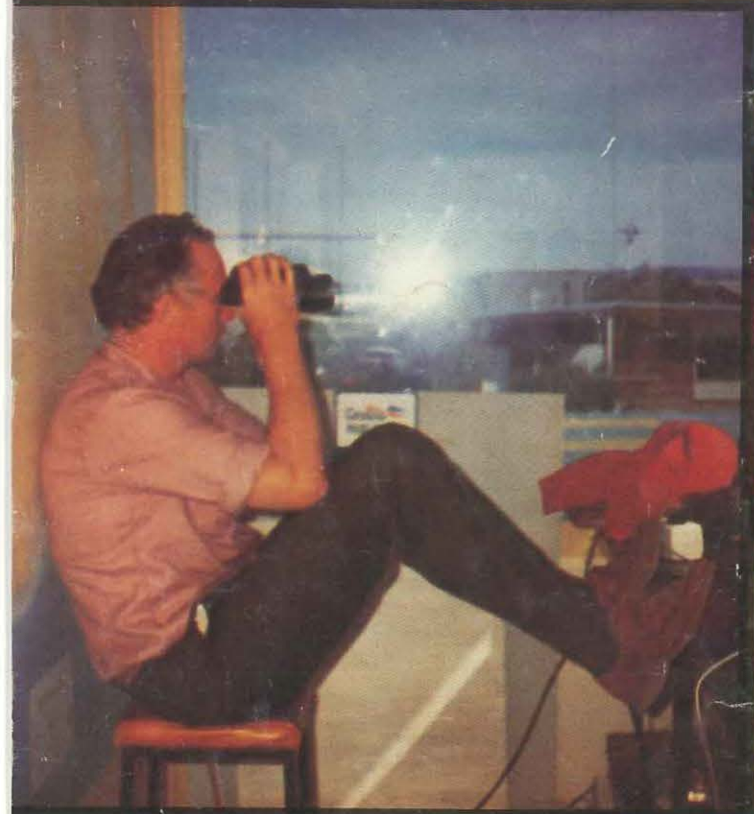

AUSTRALIA

Aviation Safety Digest

BUREAU OF AIR SAFETY INVESTIGATION

116/1983

Contents

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Covers
One of the services provided by the Department of Aviation is that of establishing Air Traffic Control services at certain localities for special events. The front and back covers of this issue of the *Digest* depict scenes at the aerodrome and Airways Operations facilities at Bathurst during the running of the 1982 Hardie 1000 motor race meeting.

Weight and balance

All aircraft pilots' operating handbooks contain a cautionary note to the effect that:

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRCRAFT IS LOADED PROPERLY

The 'loaded properly' caution refers to the fact that the aircraft must only be flown with its weight and centre of gravity (C.G.) position within the approved limits.

Centre of gravity is a determining factor in flight characteristics. If the C.G. is too far forward it may be difficult to rotate an aircraft for takeoff or landing, while if it is too far aft the aircraft may rotate prematurely on takeoff or try to pitch up during a climb. In short, longitudinal stability will be reduced and this can lead to inadvertent stalls or spins. Further, spin recovery becomes more difficult as the C.G. moves aft of the approved limit. This fact was graphically illustrated in the following report issued by the U.S. National Transportation Safety Board (NTSB).

• A pilot and his student were practising spins in a PA28-140 when one of them was heard to call out over the radio, 'It still won't come out. Mayday Mayday.'

Witnesses saw the aircraft spinning down almost vertically before it hit the ground. The NTSB investigation disclosed that the aircraft had a gross weight of about 1902 pounds and that the C.G. was about 87 inches aft of the specified datum at the time of the crash. Spins and certain other aerobatic manoeuvres are permitted in the PA28 only when it is used in the utility category, in which configuration the gross weight and centre of gravity are not to exceed 1950 pounds or 86.5 inches aft of a specified datum respectively.

The manufacturer has stated that it is hazardous to conduct spins in the aircraft when the utility category aft C.G. limit is only slightly exceeded. The investigation showed that, at the time of the accident, the aircraft had approximately 32 gallons of fuel on board. 'If this aircraft had been despatched properly for utility operation', the NTSB concluded, 'a correct weight-and-balance determination would have disclosed that the maximum allowable fuel load was about 21 gallons. The aircraft's gross weight under those conditions would have been approximately 1831 pounds, and the C.G. would then have been at the utility category aft limit of 86.5 inches.'

Accidents resulting from faulty weight and balance preparation are not, of course, restricted to aircraft engaged in aerobatics. For example, *Aviation Safety Digest 86* details the fatal accident involving a Twin Comanche which was overloaded and operating outside C.G. limits, and which pitched up uncontrollably after takeoff.

Loading an aircraft

In many GA aircraft it is not possible to fill all seats, use the maximum baggage allowance, fill up with fuel and still remain within the approved weight and balance limits. In those circumstances, pilots who do not wish to leave a passenger behind must reduce the fuel load and plan on shorter legs en route or limit the baggage carried, or both.

Note that because of the size of many baggage compartments there is sometimes a tendency to fill them to capacity, ignoring the placarded baggage weight limitations. This could produce a C.G. aft of the allowable limits and create a highly dangerous degree of longitudinal instability. Note also that for some aircraft, if the maximum baggage allowance is used, restrictions are placed on rear seat occupancy.

Improper loading and performance

An excessive or improperly distributed load will adversely affect an aircraft's performance in all phases of flight.

Cruise. At normal weights, an aircraft requires a certain angle of attack to maintain straight-and-level flight at a given airspeed. To accommodate a heavier load at that same airspeed, the angle of attack must be greater to provide the increased lift that is needed. More power must then be added to overcome the increased drag which is a consequence of the increased angle of attack. This in turn burns more fuel, thereby reducing the range of the aircraft.

Climb. An overloaded aircraft will take longer to climb to a given altitude, because the angle of attack is greater and the extra thrust required to carry the additional weight limits the rate of climb (and may also limit the climb speed) as this is dependent on the surplus power available. The additional time spent climbing at a higher power setting will also increase fuel consumption.

Flight load limit. Assume an aircraft has a maximum flight load limit of 4g. If the allowable gross weight is not exceeded, then the wings can safely support four times the weight of the aircraft and its contents. In accelerated flight (turns, pull-ups, turbulent air) the actual load on the wings of an aircraft carrying excess weight clearly would be greater than that if the aircraft weight were within the authorised limits. This results in greater stresses in the wing structure. Overloading therefore has the effect of decreasing the g load capability of an aircraft and thus could result in the wing being stressed to the point of popped rivets, permanent distortion, or even structural failure.

Load distribution. Loading an aircraft is simply a matter of complying with weight limitations and distributing the load so the C.G. falls within the allowable range. This is done by arranging the load in accordance with the C.G. envelope detailed in the pilot's handbook. If the load is distributed such that the C.G. falls outside the envelope, stability is adversely affected and abnormal control forces may develop. Stalling speed, takeoff distance, landing speed and longitudinal control may be dangerously affected.

Summary

Correct weight and balance is a crucial factor in safe aircraft operations. Weight and balance calculations are yet another aspect of preflight planning which a pilot ignores at his peril ●

Against the odds

Pilots are continually required to assess the conditions and circumstances under which they are operating in relation to the capabilities of themselves and their aircraft.

It is one of the prime skills of piloting to be able to operate *safely* right to the edge of those capabilities. The pilots who consistently do so successfully are without exception those who know their limitations and who do not hesitate to abandon a sortie or a particular phase of flight if they assess that there is any possibility of exceeding those limitations.

Often there is a very fine dividing line between safe and unsafe operations. This dividing line is perhaps more difficult to recognize when a pilot is completing a routine task, such as flying into a destination with which he is thoroughly familiar. As the pilot involved in the accident discussed below discovered, this can be a trap. When you are operating close to the limits — which in this instance were defined by the strip dimensions and the weather — you have got to keep the odds on your side.

A Piper PA28 was being flown into a private category Authorised Landing Area (ALA). The ALA, which the pilot had used before, was 600 metres long and 30 metres wide. A hot, gusty crosswind of about 12 to 15 knots was blowing from the west. The pilot described the conditions as being very turbulent. He circled the ALA several times before deciding to make an approach from the south. At about 30 feet on final approach, just as the pilot was reducing power, the aircraft encountered a violent, turbulent gust of wind and the right wing dropped about 35 degrees. The pilot managed to lift the wing, but the aircraft 'fell out of the sky', bouncing heavily after contacting the strip's surface. Touchdown was 120 metres into the ALA.

The aircraft bounced several times and despite the corrective actions of the pilot, ran off the right hand side of the strip. Substantial damage was done to the right main-plane by a one-metre high tree stump which was only 17 metres from the strip's centreline.

Analysis

Although on previous landings the dimensions of this ALA had presented the pilot with no difficulties, the turbulence and crosswind on this occasion added a new dimension for which he failed to allow. Caught out by the demanding landing conditions he was unprepared to overshoot, which would have been his best course of action either from final approach or after the first bounce. He was then further caught out by the presence of the tree stump which encroached on the minimum required dimensions of the ALA.

This pilot doubtless could have dealt with the strip dimensions, the turbulence or the crosswind in isolation. In combination, however, on this occasion they exceeded his limits, and by not being prepared for the situation the pilot allowed the odds to build up against him ●

Aftermath of Mt Erebus

by Capt. William B. Mackley (Retired)

Capt. William B. Mackley summarizes in the following article the continuing controversy surrounding the probable cause of the crash of an Air New Zealand DC-10 on the slopes of Mt Erebus in the Antarctic in November 1979, the various conclusions reached — official and unofficial — and his own conclusions based upon his broad experience as an airline captain and in the field of aviation safety.

Capt. Mackley, a Royal New Zealand Air Force bomber pilot in Europe and patrol plane pilot in the Pacific during World War II, joined New Zealand Airways Corp. as a captain at the close of the war. He transferred to TEAL, now Air New Zealand, in 1965 and retired as Fleet Captain in 1970. He subsequently returned to the airline with the title of Flight Safety Advisor, International.

Acknowledgement is made to the *Flight Safety Digest* and Capt. Mackley for permission to reprint this article.

The crash of an Air New Zealand DC-10 on the slopes of Mt Erebus with the loss of 257 lives was so far removed from the general run of accidents to commercial aircraft as to make it unique. So, too, were the inquiries, appeal and controversy that followed.

World attention was drawn to the accident because of the remote and inhospitable region of Antarctica in which it occurred. The investigation by New Zealand's Inspector of Air Accidents and the public inquiry that followed unfolded a mounting sequence of poor decisions, bad judgments, lack of oversight, inadequate communication and outright errors. All came to bear to lend sympathy to the captain and crew who, it appeared, had been grossly misled.

It was only natural that the public of New Zealand, a great many of whom had lost friends or relatives on Flight 901, would want to know precisely, not only how such an accident could occur, but in an airline that prided itself on its excellent standards and was held in high regard in the industry, why?

Initial report

It was a long six month wait for the release of the report of New Zealand Chief Inspector of Air Accidents Ron Chippindale. The Inspector was under considerable pressure to produce this report and to have it completed in this time was an impressive achievement. It must be remembered that such a report could only be compiled from personal investigation and the questioning of the many persons in any way involved with events leading up to the accident. He had no facility to take evidence on oath or to listen to the cross-questioning that would take place in a court of law.

His conclusions, while drawing attention to the inadequacies in company procedures, crew briefing and computer flight plan storage and preparation, nevertheless laid the blame squarely upon the crew. He noted seven commissions or omissions of the crew that led directly to the accident and concluded by stating that:

> The probable cause of this accident was the decision of the captain to continue the flight at low level toward an area of poor surface and horizon definition when the crew was not certain of their position and the subsequent inability to detect the rising terrain which intercepted the aircraft's flight path.

This assessment of probable cause did not please the pilot group in view of the many contributing factors that took place within the company prior to the flight.

Mahon Report

In due course, a Royal Commission to inquire into, and report upon, 10 questions relating to the crash was empanelled with The Honourable P. T. Mahon, Judge of the High Court of New Zealand, as Royal Commissioner.

