accordance with this philosophy at all which to obtain a visual impression of times over some types of terrain in a height, and although he was probably single engined aircraft; for example a basing the aircraft's attitude on the distant horizon beyond the far shore of good deal more than 500 feet might be a desirable minimum height. the lake, it is also possible that reflections

of this terrain in the water could have provided a false horizon and created an illusion of height above the surface.

But whatever were the precise factors, and their effect on the human mechanism, which combined to mislead the pilot during the latter part of his descent, there can be no reasonable doubt that, one way or another, the accident resulted from the pilot's inability to assess the height of the aircraft over the glassy surface of the water. It follows that the accident would not have occurred if the pilot had not exposed himself to the well-nigh impossible task of assessing height in these conditions. In other words, had the pilot been content to fly over the lake at or above the minimum height prescribed by the Air Navigation Regulations, the aircraft would have been operating with an adequate margin of safety and no danger would have developed.

Sequence of photographs taken during the investigation to reconstruct the probable flight path of the C.182 as it approached the dam. In the first view, the spillway appears at a distance of about one mile. From this point the Cessna continued its descent over the spillway until it struck the water at the approximate position shown in the last picture.

Comment

It is for the very purpose of providing an adequate margin of safety, that 500 feet is prescribed as the minimum height at which an aircraft may fly in normal circumstances.

As pointed out in the last issue of the Digest, to disregard rules that have been framed specifically to ensure that a flight can be conducted with an acceptable margin of safety, is tantamount to shutting one's eyes, not only to the accumulated experience of many years of aviation history, but also to innumerable object lessons learned in the past at the cost of many lives and aircraft.



The probable cause of the accident was that the aircraft was flown at an unsafe height. -

SPATIAL DISORIENTATION?

Cessna 180 Strikes Ground During Procedure Turn

In hilly country, 10 miles north-west of Scone, New South Wales and nearly 2,000 feet AMSL on the western side of the Hunter River Valley, a Cessna 180 had been engaged to spread superphosphate.

Because there was no agricultural airstrip on the actual grazing property to be treated, the pilot had arranged to use a strip on a neighbouring land holding. Although this strip is only about two miles north-west of the treatment area, the steep main ridge of the Brawboy Range, aligned north-south, lies between them and, after taking off from the strip on each spreading sortie, it was necessary for the Cessna to climb about 1,000 feet to cross the range.

The aircraft arrived at the strip at about 1330 hours and after taking the grazier who owned the property for a short flight, while he pointed out the boundaries of the area to be treated, the pilot began spreading operations at about 1400 hours, making his spreading runs on easterly and westerly headings. The terrain at the western end of the spreading runs posed no problem for manoeuvring the aircraft, but the eastern end of the area lay close to the base of the main ridge of the Brawboy Range. At the end of each easterly run, the aircraft was seen to be flying through a gap in the ridge before turning on to a reciprocal heading on the eastern side of the ridge, and flying back through another gap to make the next spreading run in a westerly direction.

For the first four spreading flights, the pilot took on loads of eight hundredweight of superphosphate and then on the fifth flight increased this to nine hundredweight. After flying a further sortie with this load, the pilot had the loader driver increase the quantity to ten hundredweight and again completed a normal series of spreading runs.

Landing back at the strip for the seventh time, the pilot requested another ten hundredweight load and, after taking off again, resumed the same spreading pattern. At this stage of the operation, the grazier's 10 year old son was watching the aircraft from the homestead, and at the end of one easterly spreading run he saw that, instead of flying through the gap in the ridge before turning as before, the aircraft nosed-up sharply and climbed steeply before carrying out a "Wing Over" type manoeuvre inside the ridge. As the aircraft turned back on to a westerly heading, still apparently in a pronounced nose-down attitude, it was lost to the boy's view behind a lower intervening hill. Shortly afterwards the boy saw black smoke coming from the area. Fearing the aircraft might have crashed, the boy called his father, who after watching the hills in vain to see if the aircraft re-appeared, telephoned the homestead of the property on which the strip was situated to enquire whether the aircraft had returned to the strip. Meanwhile at this property, the loader driver was already concerned that the aircraft had not returned. The telephone call only served to confirm his fears that something serious had happened and he immediately telephoned his base at Scone for assistance.

Calculations of the aircraft's fuel state Shortly afterwards, two aircraft then at the time of its last take off showed took-off from Scone to look for the there was ample fuel on board for the missing Cessna and some minutes later flight and it was evident that the aircraft's found the burning wreckage on the lower endurance was at least 90 minutes. The slopes of the ridge close to where it had intensity of the fire which followed the last been seen. When a ground party impact also left no doubt that there was reached the crash site they found the a considerable quantity of fuel on board aircraft almost completely destroyed and at the time. The aircraft's fuel selector that the pilot had been killed. valve was found positioned to the starboard tank. The valve had suffered fire damage but examination showed that its passages were unobstructed. The valve From an examination of the burnt-out itself was found to be correctly assembled and that it would have been capable of functioning normally.

From an examination of the burnt-out wreckage and the nearby impact marks on the ground, it was evident that the aircraft had struck the ground with considerable forward speed in a nosedown attitude while banked to starboard. Impact forces had torn the propeller from the engine and one blade had been thrown 250 feet. The propeller hub, with the other blade still attached, was found buried in superphosphate amongst the main wreckage. It was evident from the damage sustained by the propeller that it had been rotating at high speed at the time of impact.

Examination of the wreckage disclosed no evidence of any defect or malfunction in the airframe or its systems which could have contributed to the accident. An examination of the engine likewise failed to reveal any pre-impact malfunction, and there was nothing to indicate that the engine would have been incapable of delivering its normal power output at the time of impact.

There was no evidence that the pilot had attempted to operate the hopper dump valve. No superphosphate was found along the flight path leading to the impact site and although the aircraft's hopper doors were partly open their position was consistent with what could be expected from impact forces.

The pilot held a commercial pilot licence endorsed for the aircraft type, together with a Class 2 agricultural rating and had satisfactorily completed some 300 hours of agricultural piloting three months before the accident. All this flying had been undertaken in hilly terrain similar to that in which the accident occurred.



