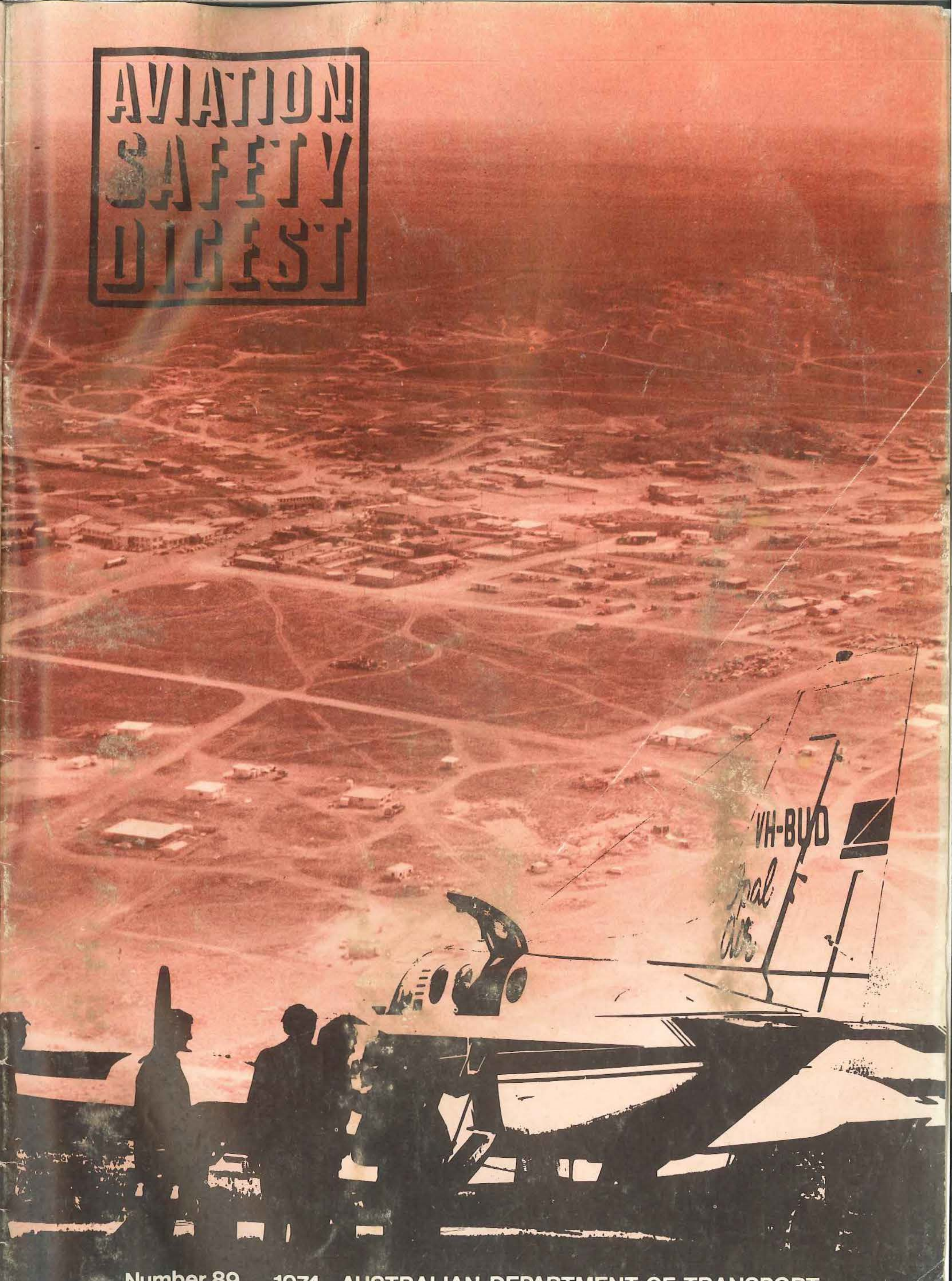
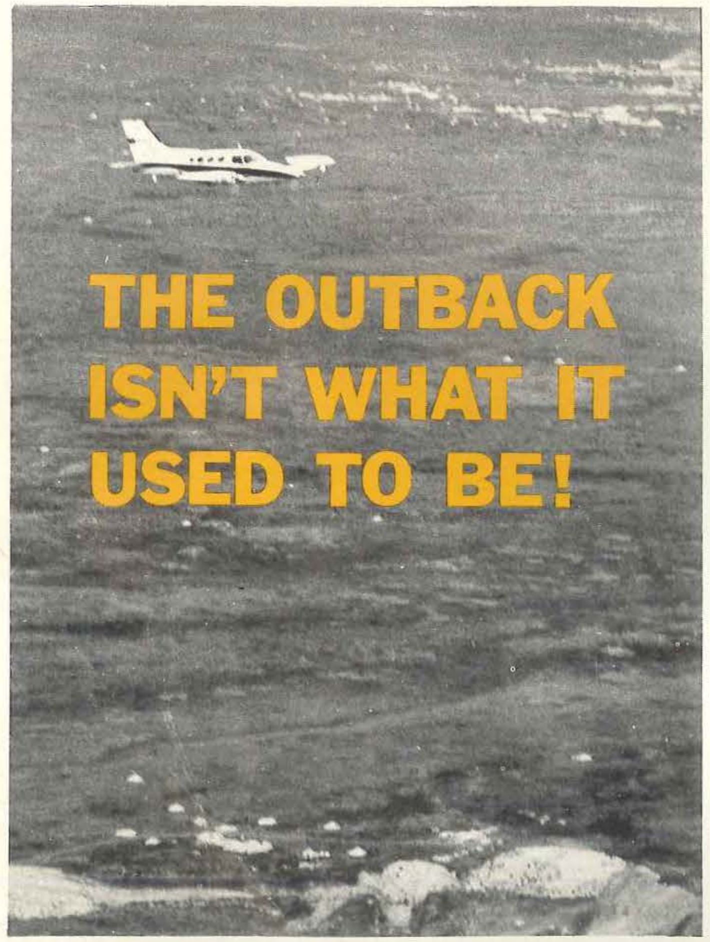
AVIATION SAFETY DIGEST



Number 89 1974 AUSTRALIAN DEPARTMENT OF TRANSPORT

THE OUTBACK ISN'T WHAT IT USED TO BE!



Coober Pedy, Andamooka, Ayer's Rock: It would probably be hard to find a trio of more romantic names in the entire Australian Outback. Yet these three fascinating places are the regular ports of call for the South Australian commuter air service that is named so appropriately, Opal Air Pty. Ltd.

Back in the early sixties, when Opal Air was first formed, the settlement of Coober Pedy was still much as it had been for nearly 50 years — a lonely, scattered shanty town of a few hundred Europeans and Aborigines trying to wrest a living from mining the elusive opal deposits of the ancient, weather-worn Stuart Ranges. For the most part it was done the hard way, sinking shafts into the hills with pick, shovel and windlass. Life in the settlement was primitive in the extreme, the only permanent buildings of any sort were the two jerry-built general stores which faced each other from opposite sides of the road to Alice Springs, and the only aircraft to visit the area were those that brought the flying doctor once or twice a month.

But despite the privations, some stayed long enough to strike it rich, and the trickle of opal buyers from the cities gradually became a steady stream, trekking overland as best they could on the dusty tracks that passed as roads. And so the stage was set for an air charter service. Thus came Opal Air, operating a Cessna 206, based on Coober Pedy, but serving also the similar growing settlement of Andamooka, 300 kilometres away to the southeast on the shores of the vast salt pan that is Lake Torrens. And as the mining townships prospered and became established, so did the charter business, and within three years the 206 had been exchanged for a Cessna 310. By the time another year was out, even this normally very adequate charter aeroplane was unable to cope with the increasing business and was replaced by an eight passenger Cessna 402. Shortly after this time, Opal Air received the first approval issued by the Department for a Regulation 203 Third Level airline operation, authorising a regular daily service between Adelaide, Andamooka and Coober Pedy. Meanwhile, as well as the boom in opal mining brought about by the introduction of mechanised earth-moving equipment, tourism was developing as an industry in its own right in the now thriving mining townships, and in 1970 the air service was extended to Ayer's Rock, specifically to cater for this trade.

Today, Opal Air operates two 402's and a pressurised 421, flying each way between Adelaide, Andamooka and Coober Pedy every day of the week. The Ayer's Rock service operates twice a week via Coober Pedy, thus providing on these days, a second service to this unique inland community. Not surprisingly, the Company's passenger and freight loadings average well in excess of 60 per cent and, in its eleven crowded years, Opal Air has flown more than 12,000 accident free hours. As much as anything, the Company attributes this achievement to the enthusiasm of the pilot-engineers who make up the bulk of its small staff.

The remarkable development of Coober Pedy over the past decade and a half, which is illustrated so graphically by the contrasting photographs of the same scene on our covers, is but one example of the way in which aircraft are playing a vital part in overcoming the tyranny of distance in Australia's Outback, bringing to otherwise impossibly remote settlements, both accessibility and the amenities of urban life.

DEPARTMENT OF TRANSPORT AUSTRALIA

AVIATION SAFETY DIGEST

Number 89 1974

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Aviation Safety Digest is prepared in the Air Safety Investigation Branch and published at two monthly intervals, through the Australian Government Publishing Service, by the Secretary to the Department of Transport and Director-General of Civil Aviation, in pursuance of Regulation 283 of the Air Navigation Regulations. It is distributed free of charge to Australian licence holders (except student pilots), registered aircraft owners, and certain other persons and organisations having a vested operational interest in Australian civil aviation. Aviation Safety Digest is also available on subscription from the Australian Government Publishing Service as shown on the order form below. Contributions for publication should be addressed to The Editor, Aviation Safety Digest, Box 1839Q, G.P.O. Melbourne, 3001.

Change of address: Readers on the Department's free distribution list should notify their nearest Regional Office. Subscribers should notify the Australian Government Publishing Service.

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Printed by Australian Direct Mail Pty. Ltd., 252-266 Mitchell Rd., Alexandria, N.S.W.

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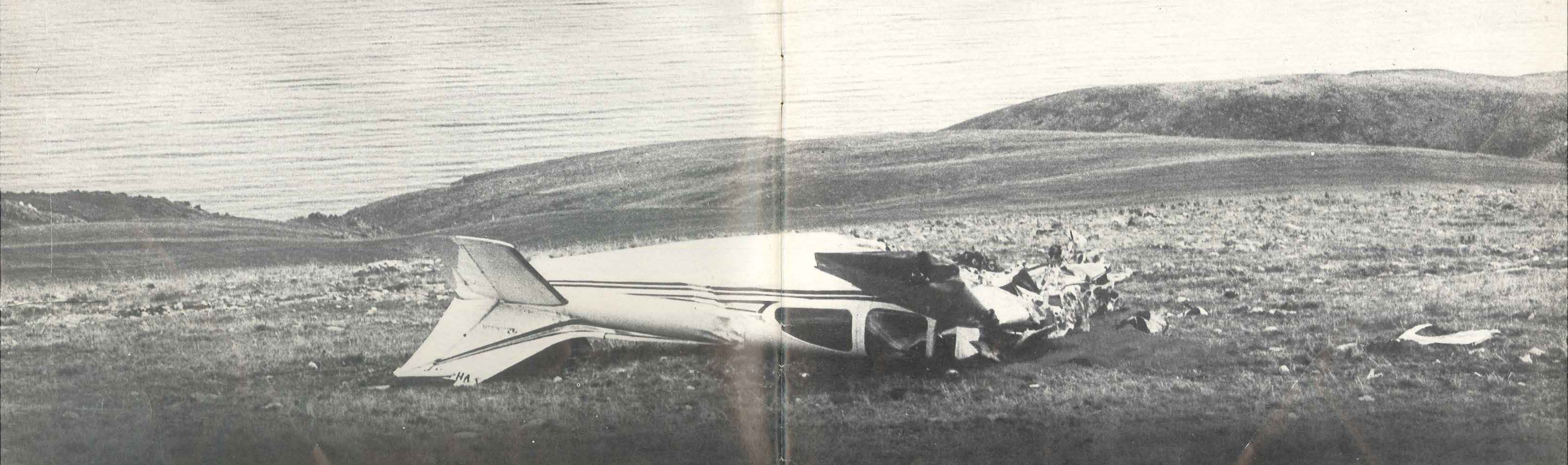
FATAL COLLISION WITH RIDGE

During the final stages of a VFR flight from Moorabbin, Victoria to Adelaide, South Australia, and while apparently descending towards St Vincent's Gulf preparatory to a visual entry to the Adelaide Control Zone at Port Noarlunga, a Beech Debonair struck the top of a ridge 680 feet above sea level, some 40 km south of Adelaide. The pilot and all three passengers were killed instantly. At the time of the accident, fog and low stratus cloud covered the hills south of Adelaide and there was extensive cloud above them.



The aircraft was operated by a flying school at Moorabbin and had been hired by the pilot for a private flight to Adelaide.

Early on the morning of the accident at 0615 hours Eastern Standard Time, the pilot arrived at the Moorabbin briefing office and obtained the route forecast which he had ordered earlier, together with a weather briefing. The route forecast predicted there would be five oktas of stratus cloud from 1500 to 2000 feet, and six oktas of strato-cumulus cloud between 2500 and 5500 feet. The significant weather section of the forecast was for scattered drizzle and fog about the coast and mountains until 0900 hours EST. The Adelaide terminal forecast given to the pilot was for CAVOK conditions. This is the term used when visibility is 10 km or more, there is no precipitation, and no cloud below a height of 5000 feet above the aerodrome elevation.

Having studied the route forecast, the pilot completed a flight plan with some care and submitted it to the briefing officer on duty. The pilot held a Class 4 instrument rating endorsed for ADF and VOR, and his VFR flight plan nominated these radio navigational aids. The route planned was via Yarrowee below 5000 feet, Mt. William to Bordertown at 8500 feet, Bordertown to Tailem Bend at 8000 feet, thence direct to Adelaide at 4000 feet. Each of these reporting positions has either an NDB or VOR, and the briefing officer gained the impression that the pilot intended to conduct the flight on top of cloud, navigating primarily by reference to these aids and then, as the forecast indicated conditions would be suitable, descend VFR into Adelaide. The briefing officer issued the pilot with the current notams, and the aircraft subsequently departed Moorabbin at 0704 hours EST.

The aircraft reported over Melton at 0721 hours and, at 0730, some four minutes after reporting over Bacchus Marsh at 3000 feet, it was cleared to enter the control area on climb to 6000 feet VFR as requested, and to track direct to Yarrowee. The aircraft reported at Yarrowee at 0743 climbing to 8000 feet, and estimating Mt. William at 0813 hours.

At 0804 the aircraft reported cruising at 8500 feet and amended its ETA Mt. William to 0820 hours. It subsequently reported over Mt. William at 0821, cruising at 8500 feet, and estimating Bordertown at 0916 hours EST. The aircraft was then instructed to call Adelaide on 120.7 MHz approaching Bordertown.