As a public inquiry, at which witnesses would be called and cross-examined by various counsel, it was open to anyone inside or outside the company who felt he or she could make some contribution to the proceedings. In this way, it was expected that all contributory causes could be examined to the n'th degree and the dominant cause determined with complete accuracy.

It was imperative that this be so, for such a report that would be disseminated worldwide would be intensely studied by other operators for the information it must contain that would lead to an enhancement of flight safety.

If it fails in any measure to examine to finality *all* contributing causes or if it reaches conclusions based on assumptions when those assumptions are capable of resolution or explanation in the court room, then it falls far short of its objective.

The *Mahon Report*, as it has become known, was released in April 1981, and immediately created controversy and even furore as a result of some of the statements and judgments put forth. Mr Justice Mahon enumerated 10 factors that co-existed to make the disaster possible, without any one of which the accident would not have happened.

Among the 10 factors, Justice Mahon gave as the dominant cause, '. . . the act of the airline in changing the computer track of the aircraft without telling the crew — it was the one factor which continued to operate from the time before the aircraft left New Zealand until the time when it struck the slopes of Mt Erebus'. He went on to state:

'In my opinion, neither the captain nor the first officer nor the flight engineers made any error which contributed to the disaster and were not responsible for its occurrence'.

This judgment was, of course, hailed by the airline pilots as a victory. How many times in the past had pilots been held blameworthy for an accident when now, with our more enlightened knowledge of human factors, weather, aircraft performance and so on, they could be exonerated? On the surface, Erebus seemed very much a case in point.

Management criticized

Perhaps the matter might have rested there had not Justice Mahon indulged in some fulmination against the company in a paragraph of the report entitled, 'The stance adopted by the airline before the Commission of Inquiry'.

Sub-paragraph 373 stated:

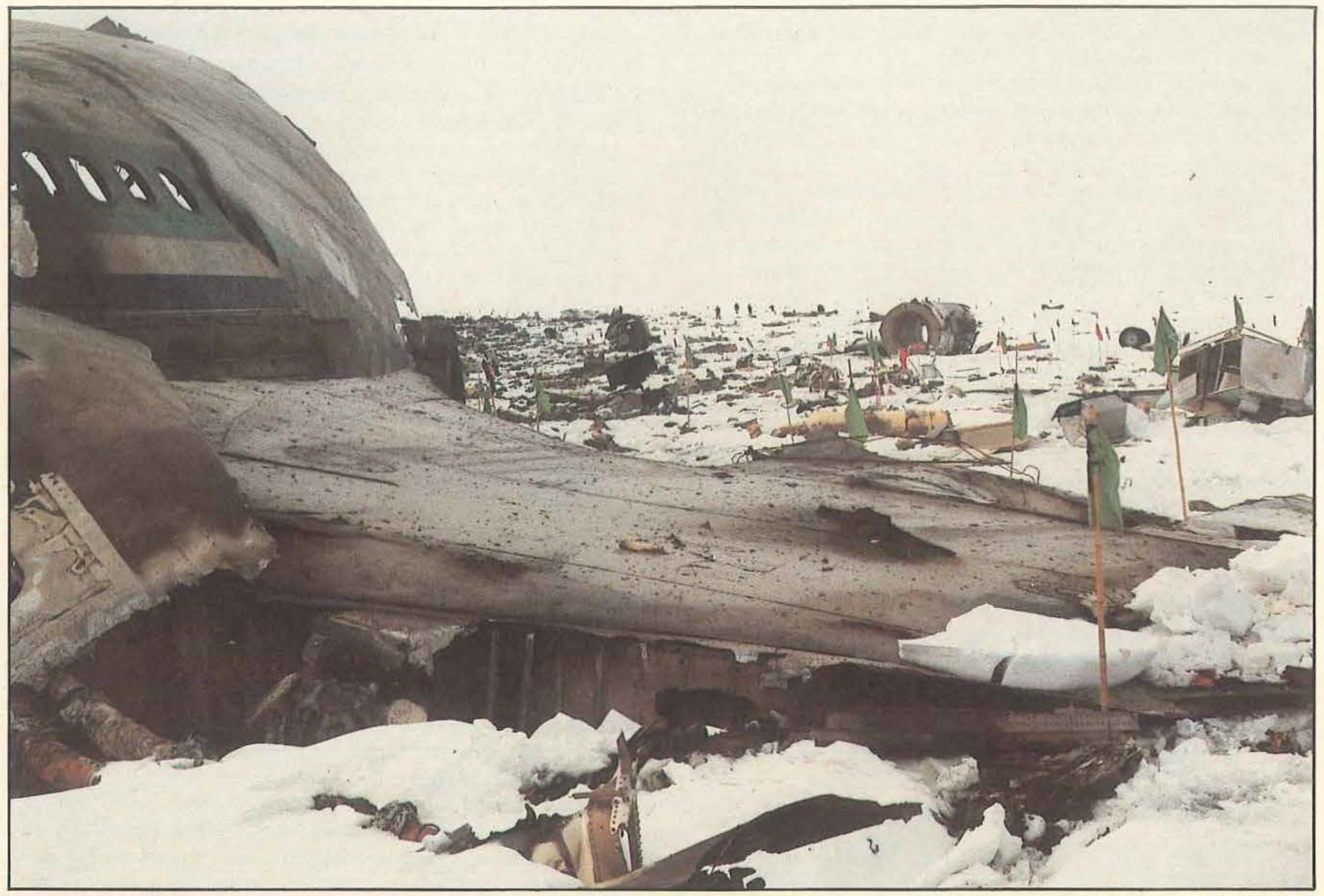
> There is no doubt that the airline chief executive, shortly after the occurrence of the disaster, adopted the fixed opinion that the flight crew was alone to blame and that the administrative and operational systems of the airline were nowhere at fault. I have been forced to the opinion that such an attitude, emanating from this very able, but evidently autocratic, chief executive, controlled the ultimate course adopted by the witnesses called on behalf of the airline.

Sub-paragraph 374 stated:

> The relevant evidence in this context was given by the executive pilots and by members of the Navigation Section. The fact that the navigation course of the aircraft had been altered in the computer had been disclosed by the Chief Inspector in his report dated 31 May 1980, six months after the disaster. But it was not until the Commission of Inquiry began sitting that the airline publicly admitted that this had occurred.
>
> Hence the tactics adopted by the Navigation Section witnesses which were designed to prove, if they could, that the computer mistake and its consequences could and should have been avoided by the crew and that the captain and his co-pilot had committed that very long catalogue of aviation blunders and malpractices to which I have previously referred.
>
> I can visualize without difficulty not only the extent but also the nature of the managerial pressure exerted on these witnesses. They all declined to admit that there had been any mistake or omission on their part which could have been a material cause of the disaster.

Let us pass on to sub-paragraph 377. It was shattering:

> No judicial officer ever wishes to be compelled to say that he has listened to evidence which is false. He always prefers to say, as I hope the hundreds of judgments which I have written will illustrate, that he cannot accept the relevant explanation, or that he prefers a contrary version set out in the evidence.
>
> But in this case, the palpably false sections of evidence which I heard could not have been the result of mistake or faulty recollection. They originated, I am compelled to say, in a predetermined plan of deception. They were very clearly part of an attempt to conceal a series of disastrous administrative blunders and so, in regard to the particular items of evidence to which I have referred, I am forced reluctantly to say that I had to listen to an orchestrated litany of lies.



Wreckage of Flight 901 was scattered over a wide range of the ice and snow-covered slopes on the northern side of Ross Island after ground impact. All 20 crew members and 237 passengers on board were killed in the accident.

(Photographs courtesy of New Zealand Office of Air Accidents Investigation).

Subsequent appeal

Such a biting accusation led to the immediate resignation of Air New Zealand's Chief Executive. The company, joined by the Chief Executive and an executive captain, then filed an appeal against these accusations with the New Zealand Court of Appeal.

The document, entitled *Judgments of the Court of Appeal of New Zealand*, under the heading, 'The challenged paragraphs', states:

> . . . the case is not an appeal from the Commissioner's findings on causation or other matters. The applicants acknowledge that they have no rights of appeal. What they attack are certain paragraphs in the Commission report which deal very largely, not with the causes and circumstances of the crash, but with what the Commissioner calls 'the stance' of the airline at the inquiry before him. The applicants say that in these paragraphs the Commissioner exceeded his powers or acted in breach of natural justice, and further that some of his conclusions were not supported by any evidence whatever of probative value. Their counsel submit that a finding made wholly without evidence capable of supporting it is contrary to natural justice.

Court's conclusion

The Appeal Court in its conclusions, which contained considerable legal discourse on the scope and jurisdiction of a Royal Commission of Inquiry, said in its judgment:

> We now come to the most serious complaint. It concerns paragraph 377 of the report (quoted above), a paragraph building up to a quotable phrase that has become well known in New Zealand and abroad. The applicants claim that these findings were not based on evidence of probative value and that the affected employees were not given a fair opportunity of answering such charges. The general allegation in the statement of claim that the findings attacked were made in excess of jurisdiction has in our view a special bearing on this paragraph. The applicants say that the paragraph affects a considerable number of employees . . .
>
> We accept that reasonable readers of the report would take from it that the conspiracy, which the commissioner appears to postulate in his references to a 'predetermined plan of deception' and 'an orchestrated litany of lies,' was seen by him as so wide as to cover all those persons. Paragraph 377 is the culmination of a series of paragraphs beginning with paragraph 373 and separately headed by the commissioner, 'The stance adopted by the airline before the Commission of Inquiry.' They include specific references to the chief executive, described as 'very able but evidently autocratic' in the context of an allusion to what 'controlled the ultimate course adopted by the witnesses called on behalf of the airline.' There are also specific references to the executive pilots and members of the navigation section.
>
> It is possible that some individual witnesses did give some false evidence during this inquiry. The applicants accept that this was for the commissioner to consider and that it is not for us to interfere with his assessment of witnesses. But the complaint goes much further than that. It is that there is simply no evidence on which he could find a wholesale conspiracy to commit perjury, organized by the chief executive, which is what this part of the report appears to suggest. Our conclusion that here the commissioner went beyond his jurisdiction and did not comply with natural justice

makes it unnecessary for us to decide whether there was any evidence that could conceivably warrant such an extreme finding. It is only right to say, however, that, if forced to decide the question, we would find it at least difficult to see in the transcript any evidence of that kind.

The language of paragraph 377 has evidently been carefully selected for maximum colour and bite and the commissioner has sought to reinforce its impact by bringing in his status and experience as a judicial officer. While unfortunate, it is no doubt that result of a search for sharp and striking expression in a report that would be widely read. He cannot have overstated the evidence deliberately. Similarly, at senior management level in Air New Zealand, there would have been a natural tendency to try to have the company's case put in as favourable a light as possible before the Commission; but it was adding a further and sinister dimension to their conduct to assert that they went as far as organized perjury.

The overturning of the paragraphs complained of in the *Mahon Report* put the boot on the other foot for the Airline's Chief Executive, and he lost no time in suggesting that the Royal Commissioner, Justice Mahon, resign.

Cabinet action

In a letter to the Prime Minister, Mr Muldoon, Justice Mahon indicated that it would be untenable for him to continue sitting as a High Court judge and that he should retire. Prime Minister Muldoon said that the Cabinet had spent more than an hour and a half discussing Justice Mahon's letter and that most of its members took the view that the Court of Appeal judgments were soundly based. However, with regard to all the background and the circumstances in which Justice Mahon found himself, the Cabinet felt it only fair that he should have an opportunity to take the matter to the Privy Council.

We are now left with two reports, that of the Inspector of Air Accidents and that of the Royal Commissioner, which in their summations are in almost total conflict. It was only natural that the supporters of these two camps would keep the controversy alive.

Press debate

Headlines in the 29 January 1982 issue of *The New Zealand Herald* proclaimed, 'Inspector's mind closed at hearing says Erebus Judge'. The newspaper continued:

> The Royal Commissioner into the Mt Erebus DC-10 disaster, Mr Justice Mahon, said last night that the Chief Inspector of Air Accidents, Mr R. Chippindale, had a predetermined and closed mind throughout the inquiry. The comment was the Judge's reaction to Mr Chippindale's criticism of the Commissioner's findings . . . Mr Chippindale alleged in the document released by the Minister of Transport that Mr Justice Mahon's conclusions would have been 'exposed as illogical' if examined and reviewed by aviation experts. Mr Justice Mahon said, 'I was aware that, if I did not accept the Air New Zealand management's view of the cause of the disaster that was accepted by Mr Chippindale, I would be very unpopular in official circles'.

