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AVIATION SAFETY DIGEST

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Cover: *At Broken Hill, N.S.W., a stretcher patient is unloaded from one of the Royal Flying Doctor Service's recently acquired Beagle 206 aircraft. The Broken Hill Base's remaining Drover, seen undergoing maintenance in the background, is being retained in service pending delivery of a third Beagle next year.*

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EDITORIAL

DISDAINFUL OVERCONFIDENCE

READING this issue of the Digest, one cannot but be struck by the similarity in the circumstances leading to the accidents reported on pages two and six.

The similarity is more than superficial. Both pilots had flying histories which disclosed evidence of highly irregular flying "training" operations; both were operating in remote areas and had made a practice of conducting night flights without proper night flying facilities, and in both accidents there is evidence that the ability of the pilots was impaired by the consumption of alcohol.

In Australia today, modern, reliable, easy-to-fly light aeroplanes have revolutionized the way of life of pastoralists, property owners, businessmen, and others who live and work in the more sparsely settled areas of the country. In the outback, the use of light aircraft in the conduct of everyday affairs has become commonplace and they have come to be accepted as the normal means of transportation. All this is good for properly used, the modern light aircraft is a safe and eminently satisfactory vehicle for personal travel in areas where made roads are almost non-existent and the distances between isolated centres of population and even neighbouring homesteads are overwhelmingly great. To anyone who has experienced the way of life in these communities, it is not in the least surprising that light aircraft have become the popular choice of vehicle for travelling any distance.

With this acceptance of private flying into the normal life of the community, it is sometimes easy to overlook the fact that, despite their apparent docility, and the ease with which they can be operated, these aircraft are still subject to the same hazards that have plagued heavier-than-air flight from the earliest days of aviation. The air is as unforgiving an environment as the sea, and accidents stemming from ignorance or defiance of this truth have on countless occasions over the years, exacted severe penalties in human life and aircraft.

The investigations carried out into the causes of these two accidents suggest that each may have involved a familiarity breeding contempt; a contempt for the fundamental hazards inherent in aviation, a contempt for the value of life and property, and a contempt for Air Navigation Regulations devised to set the standards of safety. In the course of a proper programme of flying instruction, some of the earliest precepts given to a student include the maintenance of a healthy respect for the inherent dangers of the environment, and for the soundness of the established rules. It is possible that the attitudes of these pilots took root when they began solo flying without proper instruction or licences, and that it grew as they progressed to unauthorised night flying, and finally to flying while their faculties were affected by alcohol. It hardly needs to be said that attitudes of this sort have no place in any form of aviation.

Pilots who have their own aircraft and operate in areas remote from the restraining influences of controlling authorities, carry a heavy responsibility for the protection of the lives and property which come into their care. They must know what the limitations of their experience and qualifications are; they must respect the rules that reflect the safety lessons learnt, often the hard way, over many years, and above all else, they must steadfastly refuse to compromise the standards which they set for themselves and which are set for them. In doing this, these pilots are in effect, dedicating themselves to the preservation of their own lives and the lives of those who fly with them.

Control lost after unlawful NIGHT TAKE-OFF

Shortly after taking off at night from Adavale, Queensland, to return to a station property fifteen miles away, a Cessna 182 nose-dived into the ground at full power. The pilot was killed and the aircraft was destroyed by impact forces and fire.

The pilot, who held only a student licence, was the owner both of the aircraft and of the station property to which he was returning when the accident occurred. He had flown into Adavale from the station shortly before dark that evening, bringing with him in the aircraft, a truck wheel and tyre for repair in the township. Because he wanted to use the vehicle early the next morning to load sheep, the pilot had come to Adavale with the intention of having the tyre repaired and returning to his station in the aircraft that night. For this purpose, before taking off from the station, he had lit a number of fires spaced at intervals at either side of the station airstrip, to serve as a flare path for the landing at the conclusion of his return flight.

About half an hour after he landed at Adavale, the pilot arrived at the township's hotel and, except for several occasions during the evening when he left the building to make telephone calls and to transact business, he remained in the hotel drinking beer until closing time at 2200 hours.

At 2230 hours, when the hotel licencee finished his work, he drove the pilot to the aerodrome, together with two other residents of the town, who were accompanying him to see the pilot off. The party drove directly to the eastern end of the east-west strip where the Cessna was parked and, with the aid of the headlights of the car, the pilot loaded the repaired tyre and some stores that he had purchased. He then carried out a brief external check of the aircraft and climbed aboard. After starting the engine and letting it run for a minute or so, the pilot switched on the landing lights, turned the aircraft around facing down the runway, and although a light wind was blowing from the east, began his take-off into the west. The car's headlights had been switched off by this time, and there were no other lights on the ground.

The aircraft seemed to take-off normally and climbed straight ahead to about 200 or 300 feet. The landing lights were switched off and the aircraft then began a turn to the right as though setting course for the station. Instead of taking up a northerly heading towards the station however, the aircraft continued into a steep turn back towards the airstrip. As it turned and the angle of bank steepened, the aircraft first dipped sharply towards the ground, then recovered into a steep nose-up climb. At the top of the climb, with the engine still running at high power, the aircraft seemed to hesitate momentarily, then nosed over and dived steeply into the ground. An intense fire broke out almost instantly and consumed the wreckage, but for the port wing and tail section.

* * *

Examination of the wreckage later, confirmed that the engine was delivering substantial power at the moment of impact. The examination produced no evidence to indicate that any malfunction or defect existed in the aircraft at the time of the accident. The aircraft was only lightly laden and would have been well below its maximum permissible weight at the time of take-off.

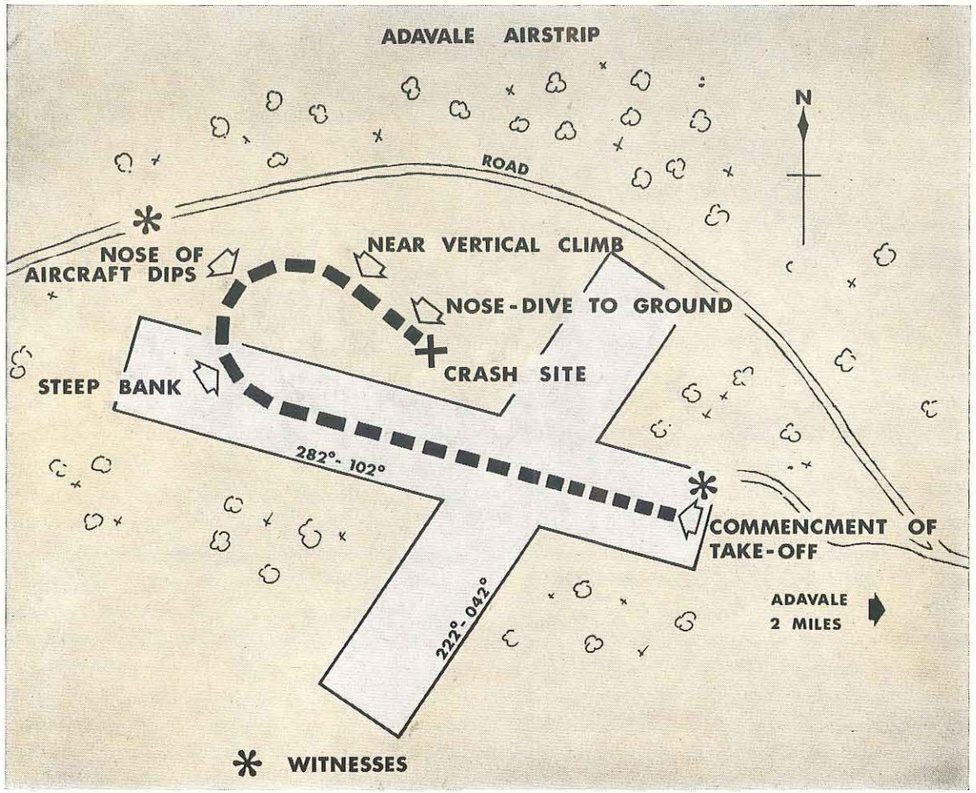
It was not equipped for instrument flight since the flight instruments fitted comprised only an altimeter, an airspeed indicator, an electric turn and bank indicator, and a magnetic compass.

The weather at the time of the accident was fine and cloudless and there was a wind from the south-east at 10 to 12 knots. Although the visibility was good, there was no moon and the night was dark. There was also a haze extending to about an elevation of 10 degrees above the ground, which would have diffused the horizon as seen from an aircraft, and made flight by visual reference difficult.

The pilot's log book could not be found and it was not possible to determine his total flying experience. It was known however, that the pilot had undergone some flying training with the R.A.A.F. at one time, and his original application for a student pilot licence, issued in December, 1964, showed that at that time, he had accumulated a total of 180 hours' experience, distributed between DH-82, Wirraway, and Auster aircraft.

In 1965, soon after the pilot purchased his Cessna, which was registered in the private category, he was granted a temporary concession for one month to operate in the aerial work (training) category, and it is likely that during this time the pilot received some instruction on the aircraft type. However, no record could be found of any such training. The pilot subsequently attempted two theoretical papers for the issue of a private pilot licence and passed one

Plan of airstrip at Adavale showing direction of take-off, final flight path and position of witnesses.



but failed the other. He retained his student pilot licence in the intervening period, but this was not endorsed for any aircraft type. There is no record that he received any dual instruction in instrument or night flying after leaving the R.A.A.F.

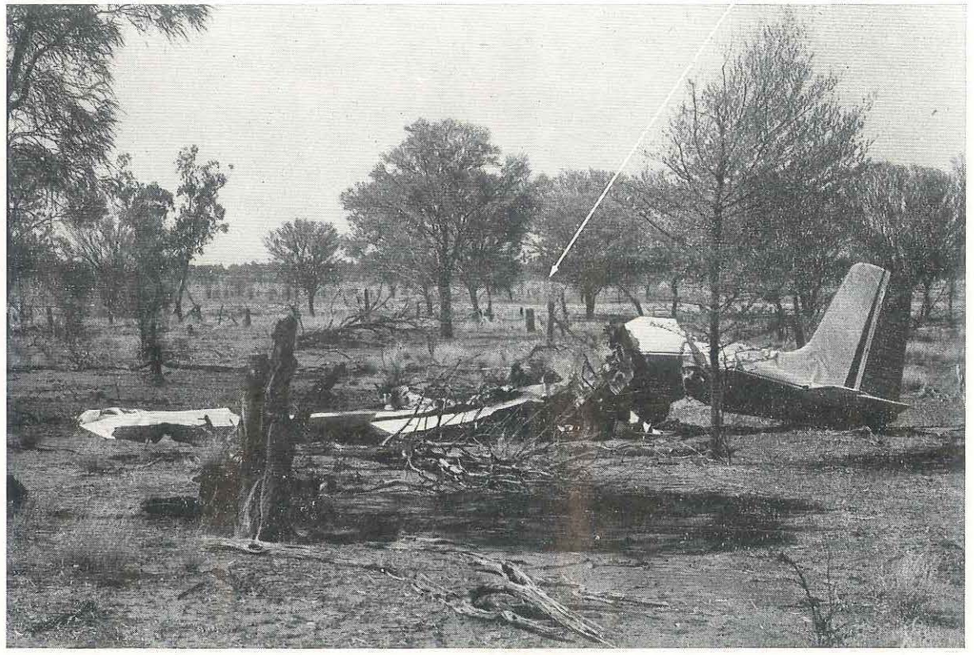
Further enquiries revealed that, since 1965, the pilot had carried out a considerable amount of unauthorized flying in his Cessna, which included several return trips between Adavale and his other grazing property near Cobar, N.S.W. From the figures recorded on the engine tachometer at the time the pilot purchased the aircraft, compared with the reading shown in the aircraft log book, shortly before the accident occurred, it was deduced that the pilot had flown the aircraft about 200 hours.