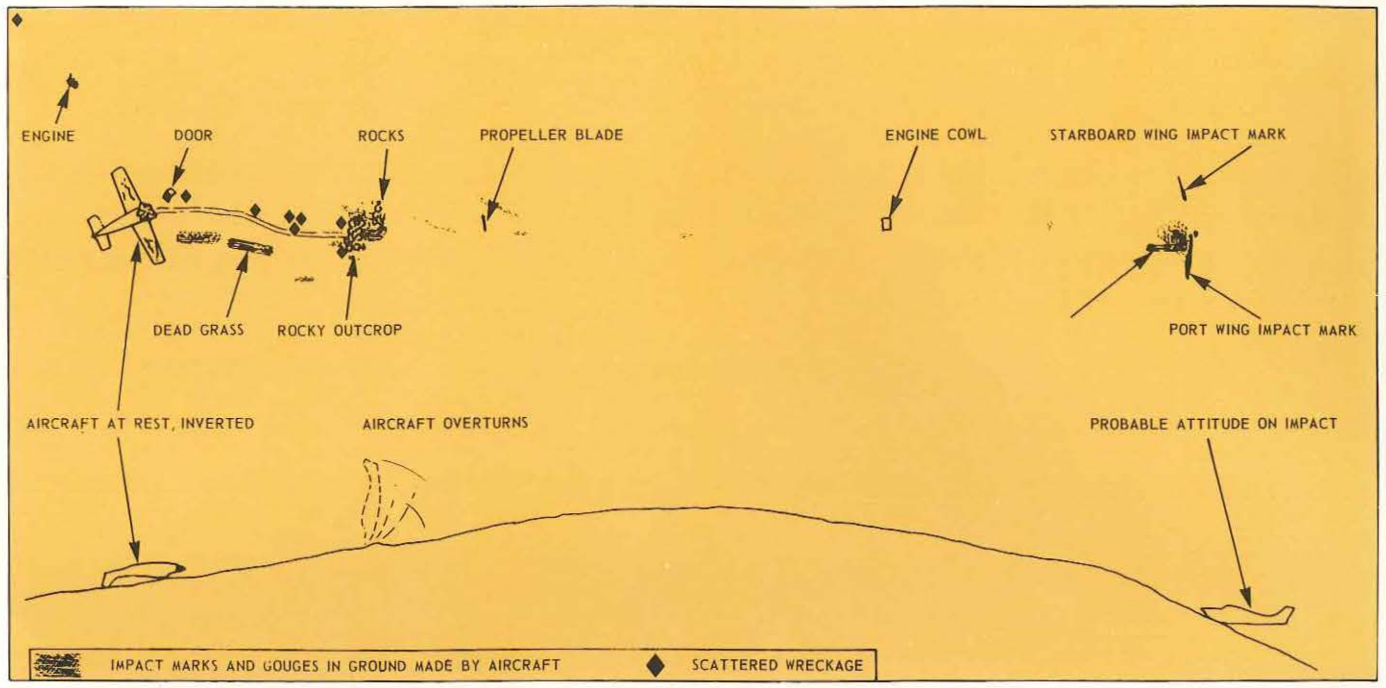
At 0918 hours EST, (0848 Central Standard Time☆) the aircraft reported to Adelaide over Bordertown at 8500 feet, estimating Tailem Bend at 0927 hours CST. Shortly afterwards, Adelaide passed the aircraft an amended forecast for the Adelaide area, indicating that there would be five oktas of stratus cloud between 1500 and 3000 feet, with drizzle about the ranges until 1030 hours CST, and five oktas of strato-cumulus between 3000 and 6000 feet. Isolated areas of fog about the mountains and in the far south were also expected until 1030 hours. Visibility was forecast to be 28 km, nine km in drizzle, 1000 metres in fog. The pilot confirmed that he had copied the weather and visibility details. Immediately after this transmission, the aircraft requested the amended Adelaide terminal forecast and this, indicating there would be three oktas of stratus cloud with a base of 1500 feet and eight oktas of strato-cumulus at 2500 feet, visibility 28 km and drizzle, with a QNH of 1020-1019, was also passed to the aircraft.

Ten minutes later, at 0906 hours CST, the pilot called Adelaide again and advised that he intended diverting at Tailem Bend to Port Noarlunga, descending outside controlled airspace and requested a clearance to enter the Adelaide Control Zone at Port Noarlunga. His ETA Port Noarlunga was 0952 hours and his ETA Adelaide 1004 hours CST.

At 0921 hours, the pilot requested the area QNH, and this was passed to the aircraft as 1019 mbs.

At 0929 hours, two minutes after the aircraft's ETA Tailem Bend, Adelaide called the aircraft to request its position and its latest ETA Port Noarlunga. Replying, the aircraft reported that it was approaching Tailem Bend at 1500 feet, but two minutes later the pilot amended his ETA Tailem Bend to 0935, and the ETA Port Noarlunga to 1000 hours. At 0934 hours the pilot reported 'abeam Tailem Bend' and, in reply to his request for an airways clearance, was told to 'expect clearance approaching Port Noarlunga'.

☆ Central Standard Time is 30 minutes behind Eastern Standard Time.



Above: Composite diagram showing profile of terrain struck by aircraft and wreckage trail from point of impact. The probable accident sequence is indicated.

Fourteen minutes later, at 0948 hours, the aircraft reported over Strathalbyn at 2000 feet and was passed a clearance to 'Enter Control Zone Port Noarlunga, 500 coastal offshore, at 30 miles (48 km) call Adelaide Approach 124.2'. The pilot subsequently read back the altitude and confirmed his ETA Port Noarlunga as 1000 hours.

At 0958 hours Adelaide requested the aircraft's position and the pilot reported, 'Present position crossing radial 180'. The aircraft was then instructed to call Adelaide Approach on 124.2 MHz and at 1000 hours the pilot advised 'Listening on 124.2'. In reply to Adelaide Approach's request for the aircraft's position, the pilot reported 'Just crossing the radial 180 — over the sea'. At this time a radar return was observed in the vicinity of the coast, approximately 20 km south of Port Noarlunga, heading west. The aircraft was then instructed to 'Report approaching Moana at 500 feet, coastal offshore'.

There was no acknowledgement and the aircraft failed to reply to further calls directed to it by Adelaide Approach, Adelaide Flight Service and Adelaide Tower.

Search and rescue procedures were initiated but the air and ground search which ensued was hampered by the low cloud and thick fog which enshrouded the hills to the south of Adelaide. Just before 1400 hours that afternoon, when the fog had lifted, the Adelaide Police received a report that the crashed aircraft had been sighted from the ground just inland from Sellick's Beach. This was confirmed a short time later when a search aircraft sighted the wreckage from the air, and reported that the crashed Debonair was upside down on a hilltop.

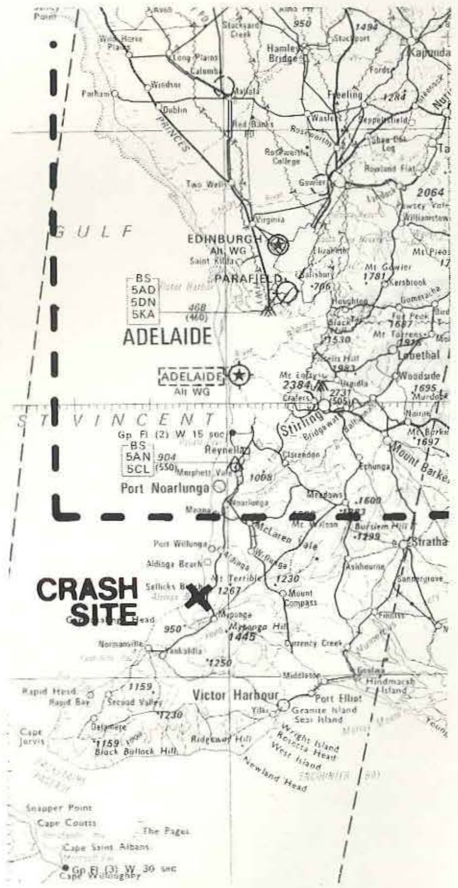
* * * *

The aircraft, flying a westerly heading in a laterally level attitude, had struck rising ground 680 feet above sea level, some 25 feet below the top of the gently sloping eastern face of the line of hills adjacent to the coast. From the point of first impact, the momentum of the aircraft had carried it up and over the rounded hill top where it had nosed-in and somersaulted on to its back. The wreckage finally came to rest on the western face of the hill, 120 metres from the initial impact point and less than 800 metres from the coast.

There was no positive evidence that the aircraft had been descending at the time of impact. If it had been descending on a westerly heading prior to impact, however, and the descent was performed at the recommended airspeed of 130 knots, a descent rate of 1233 feet per minute would have been necessary for it to have cleared another ridge immediately east of the accident site.

Examination of the wreckage did not reveal any defect or malfunction which could have contributed to the accident and there was evidence that each fuel tank had contained an adequate quantity of fuel. The current area QNH of 1019 mbs was set on the altimeter and no evidence was found that it was other than serviceable prior to impact. No evidence was found to suggest that the aircraft had at any stage been out of control.

Below: Map of Adelaide area indicating limit of coverage shown on Visual Terminal Chart.



The damaged aircraft clock had stopped, indicating 0031 which corresponded closely with the time of the last transmission received from the aircraft at 1000 hours 27 seconds CST (0030.27 GMT). The flight plan, maps and other papers were found in the wreckage and these, together with tape recordings of the communications between the aircraft and ground stations, were carefully examined to assess the progress of the flight and to ascertain whether any unusual events had occurred enroute.

The pilot had nearly 200 hours flying experience, and had obtained his Class 4 instrument rating four months before the accident.

* * * *

The flight was being conducted on a SARTIME basis, but the flight plan was annotated 'reporting all places'. Indeed, position reports and ETAs were passed at each point nominated on the flight plan, though no indication was given as to how the positions were established. There is evidence that the pilot of another aircraft, operating below 5000 feet in the Ballarat area, was concerned with the weather conditions there, and it is probable that, at this stage of the flight, the Debonair was already tracking using the radio navigation aids rather than visually. It is also probable that the aircraft's Bordertown position at 0917 hours EST was established by reference to the Bordertown NDB, as evidence from the Bureau of Meteorology, as well as from a flying instructor operating in the area at the time, indicates that the cloud development was increasing and that a visual fix from 8500 feet was unlikely.

In the vicinity of Bordertown the pilot would have had sufficient information from his own observations to alert him to the possibility that a weather problem existed. In addition, shortly after reporting at Bordertown, the aircraft was passed the amended area forecast and the amended aerodrome forecast for Adelaide. These indicated that, if the aircraft arrived over Adelaide above cloud, it would almost certainly not be able to make a visual descent. Also, as the direct route between Tailem Bend and Adelaide crosses the Mount Lofty Ranges where the highest obstructions, the television towers on Mount Lofty itself, are 2735 feet AMSL, it seems likely that the pilot decided that visual flight beneath the main cloud base, would not be possible along this track. Soon after receiving this amended weather information, the pilot said that he would divert and descend outside controlled airspace, then proceed to Adelaide via Port Noarlunga, entering the Adelaide control zone at 2000 feet subject to ATC clearance. Examination of the pilot's aeronautical and visual terminal charts for the Adelaide area showed that pencil lines had been drawn between Tailem Bend and Port Noarlunga and thence to Adelaide Airport and there seems no doubt that the amended 'weathers' governed the pilot's decision.

At 0848 hours CST, the pilot reported over Bordertown at 8500 feet with an ETA Tailem Bend of 0927 hours, but when queried by Adelaide at 0929 hours, he reported approaching Tailem Bend at 1500 feet and two minutes later revised his ETA Tailem Bend to 0935 hours. He subsequently reported **abeam** Tailem Bend at 0934 hours. Seven minutes were thus lost between Bordertown and Tailem Bend and the aircraft was descended from 8500 feet to 1500 feet enroute. It is not known exactly when the pilot made this descent, but on the basis of his report it would have been

Right: View of wreckage as it finally came to rest on western slope of hill, with waters of St. Vincent's Gulf in background. The secondary impact marks in the right foreground were made by the nose as the aircraft somersaulted on to its back.

between 0851 and 0929 hours CST. It seems likely that the descent was made to establish visual contact with the ground, in order to navigate visually between Tailem Bend and Port Noarlunga which has no radio aid; however, in view of the weather reports and observations, it is probable that it was necessary to descend through cloud to gain visual contact with the ground. Indeed, at about 0900 hours CST, shortly after leaving Bordertown, a motorist who was driving towards Adelaide, sighted what he believed to be a Debonair aircraft flying very low from the direction of Adelaide just below an overcast sky, the base of which he estimated was only about 300 feet high. He was so concerned that he stopped the car to watch and noticed that the aircraft then turned back towards the west and headed towards Adelaide, flying along the highway at low level. It was not established whether the aircraft sighted was the one subsequently involved in the accident, but the motorist's description fitted it, and no other aircraft was reported to be flying in the Bordertown area at the time. It could be conjectured that because of the increasing cloud in the direction of Adelaide, the pilot found it more practical to descend towards the east, but having established visual contact with the ground and located the highway, he turned again to follow the highway, which was an excellent 'navigational aid' to Tailem Bend. Such a 'let down' would explain the seven minutes lost on this route section.

It may also be significant that the pilot reported '**abeam** Tailem Bend' at 0934 hours rather than '**at** Tailem Bend', which suggests that the aircraft had already diverted towards Port Noarlunga before reaching Tailem Bend. The amended route of Tailem Bend to Port Noarlunga required the aircraft to cross terrain with heights up to about 1500 feet, and in view of the forecast for cloud at 1500 feet, VFR flight on this track would have been very doubtful. At 0948 hours CST however, some 12 minutes prior to the accident, the pilot reported at 2000 feet over Strathalbyn some seven km south of the amended track, and it

Another view of the inverted wreckage in the position in which it finally came to rest. The engine is in the foreground. This photograph was taken looking south and the direction of flight was from left to right. The angle of initial impact with the ground can be discerned from the flattening of the aircraft's lower forward fuselage.

seems possible that the pilot was searching for a route to the coast that would permit visual flight.

The decision made by the pilot at this time was critical. There is ample evidence that the ranges were enshrouded with low cloud and fog throughout the morning. In fact, two locally experienced pilots had endeavoured to cross them that morning, but had found it impossible to do so, even at a very low level. These weather conditions should have been quite evident to the pilot of the Debonair, and his clearance to enter the control zone at 500 feet offshore should have alerted him to the terminal conditions, but he still pressed on. At no stage did the pilot indicate that he had any kind of a weather or navigation problem. Whether in this case he was able to continue between layers, or whether he entered cloud — deliberately or unintentionally — is not known. Whatever the pilot's reason for continuing the flight, rather than diverting or turning back, the decision was a fatal one.

* * * *

In retrospect, perhaps, it might be said that this pilot was exceedingly unlucky — the accident occurred just where the coast swings westward from the predominantly north-south alignment of the eastern side of the St Vincent's Gulf. As well, the terrain the aircraft struck was the topmost slope of the last line of hills before reaching the coast. So close in fact was the aircraft to safety, that its momentum after the impact actually carried it over the crest on to the seaward slope of the hill. Thus, only a few more feet of altitude, would have averted the accident altogether and the flight would have terminated safely, apparently 'without incident'. It is all the more poignant and distressing that the margin by which four lives were lost was such a slender one, but unfortunately this is not the real point that emerges from the investigation.