The lengthy report continued with this assertion from Mr Chippindale:

> 'The change in the co-ordinates could not have been the dominant cause of the crash, for even in its changed form the flight plan was safe to fly as printed. Had it been flown by a crew of automatons, the aircraft would have flown over Mt Erebus, turned and returned safely. In the event the crew decided to descend the aircraft in an area on the opposite side of Mt Erebus to that approved for any descents, and they must be responsible for this decision.'
>
> Mr Chippindale said his report on the accident, 'was the result of the detailed investigations and deliberations of some 18 highly qualified international experts and aircraft accident investigators. The judge had stated as fact many items of hypothesis and supposition in his report. This, and his skill in rhetoric, made his report a most convincing and persuasive document'.

The New Zealand Herald of 2 February 1982 came out with further banner headlines — 'Pilots partly to blame says expert!'. The following article said, in part:

> Air Marshal Sir Rochford Hughes, who advised counsel for the Erebus Commission on technical matters, believes the pilots of the Air New Zealand DC-10 must accept part of the blame for the disaster. Sir Rochford said he believed about 90 per cent of the accident was due to organizational faults, but he could see no way in which the crew could escape accepting some responsibility. Their unpardonable lethal mistake was to drop below minimum safe altitude (MSA), relying on a navigation system whose co-ordinates they had not checked with their topographical map.
>
> He also said, 'I believe it is a basic tenet of good airmanship to check any aid, no matter how sophisticated, by some other aid or visual reference before descending below the MSA'.

'Risk' or 'assumption'?

The words of Gerard M. Bruggink in an article entitled 'Calculated risk or blind assumption' also ring in the ears.

> One wonders whether the Judge would have made a different judgment and moderated the extravagant language used in his findings had natural justice not been denied? Had the navigation group, as only one among those castigated, been given the opportunity to produce witnesses to support the statements assumed by the Judge to be untrue, then perhaps they would have been relieved of the stigma imputed in the findings.
>
> The very nature of Erebus was guaranteed to bring forth a depth of emotion in a small country like New Zealand that had not previously experienced an air disaster of this magnitude. As events unfolded in the public inquiry, considerable sympathy was generated for the crew, and, of course, Justice Mahon's findings accentuated this. The Commission's exoneration of the crew materially shifted the responsibility for safe flight away from the cockpit to the many people involved in the preparation of navigation, flight briefing, computer programming and flight plan preparation. For *any* pilot group to show enthusiasm for such a judgment, despite the evidence of crew errors and dubious airmanship, is to set back the clock in the endeavours being made to make flight safer.

Perhaps the most forthright opinion on the cause of the Erebus accident was expressed by Sir Geoffrey Roberts, TEAL's (now Air New Zealand) first Chief Executive and later its Chairman of Directors — a gentleman who can be said to be New Zealand's Mr Aviation. Sir Geoffrey says in the final pages of his book, *To Fly a Desk:*

> So many people have commented on so many different aspects of the crash that one hesitates to put forward yet another opinion. The obvious criticism that can be made of 'experts' and their theories is that anyone can be wise with the benefit of hindsight. It is also sadly true that little can be said now that will comfort those who suffered.
>
> But there is one excuse for speaking up, and it is a valid one. If we can avoid another disaster by delving into the lead-up to this one, then the delving is justified and any hurt caused in the process has to be accepted . . . I say quite flatly the main cause was the fact a pilot failed to locate himself in relation to ground features and flew his aircraft into the side of a mountain.

To the question, 'Isn't that being simplistic?', Sir Geoffrey responded:

> 'No. It's being truthful. I am aware that Mr Justice Mahon, who was the Commission, holds the primary cause lay in programming the aircraft to fly directly at Mt Erebus without telling the crew. I simply don't agree. He is a learned man, and his investigation was painstaking. He was, of course, sincere. But he was wrong. I am utterly convinced of that, and I will go to my grave knowing he was wrong.
>
> 'The error in programming was a contributory cause. The basic cause was pilot error.
>
> 'I said earlier an airline pilot may have to make only one vital decision in his life, and it has to be the right one. A vital decision was called for on 28 November 1979. The right decision was not made'.

The questioner suggested, 'Or maybe the right decision was made too late, remembering that the captain had decided to turn away just before impact?'

Sir Geoffrey's retort left no room for doubt:

> That's only playing with words. In the air, your speed is such that postponement of a decision amounts to a wrong decision. And inability to realise a decision is called for amounts to something worse, if that is possible. The moment for decision came during the descent, say at 1800 metres. Let us agree the pilot believed he was in visual meteorological conditions, even though we now know he wasn't — he was experiencing a white-out, something he hadn't encountered before. He could see the ground, but he could not identify ground features — features which are particularly prominent in the area under good weather conditions . . . Long, long before he eventually became uneasy, the pilot should have admitted to himself that he was uncertain of his position. And, such being the case, it was his plain duty to turn back and regain height. Furthermore, he should have appreciated that neither he nor his crew knew the area, and this alone should have prompted extra caution.
>
> This is a matter of airmanship, an old-fashioned term perhaps, but one that still has meaning. You can fill your cockpit with sophisticated aids, but someone still has to be sitting there to over-ride them if they go on the blink. I don't believe the day when passengers are sent off on robot-controlled flights will ever come, but, if you were to accept the findings of the Commission of Inquiry, you could almost be forgiven for concluding the day is already here.

Crucial point

The mountain of evidence generated by this Inquiry, the subsequent Appeal, the unceasing news media and the television probing and comment, in my view, overlooked a most crucial point. The captain was regarded to be and it was also stated in evidence that he was a most competent pilot. But did he act professionally? I suggest that there is an extremely wide gap between competency and professionalism!

Can a pilot be taught to take a professional approach to his job? I rather think not. I can envisage, and in my career have encountered, many situations where the professional approach may not be to the advantage of the employer — often the reverse.

Professionalism, as I see it, is an individual attribute and one that it is extremely necessary to have to ensure survival in the flying game. It is my opinion that the captain of Flight 901 to Erebus had a number of opportunities, both in flight preparation and in the conduct of the flight, to demonstrate true professionalism. Probably the over-riding one was the fact that the captain knew it would be his last opportunity to fly to Antarctica! ●

Taxiing accidents

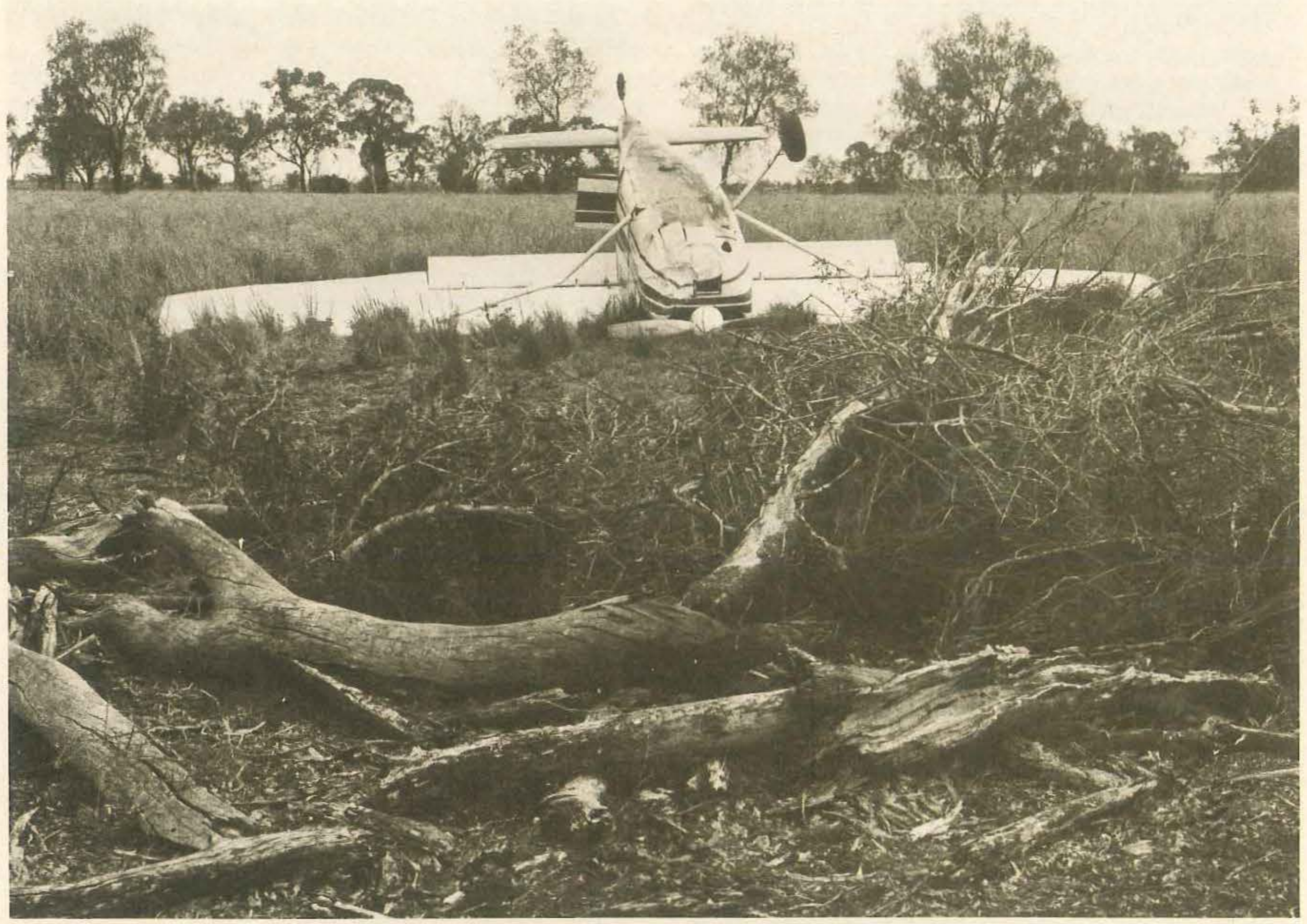
A PA-31 was being taxied towards a terminal to pick up passengers. The pilot saw a motor vehicle approaching to cross in front of him from left to right. Believing he had sufficient clearance, the pilot did not slow down or stop, and neither did the vehicle. The right wing of the aircraft struck the right rear of the vehicle.

* * *

The pilot of a single-engine taildragger experienced difficulty in seeing out of his cockpit while taxying after a late afternoon sortie, due to the combination of the sun in his eyes and the high nose attitude of his aircraft. Accordingly, he concentrated his lookout to the left side of his aircraft, where the sun was least troublesome. The consequence? His right wing struck the tail of an aircraft which was stationary on the taxiway in front of him. This caused the taildragger to swing around to the right and so add insult to injury by chopping into the stationary aircraft's left wing with its propeller. Only one comment can be made about taxying accidents of this type — there is no excuse for them. If you cannot visually clear the area through which you are moving, then do not taxy without outside assistance ●

More than meets the eye

An accident in which a Cessna 180 crashed only about one third of a kilometre from its destination seemed at first simply a case of engine failure caused by fuel exhaustion. Yet as the subsequent investigation revealed, there was more to this accident than that.



A grazier had departed his homestead strip — Point A — at 0605 hours local to fly to Point B about 100 kilometres away where he had to check water supplies for his stock. He did not expect to be away long and before departing had loaded a bull into a truck intending to transport it to another paddock immediately on his return.

On departure from Point A the aircraft's port fuel tank gauge was reading half full and the starboard just under half. The pilot soon found that the cloud en route was such that at 4000 feet he was VMC on top. After almost reaching Point B he decided he would have to turn back towards Point A if he were to get under the cloud. In the event he had to fly practically all the way back to Point A before he could descend safely and track again towards his destination. He finally landed at Point B at 0715 hours following a flight of 70 minutes — about 40 minutes more than he had anticipated.