Evidence obtained from persons who saw, or were with the pilot, during the evening of the accident, indicated that he would have probably consumed at least five 13¼ ounce bottles of beer over the period of time that he was in and out the hotel. This evidence was supported by the subsequent post mortem examination of the pilot's body which revealed a blood alcohol content of 0.22 per cent. Other witness evidence obtained, suggests that the pilot had sometimes performed aerobatics in the Cessna, and that on one occasion he had "flour-bombed" the hotel at Adavale from a low level. There was also evidence that while the pilot was living on his Cobar property, he had gained a reputation in the district for performing aerobatics, flying at night and flying while affected by alcohol.

It was evident that the pilot had carried out night landings at his Cobar property on a number of occasions. In these instances however, the preceding take-offs were probably made in daylight, especially if they were made from a larger town such as Cobar, where an unauthorised night take-off would be much more likely to attract attention. In such circumstances, darkness would have fallen while the aircraft was established in cruising flight, and the pilot would have been able to carry out a semi-visual descent with some horizon still discernible and make a visual night landing using the aircraft's landing lights. The apparent success of this technique at his Cobar property, might have lulled the pilot into a false sense of security when he contemplated this return flight from Adavale in the dark.

Although he had gone to the trouble of preparing a flare path for a landing back at the station, the pilot did not attempt to organise any assistance in the way of providing a flare path for his take-off from Adavale however simple this might have been. As well, the pilot ignored any advantage which he could have gained by taking off towards the lights of the township and, instead, took off in the opposite direction towards a completely dark landscape and directly away from the parked car which had brought him to the aerodrome and which could have easily have been positioned on the strip, to provide him with some directional reference.

The combination of the pilot's lack of training and experience in instrument flying, the lack of adequate instrumentation in the aircraft, and his consumption of a considerable quantity of alcohol in the four hours preceding the take-off, probably diminished his chances of successfully completing the flight to minute proportions. Yet, despite the very considerable handicaps that he imposed upon himself, the pilot succeeded in taking off and climbing to 200 or 300 feet and it was not until the aircraft began to turn that he lost control. Although it was necessary for him to alter the aircraft's heading by only about 45 degrees to set course for the station property, it is possible that this, in combination with the almost complete lack of visual reference available to the pilot at that stage of the flight, caused him to become disoriented and to lose control. Alternatively, it is possible that the pilot deliberately initiated a steep turn after the take-off and became disoriented in the course of this turn. One of the witnesses to the take-off believed that the pilot had intended to make a steep 180 degree turn back in the direction from which he had taken off to "beat up" his friends watching from the car on the airstrip. The car was still at the point



The burnt-out wreckage. The angle at which the aircraft struck the ground is graphically displayed by the slashed foliage of the small tree at right.

from which the aircraft commenced its take-off run, and a steep turn soon after take-off would have been necessary to quickly bring the aircraft back over the car.

The pilot's actual intentions after taking off could not, of course, be established, but in any case it makes very little difference to the lesson of this accident. There is no doubt that the pilot, suddenly deprived of visual reference, lost control of the aircraft either during the turn, or while attempting to recover from the turn. At this stage, the pilot had probably lost all sense of the relationship of the nose of the aircraft to the horizon.

There is also no doubt that the pilot left his station property for Adavale with the deliberate intention of making the return flight in darkness, though there was no real necessity for him to do so. In addition he knew that the return flight would involve a take-off in the dark as well as a landing.

The pilot's attitude to flying in general was irresponsible to say the least, but his flagrant disregard for even the most elementary safety precautions at the time of this particular take-off, was no doubt the result of over-confidence and the impairment of his ability, which would have resulted from the alcohol he had consumed.

Cause

The cause of the accident was that the pilot, who was not qualified for instrument flight and whose capacity to act as a pilot was impaired by the consumption of alcohol, did not maintain control of the aircraft following a take-off at night.

Control lost during unlawful NIGHT APPROACH

At the conclusion of an illegal night flight from a neighbouring property, a Cessna 172 arrived over a West Australian station airstrip in total darkness. The aircraft flew low along one strip, pulled up into a steep climb, then dived into the ground. Fire did not break out, but both occupants were killed and the aircraft was destroyed by impact forces.

Earlier in the day the pilot had flown from his station to a neighbouring property 50 miles to the north, to pick up a colleague in his Cessna 172 aircraft and fly him back. He arrived at the neighbouring property about noon, and was met by the manager and the colleague who was to return with him in the aircraft. The three men spent the earlier part of the afternoon at the manager's homestead, talking and drinking beer until 1500 hours, then had lunch. When they had finished lunch the men left the house and drove to the shearing sheds, ten miles away. At 1730 hours, they returned to the homestead and opened more bottles of beer, but the pilot, after having one or two glasses more, switched to soft drink and drank only this until the party left the house again shortly before 1900 hours, to return to the aircraft.

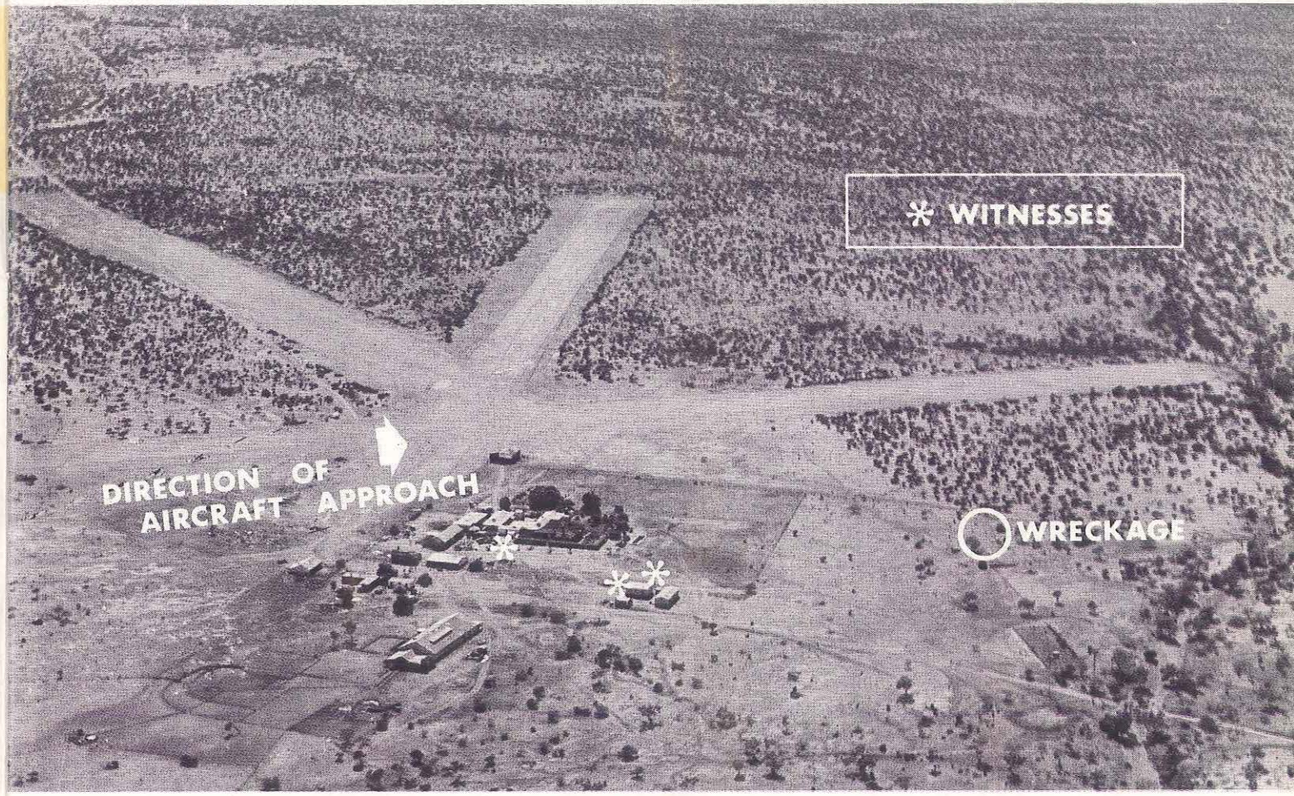
The sun had set at about 1850 hours, and by the time the pilot and his companion had boarded the aircraft and taken off, it was almost dark. The manager returned to the house and later telephoned the pilot's wife to advise her that the aircraft had left on the return flight.

It was quite dark when the pilot's wife received the message that the aircraft was on its way. Calling one of the native stockmen employed on the station to assist her, she left the homestead with the intention of lighting a fire on the aerodrome, to provide guidance for the aircraft's landing. While they were obtaining some petrol from the station bowser, the aircraft approached with its landing lights on and flew in low over the station buildings. Thinking that the aircraft had arrived safely, the pilot's wife decided that the fire would not be necessary and started to return to the house. Meanwhile, the aircraft passed very low over the homestead, nosed up into a very steep climb, from which it fell off to the right and, with the engine power unchecked, dived into the ground at an angle of about 45 degrees.

* * *

Examination of the wreckage showed that the aircraft had struck the ground nose-first while sharply banked to starboard. The aircraft had then cartwheeled for 100 feet and come to rest inverted. It was determined that no mechanical condition in the aircraft had contributed to the accident and there was no evidence of fuel contamination in the aircraft's fuel system.

The aircraft's approach, climb, and subsequent fatal dive, were witnessed by several employees of the station, most of whom were standing near the shearers' quarters when the accident occurred. The witnesses said that it was about 2030 hours when the aircraft arrived, and the night was completely dark with no moon. The aircraft



Aerial view of station buildings and airstrip, showing positions of witnesses and accident site.

flew in from the north-west at low level with its landing and navigation lights on. The witnesses could not make out the aircraft itself in the dark but were able to follow its manoeuvres quite clearly from the lights. The engine sounded quite normal up to the moment of impact. From the description of the flight path given by witnesses and a study of the damage and impact marks on the ground, it is evident that the aircraft stalled after pulling up into a fairly sharp climb and then struck the ground in a steep dive with the starboard wing down.