The final transmission from the aircraft, that it was 'just crossing radial 180 — over the sea', indicates that the pilot was monitoring the aircraft's position with reference to his bearing from the Adelaide VOR. If the pilot believed he was on the direct track from Tailem Bend to Port Noarlunga by reference to his aeronautical and visual terminal chart, he might have assumed that after passing through the 180 degree VOR radial, he would be able to descend to 500 feet, the altitude at which he had been cleared to enter the control zone at Port Noarlunga 'coastal offshore'. As is evident from the accompanying map however, the aircraft was some 20 km south of the direct track. Not only does the coastline swing quite sharply to the south-west a few km south of Port Noarlunga, but the hills which in that vicinity are several kilometres inland, extend at the accident site almost to the coast itself. Just why the pilot seemed to be certain he was over the sea is not known, but he might have sighted the coast to the north, through a break in the clouds, and this gave him an impression he was already over the coast. Furthermore it is not possible to know to which chart the pilot was referring just before the crash, but at this stage of the flight it may well have been the Adelaide visual terminal chart. This extends south only to Moana and does not show the area where the coastline swings sharply to the west.

Whatever it was that led the pilot to believe he was clear of terrain, the fact remains that precise and sole reliance on crossing a certain VOR radial for a positive fix is fundamentally unsound, and therefore dangerous. No bearing from a VOR is absolutely precise and as well, it can give no direct indication of distance from the beacon. In this case, from Adelaide Airport the bearing and distance of Port Noarlunga is 183 degrees M, 21 km; significantly, the bearing of the accident site is the same, only the distance is greater. Had the aircraft maintained the direct track from Strathalbyn to Port Noarlunga, it seems likely that the pilot would have 'got away with it', but the risk inherent in such a procedure is all too evident from what actually took place. It has not been possible to determine what headings the pilot actually flew after reporting over Strathalbyn, or how the aircraft came to be so far south of the proposed track from Tailem Bend to Port Noarlunga, but it probably resulted from changes in heading while the pilot was attempting to pick his way visually over the ranges, possibly between layers of cloud.

It is probably very significant to the story of this accident that the Class 4 instrument rating which the pilot held did not qualify him to operate in IMC, but only at night in VMC. The regulations specifying the conditions in which flight in VMC may be conducted, have been framed to ensure that pilots whose qualifications and experience is confined to this class of operation, do so within safe limitations, and over the twenty-one years that the *Aviation Safety Digest* has now been in production, many articles have been published illustrating the dangers of flight in IMC by pilots who do not hold appropriate qualifications. Although an applicant for a Class 4 instrument rating is required to demonstrate his ability to control his aircraft solely by reference to instruments this is hardly more than the first step in instrument flying, and such a rating must never be construed as a qualification to control and navigate an aircraft in IMC.

It is evident that although the weather over the route on which the pilot had chosen to approach Adelaide was not suitable for VFR flight, he gave absolutely no indication of this fact. Last year in *Aviation Safety Digest* No. 85, the article 'You're Not On Your Own' discussed this very subject, and urged pilots in difficulties to call for assistance so that the very extensive Departmental services available, could be placed at their disposal to ensure that their flight is terminated in safety.' In this case, however, assistance which might have averted the accident was not offered to the pilot because there was not the slightest indication from him that any weather or navigational problem existed. Advice from the pilot of the actual weather conditions, and any navigational difficulties he may have been encountering, would undoubtedly have called forth assistance such that a safe conclusion to the flight would have resulted.

Cause

The cause of the accident was that the pilot continued the flight into weather conditions in which he was not able to maintain the visual references necessary to ensure adequate terrain clearance on his selected flight path.

NOWHERE TO GO

While attempting to complete a flight to Merimbula N.S.W. from Latrobe Valley, Victoria in conditions of low cloud and fading light, the pilot of a Cessna 150 became uncertain of his position above cloud in the Merimbula area and called for assistance. Despite attempts to guide the aircraft to Moruya where better weather existed, it was not possible to determine the aircraft's position before its fuel became exhausted and it was forced to descend in darkness. The aircraft transmitted its last call an hour after last light as it was descending through 700 feet with the engine stopped and the pilot still not in visual contact. Despite an intensive air search no trace has yet been found of the missing aircraft.

The aircraft, which was operated by a flying school at Merimbula, had been hired by the pilot to fly a colleague from Merimbula to Latrobe Valley and return. At 1050 hours on the day of the accident, the pilot 'phoned the Cooma Flight Service Unit to obtain a weather forecast. He was told that, for the coastal area from Merimbula to Gabo Island, the area forecast indicated there would be winds from 040 degrees at 10 knots up to 5000 feet, three oktas of cumulus cloud with a base of 3000 feet, and a visibility of 28 km reducing to 6 km in drizzle. The forecast was valid until 1600 hours. The area forecast, covering the section of the route from Gabo Island to Latrobe Valley, valid until 2200 hours, indicated similar conditions except that, at 5000 feet the wind was northwesterly at 15 knots. The pilot then passed details of his flight plan which indicated that the aircraft would proceed coastal to Bairnsdale, thence via Sale and Heyfield to Latrobe Valley, and that the estimated time interval would be 105 minutes. The return flight was to be made via the same route, for which the pilot again estimated a time interval of 105 minutes. He nominated a SARTIME of 1800 hours, to be cancelled on his return to Merimbula.

After the pilot and his passenger had boarded the aircraft, it was seen to depart normally from Merimbula at about 1130 hours. It subsequently landed at Latrobe Valley shortly before 1400 hours in overcast conditions. The two men were met by a business colleague of the passenger, and driven into town to have lunch.

Meanwhile, by arrangement with the pilot, a flying instructor at Latrobe Valley took charge of the aircraft, taxi-ied it to the refuelling point, and topped up both tanks for the return flight. The aircraft took a total of about 55 litres. The instructor then carried out a water check, added a litre of oil to the engine, and left the aircraft at a nearby tie-down point. While taxi-ing the aircraft he checked the magnetos and noticed that the variation in rpm was well within the allowable tolerance. He also noticed that the aircraft's maintenance release had approximately 30 hours to run and there were no unserviceability entries.

Having had lunch, the pilot returned to the aerodrome to await his passenger who was remaining in town to transact the business for which he had made the trip. Later in the afternoon, at about 1630 hours, the pilot approached the flying instructor again and asked him the time of last light at Merimbula. After the instructor had assisted the pilot to calculate this figure as 2047 hours, the pilot telephoned Moorabbin Airport, Melbourne and amended his SARTIME to 2000 hours.

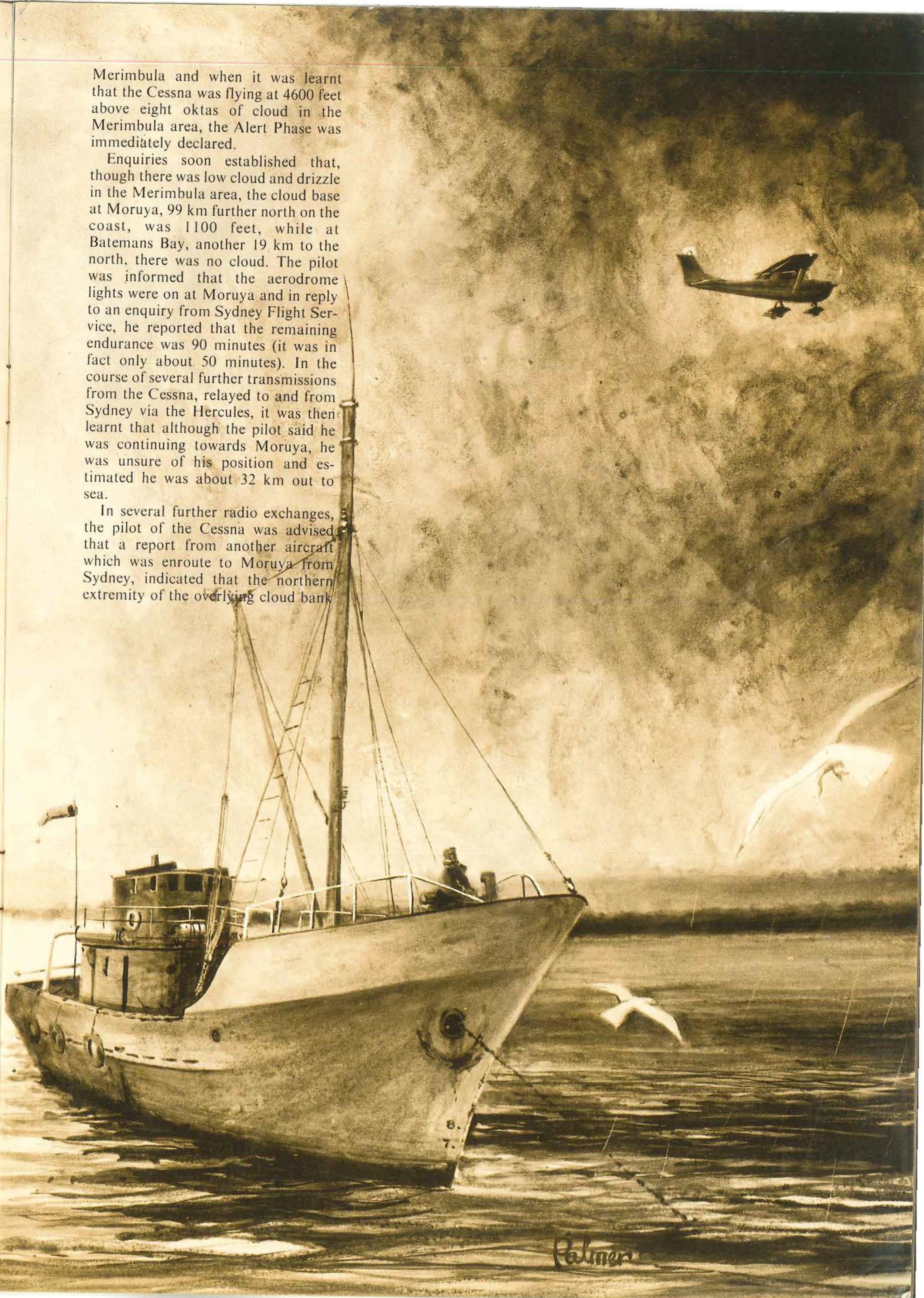
At 1735 hours, by which time the flying instructor had attended to the hangaring of his own aircraft and was preparing to leave the aerodrome, the pilot of the Cessna 150 was still waiting for his passenger. By this time the pilot was showing obvious signs of agitation at the fact that his passenger had not returned. While the instructor was locking up the club house, he explained to the pilot how to make use of the public telephone from outside the building, and suggested then, as it was getting so late and the weather conditions and light were worsening, he might care to stay at a nearby motel. The pilot however seemed emphatic that he would not need to stay overnight. The instructor then left the aerodrome for home by car.

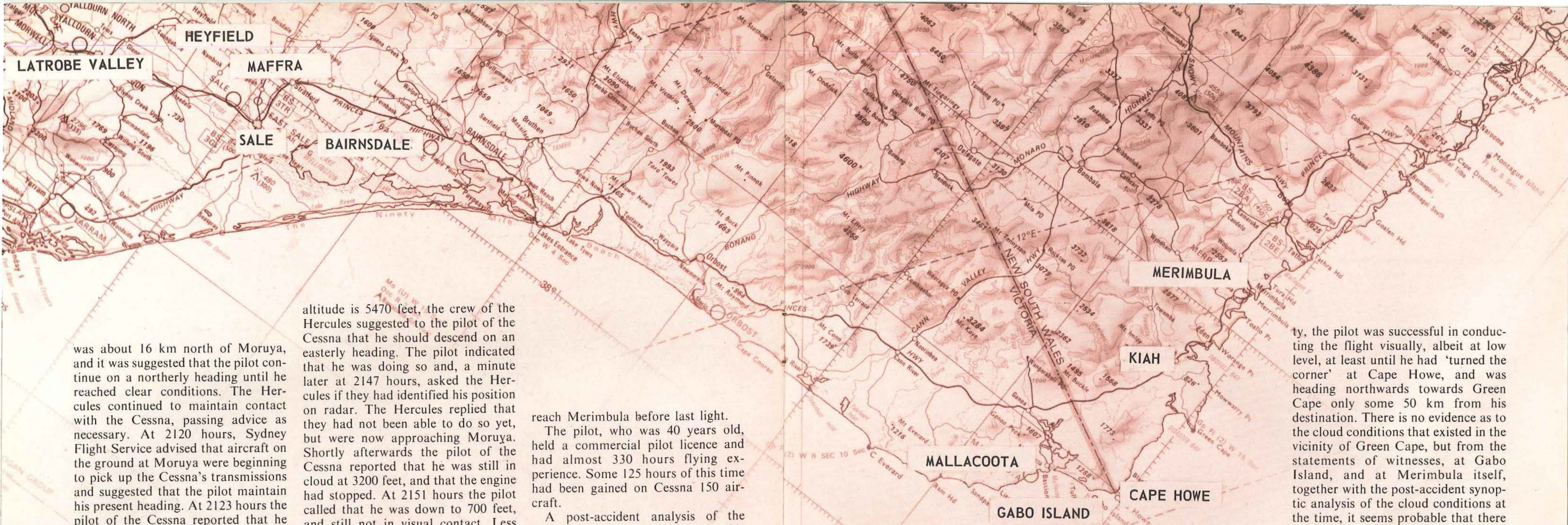
Meanwhile in town, the passenger and his colleague had completed their business at about 1730 hours, and then drove back to the aerodrome. The pilot met them as they arrived and the passenger asked if they still had time to take off. The pilot replied that it would be marginal. There was low cloud and mist in the area, but he said he expected they would 'fly out of it'. In reply to a comment by the passenger's companion that they could land at Mallacoota if necessary, the pilot said that if they were able to get that far, they 'could make it to Merimbula'. The two then boarded the aircraft and, after carrying out the normal checks, it was seen to take off into the east soon after 1800 hours. At 1829 hours the pilot called Melbourne Flight Service and reported position at Heyfield cruising below 2000 feet. Shortly afterwards he called Melbourne again to report that he had departed Latrobe Valley at 1815 hours and was estimating Merimbula at 2035 hours. The pilot requested his previously amended SARTIME of 2000 hours be further amended to 2045 hours. The aircraft did not make contact with Melbourne Flight Service again.

Later that evening in Sydney when, at 2045 hours, the aircraft's SARTIME had expired and nothing further had been heard from it, the Flight Service Unit began communications checks and when these were unsuccessful, telephoned the aerodrome at Merimbula. It was found that the aircraft had not landed there and the communications checks were continued. At 2058 hours, contact was established with the Cessna 150 via an RAAF Hercules aircraft which was operating at high level about 160 km off the coast from Merimbula. By this time it was dark at Merimbula and when it was learnt that the Cessna was flying at 4600 feet above eight oktas of cloud in the Merimbula area, the Alert Phase was immediately declared.

Enquiries soon established that, though there was low cloud and drizzle in the Merimbula area, the cloud base at Moruya, 99 km further north on the coast, was 1100 feet, while at Batemans Bay, another 19 km to the north, there was no cloud. The pilot was informed that the aerodrome lights were on at Moruya and in reply to an enquiry from Sydney Flight Service, he reported that the remaining endurance was 90 minutes (it was in fact only about 50 minutes). In the course of several further transmissions from the Cessna, relayed to and from Sydney via the Hercules, it was then learnt that although the pilot said he was continuing towards Moruya, he was unsure of his position and estimated he was about 32 km out to sea.