Things did not proceed as smoothly at Point B as they might have. The pilot was concerned about the delay and matters were not helped when, on his way back to the aircraft, his motor bike slipped on gravel and he fell off. He could not restart the machine and had to walk the last kilometre to his aircraft. He was by now three hours later than usual for this job and was concerned that his wife would be worried. The matter of the bull in the truck was also becoming urgent.

Although there was a drum of fuel at Point B the pilot did not consider using it and took off with the gauges reading only one quarter full. About 10 minutes from Point A he was alarmed when he noticed that the starboard gauge was now indicating empty while the port was flicking between a positive indication and empty.

Because he was close to his destination the pilot decided to continue rather than carry out a precautionary landing. With the strip in sight he set himself up for a straight in approach, maintaining a low approach speed and using power and flaps because of the shortness of the strip. At about 200 feet on final approach the engine stopped abruptly and without warning. In the ensuing landing short of the strip the aircraft was substantially damaged.

(continued on page 11)

The right decision at the right time

Making operational decisions is an integral part of piloting. These decisions fall into one of two categories:

- Those made on the ground during preflight planning, when factors such as the meteorological forecast, the route, weight and balance, performance criteria, fuel, etc., have to be assessed. These decisions should be made free from the constraints of time or the pressures which can arise in flight.
- Inflight decisions, which can range from the almost subconscious translation of visual and flight flight instrument cues into physical manipulation of the aircraft, to those in which a series of occurrences which may threaten aircraft safety have to be dealt with coolly and quickly.

The latter type of decision is probably the most difficult to make, for while the pilot assesses the facts and reviews his possible courses of action, his 'office' — unlike the office of most decision makers — drones inexorably onwards, in all likelihood making the situation more difficult with each passing minute and nautical mile.

The following aircraft incident is relatively simple, yet it provides an excellent lesson in decision making — both good and bad.

A Beech 23 pilot had planned a flight to an outback strip and calculated that he should land by 1859 hours local. Last light, which he obtained before the flight, was 1909 hours. Dust and smoke haze were forecast for the destination.

As the Musketeer approached its destination the pilot noticed that the setting sun was abnormally red, which indicated that a significant amount of smoke and dust haze was indeed present. The degradation of visibility caused by the haze was exacerbated by the shadows cast by hills in the area. When only about 10 nautical miles from the landing strip and with around 10 minutes remaining before last light, the pilot realised that conditions were deteriorating so rapidly that he would not reach the airstrip in time to land safely.

The pilot thus found himself in a potentially hazardous situation because of a poor decision he had made during preflight planning. He later commented: 'In hindsight I realise how foolish I was to allow only 10 minutes before last light seeing there was smoke and dust haze forecast'.

To his credit, the pilot did not try to press on to the strip, even though it was only five or so minutes away. Having realised his original mistake and assessed the circumstances, he opted for a landing on a nearby dirt road, which he effected uneventfully in satisfactory light. In the pilot's words again: 'I was conscious of the importance of making a decision to land while there was enough light to do so safely — and sticking to that decision'.

Comment

As this pilot subsequently admitted, his original decision to attempt the flight was wrong. However, having made that mistake, he did not try to justify the decision by pressing on in an effort to reach his destination when, clearly, to have done so would have put his aircraft and passengers at risk. His action in landing on the first suitable area while daylight remained was the right decision at the right time ●

More than meets the eye *(continued)*

The on-site investigation revealed that the aircraft had run out of fuel. This was, however, only one of the causal factors, which were identified as follows:

- The flight from Point A to Point B had been extended because of weather.
- A further delay occurred because of the motor bike accident.
- The pilot had an urgent job to complete at Point A and was also concerned that his wife would be worried by his lateness.
- A check of the fuel remaining in the aircraft was not carried out prior to takeoff from Point B. Further, the pilot stated that he completely forgot about the diversion on the first flight which had seriously depleted his fuel.
- The inflight decision to continue to Point A even when both fuel gauges were indicating empty was inconsistent with the circumstances.
- A short-field approach was demanded because of the strip length.
- The engine failed due to fuel exhaustion.
- Because the aircraft was in a short-field landing configuration, it could not reach the strip.
- The forced-landing area used (over which the pilot had little control) was unsuitable.

Comment

There was, then, much more to this accident than initially meets the eye. Preceding the fuel starvation of the engine was a chain of 'human factors' which precipitated the accident.

The kinds of pressures and stresses to which this pilot was subjected — some of which he generated himself — will be familiar to most, if not all, readers of *Aviation Safety Digest*. They arise from normal human emotions and are presented in this article, not to criticise the particular individual, but rather to illustrate to all readers the importance of recognising situations in which stresses are allowed to build-up to the extent that they cloud one's judgment. Pilots must be keenly aware of this and be ready to 'back-off', relax and relieve those pressures before they become dangerous ●

Inflight structural damage

Few emergencies place a greater demand on a pilot's judgment, and capacity to assess calmly all the points for and against possible courses of action, than inflight structural damage.

Pilots unfortunate enough to find themselves in this predicament sometimes experience difficulty in deciding on a course of action because of uncertainty over the extent of the damage. This doubt can arise when damage is not visible because:

- it simply is not within the field of view, or
- it is beneath the skin of the aircraft.

Structural damage can be caused by a range of occurrences — overstress, wire strike, mid-air collision, bird strike, aircraft components coming loose in flight, ground/tree strike and heavy landings are some that come to mind. The crucial question the pilot must ask himself after such an occurrence is: how quickly should I get the aircraft on the ground? This was a question two Australian pilots had to answer recently in separate accidents.

* * *

The first was a highly experienced cropduster who, when flying under powerlines, struck them with his aircraft's fin. The pilot must have been well aware that the aircraft had sustained a wire strike for immediately afterwards a witness noticed the rudder and elevators being checked very positively for freedom of movement and effectiveness.

At this stage the pilot had three options for landing. He could have landed straight ahead into the crop, but with the considerable risk of overturning. As his aircraft apparently appeared to be responding to control inputs, that option probably — and reasonably — did not seem like much of a choice. Second, the pilot could have landed on a dirt road which ran parallel to his final spray run and was some 100 to 150 metres to his right. This road was clear of obstructions and suitable for landing. Finally, the pilot could have attempted to return to his base airstrip, which was about six kilometres from the scene of the wirestrike.

By the time the pilot had tested the flight controls and had time to assess his situation, he had flown about two kilometres from the wires towards the base strip and so had only about four kilometres to go to reach it. Thus it was probably reasonable for him to expect the aircraft to keep flying and reach that strip. Tragically, it did not. While the aircraft was still about four kilometres from the strip it overflew three witnesses, one of whom saw the vertical stabiliser fall over to the right and start flapping. All three could hear the noise of the flapping above the sound of the engine. Shortly afterwards the aircraft's nose dropped and the machine dived into the ground. The pilot was killed. There is little doubt that the damage to the tailplane caused longitudinal control problems which resulted in loss of control and the subsequent crash.

* * *

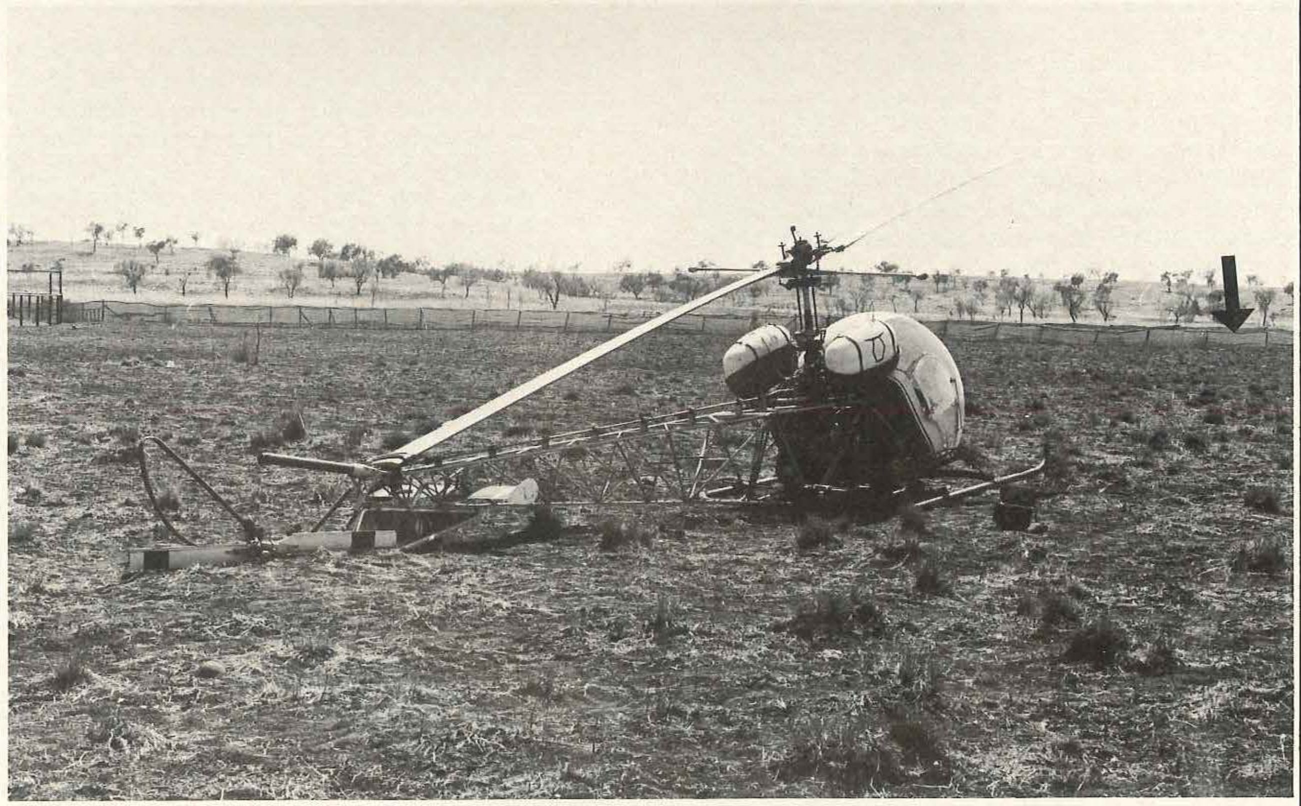
The second incident involved a helicopter which was engaged in cattle mustering. The pilot was hovering into wind behind a mob of cattle, assisting in getting them into the muster yard, when a cow broke away and ran behind the aircraft. As the pilot turned out of wind to try to stop the cow, the tail of the helicopter hit the ground. The pilot felt the thump and noticed that the aircraft had started to vibrate. He thought that the helicopter tail rotor guard had struck the cow and assessed that the vibration was not serious. He immediately landed, waved to the driver of a utility truck who was assisting him to continue to bring the cattle into the muster yard and then took off to fly over a fence to clear the yard. When the helicopter was about six feet off the ground and passing over the fence, the vibration stopped, tail rotor drive was lost and the helicopter started spinning. The pilot closed the throttle and attempted a hovering autorotation. He stopped the spin but was unable to prevent the aircraft from touching down while still moving rearwards at several knots. Damage to the helicopter was substantial.

* * *

It is not possible to make categorical statements concerning the actions pilots should take in situations such as these; indeed, it would be wrong to do so. There are many factors which come into play — for example, in the cropduster's case, how was he to assess the respective merits of a hazardous straight-ahead landing into the crop, against that of remaining airborne in a machine which may have sustained only superficial damage? A landing on the road alongside the crop may perhaps have been a different matter — then again, the pilot was only a couple of minutes flying time away from his preferred site.

In the final analysis only the pilot can assess the relative risks of continued flight in an aircraft which may have sustained structural damage. One thing, however, is certain: if a safe landing area is available and is utilised then those risks have been removed. It is infinitely preferable to assess possible structural damage from ground level ●

Tail section of the aircraft. Note the primary and secondary failures of the fin. Horizontal stabiliser and elevator damage was caused by ground impact.



General view of the wreckage. Muster yard can be seen on left, hessian-covered fence in background. Approximate point of initial ground impact is arrowed.

