Aviation Safety Digest

SPECIAL ISSUE — VISUAL FLIGHT

BUREAU OF AIR SAFETY INVESTIGATION 1986

Contents

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Mooney 201 in Western Australia. Photograph by Mr N.R. Fletcher.

Editorial

Only about 15 per cent of Australian pilots hold a Class 3 or higher Instrument Rating. In other words, the great majority of pilots must conduct their flying in accordance with the Visual Flight Rules. The subject of VFR operations is, therefore, an important one.

The definitive reference for VFR flight is the Visual Flight Guide (VFG) distributed by the Department of Aviation. This special issue of the *Aviation Safety Digest* is not a replacement for the VFG. Rather, the intention with the magazine is to present supplementary, specialist advice on selected VFR issues. Articles consist of some new material and some which has appeared in past copies of the *Digest*. A large number of Reader Contributions has been included, most submitted by senior pilots and flying instructors from within the Australian aviation industry. As such, they represent the lessons learned from an enormous amount of experience and a great deal of theoretical knowledge.

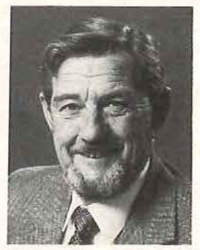
Perhaps the most widely publicised aspect of VFR operations is the weather-related accident. In fact, in the 10-year period 1976-85, the BASI computerised data base identified only 49 accidents in which 'continued VFR flight into adverse weather' was recorded as a factor. This amounts to about 2 per cent of all accidents. However, a very high degree of these accidents — 57 per cent — were fatal.

The key to avoiding becoming one of those statistics essentially lies, first, in thorough preflight planning and, second, in making an inflight decision to extricate yourself from deteriorating conditions before things have gone too far. In many accident investigations it is possible to identify a point at which, having failed to take diversionary action, the pilot who pressed on was on borrowed time. That message is emphasised here in a number of articles. At the same time, it is appreciated that circumstances can get away from any one of us. Accordingly, other articles present invaluable advice on possible courses of action should you find the weather closing in and the terrain rising: in particular, the Reader Contributions on precautionary landings and 'escape' techniques are recommended.

There are other aspects of VFR operations which, while perhaps less well publicised by the media, are just as crucial to safe flight. Navigation, the lanes of entry, meteorological knowledge, visual perception, and making the most of ATC/FSU facilities are all examined in this *Digest*.

Several points are worth emphasising in conclusion. First, if you find yourself in trouble in flight, the importance of asking for help before it is too late cannot be over-emphasised. The second point relates to the psychological pressures or mental attitudes to which we are all subject at some stage. The warning not heeded, the half-interested, half-hearted comprehension of the weather briefing, the lack of experience in the aircraft type and the prevailing conditions, the 180-degree turn that came too late — such are the causes of weather-related accidents. Finally, if en route conditions seem unfavourable, the wisest course of action may be to postpone the flight. No appointment is worth your life.

(Paul Choquenot)
Director
Bureau of Air Safety Investigation



Weather-related accidents: an overview

Introductory remarks

This study examined accidents where 'continued VFR flight into adverse weather conditions' was recorded as a contributory factor to the accident circumstances.

If a non-rated pilot continues flight into adverse weather and the weather conditions prevail, then the likely eventual outcomes of the continued flight are:

1. A collision of some sort, i.e. the pilot continues flying until such time that he collides with an object of some type, or the terrain.
2. A loss of control type accident, usually associated with disorientation.
3. The pilot continues flying until he runs out of fuel, or is able to land.

Accident analysis

Examination of the BASI computerised data base over the 10-year period 1976-85 identified 49 accidents where continued flight into adverse weather conditions was a factor in the accident circumstances. A very high percentage of these accidents — 57 per cent — (i.e. 28 accidents) was fatal.

A variety of types of accidents was involved, but by far the most frequent occurrence associated with this factor was controlled collision, most of these being controlled collision with a hill or mountain (see Table 1). By controlled collision it is meant that the aircraft was under the control of the pilot at the time of the collision, i.e. the pilot continued flying the aircraft until he hit a mountain. The other frequent accident types were loss of control type accidents and hard landings, both categories accounting for five accidents.

There was a high incidence of spatial disorientation also mentioned with the pilot factors. Spatial disorientation is a likely outcome when weather conditions are such that there is no visual horizon, e.g. when flying in cloud or when flying above a sloping cloud base. Spatial disorientation is a term used to describe situations in flight where the aviator fails to correctly sense the position, motion or attitude of his aircraft or of himself within the fixed co-ordinate system provided by the surface of the earth and the gravitational vertical. The eventual outcome of continued flight under these circumstances when the pilot has become disoriented is typically a 'loss of control' type accident. The problem is not a new one. Early in the history of powered flight it was recognised that the limitations of human sensory functions could lead to loss of control.

Disorientation is very uncommon when a pilot has well-defined external visual cues; but if he attempts to fly when sight of the ground or horizon is degraded by cloud, fog, snow, rain, smoke, dust or darkness he becomes quickly disorientated unless he transfers his attention to the aircraft instruments. The ability to maintain control of an aircraft without adequate visual cues is quite short, typically about 60 seconds, even when the aircraft is in straight-and-level flight, and is shorter still if the aircraft is in a turn. In such circumstances, loss of control occurs because the non-visual receptors give inadequate if not erroneous information about the orientation of the aircraft relative to the true vertical.

Factors

Pilot factors associated with the contributory factor 'continued VFR flight into adverse weather conditions' fall naturally into those categories where the judgment or decision-making process of the pilot is questioned.

These pilot factors are coded in the BASI data base as either:

(i) 'Operational decision; improper inflight decisions or planning'; or
(ii) 'Procedures, regulations and instructions; inadequate preflight preparation or planning'.

The pilots in this group (see Table 3) were mostly PPL holders who had between 100 and 300 hours total experience and who had no IFR rating, although a few held a Class Four rating. Flight experience for those involved in fatal accidents ranged from a lowest of 86 hours to a highest of several thousand hours.

In most cases the accident site and the intended destination point were different from the departure point, and in many cases the destination involved a fairly lengthy cross-country flight. This may indicate that the pilots involved in the accidents were sufficiently experienced to be attempting cross-country flights of considerable duration and/or length.

The other important fact to emerge from this brief examination was that the weather conditions in each fatal accident were substantially as predicted by the Bureau of Meteorology forecast. This therefore indicated that full information on the conditions was available had a weather forecast been requested. Whether or not receipt of full information on weather conditions would have changed the pilot's decision to fly or to continue the flight into deteriorating weather conditions must remain unanswered. In some cases full weather information was available, requested and received by the pilot, but a decision to continue the flight as planned was still made. Under such circumstances the operational pressures and unique circumstances surrounding each decision to continue with the planned flight must be considered, although in the case of fatal accidents such information might never be available.

Psychological pressures

Undoubtedly the specific psychological pressures on each pilot to fly under adverse weather conditions or to continue flight under such conditions may be so intense as to alter his normal basis for judgment of either his ability to fly the aircraft under these conditions, or the severity of the weather. They may also cause the pilot to delay the decision to turn back until it is too late. For example, in one fatal accident the pilot was under intense pressure to reach his intended destination in order to sign business contracts. This business pressure had influenced his decision to fly, even though the meteorological officer on duty had informed him that the weather was not suitable for VFR flight.

In another fatal accident the pilot had for some time planned a holiday trip with friends. Even though the briefing officer had advised him that conditions were not VFR, the pilot, who was very inexperienced on type (less than five hours), although he had 150 hours total, still elected to depart on his holiday as planned. By the time the pilot had reported that he was in non-VFR conditions he was also lost and flying in low cloud and rain. The weather continued to be so bad that an aerial search for the wreckage was precluded.

Of the fatal accidents there were only four where a weather report was not requested. In two of these accidents disorientation was also cited as a contributory factor ●

. . . the weather conditions in each fatal accident were substantially as predicted by the Bureau of Meteorology forecast.

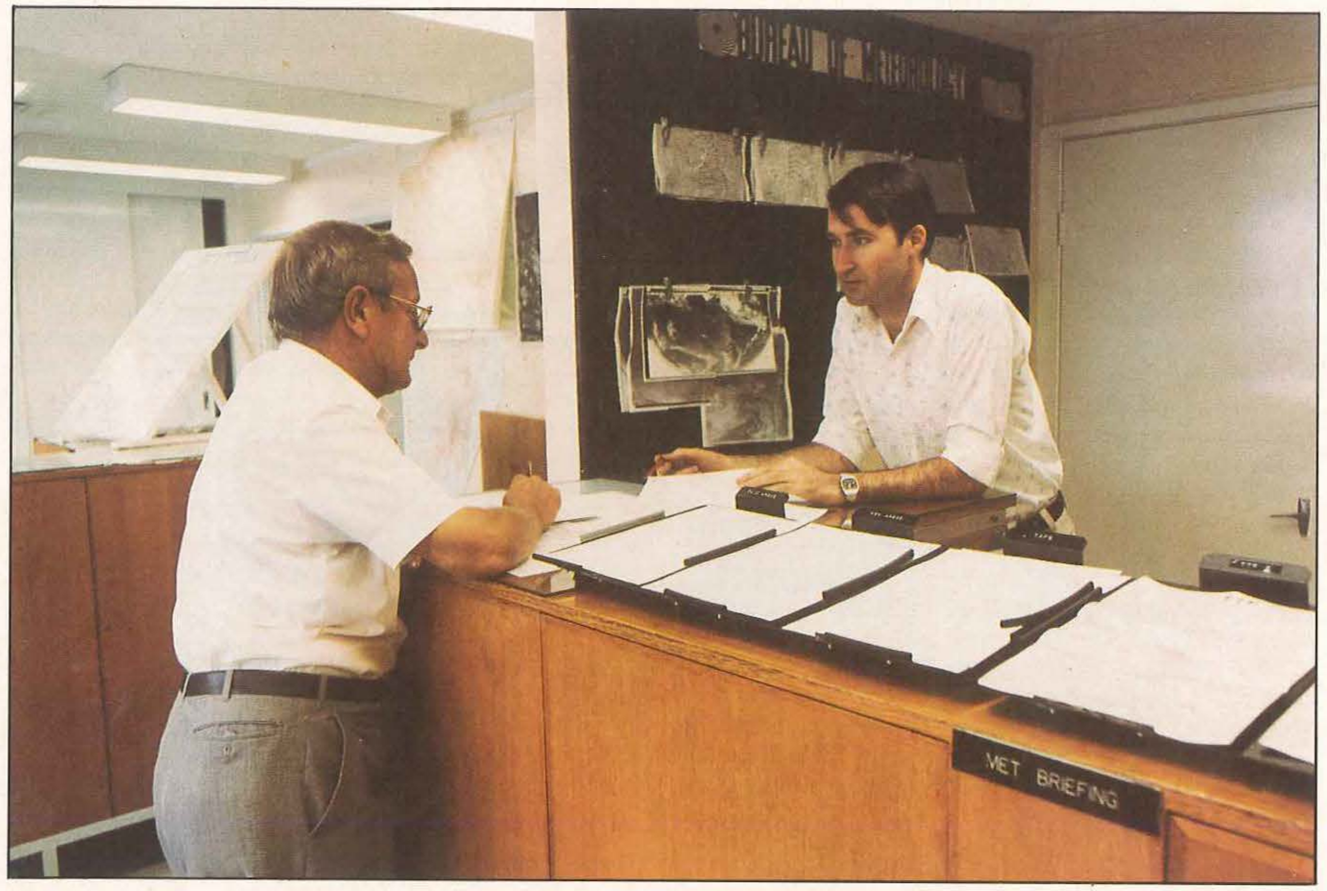


Table 1. Type of accident

Collisions (26)	
with hill or mountain, controlled	12
with hill or mountain, uncontrolled	2
with hill or mountain, control unknown	2
with level ground/water, controlled	2
with level ground/water, uncontrolled	2
with trees, shrubs or bushes	3
with electronic towers	1
with ditches or excavations	1
other	1
Hard landings	5
Loss of control (5)	
stall or spin	1
stall or spiral	1
other	3
Overshoot/overrun	3
Other accident types	10

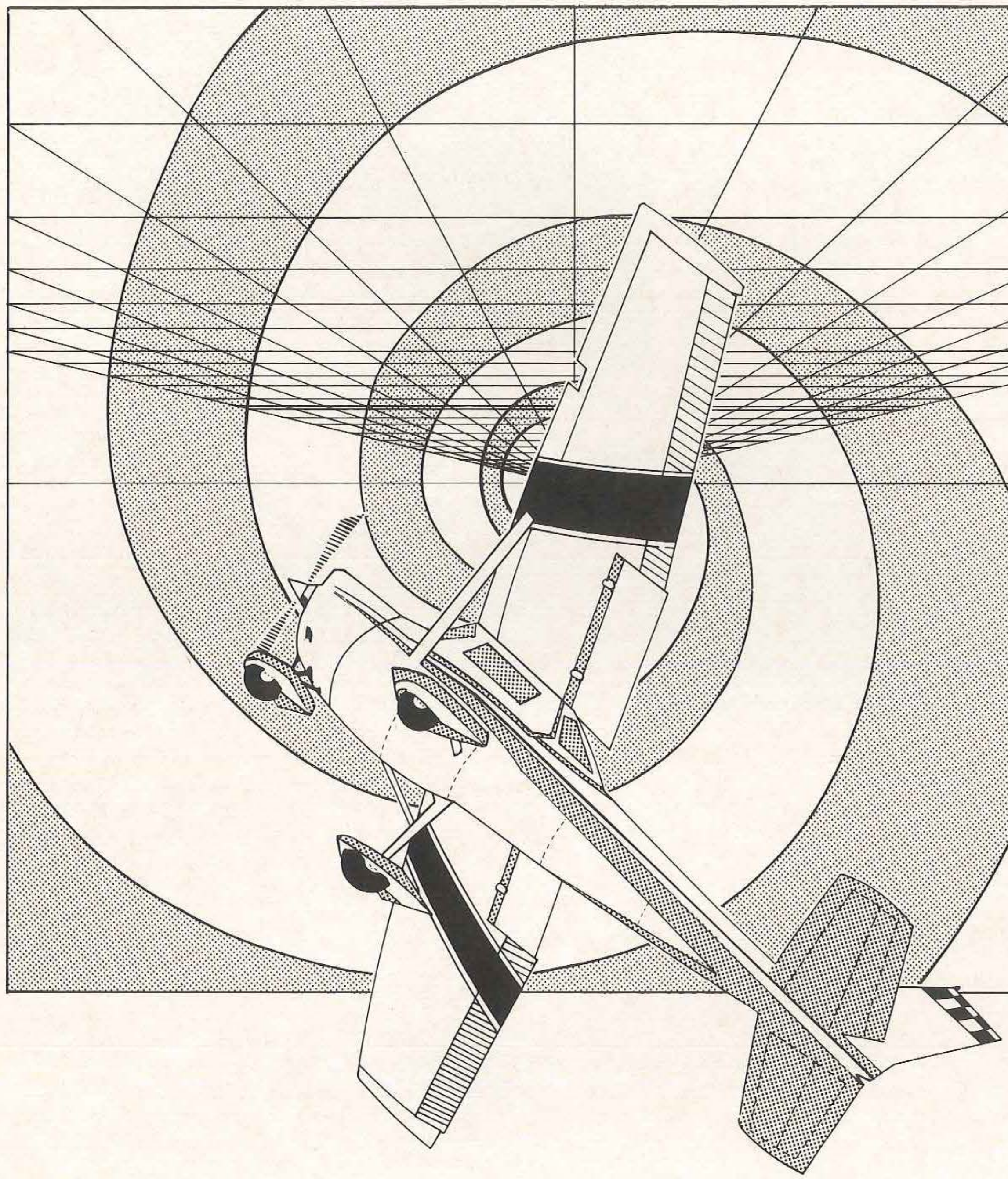
Table 2. Category of aircraft and operation

Category of aircraft	*Accidents* Total	Fatal
Multi-engine	9	6
Single-engine	39	22
Helicopter	1	
	49	28
Category of operation		
Charter	5	2
Flying training	2	-
Other aerial work	1	-
Private	35	23
Business	6	3

Table 3. Class of licence

Class of licence		Ratings	
Student	0	1st class	4
Private restricted	1	Class 4	7
Private	36	None	31
Commercial	8	Other	1
Senior comm/ATPL	4	Unknown	6
Unknown/other	0		

Sensory illusions



Accidents attributable to loss of control in cloud continue to happen because pilots persist with their flight beyond limitations imposed by the Visual Flight Rules.