As all the evidence indicated that the aircraft was being operated normally during the flying carried out in the area before the accident occurred, consideration was given to the type of manoeuvre the aircraft was seen to perform immediately before it was lost to view and the smoke from the burning wreckage sighted. The aircraft's earlier turns at this end of the spreading runs had all been made on the far side of the Brawboy Range but on this occasion, the witness evidence indicates that the aircraft nosed-up steeply before beginning the turn inside the terrain barrier formed by the Brawboy Range. Although the young eye-witness stated that the aircraft had turned to the left, impact marks on the ground showed that the turn was probably made to the right. The manoeuvre was apparently intended to be an agricultural procedure turn, of the type frequently used in top dressing operations where the terrain is suitable at the end of a spreading run. In this type of manoeuvre, the aircraft is pulled up into a steep climb and while in a climbing attitude, is turned through 180 degrees about the aircraft's vertical axis. The result is that the aircraft is in a descending attitude as it comes out of the turn and is then able to regain speed for the commencement of the next spreading run. The manoeuvre is akin to a stall turn, but in this case the aircraft is turned before the stall is allowed to develop and it thus remains fully under control with positive G forces applied

throughout the manoeuvre. From the distribution of the wreckage it was obvious that the aircraft had completed the turn sequence of the manoeuvre and had almost pulled out of the ensuing dive when it struck the ground. The investigation was therefore directed at determining the reason for the aircraft's failure to complete the turn safely, and a number of possibilities were considered.

The question of whether the pilot had attempted this manoeuvre at too low an altitude for the existing conditions was first examined, and the possible effects of wind were also taken in account. At the time of the accident, the wind was blowing from the south-east at about 15 knots and the smoke which arose after the aircraft had disappeared was seen blowing across the face of the Brawboy Range from the south-east. As the range at this point is aligned almost north-south, it is quite likely that there would have been a moderate degree prolonged or severe side slipping or of turbulence on its lee side. In these conditions, an aircraft attempting a procedure-type turn would need to be the fuel tank outlet and lead to fuel flown initially at a greater height than starvation. It is thus possible that the in calm conditions, to allow an adequate procedure-type turn manoeuvre could margin of safety.

Consideration was also given to the effects that a loss of power would have on the procedure turn type manoeuvre. A series of flights undertaken in an aircraft of a similar type during the investigation showed that at least 200 feet of altitude would be lost if an engine of the fuel on board the aircraft at the failure occurred during the first half of time of the accident, the evidence of the

such a procedure turn. An engine failure later in the turn would have a reduced. but still a considerable effect on the loss of height. In the light of this information, the question of whether the engine could have lost power as a result of fuel starvation during the turn was examined and several facts emerged which seemed to be in accord with this possibility. The aircraft had some three hours fuel on board when it departed from Scone to begin the operation and it had flown about 1 hour 40 minutes when the accident occurred. At this time the fuel selector had been positioned to the starboard tank. If the pilot had been using fuel from the starboard tank throughout the operation therefore it is possible that the fuel level in the tank would have been quite low at the time of the accident. The lavout of the fuel system in the Cessna 180 is such that with low quantities of fuel in a tank, any skidding flight, or any flight with the wing down, would be likely to uncover have had just this effect and resulted in the aircraft's engine losing power at a critical point during the turn. However, although examination of the badly damaged port fuel tank gauge recovered from the wreckage lent weight to the view that the port tank contained most

investigation as a whole was insufficient to conclude that fuel starvation had contributed to the accident.

Two other factors remained to be considered. One of these was the heading of the aircraft at the moment of impact. From the distribution of the wreckage, and the ground impact marks it was apparent that, when the aircraft struck the ground, it had already passed through the heading which the pilot would have been intending to take-up for his next spreading run in a westerly direction. This suggests, that at the time the aircraft struck the ground, the pilot had lost some measure of control of the aircraft.

The other factor was the nature of the terrain itself. In this undulating country, there would have been no real horizon reference for the pilot particularly while making spreading runs in the easterly direction, towards the broken outline formed by the main ridge of the Brawboy Range. It is thus quite possible that he could have obtained a false impression of the horizon, from the higher terrain ahead of the aircraft. In this regard it is significant that the easterly spreading runs were made to some extent in an uphill direction. It is quite possible therefore, that unless the pilot was carefully monitoring his airspeed throughout the spreading runs in this direction, he could have been led to believe the aircraft was operating in a straight and level attitude when in fact it was climbing. He thus may have attempted the procedure turn unaware that he had insufficient airspeed to complete it safely.

Although in the circumstances it is not possible to determine the exact processes that led to the onset of the accident, there can be little doubt that the pilot, because of the nature of the terrain. attempted a manoeuvre for which the performance of the aircraft was marginal. During this manoeuvre, possibly as a result of one or more of the factors already discussed, he lost control of the aircraft and it struck the ground in a nose down attitude before control could be regained.



It is probable that the pilot lost control of the aircraft during a turn, and recovery could not be effected in the height available. It has not been possible from the evidence available to determine the reason for the loss of control. -

Close-up of the burnt-out wreckage of the Cessna 180. The engine and port wing are in the foreground.



JET FUEL&AVGAS DON'T MIX!

Based on report published by N.T.S.B., U.S.A.

Soon after taking off from a general aviation airport near Atlanta in Georgia, U.S.A., the No. 2 engine of a Martin 404 lost power. While the crew were trying to diagnose the trouble, the No. 1 engine also lost power and the aircraft could not maintain height. Committed to a forced landing, the Captain put the aircraft down on an expressway, during which it collided with a car before coming to rest on a bridge. The aircraft was destroyed, one passenger was killed and the crew and 27 other passengers were injured. The

five occupants of the car received fatal injuries.

UBBO FI

THE aircraft was owned by a land development company and at the time of the accident was engaged in taking a group of prospective land buyers on a tour of inspection. The weather at the time was overcast with a cloud base of about 500 feet and light rain and fog was restricting visibility to between two and three miles. The surface temperature was 66 degrees F.

Before departing on the intended flight, the aircraft was refuelled from an airport refuelling tanker. Two hundred gallons were added to the aircraft's fuel tanks, bringing the total fuel load up to 800 gallons, and the engines were serviced with 57 quarts of lubricating oil.