In several further radio exchanges, the pilot of the Cessna was advised that a report from another aircraft which was enroute to Moruya from Sydney, indicated that the northern extremity of the overlying cloud bank





was about 16 km north of Moruya, and it was suggested that the pilot continue on a northerly heading until he reached clear conditions. The Hercules continued to maintain contact with the Cessna, passing advice as necessary. At 2120 hours, Sydney Flight Service advised that aircraft on the ground at Moruya were beginning to pick up the Cessna's transmissions and suggested that the pilot maintain his present heading. At 2123 hours the pilot of the Cessna reported that he was maintaining a heading of 350 degrees magnetic at 4500 feet. The pilot was then advised that lights were being arranged at the Royal Australian Navy's air station at Nowra, where there was only one okta of cloud, in case there was any difficulty landing at Moruya.

At 2127 hours the Hercules set course towards Moruya to make an airborne radar search for the Cessna and, at about the same time, a radar watch was opened at the Nowra naval air station. Shortly afterwards however, at 2129 hours, the Cessna reported that it was flying in cloud. The Distress Phase was declared and the aircraft was requested to climb to 7000 feet in case it was over the high terrain just inland from the coast, as well as to assist its identification on radar.

At 2140 hours, the Cessna reported that it was still in cloud at 5700 feet on a heading of 010, and three minutes later the pilot transmitted that he was at 6300 feet still on the same heading, and that he was running out of fuel. The starboard tank was empty and the port tank almost empty. Shortly afterwards the pilot reported he had run out of fuel and was descending on a northern heading, still in cloud.

Because of the high terrain which lies only a few kilometres inland in the Moruya area, where the lowest safe altitude is 5470 feet, the crew of the Hercules suggested to the pilot of the Cessna that he should descend on an easterly heading. The pilot indicated that he was doing so and, a minute later at 2147 hours, asked the Hercules if they had identified his position on radar. The Hercules replied that they had not been able to do so yet, but were now approaching Moruya. Shortly afterwards the pilot of the Cessna reported that he was still in cloud at 3200 feet, and that the engine had stopped. At 2151 hours the pilot called that he was down to 700 feet, and still not in visual contact. Less than a minute later there was a brief transmission of a carrier wave, after which the Cessna failed to respond to further calls.

The Hercules, together with two radar-equipped Grumman Tracker aircraft which were deployed shortly afterwards from Nowra, continued searching the area until after 2300 without result. At first light the following morning an intense air, land, and sea search began. The search covered a wide area of coast and sea from Mallacoota just south of Cape Howe to Jervis Bay, 88 km north of Moruya, but despite the fact that it was continued for three weeks, not the slightest trace of the missing aircraft was found.

* * * *

There was no evidence to suggest that the aircraft was other than airworthy at the time of the flight, nor that it was loaded outside its safe limits. The aircraft's calculated fuel consumption, from the time of its departure from Latrobe Valley, until the pilot reported that he was running out of fuel, was of the order of twenty three litres per hour. This figure is considered quite normal for a Cessna 150, especially considering that the pilot would probably have used a high cruising power setting in an attempt to reach Merimbula before last light.

The pilot, who was 40 years old, held a commercial pilot licence and had almost 330 hours flying experience. Some 125 hours of this time had been gained on Cessna 150 aircraft.

A post-accident analysis of the weather existing over the aircraft's proposed route at the time of the flight, showed that the forecasts which would have been available to the pilot upon request for the period commencing at 1600 hours were correct. There was scattered low cloud over Victoria, increasing towards the east, and at Gabo Island, just off the easternmost tip of Victoria near Cape Howe, there was eight oktas of stratus with a base between 1000 and 2000 feet. Further north on the N.S.W. coast, overcast cloud coming off the sea was present. In the Merimbula-Moruya area between 2000 and 2100 hours, there was an overcast layer of stratocumulus cloud with a base of between 1000 and 3500 feet, estimated to be 2000 to 3000 feet thick.

The evidence of witnesses indicates that there was low cloud and mist in the Latrobe Valley area, at the time of the aircraft's departure and that the visibility was less than eight km and deteriorating. Shortly after 1800 hours, an aircraft of the description of the Cessna was seen, apparently soon after it had taken off, passing over Traralgon, eight km east of Latrobe Valley aerodrome. According to the witness who saw it, the cloud base at the time was only about 500 feet and, though it was not raining, the visibility was no more than three to five kilometres. The aircraft was seen to fly over the town below the cloud base at an unusually low level and, when slightly east of the town, it began a turn. The witness watched to see if it was going to return to the aerodrome but instead it continued in the direction of Heyfield, apparently following the railway line. In the conditions in which the aircraft was operating, the witness felt a concern for its safety.

An aircraft of the description of the missing Cessna was seen by another witness over Heyfield at about 1820 hours. This witness said that although many aircraft fly over Heyfield as it is one of the reporting points in the East Sale Control Zone, he took particular notice of this Cessna 150 because it was flying so low and the weather conditions were so poor. The witness estimated that at the aircraft's height, the visibility would have been about eight kilometres. A similar report was made by a witness near Maffra, who estimated the aircraft was flying above the railway line at about 200 feet. At the time the visibility was so poor and the cloud so low that this witness too, felt the operation was hazardous.

About two hours later, the masters of two fishing vessels sheltering in the lee of Gabo Island, just south of Cape Howe, saw a single engine aeroplane flying past the island obviously northbound. The aircraft came from the direction of Mallacoota, passed to the east of the Howe Range, the top of which was in cloud, and disappeared in the direction of Green Cape and Merimbula. It was beginning to get dark at the time and the wind was blowing from the north-east. Witnesses in the Kiah area a few kilometres south of Twofold Bay, and in Merimbula itself, also heard the sound of a light aircraft passing overhead close to the onset of darkness, but because of the overlying cloud, they were not able to see it.

* * * *

Although the aircraft sighted at Cape Howe and heard over Kiah and Merimbula, could not be positively identified as the Cessna that was subsequently lost, the actual sighting and hearing times are in accord with what would be reasonable to expect from the aircraft's departure time from Latrobe Valley and its subsequent sighting over Maffra. There is also an acceptable correlation between this witness' evidence and the radio reports from the pilot himself to the effect that the aircraft was in the Merimbula area on top of cloud about the time of last light.

Thus it seems likely that, despite the overlying low cloud and poor visibility, the pilot was successful in conducting the flight visually, albeit at low level, at least until he had 'turned the corner' at Cape Howe, and was heading northwards towards Green Cape only some 50 km from his destination. There is no evidence as to the cloud conditions that existed in the vicinity of Green Cape, but from the statements of witnesses, at Gabo Island, and at Merimbula itself, together with the post-accident synoptic analysis of the cloud conditions at the time, it seems probable that there would have been sufficient cloud clearance for the pilot to have continued the flight visually to Merimbula, provided the aircraft followed the coast. But as a glance at the map of the coastline in this area will show, the coastal route from Cape Howe to Merimbula is several kilometres longer than the more direct route, which involves some tracking inland northwards from Disaster Bay past Kiah, to Twofold Bay and Eden.

At this stage of the flight it was beginning to get dark, and the pilot was probably becoming apprehensive that darkness would fall before he reached the circuit area at Merimbula. In the weather conditions that existed, he no doubt realised that this would mean **total** darkness, apart from the lights at Merimbula and Pambula townships to the north and south of the Merimbula aerodrome. He also probably realised that, without prior notice, laying a flare path in time for him to land, was out of the question.

For this reason, the pilot might well have decided to take the 'short cut' from Disaster Bay, though this would involve flying over terrain a good deal higher than around the coast and, of necessity, picking his way just above the hills close to the base of the cloud. The hearing report from the Kiah area not only supports this probability, but suggests that the pilot might have had difficulty 'getting through' this way. After describing the sound of a light aircraft 'coming up from the south', this witness said that 'as I was listening, he turned and went east over towards the highway, then turned again and headed towards Mallacoota'. Also, from the witness's description that it was cloudy and he didn't see the aircraft even though he looked in the direction from which the sound was coming, it seems that the aircraft was already either in, or above cloud at this point.

From the very meagre evidence that is available concerning the aircraft's movements at this stage of its flight, it would of course be pure speculation to attempt to reconstruct the sequence of events which might have befallen the aircraft between Cape Howe and Merimbula. The most that can be said is that, during this part of the flight, and possibly while attempting to track directly from Disaster Bay to Merimbula, low-lying cloud probably prevented the pilot from continuing in visual contact with the ground, and forced him to climb. Having found himself on top of cloud, he continued in the direction of Merimbula, no doubt hoping to find a break through which he could descend. As events have so tragically proved, he was not able to do so.

Once again, it is only possible to speculate as to the action the pilot took at this point. But from his radio call to the effect that he thought he was about 32 km out to sea, as well as from the fact that he believed he was still in the Merimbula area when he first established contact with Sydney through the RAAF Hercules, some minutes after his revised ETA Merimbula, it seems likely that he spent some time flying about trying to make a descent. By this time it was almost dark and so when this attempt failed, the pilot followed the only course left open to him in electing to continue north in the hope of reaching clear conditions.

Possibly if the aircraft had not run out of fuel quite so soon, this objective could have been achieved, but even then there would have been the problem of identifying the aircraft's position in time to vector it to a safe landing.

With such a small margin of daylight and endurance remaining, the safety of the aircraft was in jeopardy once it was flown north from Cape Howe and too far beyond Mallacoota to be able to return and land there while daylight remained.

The accident is a further tragic example, not only of the way in which circumstances can 'pressure' the pilot of a light aeroplane into an irretrievable situation, but also of the long-established truth that an aircraft accident is but the culmination of a long chain of unfavourable events, any one of which, if adequately dealt with at the right time, could have broken the chain and averted the accident.

Apart from the deteriorating weather conditions, one of the more significant links in this chain was the inaccuracy of the pilot's estimated time intervals. When he 'phoned his flight plan to Cooma before departing from Merimbula, the pilot notified time intervals of 105 minutes for both the outward and return legs of the flight. By contrast with these figures, the outbound time interval, if correctly computed, would have been 131 minutes, and the time interval for the return flight, based on the latest available forecast winds, would have been 158 minutes. If, as the pilot reported, the aircraft departed Latrobe Valley at 1815 hours, then its correct ETA Merimbula was 2053 hours, six minutes after last light. The pilot evidently realised his nominated time interval for the return flight was grossly inaccurate, because at 1845 hours, half an hour after departing from Latrobe Valley, he said that his ETA Merimbula was 2035 hours, implying a total time interval of 140 minutes. It is not known on what basis the pilot calculated this ETA, but even if this estimate had been accurate, it provided a margin of daylight of only 12 minutes at the aircraft's destination.

Considering the advice published on this subject in the Visual Flight Guide, this is a slim margin indeed for a flight of well over two hours duration, even in favourable weather. As it was, the weather appears to have been anything but favourable, and there is an abundance of evidence to suggest that the aircraft should never have departed from Latrobe Valley in the conditions that existed, regardless of any consideration of the daylight available to complete the flight.

Nevertheless the aircraft did depart and, even in the adverse weather which prevailed, the pilot was evidently able to reach a point north of Cape Howe. With darkness obviously approaching, the pilot should have taken timely action to terminate the flight in safety at Mallacoota, but this opportunity was not taken, and so one of the final links in the chain was forged.

In addition to the object lessons already discussed, this accident demonstrates the need, whatever the type of operation, to have a realistic and workable 'alternative plan' that can be followed if things do not work out as expected. In this case, a definite plan to land at Mallacoota if conditions for the last part of the flight were deteriorating even further, could have saved the day.

The principal lesson of this tragedy is surely that any developing flight situation which, by its nature, precludes the possibility of retaining an acceptable alternative plan, should be sufficient reason for not continuing the flight.

JAMMED CONTROLS

At Parafield, South Australia, a private pilot was undergoing a dual check with an instructor in a Cessna 172. The object of the flight was to rectify a deficiency in the pilot's landing technique, and for this purpose a series of 'touch and goes' was being flown from fully-stalled, flapless landings.

On being instructed to go around again after the fourth landing, the pupil applied power and attempted to lower the nose, by applying normal forward pressure to the control column, but the tail scraped the ground briefly as the aircraft became airborne. Thinking the aircraft was mistrimmed, he continued to turn the trim wheel further and further forward, but with little effect.

Seeing his pupil was having difficulty in lowering the nose, the instructor took control and found that the elevators were jammed in the neutral position. The instructor reduced power to lower the nose and re-set the trim to about the neutral position. Then, using a combination of power and trim to control the aircraft's attitude, he completed the circuit and, with the airport fire service standing by, accomplished a normal flapless landing. After he had completed the landing, the controls suddenly freed and full elevator movement was again available.

When the aircraft was examined by the operator's chief engineer, he found marks indicating that something had jammed between the starboard elevator horn balance and the tailplane (see photographs).

Inspection of the area of the strip on which the aircraft had previously landed, revealed a gouge mark two metres in length, which confirmed that the aircraft's tail had contacted the ground. The strip surface in this area was hard and free of stones, but some thirty metres before reaching this point, the aircraft had passed over a patch where the surface is covered with loose cinders. There was evidence that the tail had also scraped the ground lightly in this area, and that the starboard wheel had passed over some loose cinders just after touchdown.

The attitude of this aircraft type during a fully stalled flapless landing is markedly nose-up, with the tail very close to the ground. Under these conditions, with the elevator fully up, the horn balance could act as a scoop, making it easy to pick up small loose objects such as stones or cinders, particularly at low forward speed. The application of power to go around before the elevators were neutralised, could also have blasted cinders over the tailplane surfaces, particularly while the aircraft was in an exaggerated nose-up attitude.

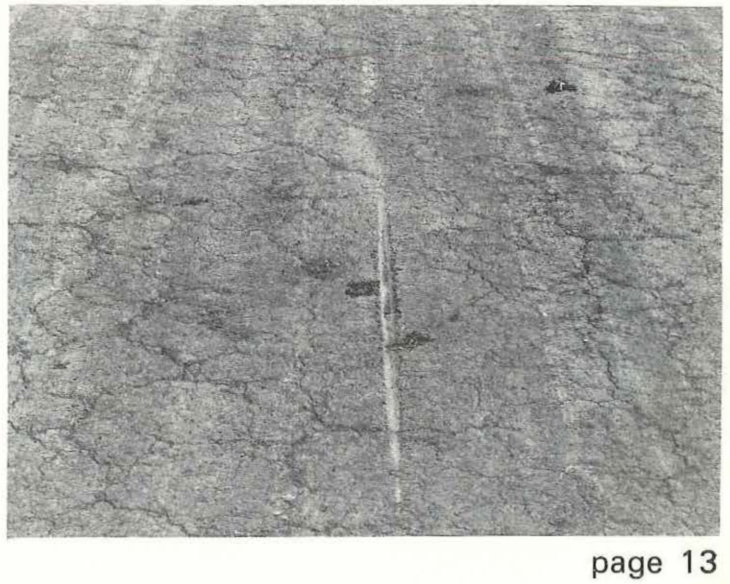
It was not possible to precisely establish the sequence of events which led to the jamming of the elevator, but the marks on the tailplane and horn were consistent with what could have been inflicted by a small piece of cinder. It thus seems likely that, when the aircraft touched down at low airspeed in a nose-up attitude, one of the cinders thrown up from the strip was forced between the elevator horn and the tailplane and became jammed there by the combined action of the slipstream and movement of the elevators back to the neutral position.