Let us look briefly at the hypothetical case of a pilot trying to press on visually in deteriorating weather.

Even though visibility is poor, this pilot can see the ground ahead and to either side reasonably well, and has every confidence that he can continue safely. Admittedly, the overcast is forcing him to fly lower than perhaps he would in better conditions, but he is not dangerously low. So on he goes.

The conditions worsen — now he has to dodge an occasional patch of cloud at his own level, which is already lower than he prefers. There isn't much forward visibility now, but he can still see the ground below the aircraft quite well, so there is nothing to worry about. Nevertheless, if the weather gets much worse he feels he might have to turn back. On the other hand, perhaps he might be through the worst of it soon, and then conditions should improve. Besides he knows it is important for his passenger to get there today.

Down to a few hundred feet now, the pilot follows a path between two big patches of stratus. Yes, there's another landmark on the ground that he can recognise, so all is well. But wait a moment, there's cloud straight ahead now too, and right down to the ground! And this time, there's no way round it. So he'll have to turn back after all.

Never mind, he knows exactly where he is and can easily retreat the way he has come. He rolls the aircraft into a medium turn to port to bring it round on to a reciprocal heading. But that cloud on the left is closer than he thought — in fact there isn't going to be enough room to make the turn in the clear! Before the aircraft has turned much more than 90 degrees, it plunges into the cloud at what is suddenly a frightening speed. He was quite sure he wouldn't be caught in cloud but here he is. If he can just keep this medium turn going at the same rate, the aircraft should be out into the clear again in a moment or two.

But what's wrong? There seems to be no end to the cloud. Perhaps the aircraft is no longer in the turn. It certainly doesn't feel as though it is turning. No, that can't be right, the needle on the turn-and-bank indicator is still well over the left. But look, that ball isn't in the centre now — the aircraft must be slipping in. Or is it skidding out? Quickly, use rudder to correct. Must try to keep calm though — now let's see, which way *is* that ball indicating? Look at the airspeed — must have let the nose drop a bit! Ease the stick back a little — that's better. Or is it now? Why is the 'g' increasing like that? And what's happening to the turn needle now — it's hard over against the stop! That turn must be tightening — push the stick forward again before the aircraft stalls. No, not that much, now it's diving again — hear the engine screaming. Look out, the altimeter is unwinding like mad! Try not to panic — must do something quick . . .

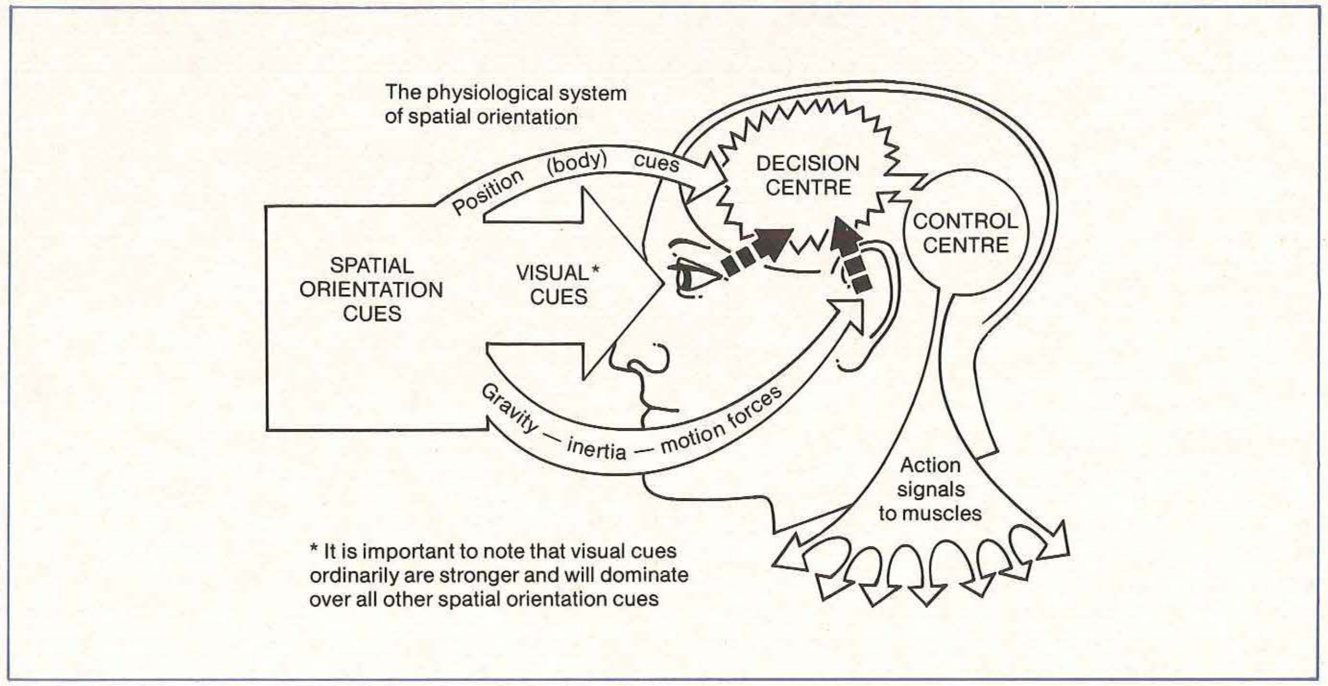
* * *

In other instances, accidents continue to occur because the pilots concerned have a false confidence in their ability to fly by reference to instruments should the weather conditions in which they are flying deteriorate to the point where this becomes necessary. *They believe that, because they have never had the slightest difficulty in interpreting the instruments when flying visually, there is no reason why they should not be able to continue to do so, just because the view through the windscreen happens to be obscured by cloud.*

Taken to its logical conclusion, this type of thinking implies that the long, expensive, and arduous training undergone and maintained by professional instrument-rated pilots is unnecessary; that any pilot can fly in marginal weather, in cloud, or at night, provided his basic manipulative ability is sound and of a high enough standard. There is an old saying that 'a little learning is a dangerous thing' and any such premise is in this category, because it takes no account of that most important occupational hazard of flying without visual reference — *sensory illusions.*

These illusions are false sensations or perceptions, derived from the various sensory mechanisms of the body, especially the organ of balance. They are natural physiological phenomena in instrument flight and are common to all pilots. The difference with instrument-rated pilots is that they are trained to disregard them, and to accept only the indications of the aircraft's instruments. It is the difficulty of learning to disregard these illusions, just as much as the actual task of learning to control an aeroplane on instrument indications alone, that makes instrument training vital to any sort of flying without full visual reference.

Flight is an unnatural environment for man and not one for which the human sensory mechanisms are well suited. But because the most powerful stimuli received by the brain are those of vision, a pilot learns to use his eyes to counteract the false sensations received from the other sensory organs. For example all pilots remember the confused feelings experienced on their first flight; but with further air experience these strange sensations very soon ceased. The aeroplane no longer seemed to be 'standing still' in the air, the horizon no longer 'tipped up' when the aeroplane banked and so on. In other words the student pilot learns to overcome the false sensations conveyed to the brain by the movements of the aircraft in flight, and learns to see these movements as they really are.



All remains well while a pilot continues to receive this visual information from outside the aircraft — while he continues to 'maintain visual reference'. It is important to note here that there is no such thing as 'partial visual reference'. Either the pilot has visual stimuli outside the aircraft or he has not. It follows that very little outside stimuli, for example the sight of a small patch of ground through a hole in the cloud, can be sufficient to maintain the visual 'input' that the pilot's brain continually needs to overcome the false sensations inherent in flight.

But once this outside visual reference disappears the false sensations from the other sensory organs suddenly become paramount. Illusions of movement or attitude are then inevitable and, unless a pilot has learned by instrument training to ignore these illusions their effect is overpowering. As a result a pilot can become convinced that his aircraft is turning, or that its attitude has changed, when it has not. Conversely, he can be led to believe that the aircraft is flying straight and level, when in fact it is 'winding up' into a spiral dive. This is the natural aerodynamic result of any uncorrected banking or turning movement applied to an aircraft, as is demonstrated to all student pilots at a very early stage of their training.

Powerful illusions of this sort are the most common form of disorientation in flight and the loss of control that almost inevitably follows has been responsible for many fatal accidents in 'below VMC' weather. They are also the explanation for the phenomenon experienced by nearly all who become disorientated in cloud — the belief that the aircraft's instruments have suddenly gone 'wild'. But very rarely is it the instruments that suddenly lose their sense of order in these circumstances.

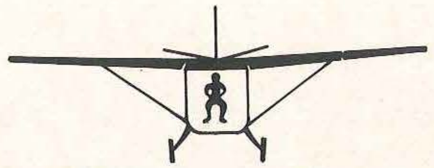
As with the pilot who becomes caught in cloud unintentionally, accidents involving 'do-it-yourself' instrument flying follow a distinct pattern of development.

In this case the aircraft, usually in a quite normal attitude, enters cloud deliberately, very likely only the sort of cloud that is 'not thick enough to worry about' or that the aircraft 'will soon be through'.

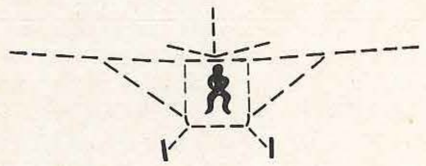
As it does so, just as with the pilot unintentionally entering cloud while trying to turn back, the world outside the aircraft changes almost instantaneously from one of familiar normality, to one alien and threatening. Inside the aircraft nothing seems to have changed and perhaps all is well so far; but the pilot cannot help being awed by this strange and unreal environment into which he has suddenly plunged. He is unable to resist frequent glances outside, as he subconsciously seeks some glimpse of the familiar world in which he can so quickly restore normality and confidence.

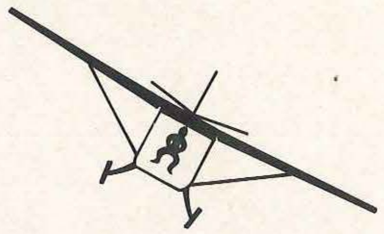
But there is none: it is up to him now to fly the aeroplane on instruments alone; those same instruments which in the past have been so helpful in making nicely balanced turns in the training area, and accurate rates of descent at the end of a cross-country flight, but which have suddenly become such inadequate substitutes for the sight of real earth and sky.

The pilot tenses a little and takes a firmer grip of the control wheel. For a few moments more all remains calm. Perhaps the aircraft feels as though it is descending a little, but the altimeter shows that it is not, so there is no need for concern — undoubtedly this is one of the 'believe your instruments' sensations he has

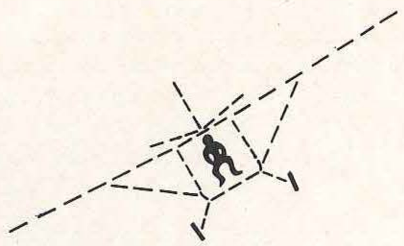


Initial straight and level flight





Gentle bank. Pilot feels aircraft is still straight and level.

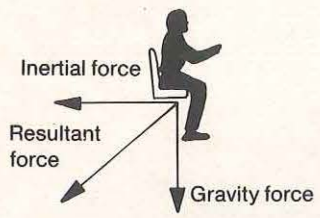


When bank is corrected on instruments pilot feels he is banking in opposite direction.

read about. Perhaps this instrument flying isn't so hard after all.

But soon the aircraft encounters some slight turbulence, perhaps no more than that found in the most innocuous patch of cloud. The aircraft bumps a little, the 'bat and ball' oscillates gently and settles down again. But now the aircraft feels as though it is flying

Normal sensation of gravity while at rest or in straight and level flight at constant speed.



During acceleration inertial force acting at right angles to gravitational force produces resultant force.

Pilot misinterprets resultant force as that of gravity, obtaining sensation of pitch-up.

one wing low — why doesn't it settle down again too? Without thinking the pilot applies a little opposite bank. He watches the wing tips to try and see when they are level again. The aircraft still feels a bit one wing low. He adds a little more opposite bank. If only he could *see* where the wings really were in relation to the horizon. But that certainly feels right now.

He glances back at the instrument panel to confirm that the wings are really level. But now the artificial horizon shows a steep bank the other way. That can't be right — the aircraft still feels straight and level. But wait — which way is the artifical horizon showing? It's always a bit hard to interpret, especially when you can't see outside. He glances at the turn and bank indicator again. The ball isn't in the middle any more. And the turn needle is well over to one side too. But before he can think which way he should correct, his glance falls on the airspeed indicator — it is registering well above normal. Very tense now, the pilot tries to correct in the most obvious way he knows — by easing back on the control wheel. The speed begins to drop a little, but at the same time the vertical speed indicator, already showing more than a 500 feet per minute descent, dips frighteningly towards the 1000 mark and beyond. And now the airspeed is increasing again, this time alarmingly. And with it the engine begins to overspeed, its note rising increasingly into an ear-splitting scream. As the spiral dive tightens, the artificial horizon topples, the directional gyro spins furiously and the needle of the vertical speed indicator plummets to full deflection down. Panic stricken, the pilot realises too late that the situation is beyond his ability. His training and experience have stopped far short of such demands.