Stay with your aircraft

The Visual Flight Guide discusses hints for survival for pilots who are forced down. The first paragraph is headed 'Stay with your Aircraft' and advises pilots that, under most circumstances, their best chance of survival if they find themselves in this potentially hazardous situation is to stay with their aircraft. As the VFG points out, it is much easier for air search observers to spot an aircraft than a walking survivor, even if that aircraft is no longer in one piece. The VFG also mentions those circumstances under which pilots could reasonably consider leaving their aircraft.

In the past year there have been two instances of pilots leaving their aircraft in harsh and remote areas, in circumstances in which there is little doubt that they would have been much better advised to have remained with their machines.

• Unable to find an outback landing strip, unsure of his position, running low on fuel and with last light approaching, the pilot prudently elected to land on a suitable gibber flat. The landing was uneventful and the pilot advised Flight Service that he was safe on the ground with sufficient water, rations and warm clothing to see him through the night. Although uncertain of the pilot's exact location, SAR authorities had a good idea of his general position and, as there obviously was no immediate problem, arrangements were made to despatch search parties early next morning. The pilot was advised via radio that he should activate his ELB at 0800 hours the next morning if help had not arrived by then.

The downed aircraft was in fact found at 0904 hours, about 15 kilometres away from its original destination. There was no sign of the pilot while the ELB, which was still in the aircraft, had not been activated. Ten minutes later, the pilot was found walking away from the aircraft along a track: although he was not certain, he thought the track would probably lead him to his destination.

As well as leaving the ELB behind and unactivated, he did not have any provisions with him, even though there was water in the aircraft.

• Flying over semi-desert terrain with few features suitable for navigation, the pilot of a helicopter became lost. When low fuel forced him to carry out an uneventful precautionary landing, it was well past last light. He had seen some lights which seemed to be nearby as he was landing and so he almost immediately set out to walk to them. He took neither water nor his ELB and did not have a compass with him. As he was operating NOSAR NO DETAILS a SAR alert was not initiated by the Department's Search and Rescue Service. A SARWATCH was being maintained by the operating company, but the pilot made no attempt to advise them of his difficulties via radio.

As the pilot walked towards the lights they changed in intensity from bright to dull, appeared to move and eventually disappeared. Nevertheless the pilot kept walking for some time before finally camping for the night.

Next day he continued walking, keeping his face into the wind, which he thought was steady from the west and which he believed would ensure that he maintained a constant direction. The operating company had by that stage reported the pilot as missing and, during the day, six fixed-wing aircraft and one helicopter searched for him. Sixteen fixed-wing aircraft, including two from the Department of Aviation and one RAAF Orion, were allocated to the search for the following day. The pilot was found at about 0900 hours, some 12 kilometres east-south-east of his helicopter.

In both of these instances it is difficult to rationalise the pilots' behaviour in walking off into desert country without any survival aids, and indeed, having abandoned equipment and provisions that might have been crucial in what were potentially life-or-death situations. One suggestion is that such seemingly inexplicable behaviour stems from a pilot's mental state after successfully executing a precautionary landing: with the pressure of the emergency relieved, the pilot may not appreciate the possible danger represented by his environment. Whatever the reason, pilots finding themselves in this predicament must make every effort to assess their circumstances calmly and rationally. As far as leaving the aircraft is concerned, they will be better placed to evaluate their chances if they are aware of some fundamental factors affecting survival.

Hazards to survival

There are seven factors which are generally recognised as presenting the major hazards to an individual's capacity to survive in a hostile environment. In the context of this article, readers should consider these hazards in relation to attempting to walk to safety.

- Thirst
- Hunger
- Extremes of temperature
- Fatigue
- Loneliness
- Boredom
- Pain

It seems reasonable to suggest that by leaving their aircraft, the pilots involved in the two incidents described above were substantially increasing their susceptibility to at least the first four of these hazards.

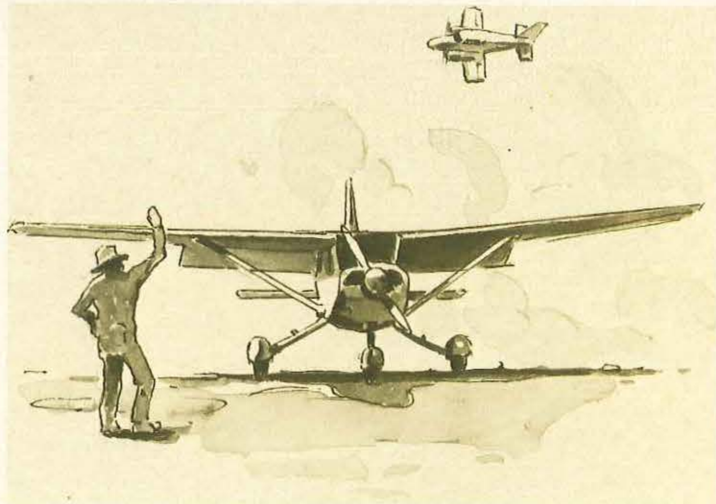
Requirements for survival walking

There are five basic requirements for survival walking. If any one of these cannot be fulfilled you should not leave your aircraft unless there are pressing reasons for you to seek assistance immediately.

- Knowledge of where you are and where you are going. If you do not know where you have landed you can rarely plan a route to safety.
- A means of setting and maintaining direction. If you have a hand compass and know how to use it you should be able to maintain a planned direction. The stars and the watch-and-sun method may also be used to hold a course. If you cannot use any of these techniques, then to set off for an uncertain destination is asking for trouble.
- Physical capacity. Most people are inclined to over-estimate their physical capabilities. A good level of fitness for recreational activities will not necessarily translate into an ability to traverse demanding and hazardous terrain in extreme weather conditions.
- Clothes make the man. This is certainly true when surviving, for proper clothing can mean the difference between life and death. It not only affords protection against the elements, but also against the potentially serious danger presented by insects. Adequate footwear is perhaps the most important item of clothing. Wet socks or uncomfortable shoes can cause grave discomfort and may completely incapacitate an individual. Unless your clothing is sufficient to protect you from any conditions you may encounter — sit and wait!
- Food, water, fuel, shelter and signalling equipment are all crucial to survival and location. The likelihood is that these items will be most readily available at the aircraft.

Summary

Unless there are pressing reasons to seek assistance immediately, pilots who are forced down in a remote area will almost invariably have the best chance of surviving if they remain with their aircraft. Any impulse to set off on foot should be resisted until a calm, rational assessment of the prevailing circumstances has been made. The odds are that any such assessment will dictate staying with the aeroplane. ●



Emergency locator beacons: valuable safety aids

It sounded a bit like a siren — an urgent, beckoning, undulating signal. It was weak at first but as the searching aircraft swept in low over the mountains, it grew louder, more demanding.

The pilot rotated the VHF frequency selector from 121.45 to 121.40, then to 121.35 and 121.30 as the signal strength increased. As the signal reached its peak, he turned briefly towards the observers and called above the engine noise, 'On top now'.

Eyes searching the thick treetops below, one of the observers reported the split-second flash of an orange object on the ground.

A second pass and they all saw it — a man standing near a plastic groundsheet with an electronic device propped up nearby.

This was the first introduction of some of the observers to an Emergency Locator Beacon (ELB) in operation.

The occasion was a field simulation exercise — part of an Assistant Search and Rescue Mission Co-ordinator's course run by the Department of Aviation's National Search and Rescue School.

Air Traffic Controllers, Police, Military and Australian Coastal Surveillance Centre staff had set out independently in four aircraft to find a light aircraft 'downed' in treacherous, heavily-wooded mountains on the southern NSW coast.

It was a scenario witnessed many times in real life around Australia each year.

Even though there is a high success rate with searches for missing aircraft, not all end as happily as in this exercise where all four searching aircraft found the target.

Sometimes the area of probability is so huge, information so scarce and the geography so inhospitable that there is little hope of finding anything in a visual search.

There was no doubt that activation of an ELB was a critical factor in finding the 'missing' aircraft and its crew so quickly in the exercise.

The Department of Aviation's Search and Rescue Organisation is a strong advocate of ELBs being included in the safety inventory of all aircraft.

Although ELBs are not compulsory equipment for all types of operations, the Department recommends their carriage by all aircraft in recognition of the fact that the correct use of these beacons can contribute greatly to saving lives, as well as to reduction of the duration and overall effort of searches.

When properly used, an ELB allows the size of the search area to be reduced quickly. Search activity can then be concentrated, and the probability of survivors being speedily located and rescued is greatly increased.

Use of the ELB

A special study by the US National Transportation Safety Board indicates that life expectancy of injured crash survivors decreases by as much as 80 per cent in the first 24 hours following an accident. This is a good reason in support of early ELB activation.

Apart from complying with operating instructions for the use of ELBs, the following advice is offered to aircrew should they ever be the subject of a search:

- Know how to use ELBs.

Review the operating instructions for the beacon, and the instructions in the AIP or the VFG relating to its activation.

- Do not be reluctant to use your ELB.

There have been cases, some recent, in which pilots equipped with ELBs have not used them even though they were in a distress situation and an air search was being conducted for them.

- Ensure that the battery is fully charged.

In one incident an aircraft made a precautionary landing in the Outback because the pilot was unsure of his position. He activated his ELB soon afterwards to help guide rescue aircraft to the scene, but, because the batteries in the ELB had run down, searching aircraft had great difficulty in picking up the signal and were unable to determine his position. Note the date of battery installation to help assess battery condition — replace the battery regularly.

- Carry out regular ELB efficiency checks.

For their own safety and that of their passengers, pilots should ensure that the efficiency of their ELB is regularly checked by an appropriately qualified LAME. If the pilot suspects that his ELB may not be up to standard, a test transmission may be made utilising the aircraft's receiver, or that of another aircraft. In such cases the proper procedure should be followed, and the transmission time kept to the absolute minimum.

- Notify the Department before conducting ELB tests or in case of inadvertent operation.

Advise your nearest Airways Operations Unit if you wish to carry out an ELB test. You may save a lot of headaches later. It should be remembered that, unless it is known that an ELB test is taking place, any ELB signal detected immediately results in the declaration of a distress phase and the commencement of search and rescue activity. This is also true of inadvertent activations and could mean the unnecessary scrambling of aircraft and crews, at great expense, only to find out it was a false alarm. If you become aware that an ELB was activated unintentionally, please advise the Department.

(Continued on page 18)

The following list of ELBs approved by the Department of Aviation was current at the time this article was written:

Manufacturer	*Type*
Buoyant Survival Beacons	
Burndept	BE346, BE369A
Elliott Bros	ERB-1, ERB-2
Garrett Manufacturing Ltd	Rescu 99
Granger Associates	142-1
Martech	EB-3B
Non-Buoyant Survival Beacons	
ACR Electronics	RLB-1, RLB-2
Burndept	BE355, BE375
Emergency Beacon Corp.	EBC 202A
Larago Electronics Mfg Inc	LELT- 1005- AF
Martech	EB-2B, EB-2BCD, Eagle N/G
Martin Aviation 1972	Omega-1
Radair Inc	Pulsar, Dart I, Dart II
Emergency Locator Transmitters	
Collins Avionics	CIR-10, CIR-11
Leigh Systems Inc	Sharc-7
Dorne & Margolin	(DM) ELT5-2, ELT5-2A, ELT6, ELT6C
Garrett Mfg Ltd	Rescu 88, Rescu 88L
Narco Avionics	ELT-10
Pacific Comm. Inc	Alert 50
Pointer Inc	Pointer II, Pointer Portable, ELT-3000
Crash Locator Beacons	
Garrett Mfg Ltd	Rescu 88A

• Pilots who hear ELB transmissions should advise any Airways Operations Unit by the quickest means available. If you do not know what an ELB sounds like, arrangements can be made to hear one by contacting an Air Traffic Control or Flight Service briefing office.

Detailed information concerning the use, design and performance of Emergency Locator Beacons (ELBs) is contained in ANOs 103.40 to 103.43.

The beacons — which operate on the 121.5 and 243 MHz frequencies — are strongly recommended for carriage on all aircraft.

ELB is a generic term which covers devices known variously as Crash Locator Beacons, Emergency Locator Transmitters and Buoyant and Non-Buoyant Survival Beacons.