The engines started normally and after a satisfactory run-up, the aircraft took off at 0916 hours local time and set course in accordance with its IFR flight plan, for Fort Myers, Florida. One minute after take-off. Atlanta departure control established radio contact with the aircraft and, as it was climbing to its assigned altitude of 4,000 feet, radar indentification was established.

Shortly afterwards, while the aircraft was still climbing, the No. 2 engine lost power. The BMEP instrument indication for the engine dropped to a reading of 100 horsepower and the fuel flow indication fell below normal. Suspecting carburettor icing, the crew applied carburettor heat and turned on the fuel booster pump. At the same time they increased power on No. 1

engine to the METO (maximum except take-off) setting. A short time later, as the cylinder head temperature gauge indication for the No. 2 engine increased to its maximum reading of 300°C, the crew opened the cowl flaps, then used the engine primer in an attempt to increase the power from the engine. At 0921 hours, four minutes after take-off, the crew declared an emergency and requested a clearance to Atlanta International Airport which lay only a few miles away to the south-west of the aircraft's position. The aircraft was then vectored towards the airport on headings which would avoid high antennas in the aircraft's path.

Six minutes later as they continued towards the airport, the crew saw that the cylinder head temperature of the No. 1 engine was also rising rapidly, and the first officer opened the cowl flaps for this engine. Shortly afterwards, when the aircraft was seven miles north-east of Atlanta International Airport, it suddenly vawed to port as the No. 1 engine lost power

completely. With insufficient power

left to maintain height, the aircraft descended and, as it broke out of the overcast cloud, the captain sighted a motor expressway directly below. Forced to put the aircraft down, the captain attempted a landing on the median strip of the expressway which was the only suitable terrain within range. After touching down in a westerly direction, the aircraft ran straight for 1,200 feet then began a gradual turn to the left. As it swung across the east-bound traffic lane, the aircraft struck and demolished a car carrying five people, then slid up an embankment and collided with the structure of a bridge crossing the expressway. The port wing was torn off and the aircraft's momentum carried it up on to the bridge where it finally came to rest at right angles to the expressway with the fuselage broken open.



The main wreckage of the Martin 404 as it came to rest at right angles to the expressway.

Examination of the aircraft and its systems after the accident revealed no evidence of any malfunction or failure before impact and it was determined that at the time of departure the aircraft was mechanically and structurally airworthy. Both the gross weight and the centre of gravity of the aircraft were calculated to have been within the prescribed limits at the time of take-off.

The aircraft was fitted with two Pratt and Whitney R2800 CB17 engines. Examination of both engines revealed evidence of severe detonation. The pistons had been severely damaged by overheating and the spark plugs showed evidence of having been operated at temperatures above their designed operating range. Fuel samples were taken from the aircraft's fuel tanks, the fuel inlet lines to the carburettors, and the fuel strainers in the carburettors themselves and were subjected to laboratory analysis. This showed that the 100/130 octane fuel in the aircraft's tanks was contaminated by iet fuel. Further investigation then established that the aircraft had been refuelled with 200 gallons of Jet A fuel before departing for the flight. It was found that 100 gallons of jet fuel had been added to each of the aircraft's two fuel tanks when the total fuel load was brought up to 800 gallons. This was despite the fact that the aluminium cover plates fitting over the fuel tank filler caps on the upper surface of the wings were and had at one time been a helicopter each stamped "Fuel-100 Octane min. 685 US gal." The aluminium cover plates were unpainted and the markings were legible at the time the wreckage He worked for the company at weekwas examined.

Examination of the records of the company that carried out the refuelling operation showed that the fuel supplied had been correctly identified and invoiced as Jet A fuel. Similarly, the oil supplied to the aircraft had been correctly invoiced as reciprocating engine oil. It was also found that the tanker vehicle used for the refuelling operation had the words "Turbo Fuel" displayed in large letters on both sides of the vehicle, and on its right hand side, the words "Jet A" also appeared in two places.

The refuelling company concerned had been in business at the airport for five years and during this period the number of persons employed had increased from 20 to 40. During the same period its fuel sales had increased from 20,000 to 78,000 gallons a month. The company had no formal training or checking procedures for the attendants who performed the refuelling operations, but new employees were trained by working with experienced attendants.

Two attendants were involved with the refuelling of the aircraft on this occasion. One, a full time employee who was 22 years of age, had been working for the company for nearly 12 months, and had previous experience with a fixed base operator at another airport. He had also served four years in the Navy gunner. The other attendant aged 19, was a part-time employee and had been with the company for some six months. ends and during the week was attending -F.A.A. "Aviation News" photograph

a technical school where he was studying to be an aircraft mechanic.

It was found that the men had refuelled the aircraft while moderate rain was falling. The full time employee had attended to the tanker while the other employee had taken the hose and nozzle to the tank filler inlets on the top of each wing. The latter said that he did not notice any marking on the fuel caps to indicate the tank capacity or the type of fuel used. An attendant employed by another company was also present during the first part of the refuelling operation, and said afterwards that he saw the "Jet A" marking on the fuel tanker during the servicing.

The manager of the refuelling company said that the attendants knew that they were delivering jet fuel to the aircraft, and that the error had been made in aircraft and engine identification. The company had recently refuelled a number of Convairs which had been converted to turbine engines and used jet fuel. The manager did not remember having serviced any Martin 404 aircraft previously. The attendant who had brought the tanker to the aircraft said that he had seen similar aircraft that took Jet A turbine fuel, and he had assumed that this was the proper fuel for this aircraft.

The captain of the aircraft had instructed the first officer to watch the refuelling operation, which he did from a position under the wing and also from an adjacent hangar. From these positions, the first officer could watch the meter indicating the amount of fuel being dispensed from the fuel tanker. Immemeter, the tank itself was placarded "Turbo Fuel Flammable".

When the refuelling was completed the captain signed the invoice which clearly indicated that the fuel supplied was jet fuel. The first officer then drained the fuel sumps but did not detect any water or other contamination. The fulltime refuelling attendant said that at the captain's request, he too had drained the fuel sumps and had noted that the fuel had kerosene in it because it was "very slippery".

It was clear from the investigation that the aircraft was mechanically and structurally airworthy at the time of its departure and that there had been no failure of the airframe or aircraft systems. The weather was satisfactory for the type of operation planned.