If the base of the cloud is not too low when this sort of situation develops, it is possible that the pilot may have room to recover from the resulting 'graveyard spiral' before the aircraft plunges into the ground. But there is also an excellent chance of structural failure occurring during the recovery, as a result of the excessive aerodynamic forces that this inevitably applies to the airframe. Even the few pilots who have been lucky enough to succeed in recovering control after emerging from the base of a cloud, have in most cases caused severe structural damage to their aircraft. Usually, however, when a non-instrument pilot loses control in such a situation, the cloud base is already low, if not actually lying on the higher terrain, and a catastrophic ending to the flight can be the only result.

Some pilots with no first hand experience of flight in instrument conditions may feel that such sequences of events are exaggerated. We assure you that they are not and refer sceptics to an article published as far back as *Aviation Safety Digest* 20 in December, 1959. This described a study undertaken by the University of Illinois in the United States to determine the extent to which non-instrument pilots could retain control of their aircraft in instrument conditions. *The study showed that, of a representative group of twenty non-instrument pilots, not one was able to retain control when deprived of visual reference.* Unfortunately for a number of people, the warning this series of tests sounded to all non-instrument pilots, has too often gone unheeded.

The warning applies also to those of us who have done a little instrument flying for private or commercial licences, as well as to those who perhaps had a lot of instrument experience a long time ago. Although our reaction might be 'that doesn't apply to me — I *know* how to fly on instruments', the unpleasant fact is that we are little safer than the pilot with no instrument experience. Indeed, we may be the more dangerous in marginal conditions because we are reluctant to recognise our limitations.

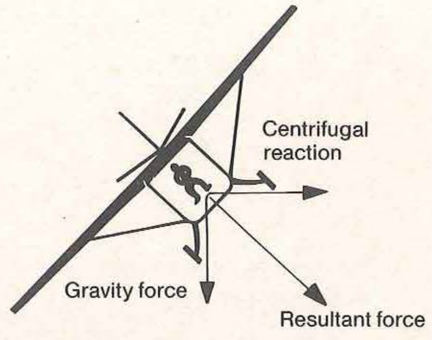
* * *

The illusions which bring about disorientation and loss of control in cloud, though very real to the person experiencing them, are simple in character and can be traced to the vestibular apparatus in the inner ear which maintains the sense of balance. This organ achieves its purpose by conveying sensations of orientation to the brain. The vestibular apparatus consists of a sac and three semi-circular canals at right angles to each other. The sac contains a membrane which senses the direction of gravitational force, so controlling the balance of the body when it is stationary. The canals contain a fluid and small sensory hairs connected to the nervous system. The fluid reacts to rotational movements of the head, stimulating the hairs so that a nerve impulse conveying an appropriate impression of movement is transmitted to the brain, thus controlling the sense of balance while the body is in motion.

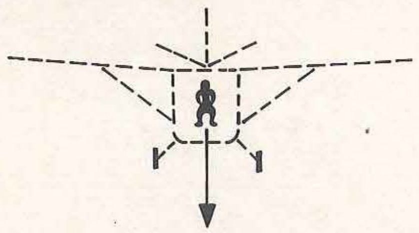
The balance mechanism of this inner ear apparatus works well enough while we remain on our natural habitat — the ground. Here, even with our eyes closed, we can maintain our balance. But maintaining our equilibrium in the air is a very different matter. In the first place, in the three dimensional motion of flight, centrifugal reaction often distorts the effects of gravity, giving our balance and orientating mechanism a misleading stimulus. In a properly co-ordinated turn for instance, 'down' is always felt to be the floor of the aeroplane, regardless of the angle of bank. Secondly, while our balance mechanism is well able to sense the comparatively small angular accelerations involved in normal body movements in relation to the ground, it can be completely deceived by the large scale angular accelerations imposed upon the body by an aircraft in flight. In very gentle turns the rate of change of direction may be insufficient to cause any movement of the fluid in the semi-circular canals of the inner ear, so there will be no feeling of turning. In prolonged turns, even though a turn may have been sensed when it began, the fluid in the canal 'catches up' with the motion of the aircraft. The turn is then no longer sensed and we feel that it has stopped. Similarly, if a recovery from a turn is made suddenly, the inertia of the fluid in our inner ear canals causes it to flow for a brief period, which can give us the completely false impression that we are turning in the opposite direction.

It should not be hard now to see why the effect of these reactions is to produce illusions and disorientation when an untrained pilot attempts to fly in Instrument Meteorological Conditions. For example, a gradual entry into a turn or spiral can go undetected until a dangerous degree of rotation has been reached. Another common illusion, sometimes experienced even by qualified instrument pilots, is 'the leans'. Should the aircraft recover slowly from a movement in the rolling plane, the pilot may feel that it is still banked. Conversely, if the aircraft makes a sudden recovery from a banked attitude, he might feel that it has banked in the opposite direction. Sensations of turning during straight and level flight and sensations of climbing whilst banking are particularly convincing in Instrument Meteorological Conditions. Again, a rotary movement suddenly discontinued can give a strong sensation of rotation in the opposite direction. This situation may occur during recovery from a spin when there is no satisfactory ground reference, and the sensation produced may be so strong that the pilot attempts to correct it and goes into a spin in the opposite direction. Another very powerful illusion responsible over the years for a large number of accidents, is the sensation of climbing during a rapid forward acceleration. During takeoffs on dark nights with no visual reference once the flare path is left behind, this illusion has deceived even highly experienced instrument-rated pilots. As a result their aircraft have been unwittingly flown into the ground.

The only way these illusions can be overcome is by using the sense of vision to counteract them. If there is no visual reference outside the aircraft, the pilot's vision must be transferred immediately to the indications of the aircraft's instruments. For a pilot to gain sufficient visual stimulus from these instruments to enable him to



During a turn centrifugal reaction, acting at right angles to that of gravity, produces resultant force.



Because resultant force acts in same direction as gravity in straight and level flight, pilot feels aircraft is still in this attitude.

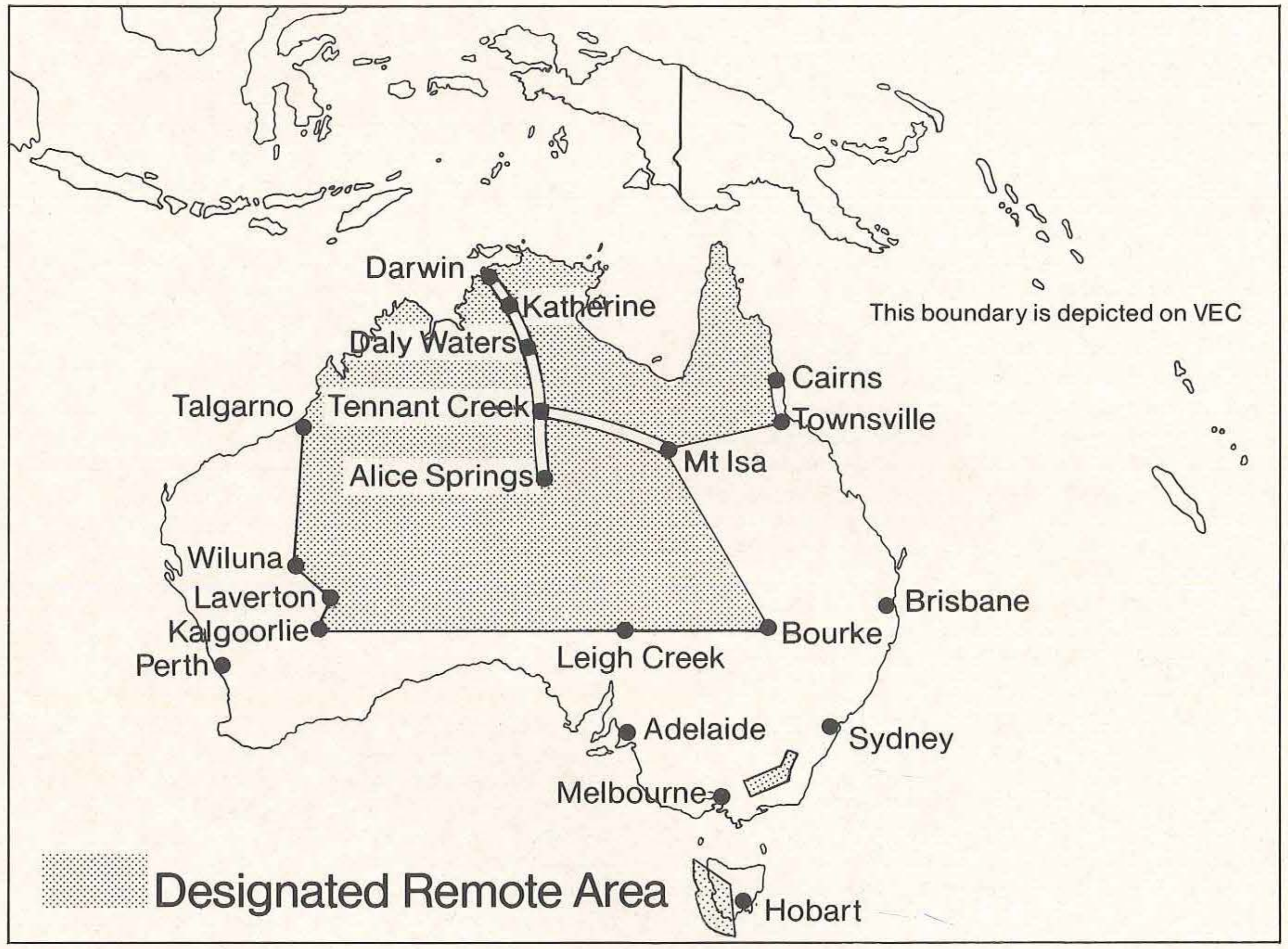
overcome the illusions from his other senses, his responses must be conditioned by long and thorough instrument flying training.

There is simply no short cut to this stage — either a pilot has been properly trained to fly on instruments, or he must face the inescapable fact that he will not be able to do so. If this is the case he must avoid placing himself in situations where he is likely to be deprived of visual reference.

Deliberate flight into instrument conditions is forbidden unless the aircraft is properly equipped for such operations and the pilot holds an instrument rating. But in the situations we have been discussing regulations alone cannot prevent accidents. The responsibility lies with the individual pilot. As we have seen, it is not good enough to be willing to turn back if conditions become impossible for flight in VMC. By that time it might already be too late. When it becomes apparent that the weather is deteriorating, we must discipline ourselves to turn back while there is still room to manoeuvre safely and before the weather closes in behind us ●

Navigation: key to safety in remote areas

A review of accidents and incidents related to navigational difficulties in remote areas of Australia reveals a common theme — lack of experience coupled with inadequate flight preparation.



Note 1 — Flight through corridors shall be made within sight of the highway concerned but in no case more than five miles therefrom.
Note 2 — Australian administered islands adjacent to the Remote Area between Talgarno and Cairns are part of the Designated Remote Area.
Note 3 — Mainland within 50 nm of Darwin excluded from Designated Remote Area.

Cross-country navigation in a light aircraft today is a very different matter from what it was three decades ago when the *Digest* first began publication. In that era of fabric-covered tail skid and tail wheel aeroplanes, which cruised at 80 knots and had an endurance of only about two and a half hours, a pilot's problems were mostly manipulative ones. If he could master these properly, the performance limitations of his aircraft made it unlikely that he would get into a great deal of trouble on a cross-country flight.

Today, the exact reverse is true. From a manipulative point of view, most single-engine light aeroplanes, even high performance ones, are much easier to fly than their predecessors. But their speed and range is often such that quite minor navigational errors can easily become compounded into major ones if the pilot is not 'on top' of what he is doing.

In years gone by, apart from aircraft operated by aerial medical services, developmental air services, mining groups and aerial survey organisations, very little general aviation was done in the distant, sparsely settled areas of Australia. Those that *were* operating, were in the main, flown by highly experienced 'bush' pilots who knew their particular area intimately and whose names became household words in the regions they served. Today, however, the expansion that has taken place in the general aviation industry, and in private flying in particular, has changed this picture completely.

The fact that light aircraft are easier to fly and have an extensive range, naturally and quite properly encourages their use for long cross-country trips and 'tours'. And the increasing use of light aircraft for business as well as for pleasure, has inevitably led to a great deal more flying being done in the very areas where the light aeroplane is by far the most practical means of transport. This in turn has meant that many pilots, whose flying training and practice had previously been confined to operations in the more populous regions of the continent, have suddenly found themselves having to cope with the far different problem of navigating accurately in areas where hundred of miles separate the sort of landmarks and check points they have previously been accustomed to — highways, towns, railways and so on.

The transition to this type of navigation is not one to be taken lightly, as many less wary pilots have already found to their cost. Pilots who have little or no experience in flying in remote areas may not appreciate that the Australian outback is a big country and, though light aircraft navigation in remote parts of the continent is not necessarily more difficult than in our closer settled areas, it is a task abounding in pitfalls for the unwary and the ill-prepared, and by its very nature is far less forgiving.

There are two particular factors which have undoubtedly contributed to navigation problems encountered by inexperienced pilots in recent years. Both relate to pilot attitudes.

Over the past few years, the promotional advertising for some types of light aircraft has fostered the notion that the skills and judgments necessary to fly an aeroplane are little removed from those required for driving a motor car. Unfortunately, amongst some would-be aviators, this seems to have stimulated an 'aerial driver' outlook rather than a proper 'pilot-in-command' philosophy and has done nothing to encourage amateur pilots to aim at professional standards in all aspects of their flying.

The same sales promotional campaigns, in conjunction with undoubted virtues of the aircraft themselves, also seem to have introduced to the ranks of aircraft owners and pilots, persons who have learnt to fly because it provides them with an efficient means of transport in country or outback areas, but who have no real interest in flying other than this.

Attitudes of this sort are in marked contrast to the emphasis on leadership and enthusiasm, pride in skill and airmanship, and *esprit de corps*, which so characterised the aero club and flying school movement three decades or so ago, when private ownership of aircraft was the privilege of the very few. As a result, light aircraft flying today is much less subject to imposed discipline and far more individualistic in character. It is all the more necessary therefore that individual pilots take care to cultivate in themselves the right attitudes and self-disciplines so necessary for conducting their flying in a sound and safe manner.