The pilot held a restricted private licence, issued three months before the accident. Although he had officially flown some 240 hours as a pilot, it is probable that his actual flying experience was somewhat more. In 1964 he had bought an Auster aircraft and employed a pilot to fly it for him on aerial inspections of the station and other private operations associated with the running of his grazing property. This pilot remained in the station-owner's employ for about 12 months, after which a succession of pilots were employed until mid-1966. During this period, the station-owner sold the Auster and replaced it with a Cessna 172. Not long after the resignation of the last-employed pilot, a rumour reached the Department that the station-owner was flying the Cessna himself. When challenged about this, the station-owner admitted acting as pilot-in-command of the Cessna on several flights he had made in the vicinity of his property, and said that although

he did not hold a pilot licence, he had previously held a student pilot licence and received some eight hours' flying instruction at a flying school. The station-owner gave the Department an undertaking that he would complete his flying training and would not fly again as pilot-in-command until he was properly qualified to do so.

Examination of the pilot's log book after the accident, showed that, except for one entry made the day following his licence test, he had kept no further record of his flying times. A check of the aircraft's records showed that from the time the pilot had been issued with his private licence to when the accident occurred, his aircraft had flown 212 hours. Of this time, 12 hours had been flown by another pilot while ferrying the aircraft to and from a maintenance shop, but the remainder had been flown by the owner himself on flights around the property.

From other evidence obtained during the investigation, it was learned that during 1965, even while the owner still had a qualified pilot in his employ, he had frequently flown the Cessna on his own. He made night landings on a number of occasions during this period, when he arrived back at the homestead airstrip after dark. No flare path was available for any of these landings, but when it was known at the homestead that the owner was intending to return after dark, a fire would be lit at the side of the strip. It had been the owner's practice when approaching for a night landing to fly across the aerodrome and over the windsock at low level, then to turn and land.

After gaining his restricted private licence in December, 1966, the owner continued to fly the aircraft on property inspection and sheep mustering flights, and on at least several more occasions, he landed back at the homestead airstrip well after nightfall. One of the native stockmen who worked on the property said that his employer often flew at night, and would sometimes pick up stockmen at the out-station airstrips, when they had finished work at the end of the day, and fly them into the homestead strip after dark.

From all this evidence, it is apparent that the pilot was competent to act in command of his aircraft and was familiar with the appearance from the air of the country surrounding his property, despite the fact that the area of his operations extended well beyond the normal limits endorsed on his restricted private pilot licence. The fact remains, however, that the pilot had no formal training in night flying, and although he had flown home at night at various times, his level of competence can only be regarded as being quite inadequate for safe operations at night.

It is evident that the night on which the accident occurred was a particularly dark one with no moon. In contrast, on this occasion, the station buildings were brightly lit, more than usually so, because it was shearing time at the station and the shearers' quarters were occupied. Having sighted the lights of the station, the pilot made his customary low-level approach over the station buildings with the aircraft's landing lights on, then apparently pulled the aircraft into a steep climb, possibly initiating a turn to the right at the same time.

In these circumstances, the transition from the visual reference provided by the lights of the station buildings, to the blackness of the night sky and the completely dark landscape surrounding the station buildings, would have been very abrupt, and, in the climbing and turning attitude in which he had placed his aircraft, the pilot could have become disoriented very quickly. The glare from the landing lights would have lessened even further the pilot's chances of maintaining visual reference, once the lights on the ground had passed out of his view. Having become disoriented in this way at such a low level, the pilot would have had virtually no chance of recovering level flight in the height available to him. The pilot's loss of control in these circumstances follows an all too familiar pattern, and is only

The wreckage of the aircraft as it came to rest, looking in the direction of impact. The shearers' quarters, near which some of the eye witnesses were standing, can be seen in the background.

what is to be expected of a pilot, with no instrument flying ability, when suddenly exposed to conditions demanding precise and immediate control reactions based on instrument indications.

The other major factor in the events leading to this accident is of course the alcohol which the pilot consumed before beginning his homeward flight. The post-mortem examination of the pilot's body showed a blood alcohol level of 0.18 per cent and evidence obtained from witnesses indicates that the pilot consumed the equivalent of between 12 and 15 glasses of beer while at his neighbour's property throughout the day of the accident. There is little doubt that, as a result, the pilot's judgment and ability would have been impaired.

Although the evidence of several witnesses indicates that the aircraft departed on its homeward flight at about 1900 hours, it was 2030 hours before it was seen approaching the home property. The distance between the two homesteads is only 50 nautical miles and, even if a large degree of tolerance is allowed in the reported times of arrival and departure, the elapsed time for the flight is still unduly long. While it is possible that the pilot, for some reason, deliberately diverted from the direct track, it seems more likely that he experienced difficulty with his navigation on this occasion despite his familiarity with the country. If it were so, this might add some weight to the suggestion that the pilot's ability was affected by the quantity of alcohol he had consumed.

Cause:

The probable cause of the accident was that the pilot, whose judgment and ability were impaired by the consumption of alcohol, did not maintain control of the aircraft when he was suddenly deprived of visual reference during a flight at night.

Making the best of it...

While making a private flight from Mt. Isa, Queensland, to Calvert Hills station in the Northern Territory, some 50 miles south of the Gulf of Carpentaria, the pilot of a Beechcraft Bonanza experienced serious engine trouble and the aircraft lost height. After unsuccessfully attempting to diagnose the engine defect, the pilot carried out a successful wheels-up forced landing on a disused airstrip.

The first sign of trouble occurred an hour and a half after departing from Mt. Isa, when the aircraft was cruising at 8,500 feet over rugged, timbered terrain, in the Nicholson River District, 50 miles short of its destination. The engine "missed" once or twice and the pilot immediately applied carburettor heat and watched the manifold pressure gauge, but there was no indication that ice had formed in the induction system. Within a minute or so, the engine began to run roughly. The pilot returned the carburettor heat control to "cold", moved the mixture control to full rich and re-positioned the fuel selector from the starboard to the port tank. This made no difference to the engine roughness which was now continuous, so the pilot moved the mixture control from rich back to idle cut off, then back to rich, and opened and closed the throttle several times but still the engine roughness continued. Finally, he checked the magneto switches, but there was no appreciable change in engine RPM on any selection. By this time, the aircraft had lost 4,500 feet and the oil temperature was rising quickly. Realising that a forced landing was inevitable, the pilot headed the aircraft north from his flight planned track towards an area where he knew there were two disused airstrips — the only sites in the surrounding area at all suitable for a forced landing.

The pilot transmitted two "Mayday" calls on VHF, the only communication equipment fitted to the aircraft, and selected the better looking of the two strips for an approach to land. The pilot saw there were small saplings growing on portion of the strip, but with the undercarriage lowered, he continued the approach towards a clear section, intending to use hard braking after touchdown and to ground loop the aircraft if necessary. During the last stages of his approach, however, the pilot saw that there were ant beds in the long grass on the strip so he quickly selected the undercarriage "up" and carried out a wheels-up landing. The aircraft struck a sapling and an anthill as it touched down, but damage was confined mainly to the undercarriage doors, the underside of the fuselage and the propeller.

The pilot's distress calls were not heard by any ground station or aircraft, but when the aircraft had not reported by its SARTIME of 1800 hours local time, extensive communication checks were begun and the phases of search and rescue were progressively introduced. The checks failed to reveal any news of the aircraft and at 2015 hours, the Distress Phase was declared, and arrangements for an aerial search for the missing aircraft were put in hand. Plans were made for an initial search to commence the following morning, using eight aircraft including three DC-3's.

The first DC-3 departed Mt. Isa at 0600 hours the following morning and commenced a track crawl search of the Bonanza's flight planned track between Mt. Isa and Calvert Hills. An hour and a half later, the DC-3 reported that it had had a disused strip in sight on which there was a white object. Five minutes later the DC-3 called again to report that it had identified the missing Bonanza on the strip, and that it was in radio contact with the pilot, who was uninjured and had adequate food and water supplies.

After the pilot had advised that the strip would be unsuitable for a light aircraft to land, the DC-3 was requested to hold position over the airstrip while arrangements were made for a helicopter to be directed to the strip to pick up the pilot. It so happened that a Bell helicopter was based at a campsite at Wollogorang Station, 30 miles north of the forced landing site, and one of the other search aircraft was despatched to the station to contact the pilot of the helicopter. The

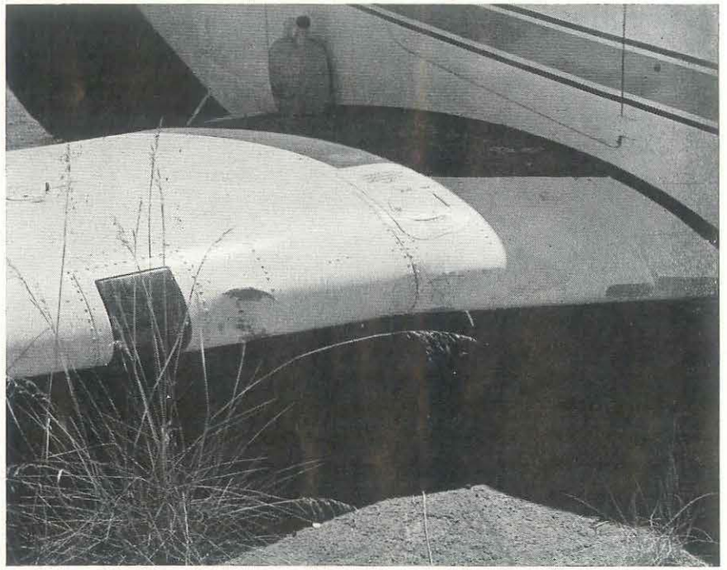
The aircraft wheels-up on the disused airstrip. Note the rugged terrain in the background.

helicopter subsequently departed from Wollogorang Station at 0930 hours and arrived at the forced landing site half an hour later. By 1015 hours the pilot had been safely picked up and the DC-3 was then cleared to return to Mt. Isa.

The Bonanza's engine was dismantled and inspected later and it was found that the No. 2 piston had broken up. Metal from the broken up piston had circulated in the engine oil causing the oil filter screen to collapse. The break-up of the piston was attributed to the failure of the top compression ring on the No. 2 cylinder, which had allowed combustion gases to torch past the side of the piston. The reason for the failure of the compression ring could not be determined.

Comment

Most accident reports that appear in the Digest are published because they contain a lesson from which pilots and others can benefit if they care to apply the experience to their own operations. This



Damage to the leading edge of the wing, sustained by striking anthills on the disused airstrip after touch-down.

particular report is included for the same reason, but in this case the story is a refreshing change. In contrast to the "what not to do" type of accident reports that appear so often in the Digest, it is a first-class example of "what to do" in an emergency.