It was equally clear that the aircraft had been erroneously serviced with 200 gallons of jet fuel before departure instead of 100/130 octane avgas. One hundred gallons of jet fuel were added to each of the aircraft's two fuel tanks. which already each contained 300 gallons of 100/130 octane. In consequence the octane rating of the fuel was reduced and resulted in high engine operating temperatures, severe detonation, and finally, extensive and sustained power loss in both engines. Although the operation of the engines was satisfactory enough to accomplish a successful takeoff while the water injection system was being used, detonation and pre-ignition would have developed immediately the water injection was discontinued when the take-off was completed. The apparent inability of the crew to recognise the symptoms of detonation or to assess its cause prompted them to apply carburettor heat which would have increased induction temperatures still more and could only worsen the condition of the engines. As a result of the detonation and pre-ignition, the temperature of both engines reached the maximum reading of 300°C on the cylinder head temperature gauges. The crew's action in opening the cowl flaps in an effort to rectify these high temperatures resulted in an increase in drag, which aggravated even further the already critical thrust-drag configuration of the aircraft.

It was evident that no clear understanding existed between the crew of the aircraft and the refuelling attendants as was also apparent that the attendants number of the cases, the required grade did not have sufficient training or experience to recognise what fuel the aircraft required. Both attendants knew they were servicing the aircraft with jet fuel, but evidently did not realise it was equipped with reciprocating engines which require avgas. Even so, the mere fact that they added 57 quarts of reciprocating engine oil to the engines during the same refuelling operation, should have been enough to alert them to their error. At the same time the first officer should have noticed the markings on the fuel tanker and the captain, who signed for the fuel, should have seen from the invoice that the wrong type of fuel had been supplied.

As a result of this accident the National Transportation Safety Board has recommended to the United States Federal Aviation Agency that Federal Aviation Regulations be amended to provide for a more effective fuel colour coding system on aircraft and refuelling equipment.

Comment

Here we have a situation in which all the people concerned in a refuelling operation - refuelling attendants, first officer and finally captain, each missed a whole series of cues, any one of which could have served as a warning signal that the wrong fuel was being supplied to the aircraft. The case is an almost classic example of error resulting from preconceived ideas, of familiarity breeding contempt, and of complacency on the part of all parties concerned. The whole purpose of publicising the story in the Digest is, of course, to pose the question "Could it happen here?", and to see what can be learnt from it to prevent a similar catastrophe.

The truth of the matter is that it has already happened here, though fortunately without such tragic or costly results. A very similar occurrence, involving a Piper Aztec departing from Gurney, Papua, was reported in Digest No. 64, and two incidents overseas of essentially the same character were described in Digest No. 54. Other similar incidents, involving the contamination of water methanol tanks by turbine fuel or avgas, were reported in earlier issues.

All these cases have much in common with this latest one in America. In all of them, the persons responsible overlooked or failed to notice cues that could

diately to one side of the tanker's fuel to the type of fuel to be supplied. It have alerted them to the error. In a of fuel was clearly marked on the aircraft filler caps, and in others the pilot signed a delivery docket which clearly specified fuel of a type unacceptable for the aircraft. This experience shows quite conclusively that such safety precautions as fuel tank marking, colour coding systems and other aids to correct fuel identification, although highly desirable, can never be completely reliable or "foolproof".

> As with so many other things in aviation, the only real answer to the problem is vigilance by all parties concerned, leaving nothing to chance or to "the other fellow". In Australia this applies particularly when refuelling is carried out at remote or seldom-frequented aerodromes by persons other than accredited oil company agents.

> An accredited oil company aviation agent has been trained by his company to ensure that refuelling operations are safely and efficiently carried out, and that the high quality control standards imposed on the manufacture and storage of aviation fuels and lubricants, are maintained throughout the refuelling operation.

> By contrast, an "unofficial" refuelling attendant such as might be found in a country area where there is no appointed oil company aviation agency, may be a person who has little knowledge of aircraft, the fuels they require, or safe refuelling procedures.

> In any such case, where for one reason or another it is not possible to obtain fuel from an accredited aviation agent, the pilot-in-command should be even more vigilant than usual to ensure that the fuel supplied to his aircraft is acceptable as regards type, grade and freedom from any form of contamination.

Dual in the Sun

In this article, a reader tells of two unnerving near misses he experienced in the course of a single afternoon's flying. In view of the several mid-air collisions that have occurred in Australia during the past two years, the article should provide food for thought for any pilot who at times may be inclined to feel he has the sky to himself.

planned a flight from Ballarat, Victoria sun was now very low in the western sky to Derrinallum, some 38 miles to the south-west. The purpose of the flight was to negotiate a contract for aerial top dressing, and I was using one of my company's Pawnee aircraft.

I departed Ballarat at about 1400 hours local time, and while passing to the west of a country football ground at about a thousand feet, some 15 minutes later, I was startled to see a Cessna 150 appear from under my port wing root heading almost in the opposite direction, and only 50 to 75 feet below me. I had not seen this aircraft as it obviously approached "out of the sun" at about the same altitude. The Cessna, after passing so closely underneath, gave no indication that its pilot had observed my presence. possibly because of the aircraft's high wing, and possibly because his attention could have been concentrated on the football ground he was approaching where a game was in progress. After

gathering my startled senses, I continued to Derrinallum and completed by business. For the return flight, I decided to

deviate via Yarrowee, some 25 miles due south of Ballarat, to carry out an aerial inspection of an agricultural airstrip located a short distance to the south of the local NDB. After looking the strip

On a Saturday afternoon recently I over, I altered heading for Ballarat. The and as I was passing abeam Yarrowee itself. I was suddenly confronted by a Cessna 172, on my port side at about the same height and heading at right angles to my aircraft. The machine just seemed to pop out of the eve of the sun and when I first saw it, was on a collision course only some 500 feet from me. I immediately broke away to starboard. descending very steeply, avoiding a collision only by the narrowest of margins. The Pawnee's highly responsive and manoeuvreable qualities were a great help in avoiding the other aircraft.

> The Cessna continued on its way, taking no avoiding action and gave no indication of having seen me. After the earlier near-miss. I was paying even more attention than usual to the up-sun area. Had this not been the case, there is little doubt that a collision would have occurred.