It is fortunate indeed that the jamming occurred in the neutral position and not in one which would have produced a violent nose-up or nose-down reaction. The fact it is possible for the controls to become jammed by such an unlikely chain of events, suggests that it could be good practice during circuits of this type, to return the elevators to neutral **well before** applying power to go around.

The experience also suggests that pilots should consider the nature of the strip surface in relation to the type of exercise they are flying. Obviously, in some types of aircraft, flapless landings require special care when carried out on natural surfaces.

Close-up of outboard edge of starboard tailplane showing score marks made by cinder jammed between tailplane and elevator horn. The buckled lower skin of the tailplane was partially straightened by an engineer before the photograph was taken.

Gouge in strip surface caused by aircraft's tail after power was applied to go around.



INVITING DISASTER

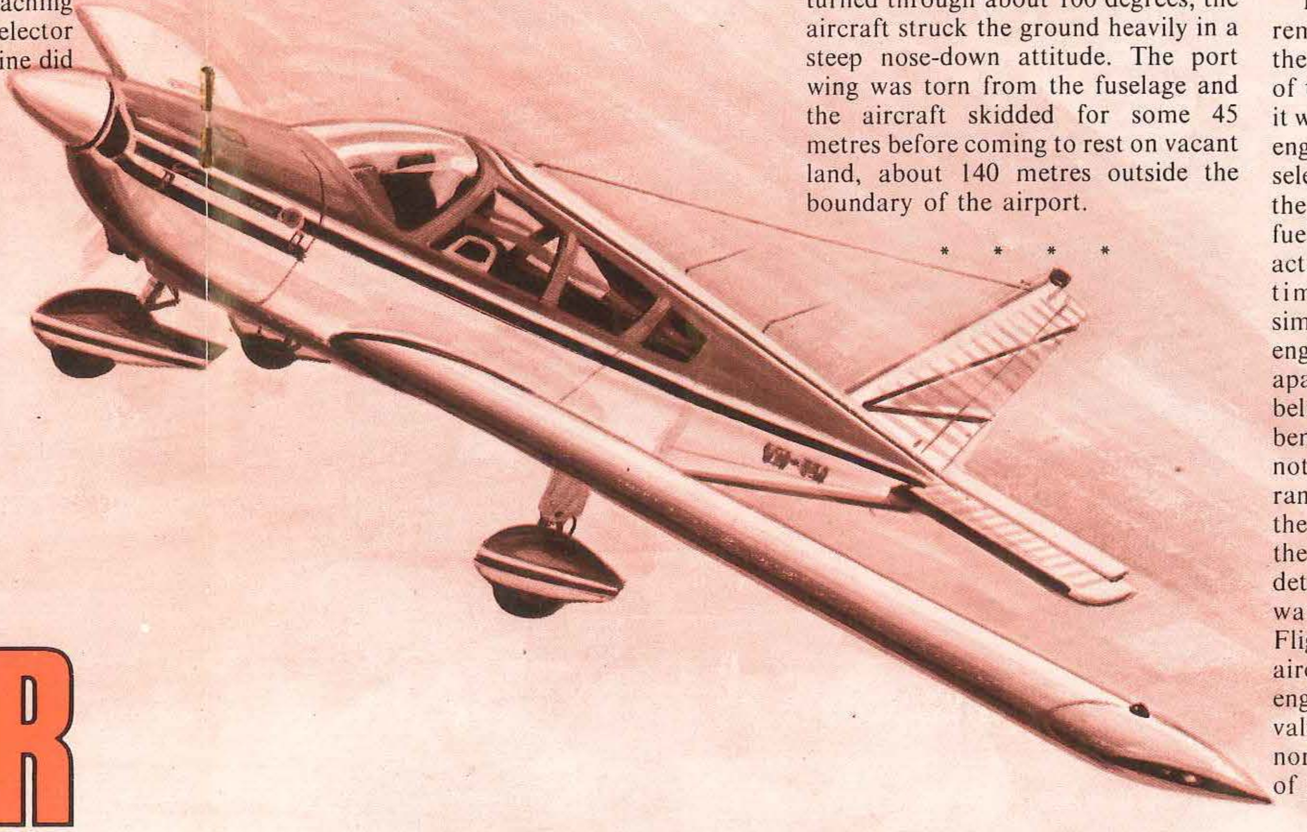
Shortly after taking-off from Bankstown and at a height of about 200 feet, a Cherokee 235 lost nearly all engine power. While turning back towards the airport, the aircraft struck the ground in a steeply banked nose-down attitude a short distance outside the boundary fence. Both occupants were seriously injured and the aircraft was destroyed.

The pilot, who held a restricted private licence, had arrived at the airport during the morning, intending to do a period of circuit and landing practice in the aircraft. Although endorsed on the Cherokee type, he had flown the 235 model only once before. After completing a daily inspection, the pilot started the engine and taxied to a fuel depot to have the aircraft refuelled. The Cherokee 235 has a four-tank fuel system comprising two main tanks in the inboard sections of the wings and two moulded fibre-glass tanks which form the wing tips. The pilot added a total of 114 litres to the main tanks to bring them up to full. He did not add any fuel to the tip tanks, but noticed they both contained small quantities.

While taxi-ing out towards the holding point, the pilot had difficulty with the radio and returned to a nearby parking area to shut down the engine and trace the cause. He rectified the fault and, a short time later, he happened to meet an instructor with whom he had flown before and asked him to go along on the flight. The instructor agreed and shortly afterwards, they boarded the aircraft and taxied to the run-up bay. After conducting his pre-take-off checks and an engine run-up, the pilot took-off and completed a circuit intending to do a touch-and-go landing.

After touching down normally, the pilot allowed the aircraft to roll straight ahead and then opened the throttle to go around. But just as the aircraft became airborne, the engine seemed to hesitate momentarily. Quickly deciding to abandon the take-off, the pilot closed the throttle and the aircraft settled back on the ground. He continued to the end of the runway and turned off at the perimeter taxiway. Intending to carry out another circuit, the pilot taxied back to the holding bay where he carefully conducted a lengthy engine run-up. He checked all engine controls for correct operation and moved the fuel selector over its full travel, pausing at each detent to check the fuel pressure. He said later that he then returned the selector to the port main tank position. Throughout these checks the engine could not be faulted and, as everything seemed in order, he reported ready and lined up.

At first, the take-off progressed normally and the pilot saw that all engine instruments were indicating correctly within their respective green arcs. But at about 200 feet, the pilot said, the engine suddenly lost '85% power or more'. Pushing the nose down, he called 'handing over' and the instructor immediately took the controls, and began a turn to the left. Reaching down, the pilot moved the fuel selector to another position, but the engine did not pick up again.



Meanwhile, the attention of an experienced private pilot who was on the ground in the hangar area, had been drawn to the Cherokee by an engine sound he described as 'spluttering'. Looking up, he saw the aircraft about over the boundary fence and he watched it level out before beginning a descending turn to the left. Although the turn seemed normal at first, the angle of bank quickly increased to about 40 or 50 degrees. As the aircraft neared the ground, the rate of descent also increased rapidly and after it had turned through about 100 degrees, the aircraft struck the ground heavily in a steep nose-down attitude. The port wing was torn from the fuselage and the aircraft skidded for some 45 metres before coming to rest on vacant land, about 140 metres outside the boundary of the airport.

* * * *

A detailed examination of the aircraft and its systems did not reveal any mechanical cause for the engine malfunction. During the on-site investigation, the fuel selector was found set between the port tip and port main tank detents and it is probable that this was the position selected by the pilot after the engine lost power. The entire fuel system, including the electric and engine driven fuel pumps, the fuel selector, fuel drains and system filters, and the tank vents, were all carefully checked but no defect was found.

The engine was subsequently removed from the wreckage and, after the impact damage sustained by some of the components had been rectified, it was fitted to a test stand to enable an engine-run to be conducted. The fuel selector and electric fuel pump from the aircraft were incorporated in the fuel plumbing to the stand so that the actual conditions in the aircraft at the time of the accident could be simulated as closely as possible. The engine started and ran normally and, apart from some degree of vibration believed to have been induced by a bent crankshaft, its operation could not be faulted throughout the power range. Tests were also conducted with the fuel selector positioned between the port tip and port main tank detents, and an adequate flow of fuel was still available to the engine. Flights were undertaken in a similar aircraft to establish the effect on engine operation of an open fuel drain valve, but the engine continued to run normally and the only result was a loss of fuel from the open drain valve.

There was evidence that there had been ample fuel on board the aircraft for the flight. Before taking-off on his first circuit, the pilot had filled the main tanks to capacity. Both tip tanks were shattered by impact forces and were found to be empty after the accident, but there was evidence that they had contained small quantities of fuel. The owner of the aircraft had been the last person to use it before the flight on which the accident occurred and he estimated that when he left the aircraft, there were about 16 litres of fuel in the port tip tank and about eight litres in the starboard. These quantities were consistent with the amounts the pilot estimated to be in the tanks during his pre-flight inspection. During the investigation, only nine litres were drained from the port main tank, but fuel was seen pouring from the ruptured port tank by the crew of a fire tender when they arrived at the accident site. Ninety litres were later drained from the starboard tank.

After selecting each tank in turn during his pre-take-off checks, the pilot said he returned the selector to the port main tank position. When the engine lost power, his immediate reaction had been to change to the port tip tank as, by moving the selector to this position, it is designed to come up against a spring-loaded stop and he believed he could be assured of a positive tank selection.

A summary of recommended fuel system operating techniques published by the manufacturer had been appended to the aircraft's flight manual. This information stressed that all take-offs should be made on the fullest main tank to assure the best fuel flow, and that this tank be selected before or immediately after starting the engine in order to allow an adequate flow of fuel to be established before take-off. However, in performing his pre-take-off checks, the pilot had moved the selector over its full travel, pausing at each tank, including the tips, which were both low on fuel.

No mechanical reason was found for the engine hesitating during the touch and go landing which caused the pilot to abandon his earlier take-off. At the time, the instructor attributed the hesitation to technique associated with power application and engine-propeller response. Also, no mechanical reason for the loss of power during the final take-off was found, but it is possible that the pilot's procedure of 'exercising' the fuel selector during the engine run-up might have permitted air from either of the nearly empty tip tanks to enter the fuel line 'downstream' from the selector valve and interrupt the flow of fuel to the engine at a critical stage of the take-off.

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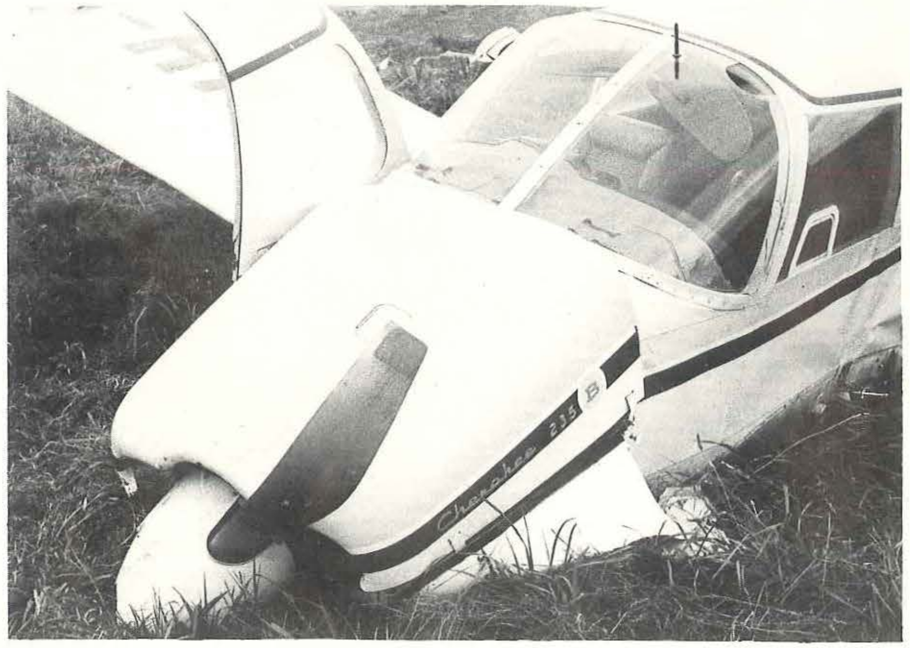
Just as the cause of an accident rarely lies in one isolated event but can nearly always be attributed to the outcome of a chain of adverse circumstances, so there is nearly always more than one safety message brought to light during the investigation. In the case of this accident, one of these lessons concerns the wearing of shoulder harness. Both front seats in the aircraft were equipped with shoulder sashes and inertia reels, and the pilot in the left hand seat had his harness correctly fastened at the time of the accident. But in the case of the instructor, though he could not remember any details of the accident, the evidence indicates he was not wearing his shoulder sash at the time. The pilot in the left hand seat sustained no injuries to the head, whereas the instructor suffered severe facial injuries and the right-hand control wheel was fractured.

The accident happened at a time when the requirement for upper body restraint in general aviation aircraft was being implemented and not all aircraft, particularly some earlier models, were so equipped. It is possible that the instructor, who had not flown in this particular aircraft before, might not have realised a shoulder sash was fitted, especially as it would have been retracted when he boarded the aircraft. It is difficult to accept however, that he could have remained unaware of the fact that the sash was provided, as the pilot in the left hand seat had his correctly fastened.

For some time now, most general aviation aircraft in Australia have been fitted with either a full shoulder harness or lap-sash combination for the front seats and their use has become widely accepted. On several occasions in the past, the Digest has published articles emphasising the value of wearing correctly fitting shoulder harness and this recent accident is a further example of the consequences of a pilot declining to take advantage of the protection offered by proper upper body restraint.

But possibly the most important lesson of all to be drawn from this accident involves the manoeuvre being attempted when the aircraft struck the ground. From the evidence of witnesses, and the pilot in the left-hand seat, it was clear that the aircraft was being turned in an attempt to regain the airport after the engine failed. The instructor, who suffered serious head injuries, was later unable to recall the flight or any details of the accident but, immediately after the crash, he told a witness he had 'tried to get it back'.



Top: The extensively damaged aircraft as it came to rest with the separated port wing in the foreground. The airport movement area can be seen in the middle distance.
Centre: Fuel selector of aircraft showing setting between port tip and port main tanks.
Bottom: Close-up of aircraft's nose showing deformation of forward fuselage. Buckling of the skin is also evident near where the starboard wing was torn off.

When the engine failed, the aircraft was approximately over the up-wind end of the runway at about 200 feet. From this position, the terrain immediately ahead of the aircraft would have seemed less than ideal for a forced landing but, apart from several low fences and shallow drainage ditches, there were few obstructions for a distance of some 1200 metres from the end of the runway below the initial climb-out path. In fact, successful forced landings have been carried out in this area.

For a pilot confronted with the prospect of a forced landing on unfavourable terrain following engine failure at a low height after take-off, the temptation to turn back towards the field can be almost overwhelming. There have, of course, been instances where the manoeuvre has proved successful, but against these are far more occasions where the attempts have ended tragically.

It is not possible to set down rigid guidelines to cover every situation, as the correct action to take depends very much on such factors as altitude in hand, wind strength and direction, as well as the engine power still available. But in the case of a substantial loss of engine power at a low height immediately after take-off, it is inviting disaster to attempt to turn back to the field. The need to land straight ahead is impressed on pilots from their earliest training days and there is every possibility that, had the pilot in this particular accident chosen to do so, damage to the aircraft and injuries to the occupants would have been considerably less severe.