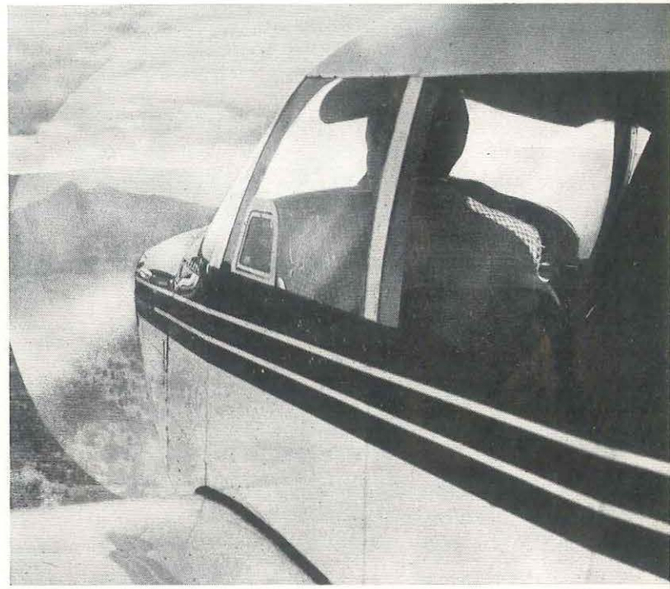
The type of engine malfunction which the pilot experienced, and the terrain over which the aircraft was flying at the time, placed the pilot in a most unenviable position and he undoubtedly selected the best possible landing area available to him. Had he not located the disused airstrip, the forced landing could have hardly been successful at all as the country is rugged and heavily timbered for about 40 miles in all directions from the point at which the engine trouble occurred. Dried up water holes in the bed of the Nicholson River to the east, would probably have been the only possible alternative site for a forced landing. Inspection of the strip later showed that there were numerous anthills hidden in the grass on the strip and the pilot's decision to retract the undercarriage at the last possible moment during his approach was fully justified. Had these anthills not been on the strip, the forced landing would have been much more successful, and the aircraft would probably have suffered no damage other than that which would have been inflicted by running into light saplings towards the end of the aircraft's landing roll.

The nature of the engine failure, revealed when the engine was dismantled, underlines the good airmanship which the pilot showed in turning towards the disused airstrip while trying to rectify the engine trouble, and then in carrying out a forced landing promptly, once severe vibration had set in and he saw that the engine oil temperature was rising.

Cause

The cause of this accident was that subsequent to loss of engine power the pilot was committed to a forced landing on unsuitable terrain. The engine malfunction was caused by a failure of the No. 2 piston.

KEEP IT BRIEF ... and to the point



Remember our little articles "How Good is your RT" and "Mean What You Say" in our June and December, 1964, issues? Perhaps not, they were rather a long time ago and it will not do any harm to mention the subject again now.

The primary object of radiotelephony in aviation is, of course, to assist pilots to complete their flights safely — that much is obvious. What is not so obvious, is that this objective can sometimes be defeated by ambiguous transmissions, to the point where it might have been better to remain tight lipped and to have said nothing. Let's take an example, not necessarily a very exciting one but it illustrates the point.

A pilot was flying a Piper Cherokee from Brisbane to a destination south of Sydney. He planned to fly below the control area with an ultimate cruising level of 8,000 feet. About 35 miles south of Brisbane close to the boundary of the 4,000-6,000 feet control area step, the pilot was climbing through 3,500 feet when he saw that there was a good deal of cloud ahead at about 5,000 feet and realised that he would probably have some difficulty in maintaining VFR at a cruising level of 8,000 feet. He decided he had better tell someone about the situation and so he passed a message to this effect: "Unable to maintain VMC 8,000 feet so will proceed BCTA."

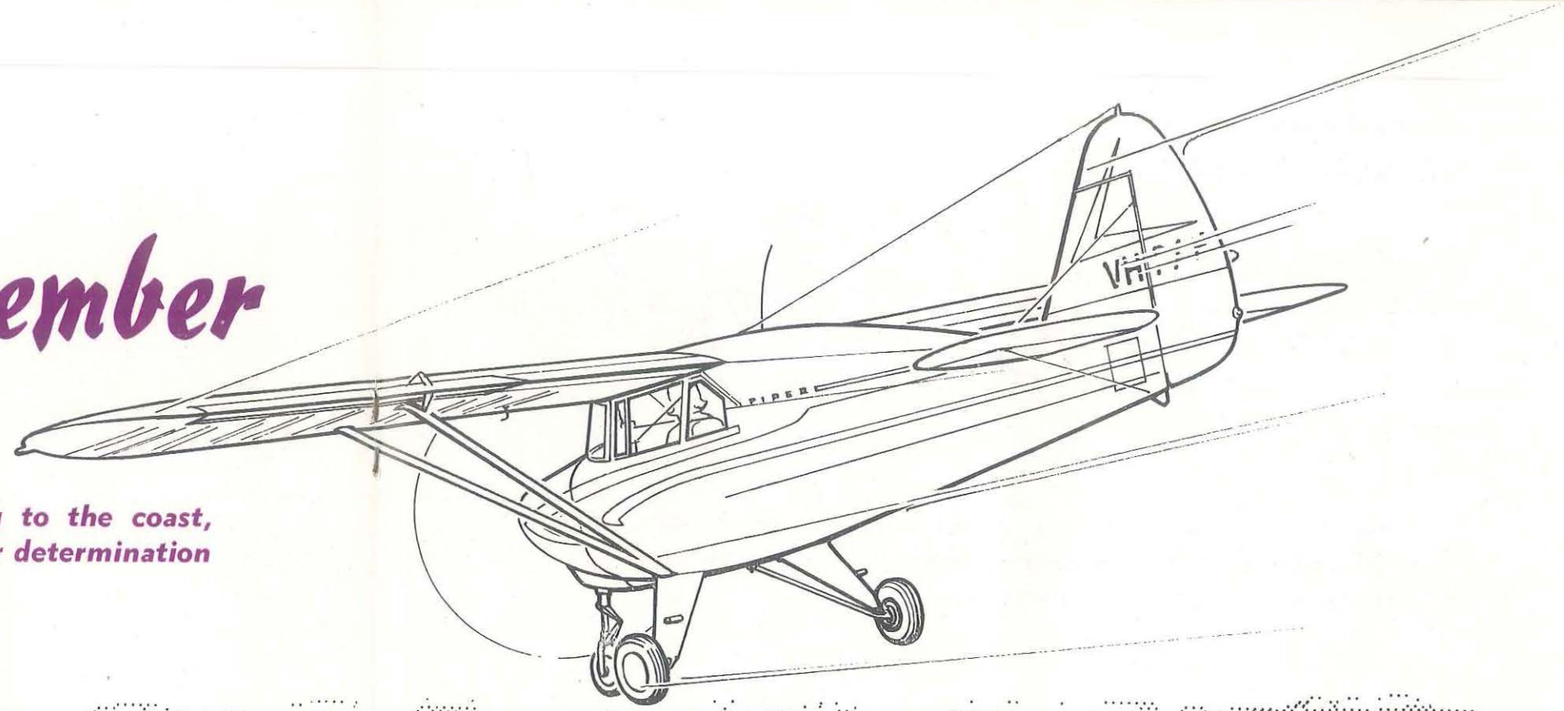
Perhaps you begin to see the point we are trying to make. If you were asked to criticise this transmission, you could probably say that the first half is ambiguous and the second half is redundant. The ambiguous part of the transmission suggested to the recipient that the aircraft was at 8,000 feet, i.e., at least 2,000 feet above the lower limit of controlled airspace in that particular area. As we all know, an unauthorised penetration of controlled air space, is regarded as a serious incident and that's what this one begins to look like. The redundant part is self-explanatory, for the whole flight was planned below the control area anyway!

Of course it has all been sorted out now, but not before the unwary recipient we have already referred to was gently admonished for his hasty, but perhaps understandable assessment of the situation and not without all the unnecessary effort of investigating the alleged incident, and reaching a conclusion.

But don't let this story put you off. The Department does want you to advise your intentions. Just be sure you think what you're going to say before you press the microphone button! A few moments spent in this way helps to avoid verbose transmissions which, far from helping to convey the intended message, are often contradictory and ambiguous. Similar problems can arise in large aircraft amongst the crew members themselves and could lead to misunderstandings, especially in an emergency. This is the reason why procedures such as standard phases, check lists, and emergency drills have been developed. Use them to the full, but in a situation where they can't be used ensure that your message conveys the right impression.

Pilot Contribution

A Day to Remember



For this private pilot, flying instead of driving to the coast, seemed an ideal way to begin her holiday. But her determination to get there almost made it a one-way trip!

IT'S as still as fresh in my mind as if it had just happened — lessons like this one are not forgotten easily.

It was Christmas Day and I'd had my private licence about 12 months. As well, my husband's instructor had talked me into doing a few hours "under the hood". Goggles and yellow screens in an aircraft cockpit in Western Queensland's summer temperatures are anything but pleasant, but as it turned out, those few hours prevented two children being orphaned!

For our Christmas holidays on the coast, my husband and I decided to hire a Piper Colt to avoid having to spend almost a whole day driving at speed over bad roads. It is possible to maintain high average speeds on the inland roads, but fatigue sets in as the hours go by, and every so often a near miss with a kangaroo or a stray horse does nothing to improve one's blood pressure.

So we sent our two elder children down on the Friendship a day or so in advance, and on Christmas morning, set off for a lazy 4½ hours in the air, via Roma. On track, with the baby sleeping in my husband's lap everything seemed serenely peaceful — no red eyes, no near misses, no crashing or banging over bad roads, no burst tyres or stone-damaged petrol tanks. This was certainly the way to travel!

But approaching higher country towards Roma, the "same old story" began. There had been wisps of cloud above and below us from about half way on our first leg, but now the clouds above us came down, and the clouds below thickened. We dropped below the lower layer and, with a clearance of something like 1,000 feet over real "tiger" country, we could see a gap between the now very solid cloud base and the range of hills which lies between the Maranoa River and Roma. We flew on towards this gap over steadily rising ground. Then quite suddenly and without warning, there was a big patch of cloud in front of us and we were in it! We were committed now with only one place to go, and that was up, and I set the aircraft to climb.

Everything still seemed peaceful until the light started to change from grey to white, then to intensely white, and then at 7,000 feet, a watery sun appeared through very hazy cloud. Next, without any sensation, the engine suddenly started to scream, and the sun began to rotate around the wing tips and the cloud changed back to that whitish grey that appears in soap powder advertisements. Every instrument seemed to have gone mad, the compass was spinning, and the turn and bank indicator was behaving crazily. For a moment or two I panicked, then my husband shouted "Do something!" and I was shocked back to reality.

"Just keep quiet and let me concentrate", I told him, sweating as I regained control again. This time I knew I had to go up right through it and out on top, even if that meant climbing to 10,000 feet! Never in my life have I concentrated so intensely as I did in the next few minutes that it took us to fly through the cloud and break out on top. The break-through after such an experience was almost awe-inspiring in its brightness and beauty. The baby still slept on peacefully.

"How far does this extend?" I wondered aloud.

"Well, I couldn't face up to returning through that", my husband retorted. I wanted to turn around there and then, but he suggested we maintain our heading and take stock of our situation.

"But where are we?"

"I don't know, but we still have about two hours endurance left and that will get us back home or at least to Charleville" he replied.

"What if this extends over Roma?"

"Here's what we know. We have ample fuel to go as far as Roma on ETA. If there is no break in the cloud we can return along our track and we should be able to get back to a cloud-free area about 50 miles this side of Tambo. From there on we'll be home and hosed."

"Well, in exactly 15 minutes if I can't see a break I'm heading back, and we'll have tinned fish for Christmas dinner", I said with consternation.