Some ELBs are designed to be fitted to aircraft, others are portable. All can be operated manually but some are designed also to be activated by impact forces and others by contact with water ●

In brief

Aircraft operating from unpaved fields may pick up a little 'something extra' during rainy periods. Recently during a brake inspection the wheel fairings were removed from a Piper PA28 which had been using a dirt runway. Each fairing had nearly 10 kilograms of dirt caked inside — potential interference with wheel rotation and braking. For sustained soft-field operations, temporary removal of the fairings should be considered. If this is done, engineering regulations, and the effect of removing the fairings on weight and balance, must be taken into account ●

Jumping the battery to start the engines led to a complete electrical failure in a Twin Comanche on an IFR flight. The pilot found himself 'in the dark' as the gear came up after takeoff. Fortunately he was able to remain VFR and recover safely.

A low-charge battery and an alternator are a bad combination. The alternator field is normally excited by battery power, but if the battery voltage is less than 50 per cent there is no output from the alternator. A generator is self-exciting and will recharge a weak battery ●

Caffeine and flying

Preflight briefings and post flight exchanges of experiences would not be the same without the ever-present cup of coffee. While *Aviation Safety Digest* would never suggest that this time-honoured practice should cease, there is sufficient data available to indicate that consumption of beverages and food containing caffeine should be limited.

An American survey revealed that, among aircrew, 80 per cent consumed coffee in some form, with about 26 per cent at the 3-4 cups per day level, 17 per cent at 5-6 cups per day, and about eight per cent at seven cups and over per day. Most of these people regarded caffeine as a safe, legal stimulant and so did not have any particular concern as to the quantity they were consuming or the possibility of adverse effects. Yet medical evidence suggests that consumption of caffeine should be limited.

The effects of caffeine

Caffeine is described as non-adaptive, i.e. regular use does not diminish its stimulatory effects. It is not physically addictive in the sense that withdrawal will harm the user or produce violent symptoms. It does, however, seem to be psychologically addictive and not easily discontinued. Some tolerance is evident in that it takes more to get the same effect with continued use. The following are key descriptive characteristics:

- Antidepressant
- Stimulant
- Maintains wakefulness
- Affects the tone of muscles by its effect on the nerve cells that control them
- Causes increased peripheral blood flow by dilation of blood vessels, and *decreased cerebral blood flow*
- Does not significantly affect objectively measured intellectual performance
- *Does affect speed of accomplishment of motor tasks significantly*
- Tolerance is slow to develop and slow to disappear (may require more than two months of abstinence)

Following on from these characteristics, there is a list of symptoms which have been attributed to regular consumption of large doses of caffeine and which, if manifested, should lead you to think seriously about your intake of caffeine:

- Insomnia
- Sense of dread, depression
- Anxiety
- Fatigue
- Loss of balance
- Faulty thinking
- Finger tremor
- Increased reaction time

Clearly, the majority of those symptoms would be harmful to safe flight operations.

Common sources of caffeine

The table below lists the most common sources of caffeine and their caffeine content measured in milligrams per 'six ounce' cup:

• Regular coffee	100 mg/cup
• Instant coffee	60 mg/cup
• Decaffeinated coffee	3 mg/cup
• Regular tea	75 mg/cup
• Instant tea	30 mg/cup
• Cocoa	6-40 mg/cup
• Cola	60 mg/cup

For regular coffee the method of preparation can cause considerable variations in strength, as the following table shows:

• Automatic	15 mg/cup
• Dripolator	142 mg/cup
• Electric percolator	104 mg/cup

Research suggests that the sources from which most people get caffeine are, in order of priority, coffee, tea and cola. Because some caffeine is routinely removed during the processing of all coffee, the greatest to the least amount of caffeine among the various forms of coffee can be listed as follows:

- Regular
- Instant
- Decaffeinated regular
- Decaffeinated instant

Summary

Pilots should realise that coffee is not a harmless beverage that can be safely consumed in unlimited quantities, and that consumption of more than four cups per day or over 400 milligrams in a 24-hour period could cause undesirable physiological effects. It should be noted that, because of its properties as a stimulant, coffee can serve a useful purpose when moderately consumed on occasions during which optimum vigilance is demanded. On the other hand, over use has been reported to cause loss of balance, decreased cerebral blood flow and slower reaction capabilities; while excessive consumption after a flight might impair adequate rest and contribute to unnecessary fatigue on the next day's flight.

All individuals associated with aviation should be aware of the possible hazard of using too much caffeine. Moderation has generally been regarded as an important rule for most practices, so if you are experiencing any of the adverse physiological symptoms detailed in this article, then it may well be that you need to review your consumption of caffeine ●

Engine fires in flight

It has been observed during flight tests conducted in multi-engine aircraft over the last few years, that a significant proportion of pilots believe the safest method to secure an engine in the event of fire is to turn off the fuel and allow the engine to consume the fuel remaining in the supply lines before shutting it down and feathering the propeller. Some even advocate selecting maximum power and full rich mixture to reduce the running time of the engine after the fuel has been selected off! The aim of this article is to correct these improper beliefs.

For a fire to occur three basic ingredients are essential: **fuel, oxygen** and a **source of ignition**. Once a fire has started it must be deprived of either fuel or oxygen to extinguish it.

In an aircraft, possible fuels for a fire are: engine fuel and oil, de-icing fluid, hydraulic fluid, electrical insulation, rubber and synthetic seals, plastics, tyres, some metal alloys, etcetera.

Possible sources of ignition in a normally operating engine are the exhaust system and turbocharger. If malfunctions occur ignition for a fire could result from electrical and ignition system faults, exhaust gas leaks, etcetera.

Obviously oxygen is nearly always present to sustain combustion.

Consider the following hypothetical case: a typical turbocharged engine suffers a partial failure of the fuel line between the engine-driven fuel pump and the fuel control unit. Fuel is immediately sprayed throughout the rear section of the engine nacelle and ignited, possibly by the normally red-hot, turbocharger head shroud. Even though the temperature of the burning fuel probably exceeds 800 degrees Celsius, the pilot is not immediately alerted to the fire because the aircraft is not fitted with a fire warning system.

The engine continues to operate, apparently normally, because despite the leak, there is sufficient fuel still being delivered to it. After about 30 seconds to a minute, the fire breaches the oil lines to the turbocharger controller; engine oil is pumped into the nacelle and also ignites. At about this point the pilot would probably realise that something was wrong. The turbocharger would begin to malfunction, the engine oil pressure would be low and there would be smoke coming from the nacelle with possible scorching of the cowls. In addition there could also be malfunctions of other engine accessories as they become affected by the heat. Other sources of fuel for the fire would also begin to ignite.

There is no need to draw the story to a conclusion to recognise the similarity between it and two actual fatal accidents. One involved a Piper Aztec near Nadzab in Papua New Guinea and the other a Beech Queen Air near Alice Springs. Both accidents involved inflight structural failure caused by engine fires. In both cases less than three minutes elapsed between the pilot becoming aware of an engine fire and the wing separating following failure of the main spar. The evidence suggested that both pilots had initiated engine shutdown without delay. The fact that structural failure still occurred emphasises the importance of extinguishing such fires as soon as possible.

Returning to our hypothetical case: consider the possibility that the pilot elected to shut off the fuel and wait until the engine stopped from fuel starvation before feathering the propeller and completing the shutdown procedure. The period of engine operation after selecting the fuel off can vary considerably between aircraft types but in most cases will be significant when compared with the period between the pilot's recognition of fire and a catastrophic failure of the aircraft.

The important point here is that every second of engine operation after a fire has been detected could be increasing the severity of the fire if fuel or oil is being pumped out to feed it. Remember that the fire may be well established before the pilot is alerted. The high temperatures associated with the fire could have already melted fuel and oil lines.

On the other hand if the pilot immediately implemented the engine shutdown and propeller feathering procedures, including selection of the fuel mixture to idle cut off, all fluid pressures would quickly decrease and fuel, oil and hydraulic pumps would cease to feed combustible fluids to the fire. Immediate engine shutdown could also preclude development of the fire to the self-sustaining stage and could remove sources of ignition which may be necessary to sustain the fire in its early stages.

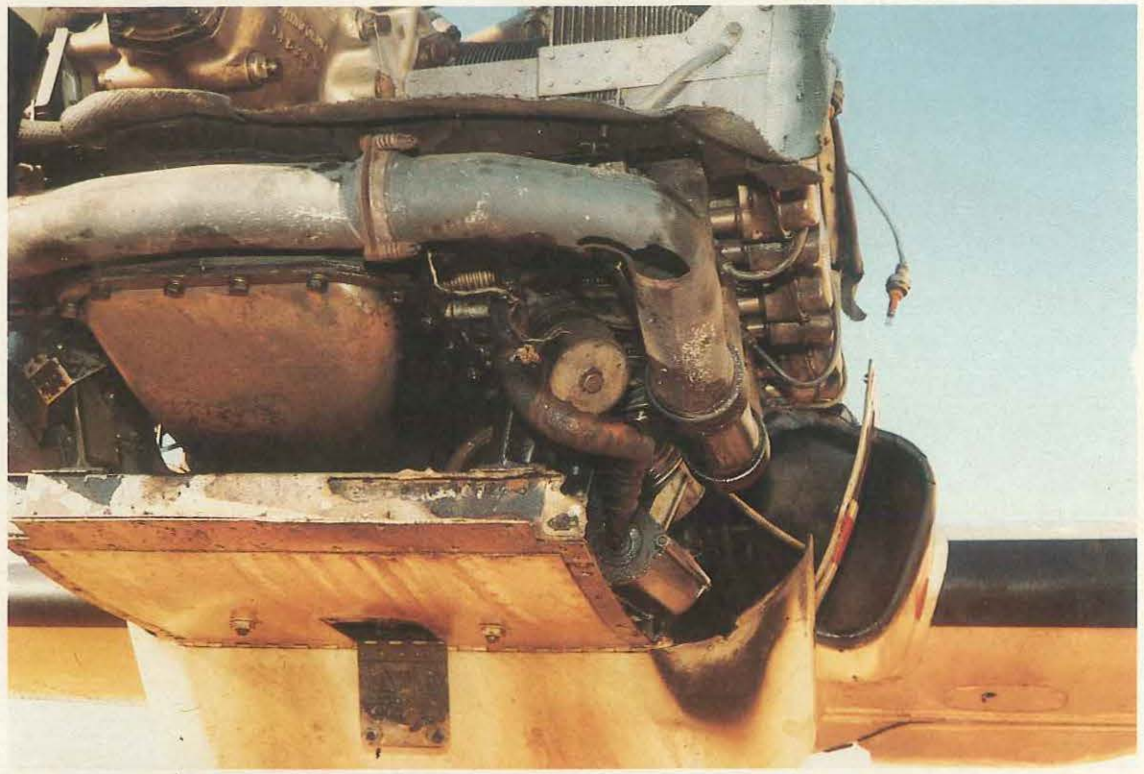
During the years 1977-81 inclusive there were 34 reported engine fire incidents in Australia. Of these none would have been aggravated by immediately shutting down the engine and feathering the propeller. Continuing operation of the engine to consume fuel from the system would not have assisted in controlling any of the fires. In 12 of the incidents, however, continued engine operation would have resulted in the increased severity of the fire. Ten of these 12 incidents involved fuel leaks downstream from the engine driven pumps. Of the remaining two, one was caused by a defective exhaust and the other by carbon build up in the exhaust system.