A controlled forced landing straight ahead is likely to result in far less damage and injury than an uncontrolled 'arrival' while attempting to turn back. In other words, if you must 'drop in' without warning, do it gently.

CARBON MONOXIDE POISONING

Although accidents in which carbon monoxide poisoning is a factor are rare, reports continue to reach the Department from time to time of instances where the effects of carbon monoxide have been felt in aircraft. Because carbon monoxide poisoning is so insidious, it is essential that its symptoms be recognised before they manifest themselves to a dangerous degree. Unfortunately, the physical properties of the gas make its presence difficult to recognise when mixed with air and it is this factor that can pose such a hazard when the gas contaminates the interior of an aircraft.

PHYSICAL CHARACTERISTICS

Carbon monoxide is a colourless, odourless and tasteless gas formed by the incomplete combustion of carbonaceous matter. It is found in the smoke, fumes or exhaust gases of stoves, furnaces, internal combustion engines, and almost any other process in which hydro-carbon fuels are used for power or heat production. The amount of carbon monoxide in the exhaust gases of an aircraft piston engine varies with such factors as the cylinder temperature and the ignition timing, but generally is proportional to the fuel-air ratio of the mixture entering the cylinders. A full-rich mixture setting as used for take-off power can produce as much as eight percent by weight of carbon monoxide in the exhaust gases, or nearly two cubic metres of the gas per kilowatt developed by the engine per hour (60 cubic feet per horsepower per hour). At a typical lean mixture cruise power setting, the concentration is reduced to about three percent.

Carbon monoxide is toxic to human beings when inhaled in abnormal amounts. This effect is the result of its reaction on the blood which causes a deficiency of oxygen in the body tissues. Oxygen of course, is essential to life and is carried from the air in the lungs to the tissues of the body by a blood substance known as haemoglobin. Carbon monoxide exerts its harmful effect by entering the body through the lungs and combining with haemoglobin to form carboxyhaemoglobin. The affinity which haemoglobin has for carbon monoxide is some 200 times greater than it has for oxygen, with the result that quite a small concentration of carbon monoxide can render ineffective a large amount of haemoglobin as an oxygen carrier. Depending on the amount of carboxyhaemoglobin — usually expressed as a percentage of the blood's total haemoglobin content — symptoms of lack of oxygen, or hypoxia, will occur.

Susceptibility to carbon monoxide poisoning varies significantly with the individual but depends primarily on exposure time and the concentration of the gas in air. Exposure to amounts of only 600 parts per million (ppm) in air for periods of four hours can result in a saturation of carbon monoxide in the blood of more than 40 per cent and may ultimately lead to collapse. One thousand ppm and over can cause unconsciousness in as short a time as an hour. Even concentrations of carbon monoxide as small as 200 ppm can have perceptible effects on a person's general efficiency and alertness in periods of over an hour and a half.

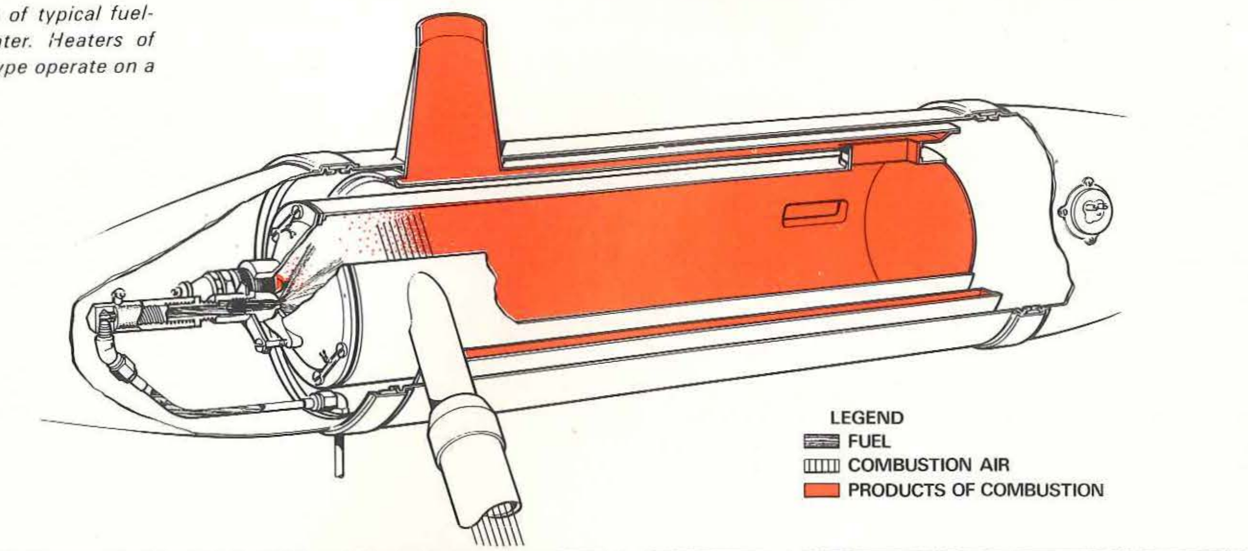
SYMPTOMS

The cells of the brain — the most highly developed in the human body — are also the most sensitive to lack of oxygen. With a level of up to 20 percent saturation of carbon monoxide in the blood, a generally sluggish feeling, drowsiness, a tight feeling in the chest, or a slight headache may be experienced. Frequently, the first signs are a loss of power in the limbs and a tightness across the forehead. As the blood saturation level increases, these early symptoms usually progress through more intense headaches, impairment of vision, weakness, dizziness, fainting sensations and severe nausea to eventual coma or collapse.

As already mentioned, the effects of carbon monoxide poisoning are particularly dangerous because they are so insidious. A person may suffer from impaired judgement and reasoning power, yet because of his reduced alertness, he may be completely unaware that his efficiency is deteriorating. Thus the gradual carbon monoxide poisoning process can go on undetected until his general efficiency is lowered to the point where he begins to make mistakes. In the case of a pilot, these may be confined initially to small omissions and errors of judgement but eventually, his manipulative skill and decision making ability may be reduced to such an extent that major errors occur.

Aircraft crews have to contend with an added danger in that the effects of carbon monoxide and altitude are cumulative. Intake of oxygen by the lungs depends on atmospheric pressure and the amount of oxygen absorbed by the blood thus decreases with altitude. Carbon monoxide further deprives the body of oxygen, and the combined effect can be judged by the calculation that a pilot flying at 9 000 feet, with a 15 percent carbon monoxide saturation in his blood, would be experiencing the hypoxic effects of flight at about 16 000 feet.

For aircrew who live in closely settled urban areas, the situation can be even further aggravated by exposure to automotive exhaust fumes unavoidably inhaled in the street, while those who habitually smoke carry their own supply of carbon monoxide in their blood. Approximately one to two and a half percent of the total volume of cigarette smoke is carbon monoxide, and about half the carbon monoxide present in the inhaled air is absorbed into the blood. Thus, smoking one cigarette results in the saturation of one to one and a half percent of the body's haemoglobin with carbon monoxide. It has been shown that, for a person who smokes about 20 cigarettes a day, or is a regular pipe smoker, a carbon monoxide saturation of up to five percent is usual.



Cut-away diagram of typical fuel-burning cabin heater. Heaters of the exhaust muff type operate on a similar principle.

POSSIBLE SOURCES

The greatest danger of carbon monoxide contamination in aircraft occurs where fire breaks out. Apart from the obvious hazard to the aircraft and its occupants from the fire itself, smoke entering the cabin will contain dangerous concentrations of carbon monoxide. Furthermore, other toxic gases may also be present. But the danger may not always be so obvious. Faulty cabin heaters, either of the exhaust muff or fuel burning type, are often a source of contamination. In addition, carbon monoxide can enter the cabin at any time through the various small openings in the firewall if leaks develop in worn or defective exhaust system components.

Cabin heaters of the exhaust muff type utilize a heat exchanger which consists essentially of a sheet metal jacket wrapped around part of the engine exhaust pipe. Outside air is admitted to the jacket, usually through a flexible hose leading from an air intake at the front of the engine cowling. This air is heated in the jacket by the engine exhaust and then ducted to outlets at various points inside the cabin. Fuel-burning heater systems work on much the same principle, except that the necessary heat is provided by a burner which operates from the normal engine fuel supply.

Should cracks or holes develop in the exhaust pipe or heater assembly, the incoming air may become contaminated and carbon monoxide may be piped directly into the cabin. Because of the corrosive nature of the exhaust gases and the high temperatures involved, such faults can develop in a relatively short time. It is for this reason that exhaust and heater systems must be thoroughly inspected for defects at regular intervals; in fact, some aircraft manufacturers recommend inspections as often as every 25 hours flying time.

DETECTION

In some coal mines, canaries have been used to detect carbon monoxide, because they are particularly susceptible to the gas and can thus give early warning of its presence (a supply of oxygen is kept ready to revive the bird!). However, most pilots would agree that this method of detection is hardly appropriate for use in aircraft, so reliance obviously must be placed on other more practical means. By far the best defence for pilots against carbon monoxide poisoning is to be alert for the onset of its early symptoms. A headache or throbbing of the temples, general drowsiness, dimming of vision or loss of power in the limbs, are all warning signs that carbon monoxide is present in the cabin. Several cases are known in Australia of alert pilots recognising such symptoms in time to make an early, uneventful landing, so enabling the source of the carbon monoxide leakage into the cabin to be located and rectified. Furthermore, although carbon monoxide is colourless and odourless, the engine exhaust gases with which it is mixed contain nitrogen dioxide and aldehydes which give the exhaust gas its characteristic disagreeable odour. The smell of exhaust fumes in the cabin is thus another indication of the presence of carbon monoxide. If any of these effects are experienced, the cabin heater should immediately be shut off and windows and fresh-air vents opened, subject of course, to any placarded airspeed limitations. The occupants of the aircraft should refrain from smoking, because this also increases the carbon monoxide level in the body. A landing should be made at the first opportunity and the pilot should not resume flight until he has been treated by a doctor. The aircraft should be thoroughly checked before further flight for possible sources of carbon monoxide contamination, with particular attention being paid to the exhaust manifold and heater assemblies.

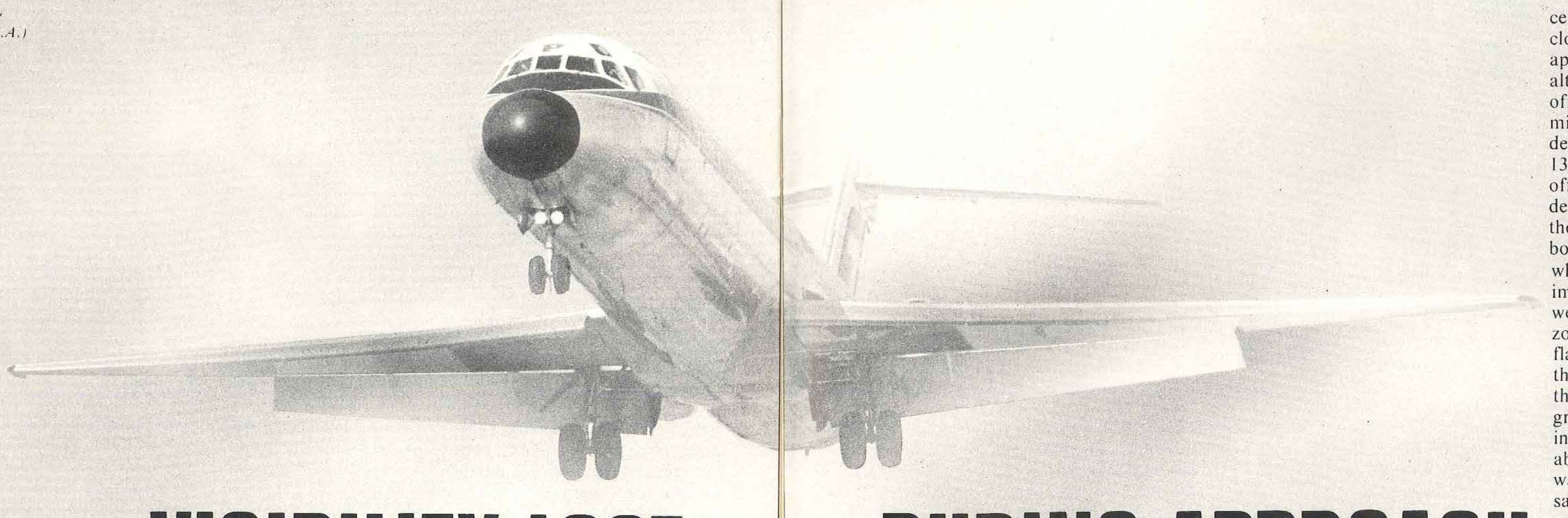
TESTING FOR CARBON MONOXIDE

Design requirements governing the airworthiness of aircraft include standards aimed at keeping cockpit and cabin air contamination within safe limits. Under these standards, the maximum acceptable concentration of carbon monoxide in air is 50 ppm. Carbon monoxide contamination checks are carried out as a routine part of the type certification for all new aircraft types brought on to the Australian register and for other aircraft which have undergone major modification, or are engaged in special operations such as supply or parachute dropping, which involve the removal of doors or windows.

If at any time, an owner has reason to suspect carbon monoxide contamination in his aircraft, he should advise the Department of Transport and arrange to have the cabin air sample-tested under operational conditions. These checks are simple and reliable, and the time involved in conducting them is small indeed — especially when compared with the possible consequences of exposure to carbon monoxide in flight.

After making a straight in approach to land at Fort Lauderdale, Florida, U.S.A., in heavy rain and poor visibility, a DC9 landed so heavily that the main undercarriage failed, the tail section broke away from the fuselage, and the aircraft was subsequently destroyed by fire. Of the ten persons on board, only the captain and two other occupants sustained injury.

(Condensed from a report issued by the National Transportation Safety Board U.S.A.)



VISIBILITY LOST DURING APPROACH

The Flight

The aircraft was operating a scheduled passenger flight from Miami, Florida, to Cleveland, Ohio, with an intermediate stop at Fort Lauderdale, about 74 kilometres north-east of Miami. The flight departed Miami at 1511 hours, climbed to 3000 feet, and after a period of radar vectoring was cleared for an ILS approach to runway 09 left at Fort Lauderdale and instructed to follow another inbound DC9.

At 1515 hours the aircraft was cleared to descend to 2000 feet and was advised that the destination weather was overcast with a cloud base of 700 feet, a visibility of 1000 metres, and that there was a thunderstorm with heavy rain in the area. In response to a query from the approach controller, the other inbound DC9 said they would require 1500 metres visibility before they could conduct the approach and this aircraft was then cleared to climb back to 3000 feet to hold until the weather improved. Shortly afterwards both aircraft were advised that the glide slope portion of the ILS was now out of service and the controller also queried the aircraft subsequently involved in the accident, as to the weather minima it required for an approach with the glide slope inoperative. The crew replied that 700 feet was 'enough'.

The aircraft was then instructed to descend to 1700 feet and radar vectored for a straight-in localiser approach to runway 09L. Shortly after changing to the tower frequency, the aircraft was instructed to report over the outer marker inbound, and was informed that the wind was from 180 degrees at 10 knots. The flight was then advised again, this time by the tower controller, that the cloud base was estimated at 700 feet, the visibility was 1000 metres with a thunderstorm and heavy rain over the airport. Ten seconds later, the controller reported that the glide slope appeared to be back in, but almost immediately announced that it had 'gone out again'. The aircraft did not reply to these transmissions.