> My attitude to maintaining an adequate look-out for other aircraft has always been to pay more attention to the relatively blind up-sun area. But from the experience of these two near misses, I believe it is the pilot flying away from the sun who must be more vigilant than normal, because the pilot of any approaching aircraft is likely to be partially blinded by sun glare.

> With two such shocks in the one afternoon, I was glad indeed to arrive back "in one piece". I can only hope this mention of the dangers "out of the sun" might help prevent other possible accidents.

Comment:

The possibility of a mid-air collision one that pilots must continually keep in mind whenever they are flying VFR out-side the confines of controlled airspace. particularly when visibility is not as good as it could be. It is a problem that must be given even greater attention as the ion of light aircraft increases in utilisa Australia.

Overseas of course, the danger of mid-air collisions has been a major problem for some time and, in view of our contributor's experience, it is nerban timely to look at some comment and advice on the subject published recently by two of our overseas contemporarie Writing in "Air Line Pilot" i Inited States, a former fighter pilot of tends that an understanding of visual collision avoidance would prevent many collisions and near-collisions.

He continues: "Many pilots, regardless of their experience level, do not understand rate of closure and therefore how to evaluate and take proper action when another aircraft enters their near airspace.

"The military pilot learns to set up a collision course in order to join up in formation and to hit an aerial target in gunnery. We all, whether realizing it not, set up a collision course with some point on the bound when we approach for landing. Whether using an instrumented glideslope or a visual one, there is a pre-determined point of interception. If this spot rises on us, we will under shoot, if it moves towards us, we ar overshooting.

"In the air the same holds true. When we see another aircraft and it has movement-left, right, up or down-we know that we will not collide. We will pass off opposite to the direction of observed movement. The rate of movement governs the margin of separation. This means that any turn, climb or descent we make that increases the rate of move-



ment, also increases the separation. This manoeuvre need not be violent, except in a case where there is a high rate of closure, and the aircraft stays in the same relative position . . . remember, YOU CANNOT HIT ANYTHING WHICH HAS MOVED OUT OF THE SPOT FROM WHICH IT WAS FIRST OB-SERVED. It must become stationary at some point in order for there to be a collision.

"The old fighter pilot's rule of always turning towards the enemy and keeping him in sight as long as possible, is still the rule in visual collision avoidance. By keeping him in sight until the danger is past, you remain in control of the situation. There is an exception to every rule. As seen in 'D' below, we would climb if the other aircraft were descending. Carefully visualize yourself in the other level flight and common altitude situations and the "keep him in sight"

him so you are increasing the separation by making him move faster.

"A point to remember when looking for called targets is to area scan. Pick an area and stop your eye movement. In this way you will pick up anything moving across this area. In other words, look and stop, look and stop. By virtue of its movement we know it is not a potential collision UNLESS he makes a change of direction which will slow his apparent movement or cause him to become stationary.

"The moving target attracts attention and so is not as hard to see, but the stationary target does not attract attention and is the ONLY one where a midair collision results."

A recent issue of the United States Naval Aviation Safety Review "Approach", instances several examples of

actual mid-air collisions then goes on to

screen or just outside the cockpit. Sighting distances are greatly reduced. Shift gaze frequently to instrument panel, wingtips and distant objects.

"Fixation. A tendency for fixation must be avoided, scan in sectors, shift gaze vertically as well as horizontally. Practice focusing on objects of known or accurately estimable distances when available. This aids in avoiding fixation and in earlier detection of airborne targets. "Contrast. Objects are more easily seen against contrasting backgrounds; in extremely low illumination, objects are detected almost entirely by contrast. Contrast or relative motion are the visual values which will most likely stimulate the eye. In dull skies, total airframe contrast is likely unless its color scheme blends with the background.

"Turbulence. In extreme cases can cause deterioration of vision. Prolonged flight



rule should become clear. Each of these discuss the problem in some detail. The situations may be a near miss, but not a collision.

"Some might question 'D' because it is an 'automatic' near miss, but it is a definite near-collision, not a possible collision. If a turn in the direction of the other aircraft's movement were made, he would be lost from sight and there would be no way to know when it would be safe to turn back. Losing sight means losing control of the situation and full dependence on the other pilot to see and avoid.

"Some points to remember when meeting an aircraft head on are the following. When head on and in level flight-go down and turn right. Down to keep him in sight and turn so that if he sees you he will react in the opposite turn. If you see an aircraft head on but are uncertain of his altitude, look for the followings signs: If any belly or underwing shows, go down and turn right. If you see any part of the top of the aircraft, climb and turn right. This is one time when you lose sight of him, but you were already projected to be above

article continues: "There are many reasons for a pilot failing to see and avoid other aircraft. Here are the most important ones:

"Cockpit preoccupation. A conscious effort to improve pilot instrument scan will greatly reduce time spent looking inside the cockpit. High closure rates created by modern aircraft demand that considerable time be spent looking outside the cockpit during visual flight conditions. Crew-members can greatly assist pilots, particularly if they are properly briefed on how to look, what to look for and how to report targets.

"Factors affecting vision

- (1) Fatigue-Adversely affects vision by slowing muscular action of the eyes.
- (2) Glare-Overstimulates the eve and causes loss of sensitivity.
- (3) High altitude—Hypoxia, when present, results in loss of visual acuity, constriction of visual field and difficulty in focusing.
- (4) Space myopia—At high altitudes and with the absence of objects to focus on, eyes tend to focus at the wind-

in turbulence is fatiguing and lessens alertness.

"The total time required to perceive and recognize an aircraft, become aware of a collision course, and decide which way to turn, may vary from as little as two or three seconds to as much as 10 seconds or more, depending on variables affecting the individual, types of aircraft involved and the geometry of the closing situation.

"A great deal of effort has been expended to develop better rules, procedures and navigation systems to decrease midair collisions but much can be done by the individual pilot to reduce this hazard. Such individual efforts should include:

- · Avoid areas of known traffic congestion such as student practice areas and airport approach zones.
- Use positive control when available.
- Know the hemispheric rules* particularly as they apply to VFR flight.
- Be especially vigilant in the vicinity of navigation aids and terminal areas, where a great many mid-air collisions occur." -
- * i.e. quadrantal rules.