The following comments, taken at random from BASI's investigation files, give some idea of the problems that are being encountered in remote area flying:

- 'The pilot did not positively establish his position in relation to a selected fix point before continuing on to the next fix point'.
- 'The pilot became lost in a remote area because he did not make adequate preparation before departure, to ensure the safe navigation of the flight'.
- 'The pilot's navigational competence is obviously suspect, as shown by his failure to use his computer to calculate heading, ground speeds and times, and by his general lack of directional sense. If a forced landing had become necessary, the task of establishing a search probability area would have been made much more difficult because of the poor flight plan lodged by the pilot'.
- 'The situation in which the pilot found himself is typical of what results from sloppy flight planning and inattention to map reading by an inexperienced pilot operating in a remote area. It could be said that this pilot was a SAR phase going somewhere to happen'.
- 'The pilot was inexperienced both in flying generally and with the remote area in which he was operating. His aircraft carried no survival equipment, water, matches or survival beacon, and he had set out on the flight without ensuring that his HF radio equipment was serviceable. His flight planning was meagre in the extreme, and made no allowance for wind or for checking the progress of the flight in relation to recognisable landmarks'.
- 'The procedure adopted by the pilot in following unsealed roads involved substantial deviations from the flight planned track. As this was his first flight to the Northern Territory however, prudence might have dictated following the well-defined Barkly Highway to Tennant Creek, thence the Stuart Highway to Daly Waters'.
- 'The tendency to deviate from the flight plan with no real justification, instead of sticking to the plan, is something like people lost in a forest going round in circles. Obviously a plan is a plan and it should be adhered to unless a positive fix indicates the aircraft is off track'.
- 'If ever there was a case to demonstrate that accidents don't "just happen" but are the culmination of a chain of unfavourable events and circumstances, this one does. In this case, the chain was formed by a series of factors which, for the most part, could be listed under the general headings of inadequate flight preparation and lack of planning'.

These case histories, together with other accident and incident report data in the same category, show that there are several common factors contributing to the high incidence of navigation difficulties in the outback. For nearly always when navigational problems develop, the pilot is lacking in overall experience, recent experience or perhaps both. It must of course be accepted that inexperience in either of these areas will inevitably result in some mistakes. After all, this is no more than the price of real experience. But proper flight preparation and a sense of one's own limitations should ensure that such mistakes do not develop into navigational disasters. Clearly, one of the chief weaknesses is lack of real flight preparation — not just simply filling in a flight plan form, but as Air Navigation Regulation 231 on flight planning puts it, '. . . studying all available information appropriate to the intended operation . . .' This of course includes obtaining adequate information on weather conditions, both en route and at the destination, as well as the provision of an 'emergency plan' that will enable the aircraft to safely reach an 'alternate' if things go unexpectedly wrong. Also, if the flight is to be through one of the designated remote areas, it includes making provision for the special requirements concerning the carriage and use of HF radio and survival beacons.

And not only must one's technical competence and knowledge for the task be carefully considered. The flight time limitations laid down in Air Navigation Orders have been devised because experience shows them to be an essential component of safe aircraft operations. There are very sound reasons for them and pilots must remember that, just as a machine cannot function properly if it is not adequately fuelled and maintained, so the human body cannot function efficiently without proper food and rest at the right intervals.

Once in the air, other weaknesses in navigational technique take their toll. Principal among these seem to be inability to map read accurately and failure to appreciate the need to keep a detailed inflight log. Frequently too, the effect of these inadequacies is worsened by pilots becoming convinced, without any real evidence, that they are in a particular position, and by their becoming flustered, which leads them to make rash, ill-considered decisions.

There is evidence too, that some pilots, when venturing into unfamiliar territory, are reluctant to seek out and to clarify, from Briefing Officers, the very information that might save them from difficulty. This is probably born of a reluctance to admit their lack of knowledge of the area or their unfamiliarity with particular aspects of flight planning, but pilots who feel this way should remember that pride is a quality best forgotten when undertaking flights in the remote areas of Australia.

It has been pointed out many times that the development of an accident is nearly always an evolutionary process. In other words, an accident does not 'just happen', but is usually the culmination of an insidious chain of events or incidents. Nowhere is this more true than with accidents resulting from navigational errors, where the event itself usually develops from seemingly insignificant omissions, errors and misjudgments, which, to the pilot concerned, seemed quite unimportant at the time. Yet with hindsight, it is frequently possible to see that if the formation of that chain could have been interrupted, the accident itself would have been averted.

One almost certain way of interrupting such a chain of events, provided that it is done in time to alter the course of the accident evolutionary process, and which is by far the most effective answer to a pilot's navigational problems when the situation seems to be getting out of hand, is to call for assistance. Over the years, incident records have revealed instances of pilots having been reluctant to call Air Traffic Control or Flight Service Units when confronted with navigational difficulties. No doubt, the number of such cases is much greater than is revealed. It is clear from the facts surrounding the known cases that the specialist officer on the ground could have provided valuable assistance had they been appropriately alerted. It is equally clear that failure to alert the ground organisation in such circumstances may expose perfectly innocent people to grave danger.

A point to be remembered is that the Department has a policy of granting immunity from disciplinary action to those pilots who, because of navigational or other difficulties, have a need to request assistance from the ground organisation. Certainly, such occurrences will be investigated. But this is done so that the circumstances which lead to the occurrence will be properly understood to the ultimate advantage and safety of users of our airspace.

* * *

What then can pilots, who are inexperienced in remote area navigation, do to avoid its many pitfalls? As already indicated, the answer lies in adequate flight preparation and in sound inflight judgment based on that preparation. Obviously pilots who have not done their homework properly for a particular route cannot expect to make the right inflight decisions when the unexpected occurs.

The advice summarised in the section that follows this article may seem common sense and obvious to most. So it is — but it is also so basically vital to safe cross country navigation that it cannot be repeated too often.

Pilots who follow these rules will greatly improve their chances of completing their flight successfully and uneventfully. If however, despite all precautions, a pilot does require assistance he will have ensured that the SAR organisation is well informed about his intentions and is thereby able to provide whatever assistance is necessary. On the other hand, if a pilot has been aimlessly following odd roads or tracks without keeping any navigational log, the SAR organisation's task is immeasurably more difficult.

And don't think that because you have made one or two trips in remote areas you will be immune from trouble — it takes a lot of experience spread over different seasons and conditions (summer, winter, drought, particularly favourable seasons for growth and so on, all of which can change the appearance of the country radically) to become an accomplished remote area navigator. BASI's records show that the more experience a pilot has, the more he follows these golden rules.

To disregard any of these factors in the planning and subsequent conduct of a flight, can, as has been proved so many times before, lead to results that are not only tragic, but in all probability permanent. As a qualified pilot, you have the complete trust of your non-pilot passengers and their lives are in your hands. It is a heavy responsibility — see that you are worthy of it ●

Following the Stuart Highway. Photograph by Mr Brenton Hollitt.

Hints on flight planning and navigation in remote areas

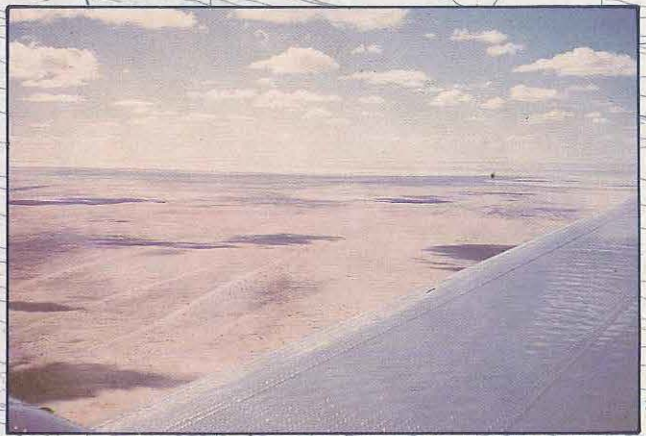
• Plan the flight carefully and unhurriedly, making use of all available information. Ensure that your maps are adequate and that they are current editions. Examine your proposed route, noting landmarks and distinguishing features. Study these and plan to track via clearly recognisable landmarks that you will be able to identify when you fly over them. Also study the features on either side of your planned track so that you will know if you drift off track. Read the advice contained in the front of the Visual Flight Guide — and follow it. Be sure you have the required radio and survival equipment and that it is in good condition — and make certain it includes sufficient water, matches, a torch and a mirror for signalling.

Iron ore in Onslow area near Fortescue River.

* * *

• Make use of the local knowledge of briefing officers experienced in the area, and of other pilots who fly the route frequently. Determine what fix points are the most suitable and obtain all possible information on landing areas along the route. Ensure that this information is as reliable and up-to-date as possible, for non-licensed landing grounds on station properties are often abandoned in favour of new or more suitable sites. As far as practicable, plan your flight over these landing areas. Be particularly careful of unmade roads and tracks as aids to navigation. In the outback, these are changing constantly and in open country new tracks can be formed literally overnight — simply because a vehicle happens to be driven through the area. Remember too that the appearance of the country can alter almost out of recognition with a change in the season, or after good falls of rain or bushfires.

• Obtain a thorough meteorological briefing and be particularly wary of areas where visibility may be reduced in dust or haze. Cloud shadows on the ground can also cause visual problems, so flights on days with a scattered cloud coverage require special care. Be willing to delay the flight until conditions improve, if the weather appears marginal or difficult.

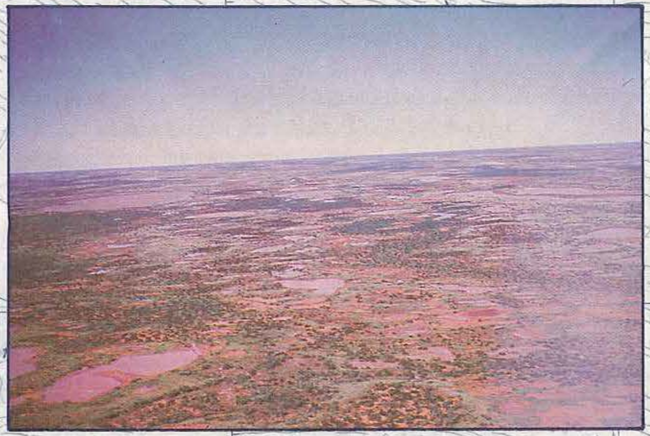


Sand ridges and cloud shadows with Lake Eyre in the distance.

* * *

• Plan to fly high enough to obtain a general picture of the country. There are few airspace restrictions in remote areas and generally when the weather is good and the sky clear, the higher you fly, the easier will be your visual navigation. Remember too that higher cruising altitudes will give a better range of communication on VHF. Cross-country flying in the inland is also much more comfortable when your aircraft can cruise above the convective turbulence layer. But don't allow a cloud layer at a lower level to impede your visual navigation.

* * *



The north-west coast east of Exmouth Gulf after a cyclone.

• Allow adequate time and fuel, plus reserves, not only for the planned flight, but for any possible alternative action. Carefully consider and decide on alternative plans of action in case selected fix points are not located as expected. If the flight is being made in the latter part of the day, ensure that there is sufficient time to execute the total plan, including alternative courses of action, before dark.

* * *

• Fly headings carefully — don't allow the aircraft to wander off track simply through inattention. Check for drift soon after departure and adjust heading as necessary. Continue to check drift and make adjustments to heading at frequent, regular intervals. Don't allow yourself to be distracted from the task of navigating the aircraft, but map read carefully as the flight progresses and know where you are all the time. Where this is not entirely possible because of lack of landmarks, at least know your dead reckoning position all the time. Anticipate fix points a few minutes ahead of ETA — don't just wait for them to 'show up'. Record all headings flown and the times of making changes — in fact form the habit of keeping an accurate running log. In the long run it will pay dividends in the trouble it will save you.

In Australia the sand dunes move along their length.

* * *

• If you are unable to locate a selected fix point, immediately commence your planned alternative action. This could entail returning to the last positive fix, or perhaps diverting to some prominent landmark even if some distance away. Be prepared in these circumstances to abandon your original plan for proceeding to your destination, in favour of a destination which is easier to locate and in a more accessible area. Remember to log your headings and to check for drift.

The Georgina River.

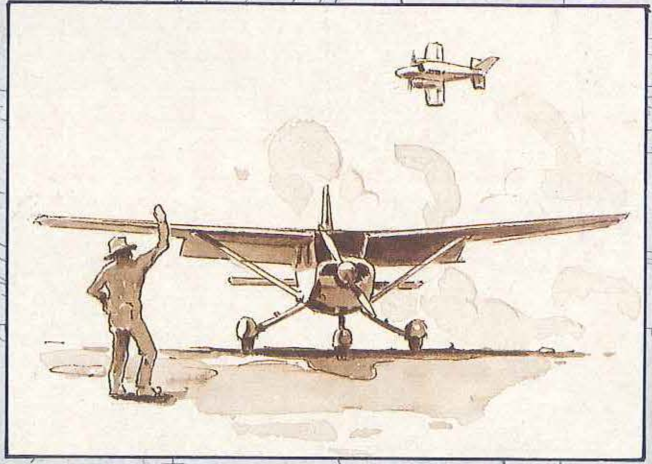
• If you do depart from your original flight plan, notify your new intentions to the nearest Flight Service or Air Traffic Control Unit. If you do become lost, don't allow yourself to become flustered or to become convinced that you must be in a certain position. Instead, keep an open mind and study the surrounding countryside. Advise the ground organisation of all headings and times flown since your last positive fix. This information will enable the SAR organisation, with its up-to-date wind and weather data, to commence a plot of your flight and assist you in establishing your position.

* * *

• Lastly, if, despite all these precautions, things go unexpectedly wrong and you are caught with insufficient fuel to reach your destination or a suitable alternative, use your last resources intelligently. Don't wait for the aircraft to run out of fuel before you make a forced landing. Select the most suitable area available to you and put the aircraft on the ground while you still have engine power for a precautionary landing approach — and daylight to see what you are doing. You may damage your aircraft but you and your passengers should be able to walk away from it.

* * *

• Having done this, stay with your aircraft. As far as possible maintain a listening watch, operate your survival beacon, lay out ground signals, light fires by night and wait for rescue ●



Reader contribution

Precautionary search and landing

If ever you find yourself in any of the following situations:

- running short of fuel
- unable to reach destination before darkness
- caught in bad weather
- suffering partial aircraft unserviceability
- pilot incapacitation etc.

it may be necessary to land as a precaution against having an accident.

In most cases only poor planning, poor airmanship and poor decision-making will allow such a situation to arise. However, a combination of adverse circumstances may leave you in the unhappy situation of being forced to land on an unprepared area, i.e. 'off-airport'.