Just under three minutes later, through pouring rain, the controller sighted the aircraft on fire, sliding down the runway on its belly. He sounded the crash alarm and the airport's rescue units responded immediately, arriving at the scene within 40 seconds. The fire was extinguished within two minutes, all the passengers and crew having vacated the cabin through the forward main door.

Investigation

On impact, the starboard main undercarriage leg had been torn from the structure and the port leg pushed up and to the rear. The nose leg had remained attached to the structure and was found in the down and locked position. The post impact fire had destroyed the outer fuselage skin of the aircraft from about the mid-wing position to the rear pressure bulkhead.

It was evident that, shortly after initial impact, the exterior of the aircraft, aft of the wing, had been engulfed in flames emanating from both wing root areas.

It was found that the leading edge slats were extended, but because of the severity of the damage sustained, it was not possible to determine the position of the flaps. However, no evidence was found of any pre-impact failure or malfunction in the aircraft.

Fort Lauderdale's runway 09 left is 2685 metres long, 50 metres wide, 10 feet AMSL and has the threshold displaced 200 metres from the beginning of the runway. The prescribed minimum descent altitude for an ILS approach to this runway with the glide slope inoperative, is 460 feet and the minimum visibility required is 2030 metres.

Examination of the runway surface revealed that initial impact was made by the starboard undercarriage leg 140 metres beyond the displaced threshold, and the port undercarriage impacted three metres further on. Skid and gouge marks commenced at the initial point of impact and continued along the runway for 830 metres, where the aircraft slid off the runway to the right and slewed through more than 180 degrees before coming to rest some 1100 metres from the displaced threshold.

A number of eye-witnesses to the accident, all of whom were close to the runway at the time, said it was raining heavily as the aircraft approached. They agreed it appeared to be higher than normal and descending in a nose down attitude. It seemed to level off momentarily, then drop vertically on to the runway.

The captain said he had assumed the co-pilot's duties for this leg of the flight, and that the first officer was flying the aircraft from the right hand seat. The flight was made in visual conditions to the Fort Lauderdale area, where clouds associated with the thunderstorm were visible over the airport. Much of the captain's time enroute was occupied with company communications and he said he did not hear the transmissions from approach control or Fort Lauderdale tower regarding the weather situation. The first officer was in contact with air traffic control during this time, and the captain said he had relied on the first officer to pass pertinent information on to him. He said that the only weather information given him by the first officer was that the ceiling was 700 feet, and he could remember no mention being made of visibility, thunderstorms or rain.

The captain continued: 'On our descent we passed through one very small cloud, and, when east of it, we were approaching our minimum descent altitude. During the approach, the first officer descended at 600-800 feet per minute with gear down and flaps at 25 degrees. The airspeed was between 135-140 knots, and he started to level off as we approached the minimum descent altitude. We were still west of the highway adjacent to the airport boundary and the end of the runway, which was in sight ahead. I thought immediate action was necessary if we were to land within the touchdown zone, so I took over, putting down full flap and closing the power levers. At this time, I could see at least a third of the runway. We were descending at a greater rate than normal, endeavouring to get down visually, when at about 200 feet we flew into a vertical wall of water. The first officer than said that the runway was right under us, so I pulled back on the elevators, which did not seem to respond fully to my efforts. I believe that this was a result of a severe downdraught associated with this wall of water'.

The first officer said the flight was in clear weather until they had passed the outer marker in-bound on the localiser. The flaps were extended to 25 degrees at the outer marker and he commenced descent, levelling off at the minimum descent altitude of 460 feet. He then requested that the flaps be positioned to 50 degrees, but the captain suggested they remain at 25 degrees. Shortly afterwards, the captain took control of the aircraft and the first officer then assumed co-pilot duties and began looking for the runway. It was at about this point that the aircraft ran into the heavy rain and forward visibility was reduced to almost nothing, but he did have occasional visual contact with the ground. Describing his first sightings of the runway, the first officer said: 'I had the end of the runway in sight, over the tip of the nose looking down . . . I called the runway and we started down. The captain had 50 degrees of flap and was back on the power. It seemed to me then that the left wing dropped, the nose cocked right, then the captain brought it back to a wings level configuration and eased back on the controls. The aircraft did not respond as I expected it would, and he eased back again, but the same thing happened. It was at this point that we hit'.

Analysis

The most obvious factor in the accident sequence was the adverse weather existing at the time of the approach. All witnesses located in the vicinity of the approach end of the runway, as well as the controllers in the tower, said heavy rain was falling and the visibility was very poor. The measured visibility of 1000 metres reported to the aircraft on two occasions before the landing was below the minimum required for the approach.

Although the captain said that the approach end of the runway was in sight at all times throughout the final approach and landing, there is little evidence to support his statement. The first officer clearly indicated he had almost no forward visibility at the time the captain took control, and that because of the heavy rain, he did not actually see the runway until almost over the highway adjacent to the airport boundary. It was concluded that heavy rain was obscuring the runway during the final stages of the approach, and that the landing was continued under these conditions.

It is apparent that the final descent was commenced by the captain shortly after the aircraft passed the middle marker position, just before reaching the end of the runway, and the descent was initiated from the minimum descent altitude of 460 feet. As the initial touchdown point was approximately 340 metres from the end of the runway, this would indicate that the aircraft's average rate of descent was nearly 2000 feet per minute. This high rate of descent at touchdown, which was far in excess of the design limits of the aircraft, was also evident from the degree of break-up at impact.

The captain said he believed he encountered a severe downdraught associated with the heavy rain shower and that this might have accounted for his inability to arrest the descent rate. Of more significance however, is the fact that the power levers were retarded to the fully closed position and the aircraft was in the full landing configuration with the undercarriage down and fifty degrees of flap extended throughout the final descent. This would result in a high rate of sink. In this situation, the proper flare height above the runway becomes critical and is difficult to assess even under ideal conditions. For this reason, a high sink rate manoeuvre on a final approach should never be attempted. In the conditions that existed at the time of the accident, the proper flare height would have been extremely difficult to determine. In fact continuing with the landing at all in these conditions was contrary to the prescribed operating practices and procedures applicable to the flight.

Although the captain said that he did not hear the weather reports and that the first officer did not advise him that the visibility was reduced to 1000 metres, he should have been aware of the existing conditions. Apart from the two direct weather advisories to the aircraft, there was considerable radio conversation between approach control and the preceding flight concerning minima, both with regard to the visibility and the inoperative glide slope. There was also a direct query to the aircraft regarding the company's required weather minima with the glide slope inoperative and, as the thunderstorm in the immediate vicinity of the airport was visible to the crew as they approached the Fort Lauderdale area, the N.T.S.B. considered it inconceivable that the captain would not have sought more information if he was not aware of the situation. The fact that the flight had been conducted almost entirely in visual flight conditions and that the airport environment had been in sight during much of the approach, might have misled the captain into believing that the local rain was much lighter and smaller in area than was actually the case. However, despite attempts to investigate this particular point, the Board was unable to find a plausible explanation for the captain's decision to initiate and continue the approach under the prevailing conditions.

The ultimate responsibility for decisions affecting the safety of an aircraft and its occupants, rests with the pilot-in-command. In this instance, the pilot made the approach without either obtaining available information on visibility, or giving full consideration to the visibility information already communicated to the flight.

An analysis of the pilot-in-command's management of the flight indicates that the crew co-ordination and performance was undisciplined. The approach for landing was initiated when the visibility was less than the permissible minimum; check list items were not accomplished in accordance with the operator's 'challenge and response' system; the flight did not report passing the outer marker as requested by air traffic control; the flight did not receive a landing clearance; and the approach and landing techniques were not in accordance with company instrument approach procedures. Considered collectively, these factors bear a significant relationship to the overall chain of events leading to this accident.

Nearly ten years ago there was a spate of accidents resulting from passengers or bystanders walking into the propellers of light aircraft on the ground while their engines were running. These unhappy experiences showed quite clearly that people who are unaccustomed to an aviation environment, can become a danger to themselves in the vicinity of aircraft whose engines are running, particularly if, as is sometimes the case with joy-ride passengers, they are excited; suffering from the effects of air sickness; or otherwise pre-occupied with their new and strange situation. Certainly the fact that, until quite recently, there have been no further examples of this particularly insidious yet violent type of accident, surely speaks well of the concern with which pilots and others concerned with operations in the general aviation industry have viewed this danger since that time. In the case of persons who are used to aeroplanes and accustomed to the particular type of operation however, it would seem reasonable to expect a lively awareness and respect for the danger of rotating propellers. But in a recent accident a man whose way of life had been intermittently involved with light aircraft operations for nearly ten years, unwittingly walked into a rotating propeller and was seriously injured because, in his own words, 'he didn't give it a thought'.

* * * *

The accident happened at a property in inland N.S.W., where two Transavia Airtruks were spreading superphosphate from an agricultural airstrip. With the intention of introducing his wife to the pilots, the owner of the property drove with her to the airstrip where one of the aircraft, already lined up for take-off with its engine running, was being loaded from the rear. The pilot was seated in the cockpit, and seeing the grazier walking towards the front of the aircraft and obviously wanting to speak to him, signalled him to come around the wing and approach the cockpit from the rear. The pilot then turned his attention back to the loading operation.

The grazier meanwhile had interpreted the pilot's gesture to mean that he would get out of the cockpit to speak to him. Not wanting to bother the pilot to this extent, the grazier put up his hand to motion to the pilot to stay where he was. As he did so, a loud 'clunk' was heard above the noise of the engine and the grazier was flung to the ground with his right arm badly injured. He was given immediate first aid and soon afterwards was flown to hospital in the passenger compartment of the other Airtruk.

Discussing the accident later, the grazier admitted that on this occasion, he had made no conscious attempt to avoid the virtually invisible propeller. During the eight or ten years that agricultural aircraft had been operating from the strip that he maintained on the property, he had been aware of the potential danger and always believed he 'would have enough sense to keep well clear'. But this time, 'it didn't enter his head'.

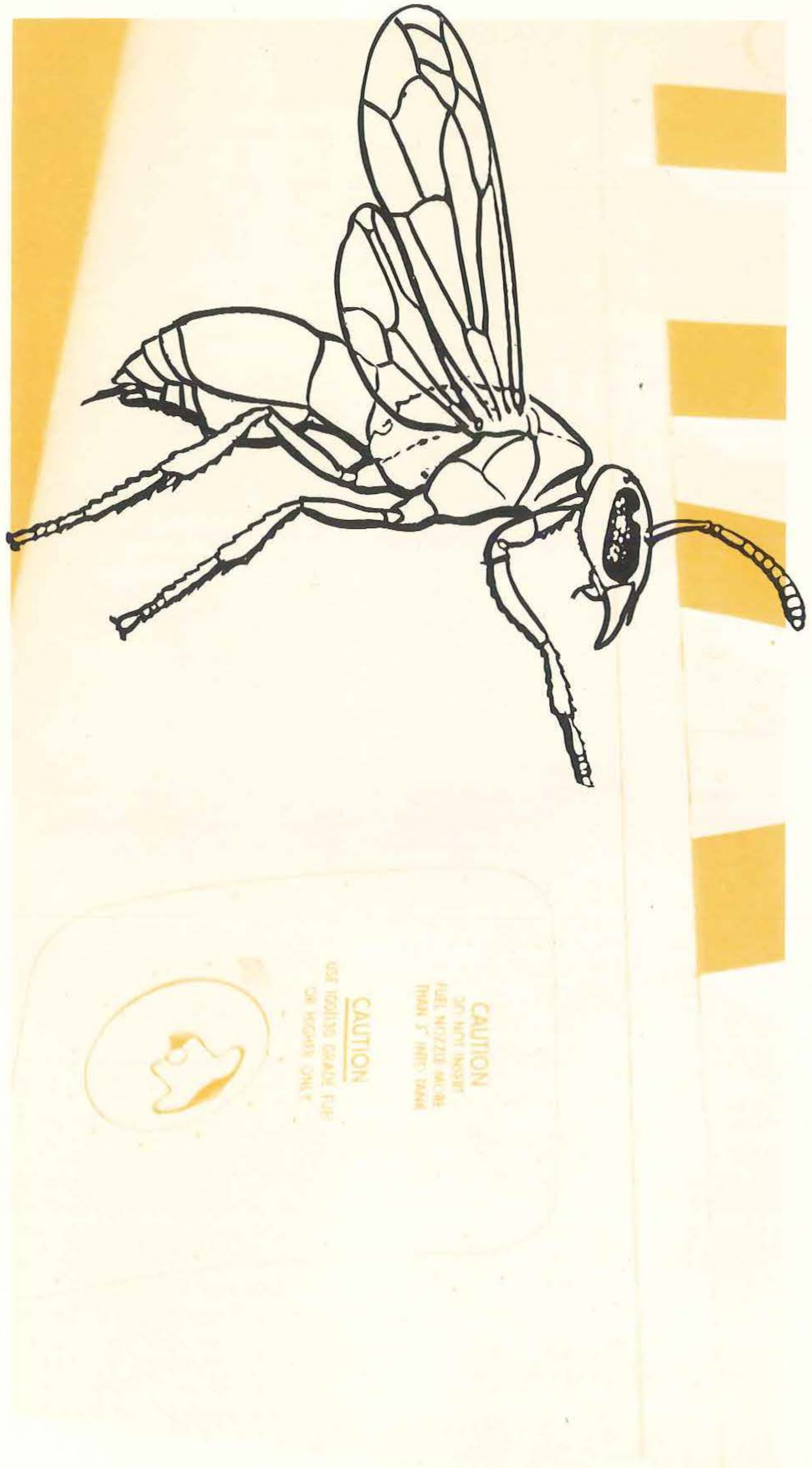
The fact that a person who had become accustomed to aircraft to a degree, can suffer a lapse in concentration, sufficient to allow him to walk straight into a rotating propeller without realising what he was doing, provides a most unpleasant reminder of the extreme care that pilots constantly need to exercise when their engines are running on the ground and people are in the vicinity. In an agricultural operation of this sort, it is obviously not practicable to stop the engine between sorties and in this case the pilot was taken completely by surprise by the grazier's action. Yet if an accident like this can happen to a bystander who is reasonably familiar with aircraft, how much more do others, such as joyride or charter passengers, or excited children being taken on a 'tour' of an aerodrome, need to be protected from themselves in the vicinity of aircraft with their engines running? As already mentioned, it is quite evident that the great majority of pilots do exercise a high degree of responsibility and care in this regard, and the reference to this accident is in no way intended to detract from what has been achieved in this way. Rather it is included in the Digest to show that this degree of care is a continuing imperative, and that no one must be lulled into relaxing his vigilance by the fact that the record is such a good one.

Whenever possible of course, pilots should arrange for spectators to be supervised and kept at a safe distance from aircraft when engines are being run. Where this is not practicable, pilots must clearly be on their guard to shut down the engine at the least sign of unpredictable behaviour by persons in the vicinity of their aircraft.

In the case of joy-riding and other passenger-carrying operations, the greatest safety will be achieved by having the passengers board the aircraft before the engine is started, and by shutting down the engine before they are permitted to alight.