• At a station property in Western Australia, a Piper Aztec was left overnight in the open ready for an early morning take-off. Soon after first light the next day the pilot, who had only just been endorsed on the type, arrived to carry out a daily inspection and found that, as a result of the heavy dew, the exterior of the aircraft was covered in large beads of moisture. The pilot cleaned the moisture off the windscreen and found it had also misted up internally. When he had completed his external inspection, he and his passengers boarded the aircraft and the pilot started the engines. After a normal warm-up period and a satisfactory runup, the pilot cleaned the inside of the windscreen before lining up for take-off. He then found that his forward vision was still somewhat obscured by outside condensation but expected this to clear as the aircraft gathered speed.

The pilot opened the throttles and commenced the take-off run but then saw that the windscreen was not clearing as he had expected. When he had applied full power and the aircraft was travelling at about 50 knots, moisture blowing back from the nose of the aircraft suddenly obscured forward vision almost completely. Seeing through the

side window that the aircraft was moving to the left side of the strip, the pilot closed both throttles. He then applied some right brake to try and bring the aircraft back on to the strip, but too late and the port main wheel ran into the soft embankment at the side of the strip. swinging the aircraft further to the left. The port wing tip then struck a small tree, which slewed the aircraft violently off the strip to the left where it collided with other small trees and ground-looped to the right, causing the port undercarriage leg to collapse. The pilot and passengers were uninjured, but as the photograph shows, the aircraft sustained very substantial damage.

Hearing of the accident later, another commercial pilot with considerable experience in operating the same type of aircraft in country areas, commented:-

producing heavy overnight deposits of dew, an Aztec left in the open has a very wet nose early in the morning. It has also been my experience, while flying in the north and inland areas of Western Australia that during operations from natural surface strips in dry weather, a fair amount of fine dust invariably settles on the upper surfaces of the aircraft.



Wipe Your Nose Sir!

"Under meteorological conditions

"Wiping this amalgam of dust and dew from the windscreen provides clear vision immediately, but the collection of dew on the long nose of the Aztec will sit there until it is either shaken off by taxi-ing, or blown off by airflow. Sufficient airflow to move the "muck" develops just after the nosewheel leaves the ground on takeoff run, and, all of a sudden, yesterday's dust, last night's dew and this morning's movement combine to apply a coffee coloured blur right across the windscreen! This obscurity is momentarily sufficient to obscure definition of strip edges, and could so easily lead to an involuntary divergence from a straight take-off path.

"The remedy of course, lies in an old fashioned pre-flight preparation of the aircraft-wipe its nose, and while at it, remove any dew on the mainplanes too! Quite apart from destroying lift over the vital leading third of the wing surface, a fair weight of water is unnecessarily carried by the aircraft until sufficient speed is reached to disperse the moisture. If this does not happen before it freezes on cold mornings, then you carry it around for a long time-if you get airborne, that is!

Misled

• This Piper Super Cub was being used on cattle mustering operations on a large cattle station. The day before the accident, the pilot and the head stockman had discussed plans for mustering in a relatively inaccessible section of the property during the ensuing few days. They also discussed the possibility of the aircraft using a potential landing area near the stockmen's camp, but from the head stockman's description of it, as well as the impression which the pilot had gained during an aerial inspection he had made to land on it.

In Rrief

On the morning of the accident, the first to the area in which the stockmen's camp was situated to see if the ground parties had left, so that he could plan where to start his aerial mustering.

Arriving over the camp site, the pilot saw a vehicle drive straight out and stop at the potential landing area which he had discussed with the head stockman the day before. In view of the decision they had made not to use the landing area for the present time, the pilot gained a strong impression that the vehicle must have been driven out to the site deliberately to attract the attention of the aircraft and to ensure that it did land there. To him it seemed that the vehicle driving directly to the previously discussed previously, the pilot decided the area area could only indicate that there was a was marginal, and that he would make case of serious illness in the camp or a ground inspection before attempting some other equally urgent need for the aircraft to land.

Thus convinced that something was pilot took-off from the homestead at amiss in the camp, the pilot made several 0730 hours to begin the mustering opera- runs over the area and judged it to be tion and as he had no radio communi- at least 700 feet in length with an apparcation with the ground teams, he flew ently level grass surface. Making a normal approach into the light wind, the pilot touched down about 30 feet inside the cleared area. The aircraft ran smoothly for about 100 feet but then

struck a shallow gully which bounced it back in the air, at the same time fouling the port undercarriage bungee and attachments. The pilot applied power as the aircraft settled back on the ground and as the weight came on to the damaged undercarriage, the aircraft fell on to its port wing tip and swung to the left, bringing the propeller blades into contact with the ground as it came to rest.

It was subsequently found that the presence of the vehicle on the area was purely circumstantial. The vehicle was being driven by a stockman from the camp who had been left to take provisions out to the mustering party. When he had heard the aircraft overhead, he realised that it was time to leave and had hurriedly set off, following a track which happened to cross the open area in which the accident occurred. On reaching this area and seeing the aircraft circling overhead, the driver concluded that the aircraft was going to land, so he had stopped to wait while it did so!



Engaged in solo flying training at Lismore, N.S.W., the student pilot of this Victa had satisfactorily completed two normal circuits and landings and one precautionary landing in clear, calm conditions. After a further uneventful takeoff and circuit, and while on short final approach for a second precautionary landing, the stall warning sounded as the aircraft neared the aerodrome boundary fence. The pilot applied power but the port wing dropped sharply and struck a fence post 107 feet to the left of the runway centreline and just short of the threshold. The aircraft pitched forward on to the ground, taking the impact on the nose wheel and propeller. The nose wheel was dislodged and the aircraft rolled to the right bringing the starboard undercarriage leg into violent contact with the ground and tearing it off. Pivoting on the stub of the nose strut, which had dug progressively into the ground, the aircraft then slewed around to the left and came to rest facing in the opposite direction. The pilot was uninjured and

At a cattle station in Western Australia, the pilot of a Cessna 182 was carrying out an aerial inspection of the property. Returning towards the station airstrip, he positioned the aircraft on a left base leg at 500 feet, but when about to turn left on to final approach to land. he noticed some new work which he wished to inspect to the right of the aircraft, and turned towards it to make a closer inspection. As the aircraft turned towards the area, which was also towards rising ground covered with tall trees, a water bottle alongside the pilot's seat fell over and rolled to the rear of the cabin, spilling the contents as it did so. Holding the control column in his left hand, the pilot turned in his seat and made several attempts to reach the bottle and stand it up. In the meantime, unknown to the pilot, the aircraft was descending towards the tops of the trees growing on the higher terrain.

released himself from the undamaged

Finally succeeding in righting the water bottle, the pilot looked up just in time to see the tree tops directly in front of the aircraft. Almost at the same

cockpit.