The aim of this exercise, then, is to teach you how to search for, locate and safely land on an unprepared site.

The technique is also most applicable to landing at unfamiliar private landing areas (ALAs). Many light aircraft accidents occur at ALAs when 'aerodrome-trained' pilots attempt landings without adequate inspection of the landing area.

Options:

If things are going wrong consider your *options*. The following options apply to all of the above circumstances but are particularly applicable to bad weather. In order, they are:

Continue. This may not be the best option but it will be the most tempting. If you decide to continue do so cautiously. Leave a back door open so that you can retreat. Decide in advance how far you will go before you review this decision.

Hold. In some circumstances it may be possible to hold until conditions improve. This will depend on the type of weather, and fuel and daylight remaining.

Detour. It may be possible to detour around bad weather and still get to your destination.

Return to your departure aerodrome.

Divert to another aerodrome or landing area.

Land off-airport. The least tempting but sometimes the best option.

Procedure

The procedure to be adopted will vary with the circumstances. For training purposes we will assume the worst combination of circumstances in which you find that you are:

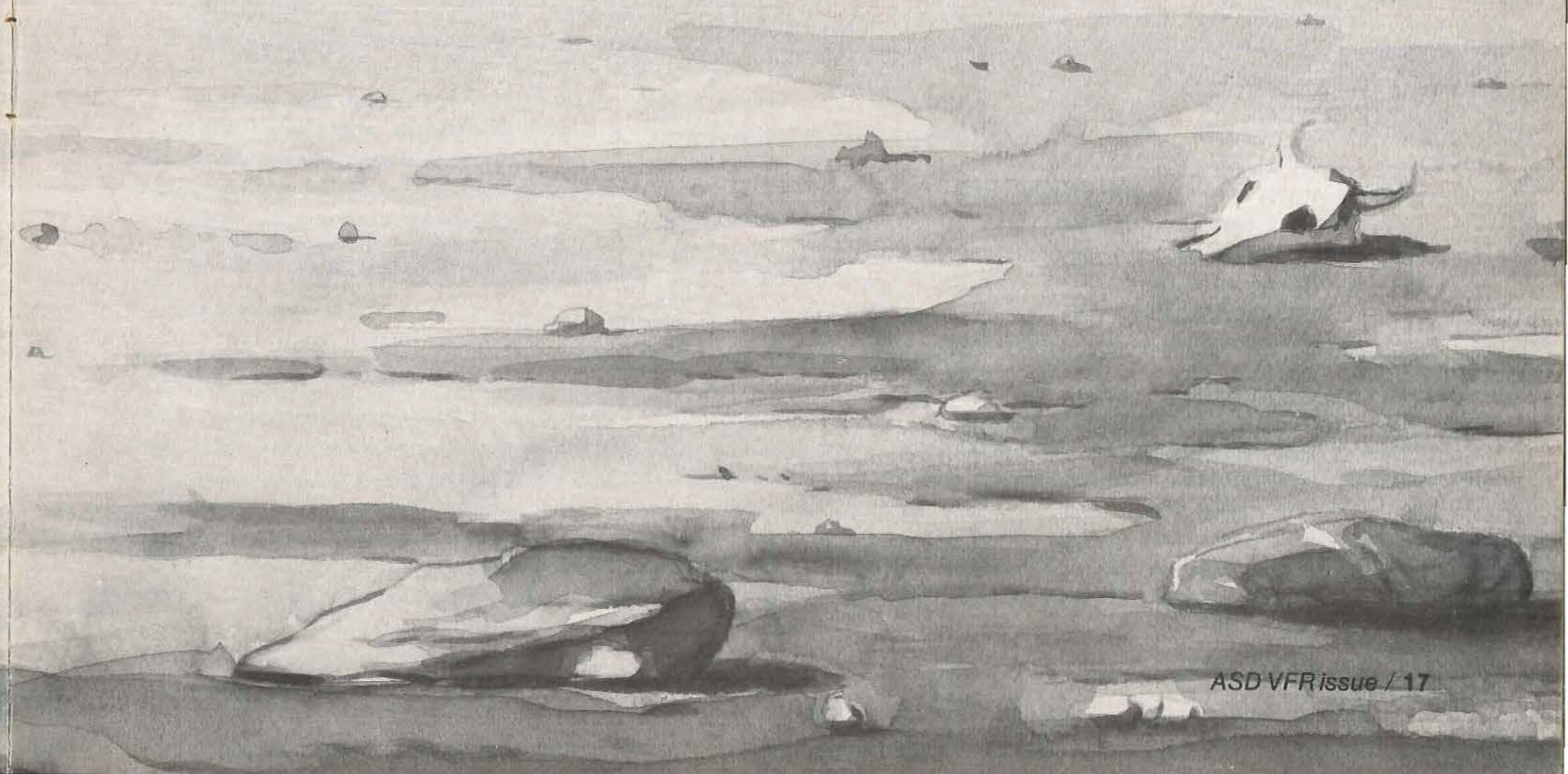
- lost;
- short of fuel and/or daylight; and
- in bad weather with low cloud and reduced visibility.

1. **Slow down.** Fly at the slowest safe airspeed. (See pilots notes for speed and flap setting). This gives you more time to *think* and to *look*.
   Keep well below the cloud base.
2. **Look for a suitable landing area.** Consider *size*, *shape*, *slope*, *surface* and *surroundings*. Carry out a methodical search. For preference follow a line feature. Alternatively, fly an expanding square or circle or creeping line ahead pattern.
   Flying down wind will let you cover more territory but your ground speed will be higher (See 1 above).
   Transmit intentions on appropriate frequency.
3. **Circle** any promising landing area at cruising height to get a general picture of the area and to look for obstructions, particularly *wires*. Check adjacent areas for poles which may indicate the presence of wires.
4. **Determine the wind velocity.** (Smoke, drift, wind shadow or wind lanes on water.) Choose a definite touch down point and landing path.
5. **Inspect the landing area.** Make an inspection run at approximately 200 ft above ground level (well above all possible obstructions) into wind and slightly to the right of the intended landing path, maintaining slow but safe airspeed (do *not*, under *any* circumstances, get too close to the stall speed). Inspect the approach area, the surface and the climb out area.
6. **Carry out a bad weather circuit.** Perform pre-landing checks and emergency landing briefing.
7. **Carry out a practice short field landing approach.** Do not come below the tree canopy height and look out for *wires*. Overshoot at approximately 50 ft AGL and carry out a further inspection of the landing area.
8. **Land if satisfied.** If you are now satisfied that a landing is feasible carry out another bad weather circuit and make a shortfield/roughfield landing. If you are in doubt carry out further practice approaches and inspections until you are happy or else go and look for another landing area.

After landing. Survival after landing will depend on circumstances. Before each flight you should consider whether you are properly equipped mentally, physically and materially to survive after a forced landing in your intended area of operations.

General. It's not *where* you land it's *how* you land that's important. A good landing in a bad area is survivable. A stall/spin or graveyard spiral may not be survivable even if you land on the biggest of airports. This procedure could take up to 20 minutes to perform, so don't leave it until the last minute to decide to land.

If you do happen to land an aircraft off-airport a careful assessment of the conditions is essential before any attempt is made to fly it out. Specialist advice may well be necessary ●



Reader contribution

Continued VFR into IMC

This article is an adaptation of a conference paper by a senior CFI from an aero club. The comments expressed on training are his personal opinion. The advice presented on dealing with difficult weather situations is recommended to all pilots.

Department of Aviation statistics show that each year an average of 264 Australian pilots fail in their attempts to defy the law of gravity and either substantially damage their flying machines and/or inflict injury on themselves or some other person. On the average, 20 of these occasions prove to be fatal.

Taken all in all, that's not a particularly good score. The resulting adverse publicity sets our aviation back just that bit more.

Of the 264 total accidents some eight, on average, result from pilots of VFR flights attempting to continue flight into IMC. Not a significant number until you realise that almost always these are fatal accidents. Eight out of 20 is a substantial number. Also, as the IMC accident is the kind of accident that is least acceptable to the general public for deep psychological reasons, it is the type which gets the most press coverage and causes most harm to our industry. It is apparent then that this is a major area of aviation safety which we must tackle together.

Although no accident is necessary, the IMC accident is the least necessary. Surely by now we all understand the problem and can avoid these situations — or can we? The cause of IMC accidents really is an attitude of mind — 'press-on-itis' — 'get-there-itis'. The disease has many names and we can all be guilty of it at times despite our best intentions.

A pilot is subjected to lots of pressures other than the demands of maintaining control of and navigating his aeroplane. A frequent major cause of pressure is the passenger or passengers. Every pilot has an inherent wish to please the passengers by reaching the intended destination, and he can often find himself being harassed by the passenger into continuing when he knows he should quit.

It would seem to me there are two distinct areas to consider. The first is the VFR pilot who becomes trapped and is forced to attempt to continue in IMC and either:

(i) loses control; or

(ii) runs into cumulus granitus under full control.

The second is illegal IFR, where the pilot intentionally enters cloud but does not observe such basic conventions as lowest safe altitude etc. Although I am only guessing, the bulk of the medium and high-time pilots must surely have been indulging in this practice.

There are several ways to try to cure this problem. The first is through education, the second is through legislation (the practice referred to is already illegal), and the third, improved facilities.

If we look at what has been done in the past, we may become a little disheartened with the results of education. The excellent *Aviation Safety Digest* has been spelling out the same message loud and clear for years and years, as have most instructors of my acquaintance — surely, there cannot be any pilots who qualify for PPLs who have not heard the words 'Keep out of cloud'.

However, I suspect that a very large percentage of pilots are not shown or even told *how* to keep out of cloud. None of the manuals tells you how, and one American writer put it: 'With the advent of IFR in the airlines and the military, the skills of (visual) contact flight in bad weather have mainly been lost'.

This fault must lie with our pilot training system — both with the schools and the regulations. It is my belief that our training environment is so restricted and constrained by regulation that it does not adequately prepare the pilot for the real world environment of General Aviation. For example, for Restricted PPL no training is permitted on Authorised Landing Areas of the normal minimum dimensions for private operations — similarly, the major training aerodromes are closed to all visual operations as soon as the weather deteriorates to minimums — thus depriving many trainees of the opportunity to experience exposure to weather below the minimums. Very few pilots can tell you when weather conditions have in fact reached the minimums.

So what are the minimums for VFR? Who can tell me what they are? — fine — and can you recognise them in flight? — and would you be prepared to abandon your flight whilst you still had 1000 ft cloud base and/or 5 km visibility? It is in this area that a great deal of confusion arises.

Air Navigation Regulation 133 permits flight at lower than 500 feet AGL above open terrain 'due to stress of weather'. However, this really does not permit any reduction in the VMC minimum, i.e. the vertical and horizontal distance from cloud. So, what does our average weather-pushing pilot do as the weather deteriorates? Normally, most pilots will accept less clearance from cloud than the ground, which leads to the old 'fin in the cloud' flight technique, which, if the cloud base is lowering, blocks his effective view ahead and will probably cause him to start running into the scuddy bits of the cloud base — so, down goes the nose in an attempt to get down — but without power reduction. As a result, the airspeed increases rapidly for little loss of altitude. He probably can no longer see ahead but probably can see down and to one side, so he starts to turn that way just in case he enters the cloud — a steep spiral dive sure is no place to start instrument flying you will agree.

The following steps detail my technique for staying out — or getting out — of trouble in weather.

1. At the planning stage of the flight, make sure that you get an adequate weather briefing. Sometimes this will be wrong: sometimes the weather is better than forecast, occasionally it is worse, and sometimes it is precisely as forecast. Make your own evaluation of the data presented. This also may be wrong. Obtain actual reports where possible. Plan alternative courses of action if the weather is anyway less than CAVOK and if it's marginal, plan alternates to your alternatives.

2. In the event of encountering low adverse weather en route, take the course of least resistance — stick to the low country. Cloud, mountains, and airplanes don't mix well. For preference, follow a line feature, such as a road, river, railway or coastline to simplify the navigation. (Please keep to the right — somebody might be coming the other way.)

3. Choose *decision points* — points at which you will make a definite decision to either return, divert or continue. The worse the weather the closer together the decision points.

4. Keep the back door open. Don't go in if you can't get out.

5. Stay well below the cloud base so that you *always have a horizon*. Much better to descend well before a cloud shelf and have a look under from way back. This is the big trick in cloud avoidance — *you must maintain a horizon*. If the cloud obscures the horizon, it is below your level. Get down or turn around before you enter it. Never, ever, push through that little gap in the hills when it looks all black on the other side.

6. Slow down — it makes so big a difference you wouldn't believe it. It's better to have a 100 mph brain in a 60 knot aeroplane than a 100 mph brain in a 160 knot aeroplane. You need time to think. But keep your IAS safely above stall speed.

7. Request assistance from Flight Service, ATC and other aircraft about actual weather.

8. Before it gets too bad, exercise one of your options: Detour, Hold, Divert, Return or Land. Remember, a good landing in a bad area is preferable to the traditional Final, Fatal Spiral. You might damage your ship, but that's really not important.

If you are ever in a situation where all of these choices are denied to you, then my advice is to go on to instruments and *climb* — safety lies upwards. Remember, though, that the tops may be higher than your aircraft can climb. Preferably, start your instrument flying well before you enter the cloud and preferably in a wings level attitude. Remember all the 'Cs':

Concentrate on your instruments . . . no peeking out, you can't be half instruments and half visual.