But within 15 minutes, breaks began to appear in the sea of cloud beneath us, and as soon as the first good break came, I cautiously spiralled down through it to see one of the most wonderful sights I have ever looked at — the town of Roma.

I doubt whether this story will ever save a life as one cannot aptly describe the fear and panic and feeling of helplessness that one experiences while imprisoned in that white gaol, a feeling that I am sure could only be experienced by a person trapped in a mine. Furthermore, I am sure that only a very few learn from the experience of others. So with utter sincerity I suggest that any pilot, not qualified for instrument flying, who still doubts that being caught in cloud can be absolutely terrifying, as well as highly dangerous, should obtain the services of a suitably qualified flying instructor, go looking for a cloud and try to fly in it. I'll wager that after they have got themselves into trouble and experienced the sense of panic this can induce, they'll *never* be caught in cloud again!

Comment

This private pilot (as well as her husband) has no doubt learned a valuable lesson and will probably never allow herself to be caught in such a perilous situation again. But we still doubt her wisdom when, after winning the battle for survival in the cloud, she agreed to continue "over the top" towards unknown conditions, instead of immediately turning back towards an area where she knew she would be able to "get down" without difficulty.

The real moral of this story is of course to turn back *before* conditions deteriorate to the point where flight in Visual Meteorological Conditions cannot be maintained. One of the reasons for setting VMC standards, is to protect "visual" pilots from the dangers of being unintentionally caught in Instrument Meteorological Conditions. Those who deliberately disregard this air navigation requirement can, like the pilot in this story, find themselves in a situation where all visual reference is suddenly and completely lost. Far too few pilots that are trapped in this way, have the privilege of recounting their experience later!

What was that we said about Pitot Covers?

In a recent Digest article we made the remark that "rarely now does an aircraft leave the ground with its pitot cover firmly in place". (See "Airspeed Indicators and Pitot Covers" Aviation Safety Digest No. 49, March, 1967). Perhaps we spoke too soon! Only a short time after this article was published, we received an Incident Report from the pilot of a Beech Baron that had done just this. The pilot's words speak for themselves:

"On take-off from Darwin there was a total absence of airspeed indication. I did a circuit and landed. The cause of the incident was that the pitot head cover was not removed before flight, which was 100 per cent pilot error. My hurried departure was in fact responsible for two instances of pilot error:

- Neglecting to check that the pitot cover had been removed; the aircraft had been given a daily inspection by engineers, but ensuring that the pitot cover is off, remains the pilot's responsibility.
- Neglecting to positively monitor the take-off safety speed. Had I done so, the take-off would have been abandoned before the aircraft became airborne. Normally, I verbally state the take-off speed as I pass through it, but on this occasion I did not look at the airspeed indicator until I was about to retract the undercarriage, by which time I was committed to continuing take-off.

The lesson learned? Don't rush it!

Puzzling loss of control during cross-country flight

A young woman private pilot was making a solo cross country flight from Cambridge Airport, Tasmania to Flinders Island, in a Cessna 172. After the aircraft had departed, the pilot's chief flying instructor learnt that strong and gusty winds had developed at Flinders Island and requested Launceston Flight Service Unit to recall the aircraft. Launceston was unable to contact the aircraft and it subsequently failed to arrive at Flinders Island. An extensive air search was carried out, and three days later, the burnt out wreckage of the Cessna was found in densely timbered country 45 miles north-east of Hobart. The pilot had been killed in the crash.

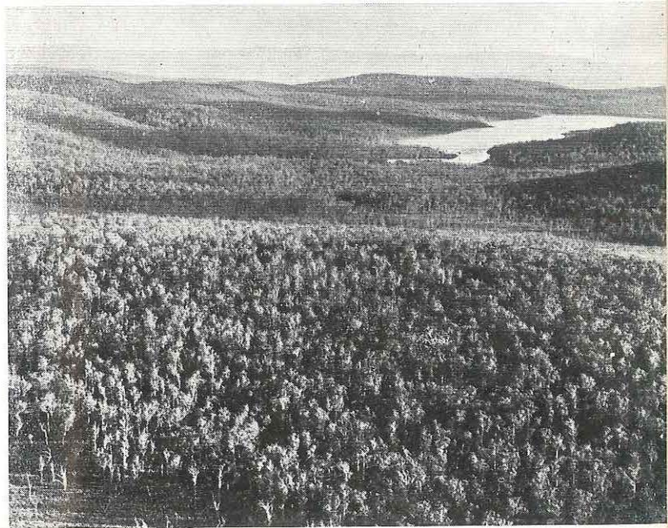
The flight during which the accident occurred, was to be a five hour solo cross country navigational exercise to qualify the pilot for an unrestricted private licence. Early in the morning of the flight, the pilot telephoned the Meteorological Office at Hobart Airport and requested a forecast covering the Hobart to Flinders Island route, with terminal forecasts for Launceston, Devonport, Flinders Island and Hobart for the period from 1030 hours to 1800 hours local time. The pilot later called at the Meteorological Office and was given a personal briefing by the forecaster on duty. Although fairly strong westerly winds with varying cloud coverage and slight to moderate turbulence were expected, the forecast indicated that the flight should be possible in visual meteorological conditions.

After collecting the forecast, the pilot returned to Cambridge Airport and prepared her flight plan for the route Cambridge-Flinders Island-Launceston-Devonport-Cambridge. The pilot's chief flying instructor checked the flight plan and authorised the flight, and briefed the pilot on the action she should take if she encountered unfavourable weather. The chief flying instructor mentioned to her that a flying instructor who was en route to Flinders Island at that time, had reported that conditions west of Launceston were unsuitable for visual flight, and he told the pilot to reassess the weather on her arrival at Launceston in the light of this report. The pilot then telephoned details of her flight plan, to the Flight Service Unit at Hobart Airport, and went out to her aircraft.

The aircraft departed normally from Cambridge and set course for Flinders Island at 1145 hours. Five minutes later, the pilot established radio contact with Launceston and was advised of the area QNH. The pilot's acknowledgement of this transmission, was the last communication received from the aircraft.

At about this time, the flying instructor was arriving at Flinders Island, where the surface wind was gusting to 40 knots with severe turbulence. When he learned that the Cessna had already left Cambridge for Flinders Island, this instructor telephoned the flying school at Cambridge and recommended that, because of the conditions, the Cessna should be recalled to Cambridge. Immediately this information was passed to the chief flying instructor, he arranged for Launceston Flight Service Unit to contact

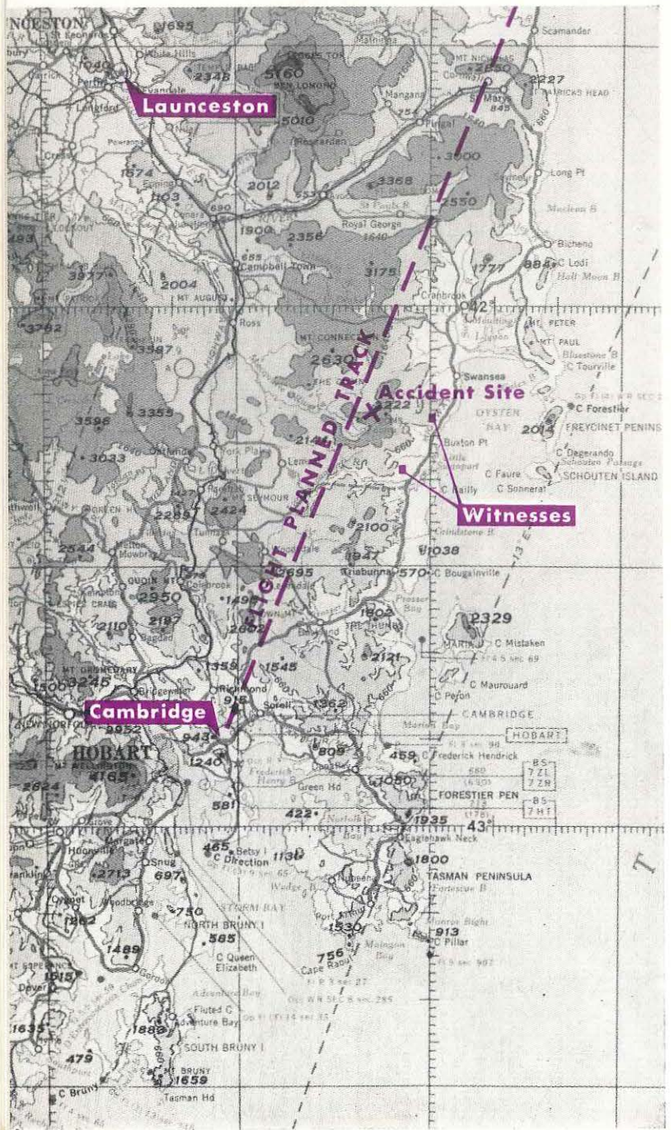
General view of the terrain over which the aircraft was flying when control was lost. The photograph was taken looking south-west and shows Tooms Lake in the background. The wreckage lies amongst the heavy timber in the immediate foreground of the picture.



the Cessna and instruct the pilot to return. The message was passed to Launceston at 1223 hours, but the Launceston Flight Service Unit was unable to establish communication with the aircraft.

When the Cessna failed to arrive at Flinders Island and its SARTIME expired, further communication checks were carried out. As these failed to establish the whereabouts of the aircraft, the phases of Search and Rescue were progressively introduced, and arrangements were made to begin an aerial search. Initially, seven light aircraft were used, three of which were light twins.

Map showing flight planned track, accident site, and location of witnesses.



The search force was supplemented the following day by a number of other aircraft, which included an R.A.A.F. Dakota, a Departmental Friendship and a Hughes Helicopter. An intensive search of an area of probability, based on the entire flight planned track between Cambridge and Flinders Island, was progressively carried out, and all likely sighting reports were followed up. The search continued until the morning of the third day after the aircraft disappeared, when the burnt-out wreckage was sighted in heavily timbered country near Tooms Lake, ten miles inland from the east coast of Tasmania.

The nature of the country in which the wreckage was lying was such that search aircraft had passed within one mile of the site at least 25 times before the wreckage was sighted. The burnt out remains of the Cessna were inconspicuous amongst the heavy timber, and but for a wing caught in the upper branches of a tree, the wreckage would undoubtedly have been much more difficult to see. As it was, 29 different aircraft had been employed in the search and had together flown 90 sorties totalling 280 flying hours.