It was clearly evident from the investigation that the pilot had not maintained an adequate airspeed during his approach

moment he heard and felt the aircraft strike the foliage. The impact swung the aircraft to the right, but the pilot was able to straighten up and he then applied power and raised the nose. Although the elevator control seemed very stiff, the pilot managed to climb to about 100 feet above the tree tops, where he turned back towards the airstrip and made a and was hanging by only one hinge.



Stall During Approach • One Thing At A Time



and the accident is indicative of the care that needs to be taken while practising precautionary landings at reduced airspeed.

normal approach and landing without further incident.

Inspecting the aircraft after landing, the pilot found that the leading edge of the wings and the flaps had been extensively damaged. Part of the starboard tailplane was missing, and the starboard elevator had been almost sheared off

• On the Spur of the Moment



This privately owned Tiger Moth was being flown by a farmer, with one passenger, from the nearby town to the farmer's property. The day was fine and the wind almost calm.

Arriving in the vicinity of his property after flying most of the 15 mile trip at a little over 500 feet, the pilot circled over the homes of two of his neighbours, then levelled out before making a straight-in approach towards his own landing strip about one mile distant.

But instead of throttling back to make a shallow descent towards the strip, the pilot suddenly decided to fly the remaining distance at low level. Leaving the throttle setting as it was, he pushed the control column forward and began to

realised, quite suddenly, that the aircraft was gaining speed and losing height much more quickly than he expected and, leaving the power on, he pulled the control column hard back to recover from the dive. The attitude changed rapidly, but the flight path did not, and the aircraft struck the ground heavily in a landing strip was made on the spur of the attitude.

The impact was sufficient to collapse the undercarriage and ram the wheels up through the lower wings. After slithering over the ground for about 30 feet, the aircraft somersaulted on to its back and slid upside down and tail first for another 135 feet before coming to a stop. Neither the pilot nor his passenger was

descend very steeply. The pilot then seriously hurt and, after undoing their harnesses, were able to lower themselves to the ground. Apart from the engine, which was relatively undamaged, the aircraft was a total loss.

> The ensuing investigation indicated that the pilot's decision to descend and fly low for the remaining distance to his moment and that it was not his habit to engage in such escapades. The pilot's total flying time amounted to only 160 hours, and he had little experience of low flying, and none of aerobatics. It is obvious that he did not realise that, with substantial power set, the aircraft would accelerate rapidly once the nose was lowered. Similarly, it is evident that

he did not appreciate the extent to which momentum would be gained during the short descent. The pilot did not reduce the power at any stage of the descent and pulled the control column hard back when he suddenly recognised the situation that was developing. The result was that the aircraft "squashed" into the ground at a high rate of descent.

Comment

So often when a low flying accident occurs, it is subsequently found that a "spur-of-the-moment" decision was a major contributing factor. Adequate planning and preparation is the essence of safety in all aspects of flying and the-moment decisions are all too often nowhere is this more true than with accidents going somewhere to happen!



Returning from a solo training exercise, the pilot of a Cherokee 140 flew over the aerodrome and noticed that the wind was virtually nil. A little later, while on final approach to land and closer to the windsock, he noticed that there were occasional light gusts of wind from the starboard side of the strip.

After a normal touch down the pilot lowered the nose wheel to the ground

and applied light wheel braking but almost immediately the aircraft swung to the right, ran off the runway and through a ditch, finally coming to a stop resting on its nose.

It was evident from the subsequent investigation that the accident was another example of the effects of "wheelbarrowing", a phenomenon to which some types of light aircraft can be particularly prone in certain circumstances.

Loss of Directional Control

operations close to terrain or obstructions. This is exemplified by the degree of care that an agricultural pilot has to exercise to ensure that his spreading or spraying runs are conducted safely. The Department's accident history shows beyond doubt that pilots inclined to spur-of-

Ground handling accidents of this type, usually involving relatively inexperienced pilots, are a recurring problem in flying training operations. Under the heading "Ground Looping in Nose-Wheel Aircraft," their causes and effects were examined in some detail in Aviation Safety Digest No. 63. Copies of this comprehensive discussion of the subject are still available and may be obtained from the Editor.

In Brief . . .

The Mooney aircraft in the picture had been chartered at Moorabbin Airport to fly a passenger to Gunbower in northern Victoria, where there was a private airstrip. As this was to be the pilot's first visit to this airstrip, the operator of the aircraft telephoned the owner of the property on which the strip was situated to obtain details of it. The owner advised that the strip was 2,100 feet long and gave details of the locality and appearance of the strip, which was clearly marked by white painted tyres. Although some reference was made to power lines in the area during the conversation, the owner did not mention the fact that a three-wire power line crossed the western approach path to the strip, 27 feet above the ground.

After an uneventful flight from Moorabbin the aircraft arrived overhead. The pilot identified the strip without difficulty and noting that the wind was from the east at about 10 knots, he flew upwind and parallel with the strip at a height of 1,200 feet as he inspected it. He then entered a left hand circuit to land into the east. The pilot saw that there were two power line arrays parallel with the approach path to the west of the strip, but he did not see the threewire power line connecting the two arrays, across his intended approach path.

On final approach, with full flap selected and at a speed of about 75 knots, the nose of the aircraft passed beneath the obstructing power line, but the fin caught in the lower two wires. The nose of the aircraft pitched up, then dropped violently and the aircraft struck the ground vertically and fell over on to its back, coming to rest 190 feet short of the strip threshold. The passenger was seriously injured, the pilot sustained minor injuries and the aircraft was damaged beyond repair.