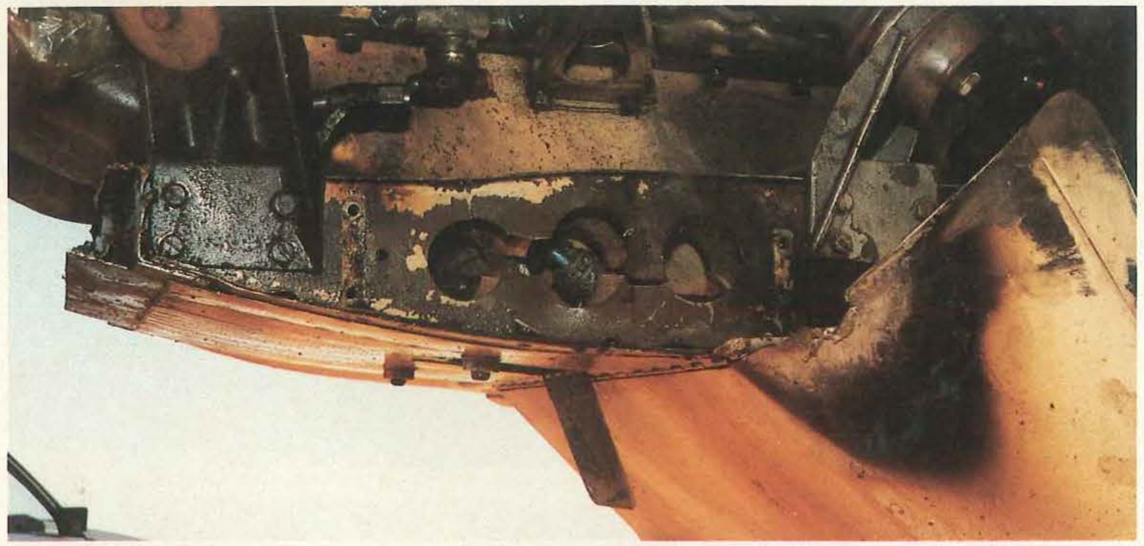
It is noteworthy that most aircraft manufacturers who include 'engine fire in flight' procedures in the emergency section of the pilot's operating handbook recommend engine shutdown as soon as possible after a fire is detected. Only one advocates the procedure mentioned at the beginning of this article.

Although this article was prepared mainly with consideration to piston-engine aircraft, the principles expressed apply equally to gas turbine engines.

In conclusion remember these factors:

- An engine fire can exist for a significant time before being recognised by the pilot.
- An engine fire can deform or melt oil and fuel lines, accessories and structural components in a very short time. Temperatures can reach 800-1000 degrees Celsius.
- Continued operation of the engine, even for seconds only, can rapidly increase the severity of the fire and the damage it causes.
- Structural failure can occur in only a few minutes from the start of the fire.
- In the event of an engine fire in flight use the procedure recommended by the manufacturer and shut the engine down, quickly.
- If there is no 'engine fire in flight' procedure in the pilot's operating handbook for the aircraft you fly, read this article again.
- For uncontrollable fires, forget the word 'divert' and think only of 'forced landing' ●





These photographs demonstrate the extent of damage which can occur in a very short time. The aircraft was cruising when the pilot noticed a loss of manifold pressure followed shortly by fluctuating oil pressure. The engine was shut down, the propeller feathered and a forced landing made at a nearby aerodrome.

The only external indication of the problem was some burning and melting of the engine cooling cowl. When the engine cowls were opened it was found that the exhaust system was holed and hot exhaust gases had been flowing into the nacelle. The engine bearers had been severely affected by heat and had dropped 50mm at the front end.

Fortunately the burning had not reached a self-sustaining situation. It was almost certainly due to the rapid actions of the pilot that complete separation of the engine did not occur.

Flying a heading and the lanes of entry

During the review of yet another penetration of controlled airspace by an aircraft which was supposed to be navigating a lane of entry, a comment was made that: 'The big problem is that many pilots do not plan, but charge off in a general direction and then alter heading in all directions trying to find the ground cues'. The record suggests that, for some pilots, this comment is not far off the mark.

It seems probable that because of the pressures which often exist in lanes of entry — dense traffic, the proximity of controlled airspace, and the normal heavy workload associated with arrival/departure procedures — these pilots become a little anxious in their efforts to identify visual cues. In their eagerness to settle into a positive track-crawl, they forget that a successful track-crawl consists of two fundamental components:

- frequent visual fixes, which are backed up by
- regular and accurate heading checks.

It is axiomatic that the visual fix is the crux of a track-crawl. However, as is the case with any navigational technique, a heading check is the basic means of confirming your tracking information. The following incident, involving penetration of the Sydney CTR, illustrates the possible hazards of ignoring heading when track-crawling.

The pilot attended the briefing office at Bankstown to file a flight plan which involved departing the Sydney area via the northern lane. The briefing officer impressed upon the pilot the importance of quickly intercepting the VFR route (marked as 007 degrees on the VTC) and of identifying the refinery and drive-in which are on that VFR route about six nautical miles from Bankstown. If you examine the Sydney VTC you will note that there are also some gasometers about six nautical miles from Bankstown, with drive-in theatres both to the north and the south. The pilot mistook these features for those on the VFR route, headed towards them, and so entered Sydney's CTR.

It is not hard to misidentify visual features: we have all done it. It is, however, important that such errors are quickly detected. In the incident above, if the pilot had paid due attention to his compass, he would have realised that the heading he was flying was over 20 degrees greater than that which, in average wind conditions, would have tracked the aircraft along the correct VFR route.

Further evidence that many pilots do not pay sufficient attention to heading checks is provided on the enlarged presentation of the western lane on the Melbourne VTC. There have been so many instances of pilots following the wrong railway line in that lane that it has been necessary to annotate the chart with the following warning:

CAUTION
Do not follow railway line heading 340° M

This is despite the fact that the two railway lines in question diverge at an angle of about 40 degrees. Clearly, pilots who have followed the wrong railway into controlled airspace have paid little heed to their compass.

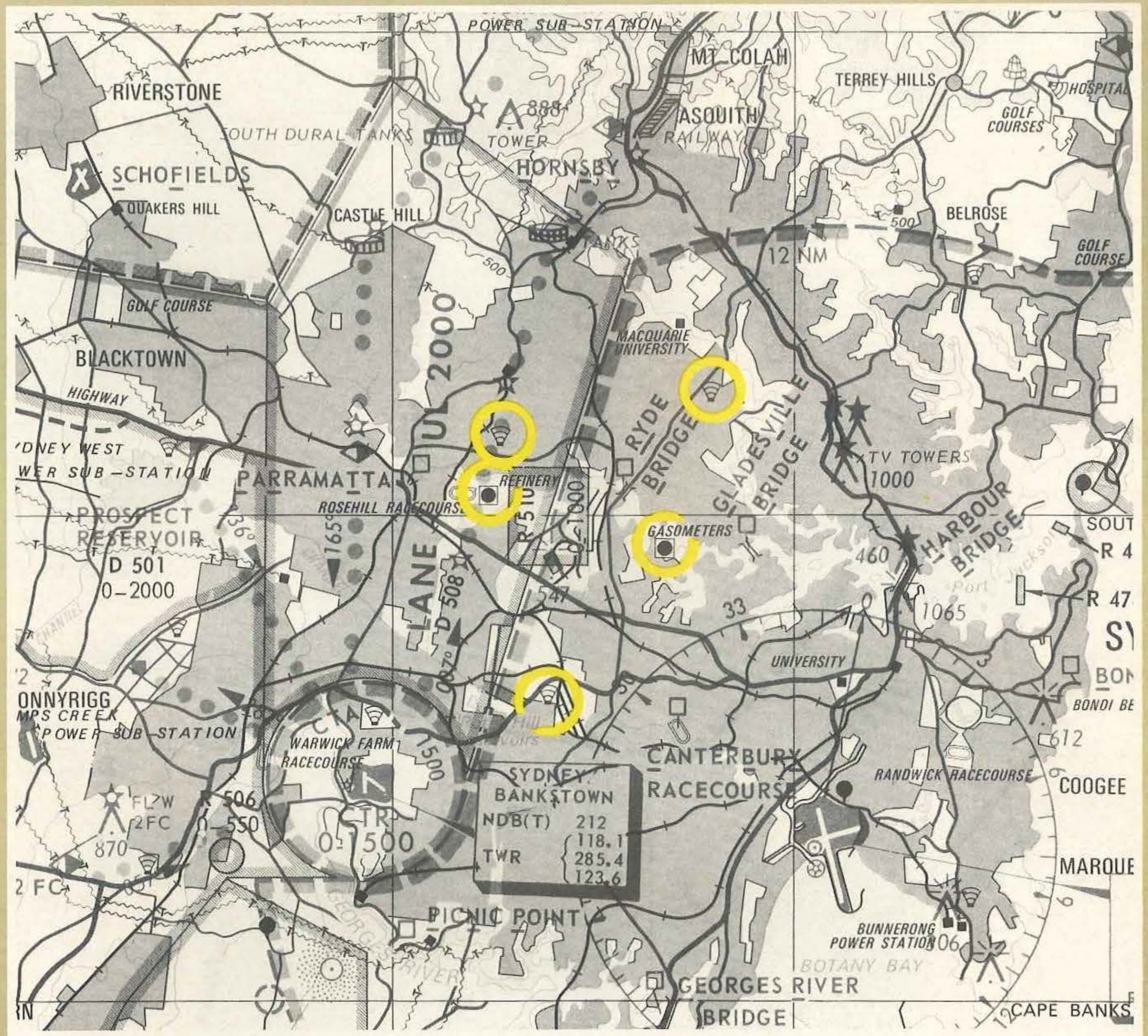
The whole question of navigating the lanes of entry was covered comprehensively in *Aviation Safety Digest 113*, and pilots who are experiencing difficulties with this aspect of flight are encouraged to review that article. In the context of this discussion, it is most important to remember that flying a heading is not an answer in itself: for visual navigation and operations in high density traffic areas, a thorough and effective lookout for other aircraft and for accurate visual fixes is paramount. Monitoring your heading is not, however, a time-consuming action, and pilots must use their compass to complement, and confirm the accuracy of, their visual navigation.

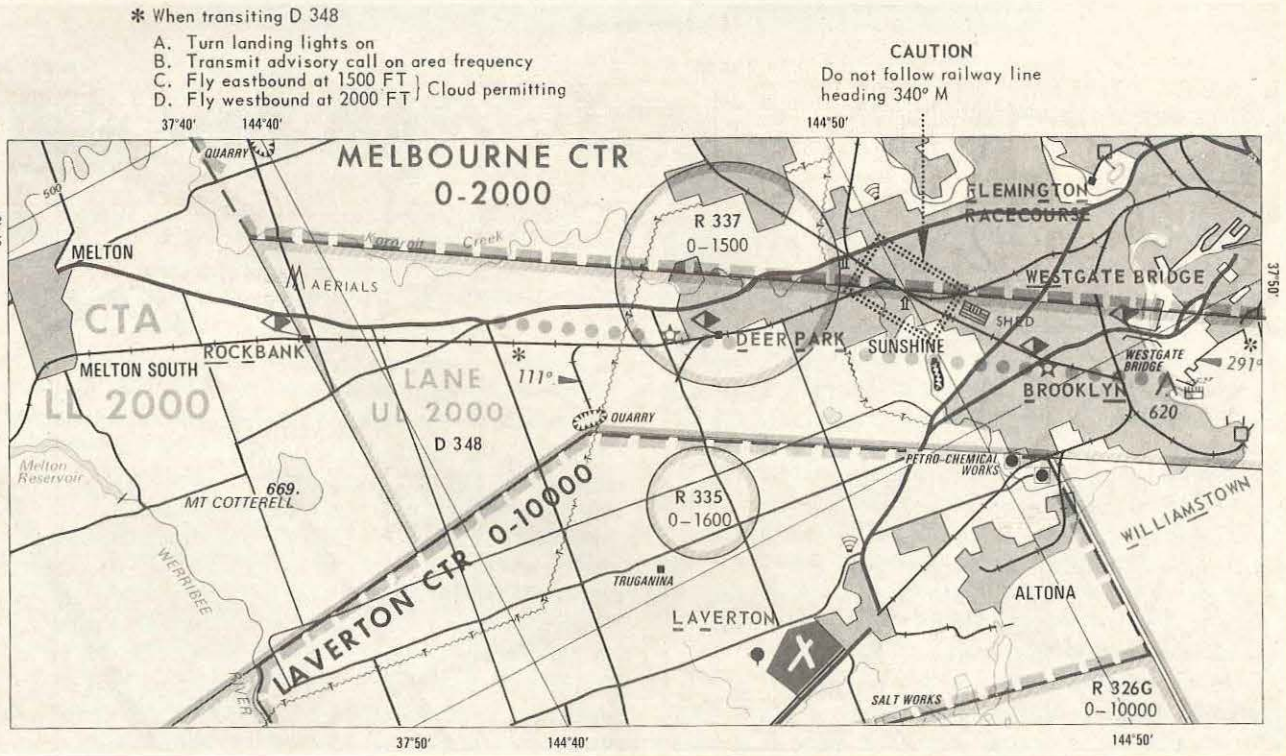
One final thought on heading checks. As a general rule, anytime your heading approaches 10 degrees or more from that which you calculated you should fly, it is time to be suspicious. You may of course have encountered winds significantly different from those forecast, but a substantial heading discrepancy should also alert you to the possibility of one of the following:

- a map reading error
- a flight-planning error (e.g. track mismeasurement) or
- a compass error.