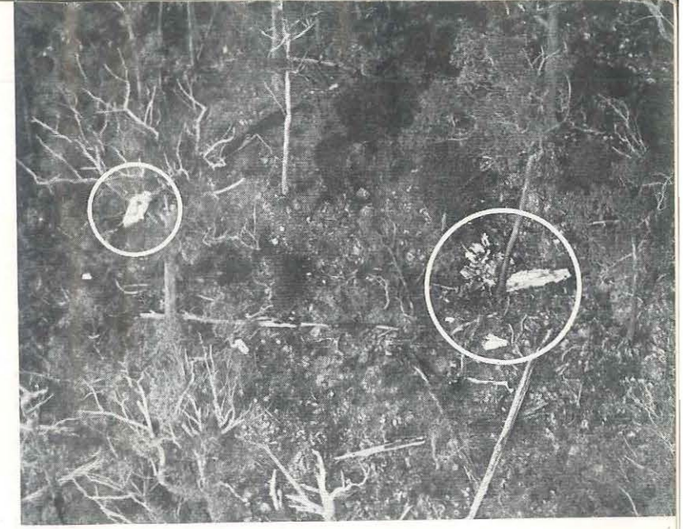
The wreckage was lying on the slopes of a ridge a mile and a half north-east of Tooms Lake. The elevation of the accident site was approximately 2,000 feet above sea level, and 100 feet below the top of the ridge. A swampy grass plain 1,750 feet above sea level lay only half a mile to the east of the accident site. The disposition of the wreckage showed that the aircraft had first struck the upper branches of a tree 75 feet high. The starboard wing had been torn off, and had lodged on a bough fifty feet above the ground. The aircraft had then dived steeply into rocky ground near the base of another tree 62 feet away. The main wreckage had been almost completely destroyed by fire, and the tree near the wreckage had fresh burn marks extending 20 feet up the trunk. It was virtually impossible to determine the attitude of the aircraft at the time of the first impact with the tree, but the branch on which the starboard wing was lodged had penetrated the wing from the trailing edge and was resting against the rear of the main spar. It was thus quite clear that the aircraft was in a most unusual attitude and out of control at the time of the first impact.

The examination of the wreckage was limited by the severe impact and fire damage, but nothing was detected to indicate that there had been any pre-impact malfunction or defect in the aircraft. The aircraft was relatively new and had flown only 80 hours at the time of the accident.

The chief flying instructor who had checked the pilot's flight plan and briefed her before her departure, said that he had told her there would probably be lower cloud over the hilly country between Tooms Lake and Lake Leake and that if this were so, she was to divert to the east and follow the coast. This was a normal procedure, as he preferred pilots to keep close to the open country on the coast, unless it was possible to maintain altitudes of between 5,000 and 6,000 feet. The chief flying instructor said that he had also briefed the pilot not to proceed across Banks Strait to Flinders Island unless the weather was good. In the event of having to divert, she was to fly to Launceston as planned, but should the weather become unsuitable for this leg also, she was to return via the east coast to Cambridge.

Asked if he knew whether the pilot had suffered from airsickness, the chief flying instructor said she had been airsick during training sequences involving steep turns, and as a passenger on cross country flights in turbulent conditions, but she had not suffered from airsickness while acting as pilot-in-command of an aircraft. She had been a safe and cautious pilot with a keen sense of responsibility, and during her training she had always carried out briefing instructions correctly. As a student, he had considered her above average.

The pilot of an Aero Commander flying from Sydney to Cambridge, who had passed over Tooms Lake soon after the time the Cessna was due in the area, said that he was cruising at 2,500 feet and had no trouble in maintaining visual flight. There was a layer of strato-cumulus cloud at about 3,000 feet which was becoming broken to about a four eights coverage over the sea to the east. Over the hills to the west of track the clearance between the hill tops and the cloud was small and there was some rain. Visibility however, was unlimited eastwards from about five miles west of Tooms Lake, and the entire coast south from the north-eastern corner of Tasmania was free of haze, mist or rain. The wind was westerly at about 20 knots and although there



The wreckage as sighted by the search aircraft. Note the wing caught in the upper branches of the tree.

was intermittent moderate turbulence, on no occasion did it become necessary for him to throttle back to turbulence penetration speed. The pilot had not seen any significant fires or any other indications that an accident had occurred in the area.

It was possible to locate only three witnesses who had heard or seen the aircraft in the area of the crash site. Two of these witnesses were men working on a property approximately two miles north-west of Little Swanport, (See map). About 1230 hours local time they had seen a single engined, high wing aircraft, flying in a northerly direction about two to three miles west of their position. The aircraft was visible just above a ridge of hills to the west of the witnesses' position and it flew out of sight behind the hills. The engine note was steady and sounded quite normal. The witnesses said the sky was clear at the time, and there was very little cloud in the area.

The third witness was a sixteen year old youth who was working with his father on a property seven miles east of the accident site. They had been working on the crest of a hill and had stopped for lunch at 1200 hours. While they were having their lunch, sometime between 1215 and 1230 hours, the witness heard the noise of an aircraft engine to the west. The noise sounded normal but was very faint. He could not see the aircraft but after he had heard the engine noise for about 2 minutes, the witness said the engine

Ground view of accident site. The enlarged photograph of the starboard wing caught in the tree, clearly shows that it struck the branch, trailing edge first.

suddenly roared for about a second then he heard an explosive "whoofing" noise, followed by silence. The boy's father did not hear the engine noise, but thought the crashing noise was a tree falling. At the time, there was very little cloud and the surface wind was a light westerly.

The fact that the pilot had established radio communication with Launceston Flight Service Unit, the evidence from the chief flying instructor that her radio procedures were consistently good, and the flying school's operations manual requirement that a listening watch be maintained on area frequencies when operating outside controlled areas, were also taken into account in endeavouring to assess the time of the accident. Because the pilot had not replied to calls from Launceston from 1225 hours onwards, it seems likely that the accident occurred before this time, provided of course that VHF communication was possible from the area at the height at which the aircraft was flying. A test flight in another Cessna 172, carried out at low level in the area of the accident, showed that the pilot should have had no difficulty in maintaining two-way communication with Launceston on the route frequency.

Although the wreckage examination showed beyond any doubt that the aircraft was out of control when it struck the first tree, the investigation failed to uncover any positive evidence which could point to a reason for the loss of control. To try and establish the reason for this loss of control, a number of possible factors were therefore considered:

- Entry into cloud: All the available evidence indicates that at the time of the accident there was no cloud at the height the aircraft was flying.
- Turbulence: Although the possibility of the aircraft having encountered severe mechanical turbulence cannot be discounted, the evidence indicates that the turbulence existing in the area at the time of the accident would have been no more than moderate.
- Structural failure: Despite the fact that the aircraft was severely damaged by impact and fire, all major components were accounted for and there was no suggestion of any pre-impact failure. All controls and cable runs were either intact, or were damaged in a manner which was obviously the result of the impact or fire.
- Engine failure: Examination of the engine was limited by severe fire damage, but it did not indicate any defect. Even if a loss of engine power had occurred, however, it would have been relatively easy for the pilot to have glided from over the accident site to the relatively clear swampy area around Tooms Lake.
- Airsickness: The pilot's chief flying instructor stated that the pilot had previously suffered from airsickness as a passenger or during dual instruction, but had not been sick in flight while acting as pilot-in-command. However, if the pilot had become airsick during the flight as a result of the turbulence, it is possible that she could have lost control while trying to turn back towards Cambridge. The pilot was a small slight person and on her flying training progress sheets, an instructor had once remarked that she lacked the physical strength to sustain a continuous steep turn. Thus, if she had once lost control of the aircraft, the pilot could have had difficulty in recovering control because of her physical characteristics.

Cause

The cause of the accident was that the pilot lost, and was unable to regain control of the aircraft. The reason for the loss of control could not be established.

SACKCLOTH AND ASHES!

In the article "Safe Cargo", published in our May issue, we described an incident in which samples of motor spirit leaked badly while being carried in an airline Friendship and the resulting fumes permeated the cabin and cockpit. To counteract the effect of the fumes, the captain donned his oxygen mask, and selected 100 per cent oxygen, while the first officer investigated and cleaned up the leakage.

We commented:—

> *"Notwithstanding the fact that the captain turned on the 'No Smoking' sign in the cabin, and briefed the hostess to ensure that the sign was strictly observed by the passengers, his decision to use oxygen in this instance to overcome the effects of the fumes, created an even more hazardous situation. The oxygen enrichment of the cockpit atmosphere resulting from the use of the oxygen, together with the fuel vapour already present inside the aircraft would have produced a highly inflammable mixture, and in the event of any source of ignition occurring, even a minor electrical short circuit, could have produced an explosive conflagration in the aircraft."*

This somewhat controversial statement has stimulated a good deal of interest and discussion and the captain concerned has since written to us to disagree, saying that he cannot see how any other technique could have ensured that he was not overcome by the fumes. "Apart from my own personal disinclination to accept criticism which is not justified", the captain wrote, "I am concerned that criticism of my use of oxygen may lead other readers of the Digest to adopt wrong techniques under similar circumstances.

"I have heard no suggestions for a better method of combating the problem as it occurred, and under the circumstances, I would certainly adopt the same technique again" the captain concluded.

The captain, of course, is quite right and his use of 100 per cent oxygen in this situation was entirely in accordance with his company's laid-down procedures as well as those of the Department, for dealing with contaminated air.

We apologise to the captain for our criticism of what was the correct course of action in the circumstances. It is gratifying to find that the Digest has so many discerning readers anxious to keep us on our toes! The discussion which the controversy has stimulated on this subject, has brought to light some very interesting questions on fuel/air contamination of cabin air, breathing of oxygen, and emergency venting of aircraft cabins when toxic fumes are present. As a result, it is now intended that these questions will be examined in detail in a further article to be published in the Aviation Safety Digest in the near future.

A new theory on squall line development gained a great deal of publicity earlier this year in the United States, as the result of the investigation of an accident to an airline BAC 1-11. An article discussing this theory and the circumstances in which the aircraft encountered extreme turbulence and broke up in flight, was subsequently published in "American Aviation" and has since been reproduced in air safety publications throughout the world.

We have no doubt that many of our readers have already seen this article in one form or another but because the subject is such an important one and of such wide-spread interest, we are risking repetition and reprinting it in the Digest for the benefit of any who may not yet have had the opportunity to study the article.

'Invisible' Squall Line Rollers

James E. Skinner

Hearing into BAC 1-11 crash unearths new turbulence theory that may revise present thunderstorm penetration procedures

Are pilots kept informed concerning development of new theories in meteorology?

Apparently not, according to testimony given during a Civil Aeronautics Board hearing into the Aug. 6, 1966, crash of a Braniff Airways BAC One-Eleven. The aircraft broke up in the air as it penetrated a mid-western line squall moving across the south-eastern corner of Nebraska.

The pilot had picked a low altitude at which to cross the storm line.

During the hearing, Dr. Tetsuya Fujita, professor of meteorology at the University of Chicago, testified that the aircraft had entered the storm system where the wind shear could be expected to be the strongest, at a point which was one of the most dangerous areas to an aircraft in the entire squall line.

Although Dr. Fujita stated that this was one of the most dangerous zones in the entire squall line, airline pilots who testified said that they approved of the action taken by the Braniff pilot and would have followed the same procedure he had used.

For years, standard meteorology courses have taught that this area between the ground and the base of the thunderstorm is the safest place to fly if a pilot has to penetrate a storm.

To learn more about Dr. Fujita's theories and to find out why he terms this one of the most dangerous zones of a squall line, this reporter visited the scientist at the University of Chicago.

Dr. Fujita has been a leader in research into the mesoscale (large scale) characteristics of thunderstorms and squall lines and possibly has done more work along this line than any other scientist. It was research into the activity of thunderstorms which brought him to the United States.