It was subsequently learned that the strip had been established before the owner, from whom the strip information was obtained, had bought the property. This property owner had little knowledge of aircraft operations and it had simply not occurred to him to mention the wires on the approach path when the operator had telephoned to enquire about the suitability of the strip.



The Unseen Power

Line Again

Above and below: The wreckage of the Mooney lying inverted in the field, almost 200 feet short of the strip threshold. A power pole which would have been on the pilot's right as he approached to land can be seen in the top picture.



False Alarm!

THE introduction of VHF survival beacons to light aircraft operations in Australia has undoubtedly contributed much in "insurance value" to the potential safety of cross-country flying, particularly in remote areas. One has only to recall the tragic case of the Wackett that disappeared in 1961 while flying from Ceduna to Cook, S.A., to realize that there at least was one instance in which a life could probably have been saved if a survival beacon had been available to the pilot. As it was, the aircraft was not found, despite a most intense air and ground search, until three years later, and then only by chance.

At the same time, the very extent to which a survival beacon has such vital insurance value, places a proportionately heavy responsibility on its possessor to ensure that it is never, even unwittingly, misused. For if the concept of the survival beacon is to remain an effective aid to search and rescue, it is essential that each and every transmission be treated as a genuine emergency.

Late last year, a large scale search operation was set in motion after a Qantas Boeing 707, en route from Melbourne to Singapore, picked up a survival beacon signal when 10 nautical miles north-west of Bendigo, Victoria, at 1455 EST. The Boeing reported the situation to Melbourne and the Distress Phase was declared immediately.

Initially, three aircraft, including another Qantas 707 engaged on crew training, and the Department's HS125 which happened to be operating locally, were requested to proceed to the Bendigo area to listen for the survival beacon's transmission. At the same time, the Rescue Co-ordination Centre began the mammoth task of telephoning every aircraft operator in Victoria to ascertain if their aircraft could all be accounted for.

The search was continued throughout the remainder of the afternoon, and the beacon seemed to be operating somewhere within the area bounded by Bendigo, Echuca, Swan Hill and Horsham. The signal was fluctuating and was directional in strength, giving the impression that the beacon was being shielded by undulating country or by a local structure such as aircraft's fuselage or a building. When resumed early the next day, the search effort was reinforced by a radio-equipped vehicle which set out from Melbourne for the area of probability to maintain a listening watch and, with the help of the aircraft, to attempt to track down the source of the signal.

After much effort and checking, the signal was traced to a farm house in the Boort district, some 60 miles north-east of Bendigo. The beacon, not being required for use at the time, had been put away in a cupboard in a room of the house.

The beacon was of a well known type designed to be activated by impact. It has no off-on switch as such, but instead a three-position switch which can be selected to "Off", "Arm" or "Test". To operate the beacon, the switch is selected to the "Arm" position and one side of the beacon's case is given a firm tap. Although the beacon cannot be activated with the switch in the "Off" position, the switch is small and is very readily moved. As a result, the central "arm" position can easily be selected unintentionally, especially in the hands of a person not familiar with the beacon's characteristics. Apparently in this instance, the beacon was unintentionally "armed" in this way and the "impact" of placing it on the cupboard shelf was sufficient to set it transmitting, all unknown to the owner.

A similar incident occurred in the north-west of Western Australia, where a similar type of beacon was apparently activated by some children who were playing with it. In this case again, the signal was first heard by a Qantas Boeing en route to Singapore, and the transmission was reported to Derby Flight Service Unit.

The Distress Phase was declared immediately and several aircraft flying in the area were requested to listen for the beacon's transmission. After a number of reports from these aircraft, over a period of more than an hour, it was evident that the signal was coming from somewhere to the south-east of Derby. A Royal Flying Doctor Service Baron

based at Derby then departed to attempt to isolate the signal and finally identified time a transmission is detected.

it as coming from a station homestead some 50 miles south-east of Derby. It was subsequently found that the beacon. which belonged to a local agricultural pilot, had been left at the homestead where it had been unintentionally activated during the pilot's absence.

The two incidents and their far-reaching consequences point to the ease with which serious and expensive search and rescue actions can be set in motion by irresponsible or inept handling of a VHF survival beacon. They also give some idea of the care that owners of beacons must exercise, particularly when a beacon is not required for immediate use and is being stored, to ensure that any possibility of a false alarm is avoided. It should be obvious that any beacon transmission which is subsequently proved a false alarm, can do nothing but harm to the overall concept of the survival beacon system, by sowing the seed of doubt as to the veracity of the emergency next

The Power of

SUGGESTION

(Adapted from Flight Safety Focus)

N overseas incident report issued recently, effectively dramatises A a frightening situation that resulted from an overall lack of vigilance on the flight deck. The following summary of the report tells its own story:

Flight Level 230 and this was later amended to FL 290. In the vicinity of an en route VOR, the aircraft was cleared to descend to FL 240. It was subsequently cleared to 11,000 feet and given the appropriate altimeter setting.

During the descent, the first officer reported to ATC on leaving Flight Levels 290, 240, 230 and then at 17,000 feet.

The flight was assigned to cruise at Next he advised the captain "Leaving one two thousand for one one thousand". As the first officer was about to report "Level at 11,000", he looked out the cockpit window and saw tree-tops just below. "G" forces during the subsequent hasty pull-out forced a stewardess to her knees in the aisle of the cabin!

> The weather at the time was overcast with a cloud base of about 400 feet,

and a surface visibility of a quarter of a mile in light drizzle and fog.

In his statement on the incident later, the captain said that the altimeters were of "the old type" and that the crew had all mis-read them somewhere during the descent. However, a preliminary read-out of the aircraft's flight recorder showed that the highest altitude attained at any time during the flight was 19,000 feet. As all three crew members obviously mis-read the altimeters by 10,000 feet throughout the greater part of the flight, is it evident that the power of suggestion had played its part very strongly in this incident. -----

Individual diligence and vigilance in flight crews is vital. Don't be misled by the actions of a fellow crew member! Always make your own checks (and double checks) and take nothing for granted in flying.



Pilots worthy of the name are those who refuse to compromise operational standards - no matter what the temptations! Self discipline is an essential ingredient of sound airmanship and safety in the air.