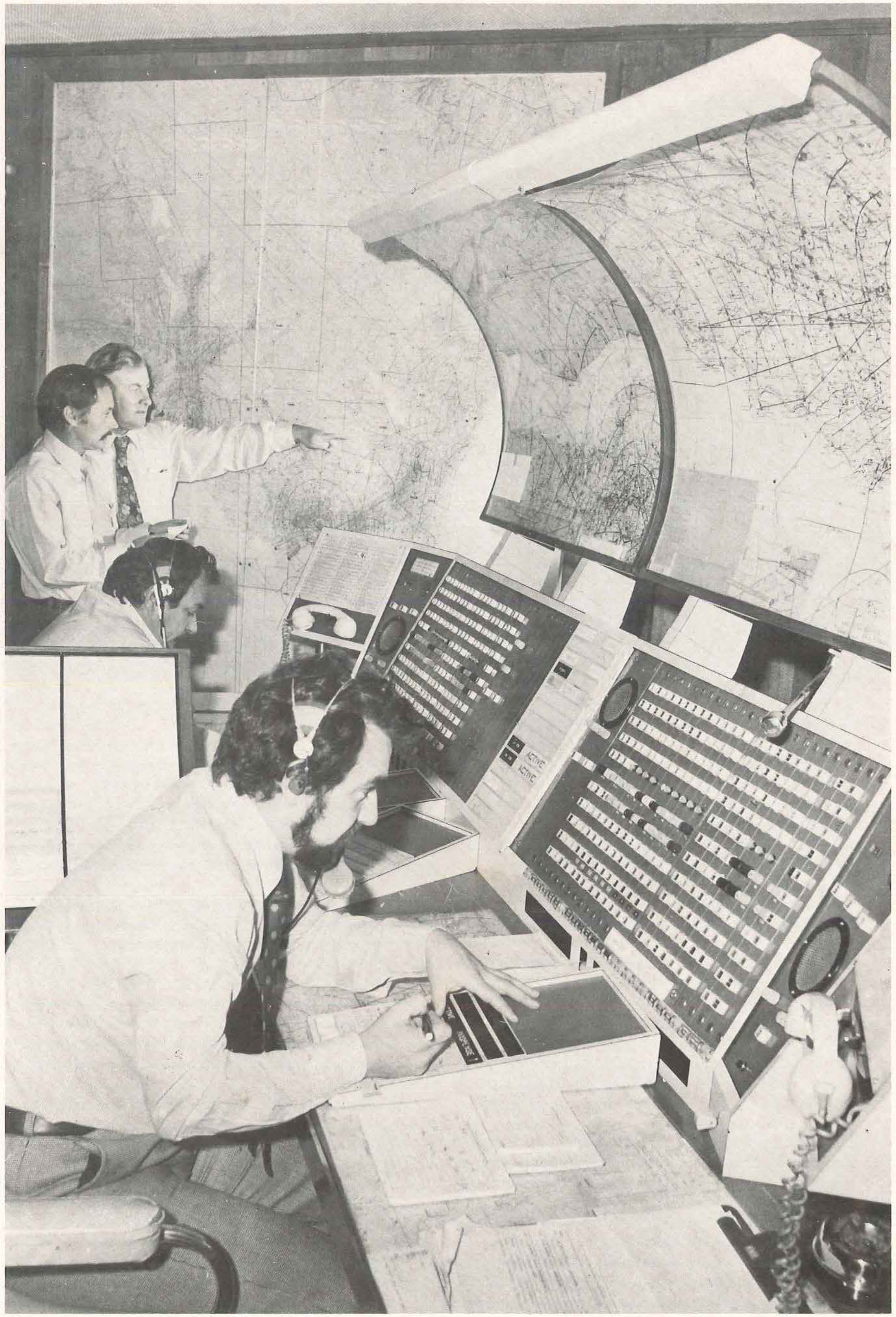
Climb. EVERY foot gained is a little less terrain to run into and you have less trouble controlling the ship that way and maybe you'll come out on top. When you do get on top — get well above the cloud tops. The breaks are easier to see that way.

Communicate. Get some help on the radio and let the IFR boys know to keep out of your way. Don't be afraid of 'Big Brother'.

Conserve your fuel, you may be up here for some time. Also, remain *cool, calm* and *collected* and *in command*, you are the *captain*.

To conclude, I will leave you with this thought:

The sky is a big ocean,
The light aircraft is a small boat.
Would you take your small boat out
on the ocean in a storm? ●



Reader contribution
Ask for help — while you still can

I detect a fairly prevalent feeling among pilots that Departmental officials are regarded with the same kind of suspicion as school teachers or policemen. The attitude is that Flight Service and similar staff are to be given a wide berth — or you could end up with a fistful of 225s. This seems to me to be another factor in the chain of events that can lead to dangerous situations for pilots and passengers.

I would therefore like to describe an incident with the object of highlighting how liaison with Flight Service can make life safer for the pilot. During my flying career I have often sought the guidance of Flight Service. They have usually put their suggestions in a tactful, indirect fashion — presumably because their transmissions are recorded. But from the Departmental point of view, I am sure that helping to keep pilots out of trouble is far more important than castigating them or, worse still, having to pick up the pieces after a crash.

My own story is about a flight from Clermont to Maroochydore where I was to spend Christmas. At the time of the incident I had a private licence, about 400 hours in command, and a new Night VMC rating. Most of my hours had been gained in remote areas of the Gulf country and northern Queensland. The aircraft was a Cessna 172 with VOR, ADF, and long range tanks. On board with me were my wife and infant son. We were tracking direct from Clermont to Maroochydore and had adequate endurance to complete the flight safely.

The flight started in the morning in fine clear weather and the forecast indicated suitable weather for the flight. However, the indications were that deteriorating conditions could be expected towards the coast late in the afternoon with buildups of cumulo-nimbus clouds, thunderstorms and rain squalls. This forecast was quite accurate and by Eidsvold we were looking carefully at the situation. By Gayndah there was storm activity and occasional squalls. We decided to keep going, bearing in mind that the weather activity was only scattered, with a high cloud base at 5000 feet, and that the coast to the east was still clear as the weather was coming from the south-south-west, so that Maryborough was CAVOK and a safe haven if needed. Our endurance was adequate to fly to alternative destinations safely, and we had plenty of daylight left.

Abeam Gympie, Brisbane called me up and asked for a report on the weather in my area. By this stage there were very heavy clouds rolling in from the south-west, areas of dense thunderstorm activity and heavy rain squalls. We kept going because Maryborough was still fine and because Brisbane advised us that the weather along the remainder of my track was still VMC. Things in the Maroochydore direction certainly did look more pleasant than Gympie.

By Cooroy I decided to give flying away for a while and see how the weather developed. I did not know the area well for one thing, and secondly conditions were now deteriorating too fast for comfort. I told Brisbane of my decision and asked them to advise what strips were in my area. By this time I could still see the strip at Noosa but it was rapidly disappearing in a rain squall. Flight Service advised that there was a nearby private strip close to a set of white cattle yards on the northern end of a lake. At this stage also I could still have safely made Maryborough.

We landed without trouble at this bush strip and waited for a while. After about half an hour the rain stopped and the clouds lifted a little. I rang a friend at Maroochydore for a report on conditions there. I also rang Brisbane Flight Service. On the basis of my local observations and the reports from Brisbane and Maroochydore I decided to continue, overflying Noosa strip for safety. At the time of takeoff, conditions were VFR at the destination and apparently along the track. The flight to Maroochydore should have taken about 20 minutes.

However, a few minutes later a heavy rain squall moved along the coast towards us. The clouds had again descended to hilltop level, so our bush strip was now hidden by cloud. We looked in the Maryborough direction to see that blanked out also.

At this stage I was circling above a very grey sea just out from the beach at about 1000 feet. That beach looked very welcoming. Just as I had finally decided that the beach was the place to head for, Brisbane called me to ask if I could maintain VMC. My prompt reply was: 'Negative, and there is a nice stretch of beach down below where I intend to land'.

We did a normal circuit and landed with full flap and minimal airspeed. I judged that the beach would be hardest where the wet sand merged into the dry. All went well and SARWATCH was cancelled from the beach.

I rang Brisbane FS from Tewantin rather expecting a blast for landing on a beach. The reaction was, however: 'Well, you would have been a bloody fool if you had done anything else! Happy Christmas!'

So thank you, Ops. Staff, for your help to me and my family on several occasions. May I say to other raw pilots that if you find yourself in a tight spot, liaise with Flight Service for advice, make up your own mind ultimately on your course of action, but do not leave either the liaison or the decision-making too late.

Comment

We too endorse the pilot's decision to land on the beach, in a situation where there was no reasonable alternative. But, unless you know the particular beach treat it with respect, particularly in nose wheel aircraft. There may be soft patches in what seems to be a firm surface ●

En route mid-air collisions:

how to avoid them

Pilots could be excused for perhaps thinking that the likelihood of a mid-air collision in Australia is remote: there is a lot of sky out there and aircraft are relatively small, so the chances of two being in the same place at the same time would seem to be minuscule. Yet the statistics show that this is not the case.

In the two-year period preceding the preparation of this article over 60 occurrences of reduced separation were reported. There were doubtless more which went unreported because pilots remained blissfully unaware of the proximity of other aircraft.

Many of these incidents occurred in the circuit area, where pilots should have had an acute awareness of the position of all traffic at all times.

On the other hand, 16 of the incidents involved aircraft which were established in an en route cruise. Given that there indeed is a lot of sky out there, there is often an understandable tendency during the cruise to be less assiduous in maintaining a lookout. It is therefore interesting to note that in almost all of these 16 incidents, the aircraft involved passed so close to each other that either one or both pilots had to initiate evasive action to avoid a collision.

This article addresses the issue of detecting other aircraft during an en route cruise by examining some of the physical, physiological and psychological problems of 'lookout' or visual search.

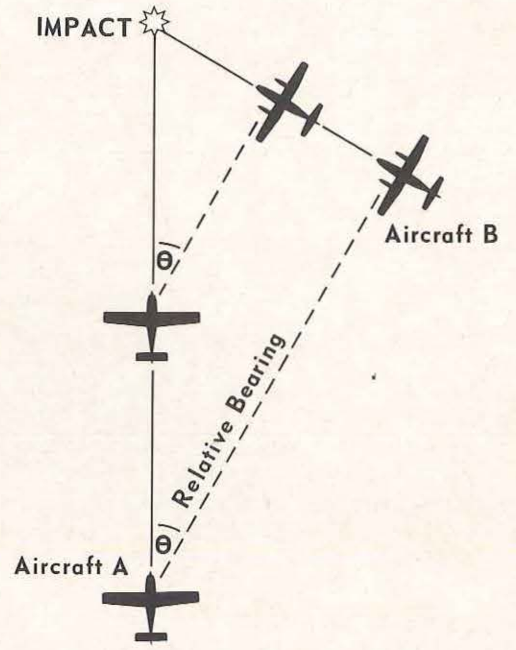


Figure 1. *Constant relative bearing equals collision risk.*

Relative motion

If two aircraft are on a collision course and these aircraft are flying on constant headings at constant horizontal and vertical speeds, then each aircraft has a constant relative bearing to the other right up until the moment of impact. Figure 1 makes this clear. Even though Aircraft A is going twice as fast as Aircraft B, their relative bearings are constant. The effect of this, of course, is that if you are going to collide with another aircraft, then that aircraft has no apparent motion with respect to you and will stay at exactly the same point on your windscreen until you hit it; in other words, it will in many respects behave in the same way as a fly squashed on the outside of the windscreen.

This absence of any relative motion is important from the point of view of detecting the other aircraft because most of the retina (the sensitive layers of cells at the back of the eye which turn light into nerve impulses to the brain) is wired up to be especially sensitive to the detection of small movements. It is not hard to imagine why this has evolved to be so. If you and your fellow cavemen were sitting around the campfire munching your mammoth steak you would not need to have your attention drawn to the woods while they were still, but even a small movement could have signalled danger. Apart from this physiological reason for moving targets being easier to detect than stationary ones there is probably a psychological reason as well, and this is that the experienced pilot will have learned to use movement as a cue to detection for the simple reason that all the aircraft he has ever seen will have had some relative movement with respect to him — unless he is one of those pilots who has had to take real evasive action to avoid a collision.

So, the relative motion problem is a very real one and can be summarised by saying that motion is a good cue to detection, pilots probably learn to use it, and all aircraft possess some relative motion except for the odd ones that you are likely to bump into (which is a bit of a shame really — much better if it were the other way round).

Time, distance and size

Some pilots may wish to argue that while the information on relative motion may be true it does not really explain how mid-airs occur: if you are going to hit another aircraft it must look as big as a barn door before you collide with it; whether it appears to be moving or not is, to put it mildly, of academic interest only.

To answer the point, look at Figure 2 to see just how an oncoming aircraft appears to get larger as it gets closer. It is roughly true to say that the apparent size of an oncoming aircraft (i.e. the angle which it subtends at your eye) doubles with each halving of that aircraft's range. Imagine the case in which a GA aircraft and a military jet are approaching each other head-on at

A real life en route near-miss. The four Hercules in formation were being photographed from another Hercules when an unidentified light aircraft tracked across their path, the pilot apparently oblivious to their presence. Photograph courtesy of Flt Lt Allan Edwards.

speeds of 150 knots and 450 knots respectively — a closing speed of 600 knots. At about twenty seconds before impact the two aircraft might be about 6000 metres apart and each will present a target to the other of only around a sixteenth of a degree. Ten seconds from impact the distance will have halved and the target size will have increased to all of an eighth of a degree; at five seconds the size will have again doubled but is still only about a quarter of a degree.

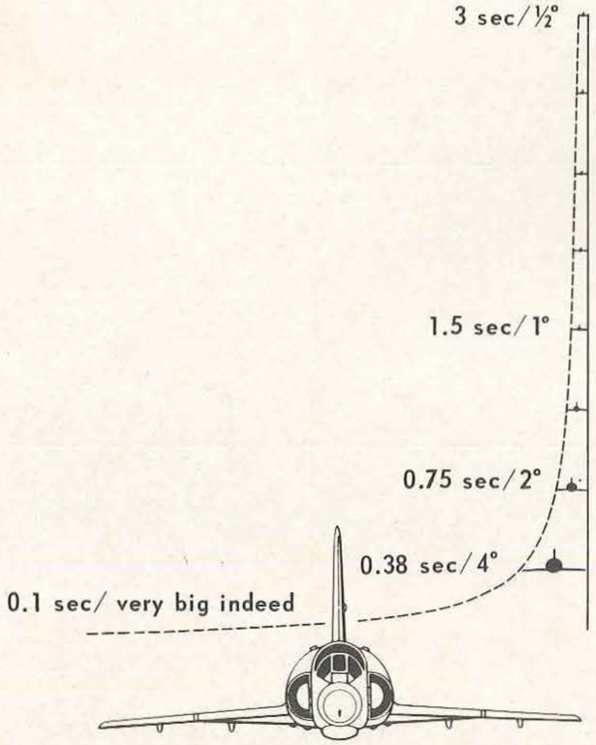


Figure 2. *Time to impact and angular size of oncoming aircraft.*

In other words, the oncoming aircraft remains extremely small until very, very late, and then it suddenly expands into something that fills the windscreen. These abstract calculations match up with the accounts of many pilots who have had mid-airs or near misses: they often describe themselves as having maintained a good lookout, then diverted their attention inside the cockpit for two or three seconds to complete some checks, only to look up and be horrified to find that the way ahead was full of aeroplane. As reaction time is usually two seconds or more this amounts to a situation pregnant with danger.

Some readers may still not be convinced that there is any perceptual problem in seeing other aircraft and might argue — with some justification — that although, for example, a quarter of a degree may sound small, it is actually a reasonably large target (it equates roughly to the size of a 20 cent coin viewed at a distance of about six metres) to miss completely, and that anyone keeping a good lookout should not really miss it. There is an element of truth in such an analysis, but it really hinges on what is meant by a good lookout, and this again bears some psychophysiological comment.