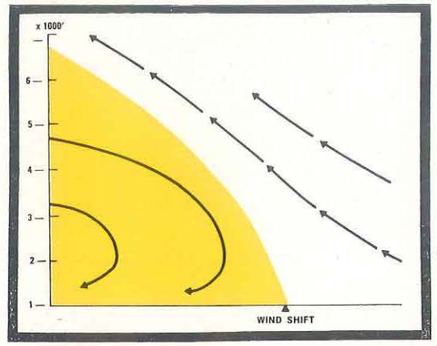
The University of Chicago had been doing research involving thunderstorms back in 1946-47 and had determined that thunderstorms contain cells which not only pump hot air up but which also bring cold air down. Fujita, working independently as an instructor at the Kyushu Institute of Technology in Japan, reached the same conclusion and prepared a paper on it. He spent an entire summer at the top of Mount Seburi in Japan taking measurements in thunderstorms. Years ago, pilots flying in these clouds would hit an area where the airplane would drop down. Colloquially, these were termed "air pockets". It was believed that these were zones of thin air which caused the aircraft to lose altitude.

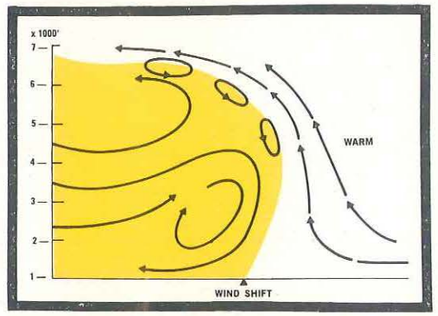
Dr. Fujita's research showed this was not thin air but rather a cell pumping cold air downward through the thunderstorm. When his research paper reached the University of Chicago, he was invited there to do further work on thunderstorms. The short-term visit has lengthened into a permanent professorship and Dr. Fujita has continued his research to the present time.

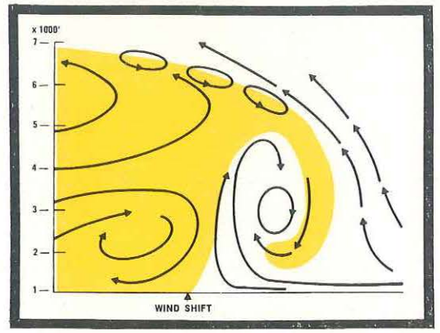
In 1953, Dr. Fujita began a study of the mid-western squall line, the "tornado alley" of the U.S. The study was supported by the U.S. Weather Bureau and was carried on by a research grant from the Bureau. It was from this continuing study that Dr. Fujita reached the conclusions which he presented at the CAB hearing. He also is in the process of developing a new theory which could have far-reaching effects on this section of the Midwest.

A thunderstorm is formed, says Dr. Fujita, when a cloud attempts to collect hot and moist air from the surrounding area. Tremendous updrafts are formed and, as the warm, moist air ascends, clouds and raindrops are formed.

Cells of warm, moist air going up are balanced off by cells which are pumping cold air downward. Warm air can continue to go up indefinitely but the cold air, as it is pumped out the bottom of the thunderstorm, can not continue downward. It spreads out and forms a cushion, a cold dome, around the base of the thunderstorm.







Growth of a roller begins with the mass of cold air pouring out from beneath a group of thunderstorms. This spreads out in front of the primary storm line and forces warm air upward, forming more thunderstorms, possibly forming a squall line. As the cold air mass is fed by increasing pressure from behind, it overruns itself, or topples like a wave breaker, spilling over and trapping warm air. The warm air struggles to rise, aggravating the rolling effect and adding strength to the tremendous shear forces.

Most mature thunderstorms are characterised by this downward draft of cold air, says Dr. Fujita. The cold air remains for several hours even after the thunderstorm dies.

If the thunderstorm is small, isolated or weak, this outflow of cold air is mild and creates no problems for aircraft. However, the system has a snowballing effect. With two, three or more thunderstorm cells, the mass of cold air pumped downward is increased. The thunderstorm is moving across the ground at a speed of from 10 to 40 mph, possibly an average of from 25 to 30 mph.

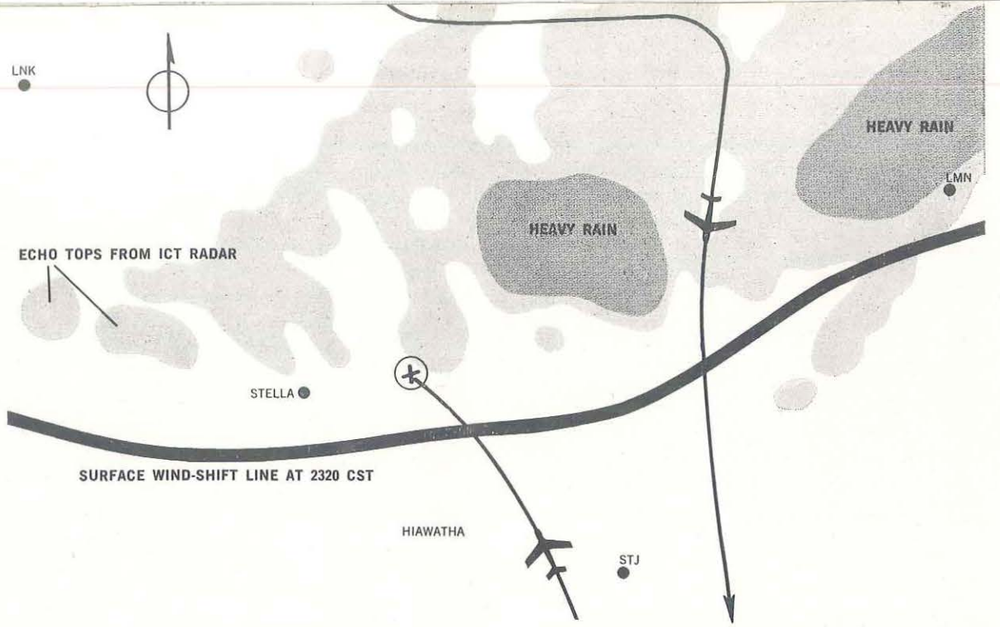
As the thunderstorm moves, the cushion of cold air goes ahead of it. As the cold air moves along the ground, warm air is forced up and more thunderstorm cells are formed. In an area of warm, moist air which will feed the thunderstorm cells, it is very likely that a line squall will be formed. If it is a weak system, the line squall could die out in a matter of four or five hours. A stronger one could last for 10 hours or more. "A well-developed squall line could have several hundred thunderstorm cells during its life", reports Dr. Fujita.

The leading edge of the cold air, the air which is pumped downward by the thunderstorm cells, creates the wind shift line. This line which comes out of a well-developed squall has quite a difference in intensity from that created by one or two thunderstorms.

"Even though it may not look wicked, it can be very dangerous", Dr. Fujita explains. The line sometimes is revealed on weather radar by what is termed a "thin line". Fujita used photographic records of these thin lines to mark the progress of the line squall across Nebraska on the night the BAC One-Eleven crashed.

The wind shift line can not be seen by a pilot. There are times that he can see the results as the line of cold air moves across the ground. There is a noticeable stirring up of dust. Persons on the ground can see the dust and feel the change in temperature as the cold air cushion from the thunderstorm moves forward.

Sometimes this line is marked by a roll cloud; sometimes it is not. It can be just as vicious if there is no cloud. As the cushion of cold air moves over the ground ahead of the line of thunderstorms, it can develop an overhang as stronger



Above is the weather system facing the pilots of two aircraft on the night of August 6th, 1966, near the south-east corner of Nebraska. A line of thunderstorms was spread across northbound and southbound flight courses and moving south-eastward. Both aircraft altered course to avoid the areas of strong radar returns. The southbound aircraft at 7,000 feet, flew through its radar "hole" unscathed. The other turned to another echo-free hole and broke up in mid-air.

winds a few thousand feet up push the leading edge of the cold air ahead of its position on the ground. Warm air can be trapped in this overhang. The result is an even greater wind-shearing effect as the warm air fights to get up above the cold air. The air circulation system associated with the line squall could have several of these roll areas, says Fujita.

It is difficult to say what velocity gusts can reach in roll areas but this zone can be the worst part of any line squall. Dr. Fujita advises that no measurements have been taken and he would hesitate to send a pilot into this area to take gust measurements. "It would be very hazardous and it is very strange that a pilot would fly into this."

As no measurements have been taken, Dr. Fujita refuses to speculate on the velocity of gusts in this zone. But he compares it to the type of wind shear which is formed on the lee side of a mountain when cold air sweeping over the top of a mountain traps warm air. A similar roll circulation with a resulting wind shear develops and sometimes also a roll cloud like that which can form in front of a line squall will develop.

Measurements have been taken of the mountainside gusts. On Jan. 10, 1964, a Boeing B-52H on a turbulence testing mission lost 35 ft. of its 40-ft. vertical stabilizer as it flew alongside the Spanish Peaks area of the Sangre de Christi mountains in Colorado.

The B-52, flown by Boeing test pilots, was able to make a safe landing. Turbulence-testing equipment revealed that it had encountered a lateral gust of from 100 to 110 ft. per second (69 to 75 mph) at the time the vertical stabilizer was broken. The BAC One-Eleven, as required by both the FAA and the British Air Registration Board, was stressed for gusts of 66 ft. per second (45 m.p.h.) at its rough air speed.

Dr. Fujita reports that the wind shift line from a well-developed line squall can extend from a few miles to as much as 30 mi. out in front of the line of thunderstorm cells. If it does extend as far as 30 mi., it usually becomes so weak that it will cause no damage.

As the pilot can not see the wind shift line, he must depend on ground communications to keep him informed of the progress of a line squall and of the location of the wind shift thin line as revealed on weather radar.

Because of his experience in thunderstorm and line squall research, Dr. Fujita was commissioned by British Aircraft Corp., builder of the BAC One-Eleven, to investigate the storm in which the Braniff aircraft was destroyed.

After checking data available, Fujita plotted

the storm line and determined what he believed to be the most severe wind shear areas of the storm. As an indication of the validity of his theories, he completed this without knowing the route of the One-Eleven. When the path of the airplane was plotted, it was found that it had just passed through this wind shear zone when it crashed.

Wind Shift Line a Key

"The aircraft crossed the surface wind shift line at 2310 CST", explains Dr. Fujita. "The time, location and altitude of the aircraft after 2310 CST were most favourable for the development of roll circulations with horizontal vortex axes parallel to the wind shift line and for that of circulations with vertical axes." In other words, the gusting shearing effect of this particular spot along the squall's wind shift line was unusually high. "Horizontal eddies of extremely large tangential velocity could be expected to form inside such a zone of strong horizontal shear", he went on to say.

According to the estimated path, the airplane penetrated the wind shift line at 2310. Time of the crash was estimated at 2312 CST. The aircraft was flown at an altitude of 5000 ft. MSL, a little less than 4000 ft. above the ground. This was an altitude which would have placed it down within the zone of the wind shift turbulence.

All witnesses to the accident, and there were several, said that the airplane caught fire in the air and crashed before it reached the main line of thunderstorms which was several miles to the northwest. Trajectory positions of parts of the aircraft showed that the T-tail broke first, followed by the right wing.