Summary

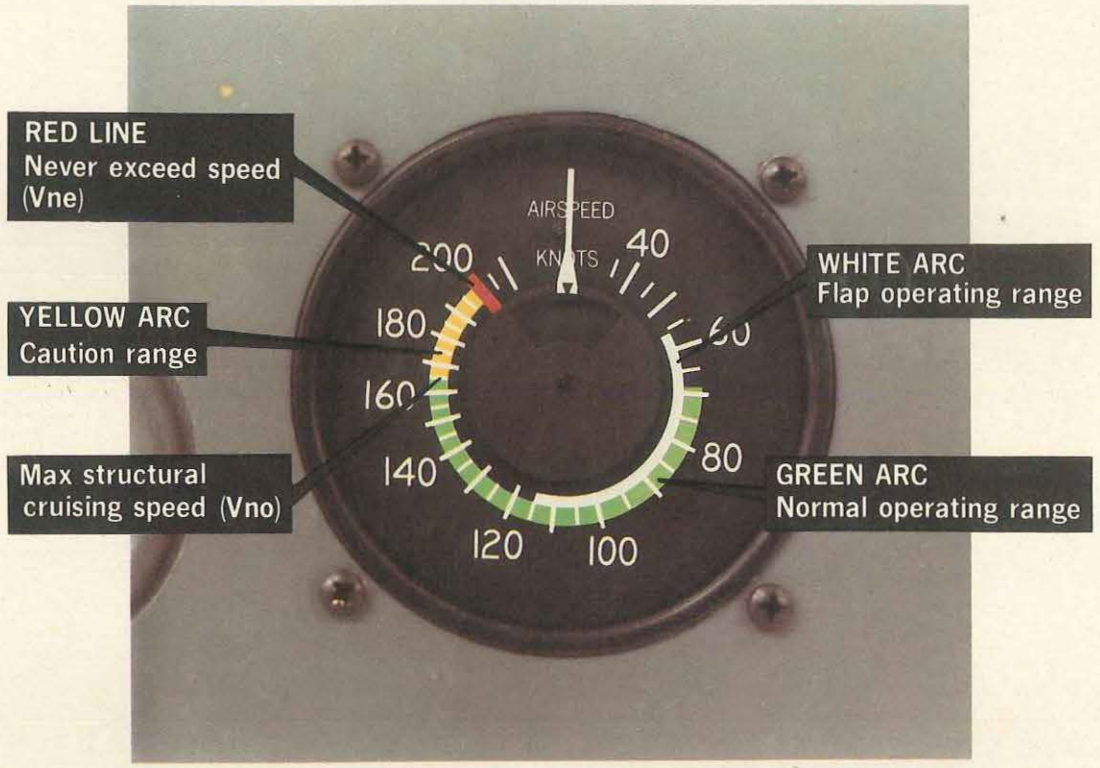
Using the compass to validate visual fixes is an integral component of track-crawling. It cannot replace the requirement to obtain regular and positive visual fixes, and neither should the pilot become fixated on his instruments at the expense of the all-important lookout for other traffic. Do not, however, forget the compass: it is an essential adjunct to map reading. Pilots using entry/departure lanes need to know the heading they should fly before they enter a lane — indeed, this data needs to be calculated during flight planning — and they should be ready to confirm tracking information by reference to the compass ●





Airspeed limitations for flight in turbulence

An article in *Aviation Safety Digest 113* describes an incident in which cargo was ejected from a Cessna 172 when severe turbulence was encountered during cruise. The occurrence serves to remind us that turbulence can be hazardous and provides a basis for the following discussion of airspeed limitations, their significance in relation to flight turbulence and the relationship of airspeed indicator colour markings to those limitations.



ASI showing colour-coded marking system

In accordance with the conventions on the colour coding of airspeed indicators the normal operating speed range of the aircraft is depicted on the instrument by a green arc. In turbine powered aircraft (and some others) the top of the arc coincides with a red radial line and defines the maximum operating speed (Vmo). This speed may not normally be exceeded in any regime of flight. In most piston engine aircraft, however, the top of the green arc defines a different limit, maximum structural cruising speed (Vno). Both these markings are prescribed to limit the stresses resulting from an aircraft's gust response characteristics. While aircraft to which Vmo limits apply may not normally exceed that speed, Vno is not limiting in the same sense — it may be exceeded in smooth air. In fact, normal cruise speed for some modern light aircraft is above Vno. The maximum allowable speed for aircraft to which Vno considerations apply is the never exceed speed (Vne). The airspeed envelope between Vno and Vne is colour coded yellow on the airspeed indicator, with Vne also marked with a red radial line.

Without considering other limitations, operations within the green arc should, then, be safe in all conditions — including turbulent air. From a gust response viewpoint that may be so, but another important limiting airspeed lies within the green arc and must be considered; this is the design manoeuvring speed (Va), the maximum speed at which abrupt or full control travel may be applied without risking damage to the aircraft. Not only is Va less than Vmo or Vno, it is often less than the normal cruising speed as well. Furthermore, it is not depicted by colour coding on the airspeed indicator — although it is required to be displayed on a placard as close as is practicable to the instrument. For example, Va for a Cessna 172M is 97 knots, substantially lower than both the normal cruising speed of about 110 knots and Vno, 126 knots. A word of caution —Va is, by definition, the manoeuvring speed at design maximum weight. At lower weights there will be a structural limiting speed which is lower than the placarded Va. Again using the Cessna 172M as an example, the manoeuvring speed at an aircraft weight of 730 kilograms is 80 knots, significantly lower than the placarded 97 knots.

ASI with provision for TAS in cruising speed range

With the significance of these airspeed limitations and their relationship to normal cruising speed in mind, consider the effects of encountering severe turbulence unexpectedly at normal cruising speed, or of continuing flight in severe turbulence — even at reduced speed. According to the specifications applied to describe turbulence severity, an aircraft flying in severe turbulence may experience abrupt attitude and altitude changes, with variations in vertical acceleration greater than one g felt at the centre of gravity; large variations in airspeed may occur; occupants will be forced violently against seat belts; loose objects will be thrown around and the aircraft may be out of control for short periods. Clearly, if prescribed airspeed limitations are not understood and observed such conditions could expose an aircraft to the risk of structural damage, not only through the stresses imposed by the turbulence, but also through those imposed by the large control inputs which might be required to maintain or regain control.

At low speed, however, another problem emerges — the risk of control loss through reduced control effectiveness and the reduced margin over stalling speed.

To provide a balance between the high and low speed problems, a turbulence penetration speed is specified for turbine powered aircraft; however, no such specification exists for most piston engine aircraft, although the operators' handbooks for some types list Va as a limiting airspeed in rough air. When no such guidance is given pilots must remember that Vno is a design limit airspeed, and they must be constantly aware of the significance of Va. Providing control response is satisfactory at Va and there is an adequate margin over stall speed, operation at the lower speed will provide a greater margin of security against overstressing the aircraft and give a more comfortable ride. If a speed higher than Va is required, or is specified for turbulence penetration, caution should be exercised, as the pilot has the capacity to overstress the aircraft structure through flight control inputs ●

Oils ain't oils!

While incidents of non-lubricants being added to aircraft engine sumps have been few, nevertheless they do occur. The end result almost invariably will be serious engine malfunction.

- Before flight the pilot topped up the engine sump with what he believed was oil from a plain, unmarked 44 gallon drum in a private hangar. Soon after takeoff he noticed a decrease in oil pressure and requested clearance for an immediate landing after declaring an emergency. Engine power remained available for the approach and the aircraft was landed without further incident. The pilot subsequently learned that what he thought was oil was in fact adhesive.
- Shortly after takeoff the engine lost power and stopped. The aircraft was destroyed during the subsequent attempted forced landing into rough terrain. Post-flight inspection revealed that the pilot had mistakenly added synthetic resin to the oil sump, causing the engine to seize. The synthetic resin had been added from plastic bottles, which were not originally oil containers and were not labelled clearly as to their contents.

Contamination of lubricating systems is not confined to the addition of the wrong fluid: replenishing oil using dirty containers, pourers or funnels, or during dusty weather, can also lead to serious consequences. As far as the lubricant itself is concerned, the practice of using only oils from clearly identified producers' containers has become accepted for very good reasons ●

Reader contribution

It is another fine Saturday morning when we arrive at the airfield, blue skies, light winds and the usual crowd.

I put my name on the manifest board and am on the first load.

Five of us gear up, check altimeters, pins and practise the formations we will attempt. Climbing into the old taildragger, the pilot calls 'clear prop' and fires up. Taxi out, line up and we are away.

The blast through the open door is familiar and we watch the horizon as we circle slowly up to 8000 feet.

It is nearly jump run and everybody is attending to last minute checks, kneeling on the floor, tightening straps. I am nearest the door so I have been elected jumpmaster. My main concern is to find the correct exit point because if anyone has to walk back to the clubhouse I will be blamed!

The pilot lines the aircraft up on my hand signals and I watch the airfield pass underneath us. We are flying directly into wind now, another 200 metres and . . . power off!

I climb out and hang from the top end of the strut, another second and the next jumper is beside me. Everyone else bunches up around the door — Ready, Set, GO — we are flying.

The first formation, a star, begins to build until all five of us are linked in a circle — good — shake and break and a quick glance at the altimeter, five grand, plenty of time. We begin the next formation, everyone side by side facing opposite directions, an accordion. Four of us are together but the last person is low, spreading out, trying to slow down and come back up.

3500 feet — break off — we all get the message and start tracking. The formation bursts outwards as everyone looks for his own piece of airspace. A quick glance around, all clear, pull, and I am looking up checking my parachute. The rest are all open around me and we are still over 2000 feet. No hassles with the Drop Zone Safety Officer about low openings. I turn toward the target and fly back downward. That was a good start to the weekend, pity about the second formation, but we will discuss it in the debrief.

Thus far this sounds like an ideal way for a skydiver to spend the day. There was, however, an additional factor which I have not yet mentioned, and which could have transformed an exhilarating experience into a tragedy. While we were climbing to our jump height, a small Piper was seen flying beneath us over the Drop Zone, apparently oblivious to the risk he was presenting, not only to the parachutists but also to himself: a collision between a skydiver free-falling at 140 km/hr and an aircraft is almost certainly going to be a disaster for all concerned.

As a rule parachute clubs welcome visitors, especially pilots; after all, they play an integral role in the skydivers' sport. So, pilots, please feel welcome to visit your local parachute club, but if doing so by air the following vital safety points must be noted:

- If transitting near an active jump area stay at least three nautical miles from the drop zone (DZ), and make an 'all stations' call on the appropriate FIS frequency, as the parachutists' aircraft should also be on that frequency. Note, however, that this call will not necessarily give you right of way over parachute operations.
- If landing at a DZ, contact the parachute club beforehand to find out whether they have a discrete ground/air frequency. Stay away from the upwind area of the DZ as this is the prime traffic zone for parachutists.
- As ground panels are often used by parachute clubs to advertise their operations look for those panels and know what they mean.
- Be aware that traffic — both aircraft and parachutists — may be heavy; at a recent Australian competition over 500 parachute descents a day were made, involving several aircraft.
- Skydivers rarely look down after exit. They look at each other, their altimeters and the formation they are attempting.

So, the next time you notice a red parachute on the chart near your intended flight path, remember that it could indicate the presence of someone emulating an air-to-air missile. The sky is for everyone — it's just that parachutists don't want to occupy the same piece at the same time as an aircraft ●