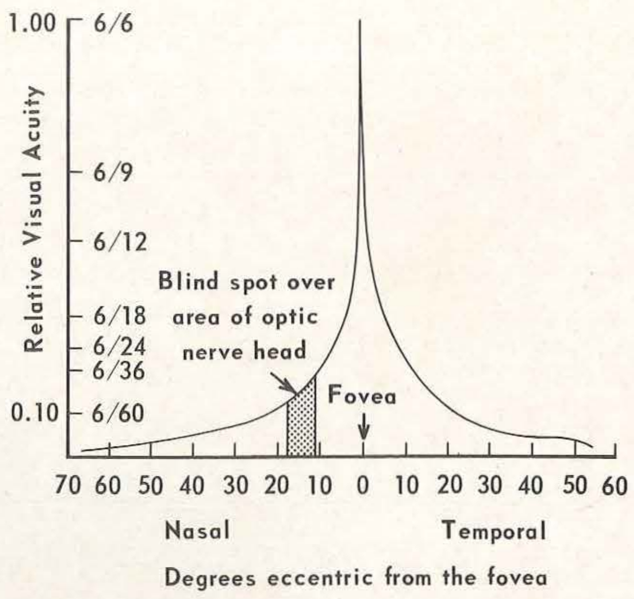


Figure 3. *The variation of visual acuity at retinal sites eccentric to the fovea. The acuity at 5 degrees to the fovea is only one-quarter that at the fovea.*

Visual acuity

The first point to be made is that the retina is not equally sensitive over all its surface. Figure 3 shows that it is only in a small, central area of the retina (the fovea) that visual acuity is good. Even at very small angular departures from this central area acuity drops off alarmingly to a small fraction of the central acuity. This does not cause any problems in everyday life because we can always use the central part of the retina to investigate anything that we are interested in and use the rest of the retina to 'fill in' the rest of the world (and attract our attention to anything interesting out there), but it does mean that if we are conducting a visual search for a small target, and the object of our search does not happen ever to fall on the foveal area, then we are extremely unlikely to see it. This is especially true, as noted at the beginning of this article, if the target has no relative movement. It is, of course, this unequal distribution of acuity over the retina which produces results such as those shown in Figure 4. In this experiment subjects were required to detect the presence of a Douglas DC3 (not a small target) at three different ranges and at differing locations on the retina. It is clear that the subjects' chances of spotting the aircraft dramatically mirror the sensitivity of the retina.

Many pilots will have experienced similar effects; it is a common experience to spot another aircraft, look away for a few moments, and then look back to the area of sky where it was but be unable to see it again because this time the aircraft's image just does not happen to land on the right bit of the retina. Sometimes, though, the aircraft will appear to pop up from nowhere as it is acquired in the right place.

Lookout and scanning

Accepting the comments presented thus far, the question now arises of how best to move the eye over the external world in order to maximise the chances of detecting aircraft out there.

Some pilots believe that the best way of searching is to

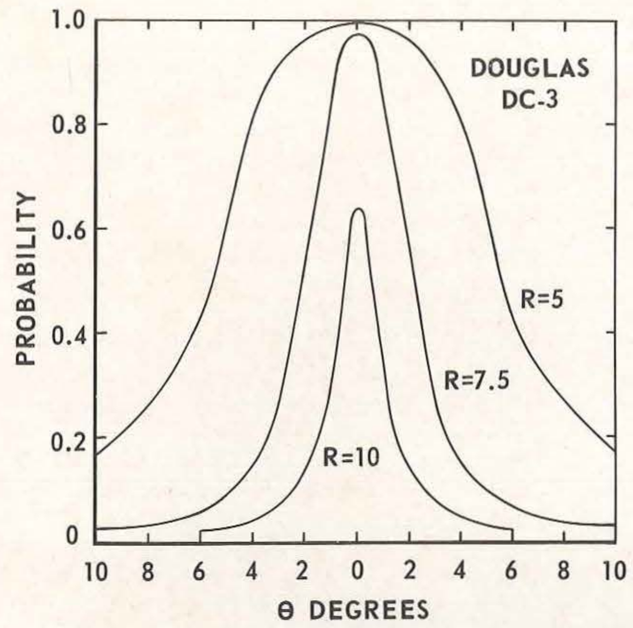


Figure 4. *Probability of detection as a function of eccentricity from point of fixation at various ranges.*

move the eyes in a smooth, continuous way over the area of interest. Unfortunately, it is impossible to move the eye in such a smooth, continuous movement unless there is something out in the world also moving smoothly which the eye can track. In the absence of such a moving stimulus, the eye can be moved only in fast jerks (called saccades) with interposed rests. What is more, it is only during the rests that it is possible to see anything. You can easily demonstrate the saccades to yourself by trying to move your eye smoothly around your room: pay careful attention to what you are doing and it will become apparent that actually you are moving your eye in jerks. However, if you hold up your finger in front of your face and move it about you can track it smoothly and easily. Alternatively, watch someone else's eyes whilst he does it.

So, when searching an empty sky the eye does not move smoothly but jerks about. There is some good evidence to suggest that if you are conducting a search it does no good to prolong the rests: that is, if you are going to see something in one of the rests, you will see it straight away and it does no good to leave your eye hanging around in the same place — it just wastes time. Thus, in experimental situations, the people with the best detection scores were those with the highest frequency of eye movements. Those people who thought perhaps that they were making slow methodical searches were in fact losing out.

The last point to make about visual searches is that of where to look. It is possible that you could collide with an aircraft that was descending (in which case you should have seen it silhouetted against the sky) or climbing (in which case it should have been seen against the ground). In the first case it probably does not matter much what colour the aircraft is painted, but in the latter case it matters a lot. Australian GA and RPT aircraft generally show up fairly well against the countryside, although this does of course vary with the aircraft paint scheme and the terrain. The effectiveness of military camouflage on low-flying aircraft, on the other hand, has to be not seen to be believed. However, it is most likely that you will bump into another aircraft that is level with you, for in this case the other aircraft will (at low to moderate altitudes) be between you and the horizon and will present to you its least conspicuous aspect, i.e. you will probably be viewing it from the front or side and the wings will effectively have disappeared. So, again it looks as though all the factors conspire to make the most threatening possibility the least easy to detect.

Conclusion

The final, crucial question is whether all this actually results in any useful advice. The first important point is that pilots should understand what they are actually doing when they search the sky — and if you have read this article up to here you should now be in that happy situation. There are a few more concrete tips that may be worth remembering. They will not guarantee that you will not have a mid-air, but if you follow them your chances of picking up that potential collision risk will be considerably enhanced.

- Remember that the aircraft you are going to collide with is the one that appears to be stuck in the same place on the windscreen — if it moves, you will miss it (but take positive avoidance action just in case).
- Remember that you are looking for a small target that gets rapidly bigger only when it is too late to be avoided. It can easily take two seconds or more to appreciate the situation, make a response and get your aircraft to change course, so minimise the time spent with your head in the cockpit.
- Concentrate your search in the area of most likely conflict, which, in many situations, will mean along the horizon, looking for those aircraft at the same level as you.
- Do not imagine that you can make a smooth, continuous search. Keep your eyes scanning the world in quick movements ● *Adapted from* Air Clues

Over many years of instruction I have noted that many pilots on Night VMC flights do not pay sufficient attention to the flight instruments during the initial climbout. On several occasions I have had to take control after takeoff on a NVMC departure because the pilot has lost control.

A typical sequence of events is as follows;

- *Overcast conditions, country airport (i.e. little light from built-up areas), takeoff direction away from town lights.*
- *The pilot takes off and climbs to 200 feet.*
- *S/he looks away from the flight instruments to retract gear and flap, record a departure time, look back at the flare path, etc. — attention is diverted from the primary task, and the aircraft, unnoticed by the pilot, begins to diverge from the selected attitude and performance parameters.*

It is imperative to adhere strictly to instrument flying procedures until the aircraft is 1000 AGL . . . other tasks must certainly be completed, but only in the right priority.

Navigating the lanes of entry

Approaching Rockbank, heading east, in the Melbourne lane.

Approaching Westgate eastbound. Note the bridge on the left, and Newport chimney stack silhouetted against the bay, to the right of the bridge.

From time to time incident reports contain accounts of controlled airspace penetrations by aircraft transiting the lanes of entry around our major city airports. In many cases the pilots of these aircraft are inexperienced and lack local experience — factors which contribute to their navigation difficulties. Frequently though, these are only peripheral to the more fundamental problems of inadequate preparation and the application of unsound or inappropriate navigation procedures. Experience and local knowledge certainly make it easier, but any pilot who recognises the problems and techniques peculiar to the task and prepares accordingly can navigate the lanes of entry without undue difficulty. However, all too often the pilots rush through the planning phase of the flight, failing to devote sufficient time to permit a complete and unhurried examination of the task ahead. While thorough preparation should precede *every* flight, the confines of the lanes of entry demand extra attention if an incident-free passage is to be guaranteed. The airborne workload can be high, and a poorly prepared pilot will be fully occupied with just the task of navigation and may not be able to cope in the event of unforseen distractions.

The following account briefly relates the details of one penetration incident and discusses some of the significant factors behind it. It is offered not to castigate the pilot, but to illustrate how such incidents can develop and to introduce some suggestions for flight planning and navigation techniques.

The aircraft had departed Moorabbin for a flight to Ballarat. The pilot intended to track via the western lane (a narrow corridor only 2.5 miles wide between Melbourne and Laverton control zones) to Rockbank, and then direct to Ballarat, with Rockbank nominated as a reporting point. But things did not go as planned. From somewhere near Westgate Bridge the actual track flown took the aircraft over Laverton and Werribee, well inside Laverton control zone. At Werribee the pilot reported his position as Rockbank. Shortly afterwards, however, he noticed that his heading was grossly in error and realised also that he was not at Rockbank. At about the same time he was intercepted by a RAAF aircraft for identification and shortly thereafter was advised of his position by Flight Service and instructed to turn right and leave the zone. He was subsequently given navigation assistance from Melbourne ATC to track direct to Bacchus Marsh, from where he completed his flight without further incident.

This penetration was the culmination of a number of factors and events, starting with the pilot being delayed by road traffic on his way to Moorabbin. He arrived at the briefing office later than he had intended and in his subsequent haste did not devote sufficient time to gain a full appreciation of the weather, made mistakes in his flight plan computations, and did not check the completed flight plan for accuracy. His takeoff and departure were without incident, but approaching the lane he briefly encountered some light mist which caused him to feel some concern about the weather at Ballarat, although it was causing him no difficulty at that stage, nor would it do so during the lane transit. However, as he proceeded he became increasingly concerned about the appearance of the weather well ahead and began pondering alternative courses of action should he not be able to continue beyond the lane. As a result of this diversion he was not attending to the immediate task of navigation and did not return to it for some time. By then he was well off track and inside the CTR.

Perhaps a more typical example involves the pilot who does virtually no preparation, thinks about the transit even less, forgets to set his directional gyro or fails to check the track, and proceeds to 'eyeball' his way along the wrong railway line or road. Melbourne's western lane again provides the setting for an excellent example. Many a pilot has blissfully followed the Bendigo railway line from abeam Westgate Bridge over Brooklyn light straight into Melbourne CTR. The lanes demand a little more attention to preparation and navigation technique than those pilots give.

The following discussion is addressed primarily to pilots who do not routinely use the lanes of entry and to those who may be intimately familiar with the geography of their home-town lanes but are considering a trip interstate. Other pilots might examine the procedures and techniques offered and compare them with their own methods.

Preparation should start with the selection of a route (although this is, of course, academic if there is only one lane). But where there is a choice, several considerations should be examined before a decision is made. Don't select a route necessarily because it is marked on the VTC or because it is the shortest. Prevailing conditions may militate against that one in favour of another that is more circuitous, but offers easier navigation, greater separation from controlled airspace, more hospitable terrain, better weather and so on.

While selecting the route, identify a feature on the approach to the lane over which the aircraft can be accurately positioned to start the transit. That point should be a reasonable distance outside the lane so that airspace constraints are not immediately pressing. Make a detailed study of the weather forecast, noting specifically significant weather, visibility, ceiling and wind. Consider the weather in relation to the topography of the lane and ensure that terrain clearance is adequate. Be aware of the turbulence that can be expected with high winds at the low altitudes to be flown during the transit and also consider the effect a changing synoptic situation might have on the weather around the time of the transit.

If preparing a flight plan, take time to check all computer work, and when finished thoroughly check the whole plan for accuracy and completeness. Apply a mental logic check to heading and groundspeed computations — airborne is not the place to discover that drift corrections, for example, have been applied in the wrong sense. If not preparing a flight plan, check the relationship between the forecast wind and the track and develop an awareness of what the wind effect will be.

Navigation technique. The close proximity of controlled airspace boundaries requires the adoption of navigation techniques that will permit precise track keeping throughout the transit. This begins with the aircraft being accurately positioned at the start. Aim to arrive over the start point previously selected with all unrelated tasks completed. These might include after takeoff checks, a departure or position report, fuel management checks, copying terminal information and so on. Check the weather ahead before leaving the start point and decide whether to continue or adopt an alternative course of action, but do not let a decision to continue influence judgment later on. Have a plan developed to cover a deterioration in the weather, or any other contingency that might make it imprudent to continue. Ensure that the directional gyro is aligned with the magnetic compass, or if a remote indicating compass is fitted, that it is indicating correctly.

Take up the planned or estimated heading from the start point and then adjust it as required to avoid straying from track. The aim is to stay on track and within the confines of the lane by identifying the various features and tracking visually over them or avoiding them on the correct side. Use the aeronautical beacons if they are available, but do not rely on seeing them. Use them as just another landmark — that is, as an aid to navigation, not as a means. Monitor progress continuously. Look for navigation features well ahead and stay ahead of the aircraft. Do not dwell on finding a particular feature if it is not seen when expected — start looking for the next one while flying the best known heading to maintain track. This is particularly important when visibility is restricted.

Concentrate on navigation, but not to the total exclusion of other considerations such as engine and fuel monitoring. Remember also that the lanes are focal points, often with two-way traffic at the same level in a relatively confined area. Keep an effective lookout going and use the radio. Broadcast intentions, listen for other traffic information and be alert for possible conflictions. Remember Flight Service does not provide a traffic information service for aircraft using or crossing the lanes. Be particularly cautious near the designated VFR approach points. These are often used as holding points by aircraft waiting for an airways clearance to enter the control zones.