Testimony at the CAB hearing indicated that the T-tail of the One-Eleven was the weakest spot on the aircraft and was the point which could be expected to fail first in excessive gusts. This does not mean that there was something wrong with the tail but only that it was a design characteristic of the aircraft. As a BAC official pointed out, if the tail were strengthened then perhaps a wing would be the weakest area. This could continue until the aircraft would be strong enough to meet any situation but it would be so heavy that it would never be able to leave the ground.

An analogy was given involving a school bus and a locomotive. The school bus is driven in front of a speeding locomotive and the bus is torn to pieces. No attempt is made to build the school bus strong enough to withstand the assault of the locomotive. Instead, an intelligent driver is put in the school bus. Warning signs are placed along the railroad track and the locomotive is given a horn and a flashing light to tell motorists it is coming and to stay out of the way.

This particular storm system was not an unusually large or strong one. The pressure field ranged from medium to strong and total precipitation ranged from light to medium. However, the spatial variation of meteorological parameters such as rain intensity and gust velocity along the leading edge of the squall system was unusually large. "The accident occurred within a relatively small area along this edge and at a location where the spatial variation could be expected to be greatest."

The pilot of the Braniff aircraft probably flew into this area after his aircraft radar told him it was a weak spot in the squall line. The point where he penetrated the wind shift line was between two thunderstorm centres and would have shown up on radar as a light area. "When the outflow and echo patterns and the flight track are compared, it is seen that the aircraft tried to avoid the area of intense echo and make the flight through the echo-free passage", Fujita explains. "Analysis shows, however, that the aircraft crossed the wind shift line where the horizontal shear was greatest."

Radar No Help

At 2312 CST, within a few seconds of the time the Braniff flight was believed to have crashed, Chicago Centre radioed to the flight, "Your present heading appears to be taking you through the lightest area to the south-west of Omaha. Are you painting the weather on your radar now?" No reply was received.

What can a pilot do to avoid the wind shear turbulence associated with a line squall? He can divert and refuse to fly through a storm line as one pilot did in this same general area on the night that the One-Eleven crashed. A pilot should be able to depend on FAA communications to keep him informed of the location of the wind shift thin line as revealed on weather radar and, knowing where this line is, he can prepare his airplane to fly through it. Slowing an airplane is recommended but Fujita doesn't go along with cutting the speed down too much because the pilot might not be able to retain control in extreme turbulence.

Safety with Altitude

If the pilot does have to fly through the line squall, Dr. Fujita recommends that the aircraft remain above the wind shift line until the aircraft has passed over the roll area, the point where shear turbulence can be greatest. This cold dome generally does not extend upward above the base of the thunderstorm.

If possible, Fujita recommends seeking a soft spot in the storm line and flying through it but again above the base of the cloud to avoid possible roll turbulence. He does not recommend flying through the thunderstorm in the areas of heavy up and down cells and where precipitation is greatest.

If it is necessary to fly underneath the thunderstorm, Fujita suggests flying as close to the base of the thunderstorm as possible. He does not approve of the old accepted practice of going under a thunderstorm half-way between the cloud and the ground or at a point about two-thirds of the way from the ground to the cloud.

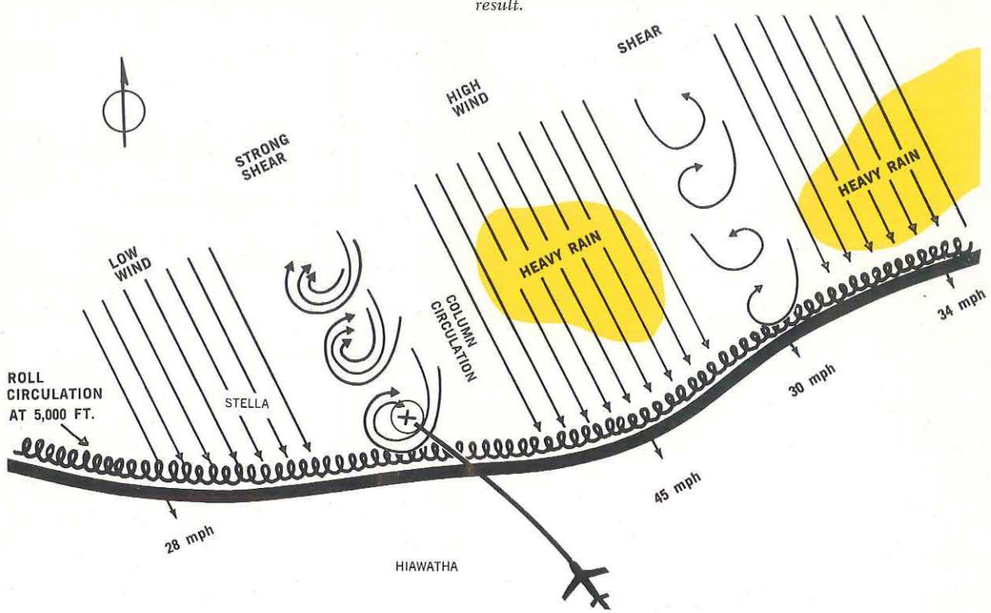
Dr. Fujita's new research into thunderstorms has developed a possible new theory. In addition to the movement of air up and down and the forward movement of the storm, he believes some thunderstorms have a circular movement. He has taken photographs which clearly indicate the circular movement of the storm cloud, and now "more or less" believes that tornadoes are spawned by these rotating thunderstorms.

Comment

Although very intense or "freak" squall lines probably occur less frequently in Australia than in North America, the frequency of "normal" squall lines is much the same in both continents. The question of squall line penetration is therefore of equal relevance to Australian pilots and operators.

We still believe that by far the best way of avoiding the hazards associated with squall lines, is to avoid them, even if this does mean a diversion! Pilots who have no alternative but to penetrate a squall line, should make use of all the aids and SIGMET information available to them to assess the situation.

Below, according to the theory of Dr. Tetsuya Fujita, professor of meteorology at the University of Chicago, is the trap that was waiting for the northbound Braniff BAC 1-11. A wave of cold air preceded the squall line, fed by heavy downdrafts spewing out from the bases of the storm cells. This flow was surging and tumbling, similar in some respects to a breaker at the beach — but it did not show up on radar. Flying just beneath the cloud bases at 5,000 feet, the Braniff pilot ran smack into it with the consequent, and tragic, result.



(Condensed from Official Accident Reports as Acknowledged)

MID-AIR COLLISION

At a country airport in New York State, U.S.A., a Piper PA22 and a Beechcraft Musketeer were approaching to land.

The Piper was being flown solo by a student pilot, who was proceeding to the airport to undergo a flight test with an F.A.A. examiner for the issue of his Private Pilot's Licence. A commercial pilot was flying the Musketeer, and was returning to the airport after a local flight.

The pilot of the Piper called the Flight Service Centre at the airport when he was fourteen minutes out, to advise his intention to land, and the Musketeer called two minutes later. Both pilots were provided with the same airport advisory information and cautioned that there was other traffic operating in the area.

As the Piper approached to land on the duty runway, the pilot evidently saw that he had insufficient clearance from another aircraft which was landing ahead of him, and he initiated a missed approach, making another circuit slightly below the circuit pattern altitude. As the Piper turned from its downwind leg on to a low, close-in, base leg, witnesses on the ground saw the Musketeer turn on to a long final approach from a wide base leg. The two aircraft converged, and as the Piper turned steeply on to a short final approach at 700 feet, they collided. Both aircraft crashed out of control half a mile short of the runway threshold. Both pilots and a passenger in the Musketeer were killed.

Examination of the wreckage showed that the aircraft had collided on converging tracks at an angle of about 75 degrees, the forward section of the Musketeer's port side striking the outer section of the Piper's starboard wing. The accident investigation concluded that the pilots of both aircraft had failed to maintain an adequate look-out and had not seen each other's aircraft during their approach to land.

C.A.B. United States.

Pilot Disoriented After Night Take-off

To test the efficiency of some newly-installed runway lights, a private pilot who was also the operator of a country airport, took off at 2150 hours local time, to make some touch and go landings. Shortly after the take-off, which was towards relatively dark, unlighted terrain, the aircraft was seen flying a low altitude, and then to make a turn to the right. Shortly afterwards it was heard to crash. The wreckage was subsequently found two miles from the airport. The pilot had been killed.

The aircraft had struck the ground in a slightly nose-down attitude while banked to starboard about 30 degrees, and had then cartwheeled and burnt. It was evident that the

engine was developing substantial power up to the time of impact and there was no evidence that any malfunction or failure of the aircraft had occurred before the crash. It was found that the pilot's night flying experience was very limited and that he had not flown at all at night in the nmety days preceding the crash. It was also established that the pilot required glasses while flying, but none were found in the wreckage. A post mortem examination of the pilot's body indicated a blood alcohol value of 0.07 per cent.

It was clear that the pilot had become disoriented after taking off towards the dark sparsely lighted terrain and had allowed the aircraft to descend into the ground. The blood alcohol value found in the pilot's body, while relatively low, would have caused a loss of efficiency and would have been sufficient to diminish his finer judgment and control. In view of the demands which the flight conditions would have made on the pilot, and his relatively low total experience and lack of recent experience, the alcohol was considered a contributing factor to the accident.

C.A.B. United States.

Bystander walks into propeller

After landing in Karaka Bay, Great Barrier Island, New Zealand, the pilot of a Grumman Widgeon amphibian taxied his aircraft up on to the beach to embark two passengers for a flight to Auckland.

When the passengers arrived, the pilot noticed that the aircraft's starboard wheel had become partially embedded in the sand. Before boarding the aircraft the pilot removed some of the sand from around the wheel, and told a group of onlookers that he did not require assistance to push the aircraft free, and that he would ask for help if he needed it.

After seating his passengers in the aircraft and before starting the engines, the pilot returned to the cabin door to finally check that all the onlookers were behind, and standing clear of the aircraft.

The pilot started the engines and let them idle for a short time, then opened the throttles to taxi down the beach into the water, but with the starboard wheel still in the sand, the amphibian did not start to roll and only pitched forward on to the nose of its hull. The pilot closed the throttles and the aircraft settled back into a three point attitude.

Several onlookers, acting on their own initiative, then approached the aircraft, apparently under the impression that their assistance was needed to push the aircraft out of the sand. One man moved to the port wing tip float, then quickly walked inboard under the wing towards the port landing wheel. Leaning forward into the slipstream from the idling propellers, the man suddenly turned and moved towards the bow of the aircraft. Seeing him going forward with his head down, the pilot flicked open his side window and shouted a warning to him, but the man walked directly into the revolving port propeller. He was struck down and killed instantly.

Department of Civil Aviation,
New Zealand.

Comment

Although the pilot of the amphibian took all reasonable precautions to ensure that bystanders remained clear of the aircraft, the victim approached the aircraft without authority, this accident emphasises again the danger that can exist to spectators in isolated localities where there is no provision for crowd control. Whenever possible, it is good operating practice in such situations for pilots to arrange for onlookers to be shepherded by some responsible person who is fully aware of the dangers of approaching an aircraft that has its engine running.