WASPS

It isn't often that a pilot has to worry why his fuel gauges are showing an *increase* in content! But this is in fact what happened and the incident draws attention to the importance of protecting *all* fuel vent outlets from the attention of 'broody' wasps.



'The fuel system on the King Air A90 uses transfer pumps to move fuel on demand automatically, from the main tanks in the wings to the nacelle tanks, thence directly to the engines. Each wing tank is a nest of inter-connected rubber cells with a capacity of 109 Imperial gallons (495 litres). It supplies fuel in such a way that the nacelle tank is always kept three quarters full until the wing tank empties. At this point, the red "No Fuel Transfer" warning sign illuminates, and the pilot switches this pump off. At this time also, the wing tank fuel gauge should read zero. If it does not, the transfer pump has failed, and the tank is not yet empty.

On the day of this incident, I was flying from Brisbane to Laleham, 40 miles (64 km) south-east of Emerald, with a full load of passengers and, having all kinds of worries with headwinds of up to 68 knots, I tried three different levels before finally settling down to cruise at 8500 feet. Because fuel consumption in a turbine aircraft at this level is extremely high, I became even more fuel-gauge conscious than usual; but on this occasion I was comforted by the appearance of having plenty of fuel. My flight plan for that day shows that I started the trip with 200 gallons (910 litres), and I recall clearly the satisfaction I felt when the 200 gallons (910 litres) seemed to be staying with me for a rather long time. But this feeling left me rapidly when, later on during the flight, the red "No Fuel Transfer" warning for the port tank suddenly came on. Yet the gauge still read a quarter full! I immediately suspected a pump failure (my flight plan shows that I noted it as a failure). If the tank really is empty and the transfer pump is switched on again, it will run for precisely 28 seconds before the red warning light illuminates once again. This time however, I tried it again and again and got all kinds of time intervals well inside the 28 seconds.

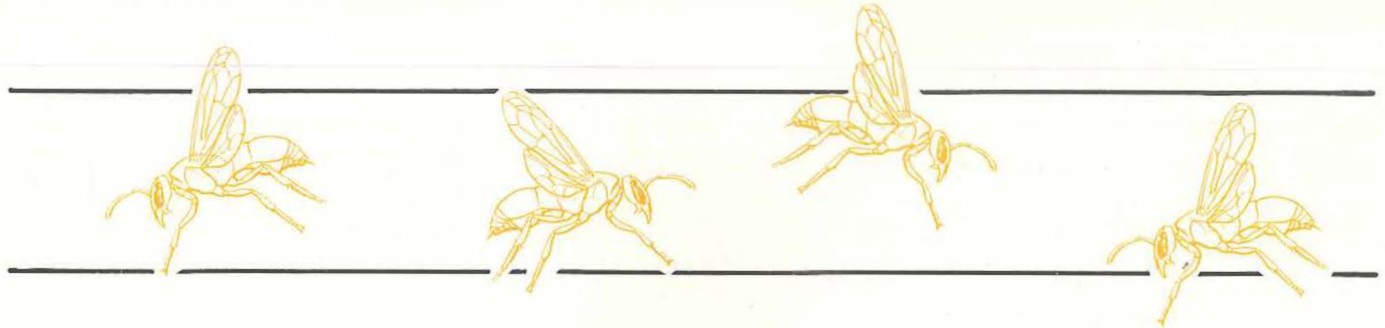
Still thinking that I must have fuel in that wing tank, I commenced cross-feeding from the port side (fuel will still flow from wing to nacelle tank without the transfer pump, but at a lesser rate, and helped to a certain degree by gravity and the demand effect of the flow to the engines). The result was that the nacelle tank gauge gradually went down to one eighth, but the wing tank went up to three eighths! I had no alternative now but to complete my flight to Laleham cross-feeding from the other side.

After an uneventful arrival I disembarked my passengers and flew on the extra 12 minutes to Emerald, where I knew I could get a well calibrated fuel check. The port wing tank (which **was** empty) took 109 gallons (495 litres) and altogether the aircraft took on 274 gallons (1240 litres) to completely fill its 325 gallon (1470 litre) capacity.

The return flight to Brisbane, with stops at Laleham and Moura to pick up passengers, was again flown using the cross-feed system so that I could complete the story for the benefit of our maintenance engineers. This time, the port wing tank ran dry while still indicating three eighths full and, from that moment until the aircraft taxied up to the maintenance hangar at Brisbane, the gauge indication gradually increased until, by the time I had stopped the engines, it was reading three quarters full! To a lesser degree I now know that the starboard side gauges were also over-reading, but I didn't notice this at the time because my attention was completely absorbed by events on the port side.

The engineers quickly found that wasps had been leaving deposits in all tank vents at every opportunity. Every time the aircraft flew, this material was drawn up towards the tank by the normal venting action, leaving room for more wasp deposit near the open ends. Finally the vents were sealed off completely and the bottoms of the rubber tanks were lifted towards the filler caps, interfering with the contents gauge transmitter systems.

As a result of this experience a very comprehensive system of plugs, tapes and red labels for all tank vent outlets now has been incorporated into our aircraft parking operation!'



Comment

Our contributor's account of this incident provides a timely reminder that blocked fuel tank vents are an ever-present possibility which can have quite serious consequences. This pilot, largely because of vigilance in his fuel management, detected something was wrong in time to avert fuel starvation or exhaustion — the consequences of which hardly bear thinking about in an aircraft of the weight and speed of a King Air!

In another comparatively recent case, this time in Western Australia, the pilot of a Bonanza was alert enough to notice that, on completing a particular flight, one fuel gauge indicated more fuel than was possible in that tank. Inspection revealed that both the tank vent pipe, and outboard vent to the check valve pipe, were blocked by foreign matter. As a result, the fuel cell had collapsed, restraining the movement of the fuel gauge transmitter.

But not always has it been possible to detect this potential source of fuel starvation in time to avoid an engine failure. In the Cootamundra district some months ago, an agricultural pilot carrying out spraying operations on a country property, found that the engine of his Pawnee was hesitating at full power. Believing that it was suffering from fuel starvation, the pilot considered it unsafe to fly and left it in the care of a maintenance engineer who had come out to the strip to investigate the trouble.

After a most searching inspection of the electrical and fuel systems, which included dismantling the carburettor and blowing out the jets, the engineer conducted an extensive ground run, including several minutes of full throttle operation at 2300 rpm. As the engineer could find no reason for the engine difficulty and could not fault the operation in any way, he concluded that the trouble must have been carburettor icing and decided to ferry the aircraft back to Cootamundra. The engineer held a private pilot's licence.

The ferry flight was perfectly normal until the aircraft was at a height of about 400 feet on final approach. At this point the engine suddenly lost power, and the engineer was forced to land short of the aerodrome in a small paddock. Before he could bring the aircraft to a stop it had torn its way through a fence and it finally came to rest with its port wing resting in a creek.

After the aircraft was recovered from the paddock, the engineer removed the fuel cap to check the tank's contents. As he did so there was the unmistakable sound of air rushing into the tank. It was then found that the fuel tank vent on the underside of the fuselage was blocked with congealed DDT.

There are other cases which could also be cited, but these three are sufficient to show that serviceable fuel tank vents are **not** something **to be taken for granted.** The nature of fuel tank vents is such that it is not practicable to fit them with mesh screens to prevent the ingress of wasps or foreign matter. Were this to be done, the screens themselves could become coated with mud or blocked in some other way, much more readily than an open vent pipe. The only ready answer to the problem is periodic inspections to ensure that vent pipes remain open to atmosphere and, when operating in an area where wasps are known to be active, to cover the vent outlets while the aircraft is standing on the ground for any length of time.

Another Case of Indigestion!

Over the years, the *Digest* has featured numerous articles based on the theme that no matter how carefully a flight is planned, how conscientiously it is carried out, or how routine a set task has become, pilots continue to fall prey to the unexpected. Recently, a further variety of 'traps for the unwary' was revealed in two similar incidents involving Victa Airtourers.

The first of these occurred at a country aerodrome in Victoria and involved an Airtourer engaged in a flying competitions programme which comprised a sequence of three events — streamer cutting, flour bombing, and forced landing on to a spot. The aircraft took off normally and climbed to 3 000 feet outside the circuit area, where the pilot released a paper streamer. After cutting the streamer the requisite number of times, the pilot reduced power and descended back towards the aerodrome for the flour bombing sequence. This completed, he applied power and climbed to 1 500 feet over the aerodrome where he closed the throttle, and applied carburettor heat, for a simulated forced landing on to the duty runway.

During the descent, the pilot saw he was approaching close behind a Cessna 150 on a normal training flight. On base leg, the Cessna reported it would be making a full stop landing, but the pilot of the Airtourer decided to continue with his approach in the hope that the other aircraft would clear the runway in time for him to complete the landing. Late on final approach however, the pilot of the Airtourer saw that the Cessna 150 had not begun to taxi clear and, realising he may not be able to land off this approach, he applied full throttle and raised the nose to climb away. But the engine misfired and did not develop any power so he closed the throttle, pushed the nose down and, after passing low over the Cessna, landed on the runway a short distance ahead of it just as it was turning off on to the grass.

When the Airtourer's engine was inspected later, it was found that a portion of paper streamer had lodged in the carburettor intake. The paper had apparently become trapped under the cowling and the engine had operated normally with 'cold air' selected up until the time the simulated forced landing had been commenced. When the pilot closed the throttle and selected carburettor heat for the descent, it would have been possible for the paper to have been sucked in through the unfiltered hot-air intake, thereby restricting the airflow through the carburettor to the extent that the engine would not develop power.

The other incident occurred in South Australia. On this occasion, the pilot of an Airtourer was practising streamer cutting when the engine began to run roughly. At first he was able to maintain height but the vibration rapidly worsened and moments later, he decided that he would have to put the aircraft down in a paddock. The ensuing forced landing was successful and the aircraft was undamaged.

As in the case of the other Airtourer, when the engine was checked later, paper was found lodged in the throat of the carburettor. Although the operator of the aircraft did not recommend that pilots use carburettor heat during streamer cutting, it was learned that this pilot normally selected hot air just before throttling back preparatory to releasing the streamer. Once the streamer was clear of the aircraft, he then locked the canopy and returned the heat control to the cold position before continuing with the exercise.

It was concluded that on this occasion, the pilot had left either full or partial heat applied, with the result that a piece of paper had been sucked in through the hot air intake, passing through the heat exchanger and finally into the carburettor.

* * * *

The possibility of paper accumulating under the cowling or being ingested by the engine is always present during this type of flying. Recently, paper was found in the cylinder baffles of an engine a week after the aircraft had been operated on streamer cutting flights.

The remedy to the problem is two-fold. Pilots can considerably reduce the chances of paper ingestion, firstly, by ensuring the carburettor heat control is in the cold (filtered air) position during flights of this type and secondly, by physically checking under the cowling *after each flight* to prevent paper collecting in the engine compartment. This is especially important when the aircraft is being used for competitions involving a series of flights, or where there is a possibility that the aircraft may be taken over at some later stage by a pilot who may be unaware that it has been used for streamer-cutting operations.

AEROSOL CANS— THEY CAN....

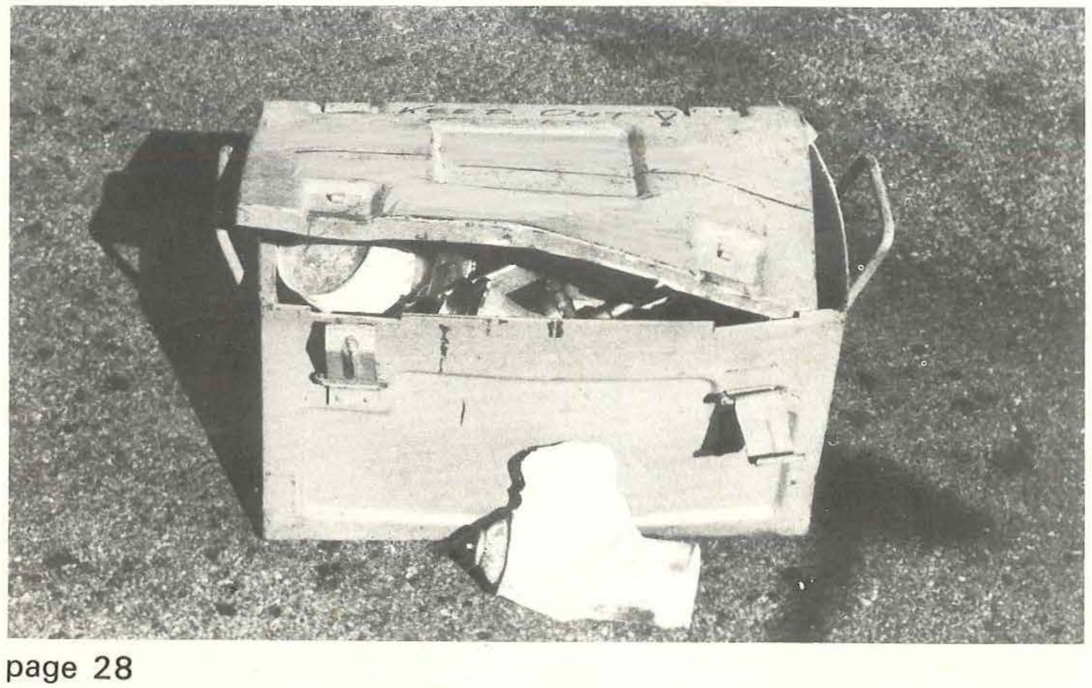
Remains of the dye-penetrant aerosol can itself after it had exploded.

Reports have come to the Department's attention relating how aerosol cans containing fluids used in the maintenance of aircraft (for example dye penetrant inspection kit) have exploded when left in direct sunlight. The greatest risk of an explosion occurs if the can is lying exposed in a closed 'bubble' type cockpit, such as is common to many types of helicopters, where temperatures as high as 82°C have been recorded. Naturally this problem is accentuated in the tropics and subtropics.

Both the International Air Transport Association, and the Standards Association of Australia specify the maximum pressure permitted in aerosol cans at a contents temperature of 54.5 degrees C, as well as the minimum bursting pressure of the can. Normally this is one and a half times the pressure generated at 54.5 degrees C. However, it is still possible for a can to fail at temperatures below that required to produce the bursting pressure, as a result of solder 'creep' in the seams of the can.

This phenomena of solder 'creep' is a function of the time the can is exposed to a particular temperature. The effect is also cumulative — once creep has taken place, the solder will not return to its original dimension when the temperature is lowered. For this reason, continual or repeated exposure to high temperatures, of the order measured in enclosed cockpits will ultimately lead to failure by creep.

A little thought will suggest that dye penetrant is not the only aerosol fluid likely to be left in an aircraft in these sort of conditions. For example pilots and crews of aircraft operating in many parts of Australia in summer are quite likely to be carrying spray packs of sunburn lotion or insect repellent. Thus, not only maintenance staff but pilots, and indeed all other persons associated with the operation of aircraft in warm sunny weather, obviously need to exercise care to ensure that aerosol cans are not left where they can be heated by direct sunlight and run the risk of exploding.



This metal tool box containing an aerosol can of dye penetrant, was left in the bubble cockpit of a helicopter standing in the sun. The can exploded, severely distorting the metal box. Only a little imagination is required to see what could have happened had the can been unprotected and the cockpit occupied!

DON'T NEGLECT YOUR RESPONSIBILITIES...

the pilot is in command— even on the ground!