Finally, do not be reluctant to request assistance if things start to turn bad. A pilot who blunders along trusting everything will be all right in the end is doing himself, other pilots and ATC a disservice. Remember that the ATC problem is greatly simplified and the controller can provide a better service if he can talk either directly or through Flight Service to a pilot who is experiencing difficulties. Furthermore, a timely request for assistance may prevent a penetration from occurring in the first place.

Conclusion

To many pilots the foregoing recommendations may appear to be unnecessarily laborious, complicating what is essentially an easy exercise. At times such a comment may be valid. In good weather, for example, an experienced pilot may well be able to navigate his way through any of the lanes with little or even no preparation. However, the penetration records show that the lanes can hold hidden surprises for the experienced and inexperienced alike. Application of the principles described will reduce the airborne workload and allow pilots to devote their attention to the navigation and other tasks immediately associated with the lane transit.

Many of the reported transgressions into bordering control zones would have been avoided firstly by thorough preparation and the application of sound navigation techniques, and secondly by a timely request for assistance when difficulties were first experienced ●

During test flights I have seen both inexperienced and experienced pilots get into trouble in four basic situations:

1. High wind. The main problem is not being sufficiently aware of, and allowing for, down draughts.

2. Low cloud base, clearly defined but over rising terrain. Often pilots fly on through low gaps in the terrain, clipping the cloud base and seemingly oblivious to the fact that they are less than 500 feet AGL. When the decision is finally made that continued flight ahead is not possible, there is frequently an inadequate appreciation of the radius of turn. Furthermore, as the pilot probably is not practised in low flying, the visual illusion of slip or skid caused by wind effect usually results in an unco-ordinated turn, resulting in over-bank and height loss.

3. Low cloud base, clearly defined but over rising terrain, with visibility reduced in rain showers or heavy rain. In addition to the problems mentioned in paragraph 2 above, many pilots do not appreciate the direction of travel of isolated showers and fly into them when it could have been avoided. One mistake frequently made is that of flying too close to the cloud base in reduced visibility. Where terrain permits, visibility can be greatly increased by flying at a lower altitude.

4. Indeterminate cloud base, rain, rising terrain. Problems arise here when pilots press on too far. A major — and dangerous — failing is to leave the decision to make a reciprocal turn too late; often pilots are either about to, or have, entered cloud before starting the 180. Once this has happened, the difficulties can be numerous and compounding.

As was mentioned before, the radius of turn is not always appreciated. Additionally, confusion can arise over the time needed to complete a turn — one minute can seem like an eternity when you are under intense pressure. There can be a tendency to over-bank, with its attendant dangers.

Any distraction or break in concentration during flight in marginal conditions or (inadvertent) IMC can result in height loss. This can be critical during 'escape' manoeuvres.

Reader contribution

Freud, Jung and all that

'The pilot continued into weather conditions . . .' How many times have we read it in the *Digest*? As the editor once said, the story has been repeated ad nauseum. We usually read, too, that the unfortunate pilot probably was the victim of the 'it-can't-happen-to-me' syndrome. The same pilot who bought it for himself and his passengers by flying into high ground after a nice old spell in stratus trying to fly IFR may well have been experienced, conscientious, and without a desire to commit suicide. He was, of course, under the influence of an urge 'to get through'; or perhaps had a bad case of 'get-home-itis'.

Yet, have we solved the mystery? Are these the sole causes of the fatal weather-related accidents? Can we fully guarantee our own safety: (1) by realising it actually can happen to us; (2) by not trying to 'get through'; and (3) by ignoring our 'get-home-itis' symptoms? We can't. We can, but we can't.

Somebody said something about it in the *Digest* a few years ago. It was a reprint from America, and to me it hit the spot. It was all to do with programming the subsconscious mind. The well-known French hypnotherapist Emille Coue wrote about it back in the 1920s in his 45-page book *Better and Better Every Day*. He described the differences between the conscious mind and subsconscious mind, and laid down these rules: firstly, the conscious mind passes all information to the subsconscious, which naively believes it; secondly, the more the information is stressed or repeated the more the subconscious believes it, and is likely to act on it; thirdly, the subconscious is the boss. Any attempt by the conscious to go against what the subconscious believes will cause the subconscious to rise up and overwhelm the conscious, even if it means causing its own death.

Coue cited an example. If you place two house bricks on the ground, put a long plank on them, and invite yourself to walk the plank without falling off, you should pass the test. Fit the same plank at twenty storeys across two high-rise buildings in zero wind conditions, and try walking across again. Whether or not you get halfway there and fall to your death will depend on how your subconscious is programmed. If, as a result of your experience with the plank on the ground, you have told yourself you can walk across at any altitude, and you have no fear of falling off, you will walk to the other side. If you have a fear of falling off but think you can make it anyway, you will probably walk part-way, get wobbly, drop to your knees, and finish the job by crawling across.

If, however, you have a strong fear of falling off, have told yourself 'I'll fall off that plank if I try to cross it', but nevertheless force yourself to do it, your subconscious will cause one of your knees to buckle, your hand to go numb as you try to grab the plank, and your body will fall to its death.

The more you try to go against what your subconscious believes, the stronger the subconscious makes that belief happen, even to the extent of causing its own death. Such is the power of the subconscious, says Coue.

When most of us plan a flight from A to B, we program our subconscious to get to point B. We usually have no doubt about getting to B. All our thoughts and expectations are of a positive nature; we think only about getting there, and work out how to do it. We rarely plan to get part-way there and turn back.

This, therefore, is the reason why so many of us push our way through marginal or sometimes even quite lethal conditions, and on miraculously arriving at our destination tell ourselves we were stupid to have done it and there was no real need for us to have tried. We were lucky this time. Yet, zingo, what happens but next time we do exactly the same thing again! In my 1200 hours of private flying I've done it at least four times, though these days it's never again.

When we reach marginal conditions, to the point where we should be turning back, our subsconscious tells us to keep going. We are programmed to get to B, and that is where we must try to get. We can't help ourselves.

A friend of mine described a similar experience when driving his car into the city centre. Before he started the motor he got out his street directory and worked out what inner city streets, including one-way streets, he had to negotiate; and how to turn eventually to the right down a laneway. When he got to the laneway after following his 'flight plan', he found a policeman at the laneway intersection directing all traffic to go straight ahead. My friend couldn't help himself; he had a powerful urge to turn down the laneway, and he turned. When the policeman came over to him, he said, 'Just book me officer; I know you didn't want me to turn in here, but I couldn't help myself. I had to turn because this is where I planned to go'. The policeman must have read his share of Freud or Carl Jung because he let him off.

All right, what do we do to stop our own subconscious minds from wiping us out one day in bad weather conditions? The answer is: we program ourselves to turn back. Before we submit our flight plan, we look it over for likely turn-back points and tell ourselves, 'If I run into marginal conditions about there, I'll turn back'. Before we start the engine, we tell ourselves, 'If I run into marginal conditions anywhere on this flight, I'll turn back'. That's all we have to do.

Any preflight planning that programs the pilot's subconscious mind to make a timely diversion when things get rough may well save his life, the lives of his passengers, and a good aircraft to boot ●

You're not on your own

Darwin Flight Service. Photograph courtesy of Mr G. Blythman.

Time and again when an accident has occurred, that accident has been the culmination of a series of unfortunate events or incidents, any one of which, if eliminated or overcome at the time, could have prevented the accident. And nowhere is this more true than with accidents that have resulted from continuing into deteriorating weather, or those that have been the final link in a chain of navigational misfortunes.

Time and again too, the subsequent investigation of these accidents has shown that, although it must have been obvious to the pilot concerned that he was getting further into difficulties with weather conditions or some other navigational problem, he gave absolutely no indication of his dilemma at the time to the airways operations system. On the contrary, his transmissions were such that his operations could only have been taken to be quite normal. On a number of occasions too, pilots have accepted a clearance, believing they could comply with it but have not requested an alternative when, later on in the flight, they experienced difficulty in doing so without infringing visual flight rules.

Why this obvious and widespread reluctance to request assistance or an alternative clearance when in need? As the Secretary pointed out in his message to all pilots in ASD 114/1982, perhaps one of the principal causes of breakdown in safety communications between pilots and the airways system is the widely held notion that a pilot will be held to account for the circumstances leading to a predicament in which he becomes involved. Indeed, it may well be for this reason that many pilots seem to hold the view that the less information conveyed to airways operations units the better.

It should be obvious that, in these circumstances, the umbrella of safety inherent in the airways operation system cannot be made available to a pilot, let alone exploited to his full advantage. On the other hand, it should be equally apparent that a great deal is to be gained from a readiness and willingness to make full use of the airways facilities that have been provided for the whole purpose of making aircraft operations safer. For this reason pilots should never hesitate to communicate with Air Traffic Control or Flight Service whenever they are in need of assistance.

Whenever a pilot does become involved in an abnormal operation, there is, of course, a need to examine the reasons and circumstances that led to that situation. For instance, the operation might have placed the aircraft and the lives of its occupants in grave danger, and it is necessary that ways and means of avoiding future situations of a similar nature be looked at most carefully. Full and frank information from pilots on the circumstances that led to such situations can thus be invaluable to those charged with the responsibility for accident prevention. Information of this sort, considered in conjunction with that obtained from other occurrences, frequently enables common factors to be isolated and identified and remedial measures developed.

The whole purpose of the Secretary's message was to encourage pilots to make full use of the services available to them, especially if ever they find themselves in a critical operational situation. To lend weight to this encouragement, the Secretary stated that pilots who do request assistance from airways operations units in such circumstances would be immune from any resulting disciplinary action, except where other parties are involved or culpable negligence is evident.

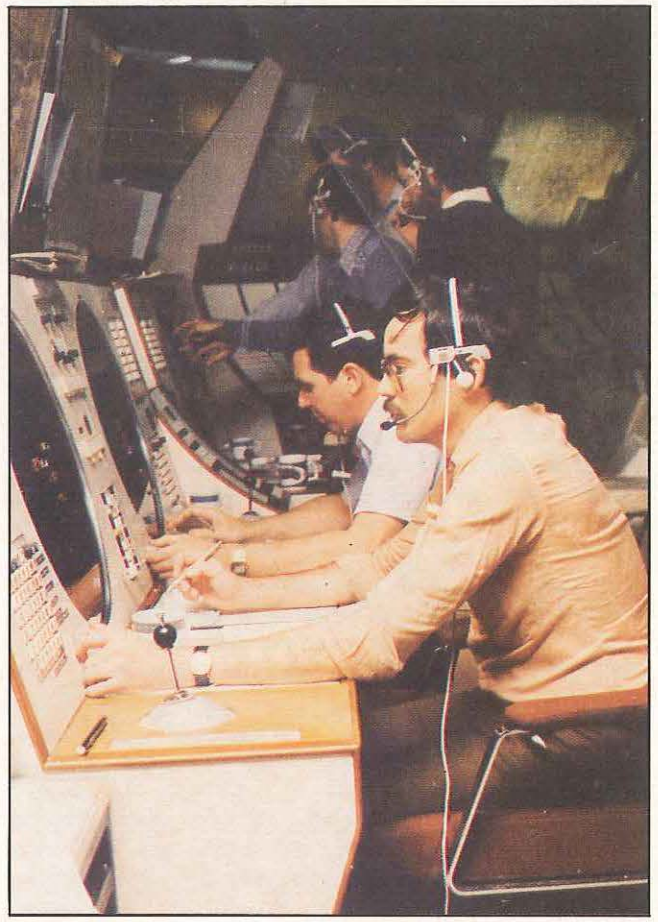
It has subsequently been very encouraging to find that a number of pilots are taking this advice to heart and are not hesitating to call for assistance when they find themselves becoming involved in a difficult situation. As the following examples show, this assistance has not only been forthcoming promptly but, in each case, has saved the pilot and his passengers from what might well have become a far more embarrassing predicament:

- Four hours after departing from Parafield, for a private flight to the Moomba gasfield, the pilot of a Piper Cherokee reported that he was unsure of his position and that his fuel state was critical with only 30 minutes remaining. The Flight Service Unit at Leigh Creek co-opted the assistance of pilots of two other aircraft flying in the area, who were familiar with the route, and from descriptions of the terrain provided by the pilot of the Cherokee, identified the aircraft's position and directed it to a nearby landing area.
- A Piper Comanche engaged in a private flight from Moorabbin to Canberra reported position at Tumut, but 15 minutes later the pilot requested navigational assistance, saying that he was over Burrinjuck Dam. The aircraft was identified on radar over Tantangara Reservoir and was then vectored to Canberra Airport.
- A Piper Cherokee reported position over Dubbo, but in the thick dust haze that prevailed at the time he was unable to find the aerodrome. After questioning the pilot, Dubbo Flight Service advised him that he was probably over Wellington and directed the aircraft to Dubbo Airport where it made a safe landing.
- The pilot of a Cessna 150 in the final stages of a private flight from Albury to Moorabbin, reported 10 miles north-east of the field and inbound, but shortly afterwards he requested assistance to determine his position. Melbourne Approach was contacted to identify the aircraft's position on radar and the aerodrome beacon was switched on. Very soon afterwards Moorabbin Tower sighted the aircraft six miles out and directed it on to a base leg for landing.
- Shortly after departing from Moorabbin for a private flight to Hamilton, and while attempting to proceed by the western light aircraft lane, the pilot of a Cessna 182 reported that he was unsure of his position and that he might have drifted out of the lane. The aircraft was identified on radar near Laverton and vectored to Melton, where the pilot resumed his own navigation.
- Seven minutes after the estimated time of arrival at his destination on a private flight from Parkes to Cowra, NSW, the pilot of a Musketeer reported that he was over a town which he was unable to identify. The Flight Service Unit contacted police stations in the area and established that the aircraft was in fact over Grenfell. An ambulance aircraft operating in the vicinity was directed to intercept the Musketeer and to escort it to Cowra where it landed an hour later.
- A Cessna 150 flown by a private pilot was making a flight from Cessnock to Wagga with an ETA of 1317 hours. In the latter stages of the flight, the ETA was amended to 1313 hours but at 1328 the pilot called Wagga and reported that he was unsure of his position. After questioning the pilot, Wagga Flight Service ascertained the aircraft's position, then directed another aircraft to intercept it and escort it to Wagga where it landed safely.
- The pilot of a Cessna 337 attempting a VFR flight from Moorabbin to Moree, NSW, reported position at Yan Yean with an estimate for Kilmore in 10 minutes time. Soon afterwards he reported that he was unsure of his position and climbing in cloud, homing on the Mangalore NDB. The aircraft was identified on radar and vectored to a clear area where the pilot was able to resume VFR flight, and the aircraft returned to Moorabbin.
- The pilot of a Piper Comanche which had departed Moorabbin on a VFR flight to Dubbo requested navigational assistance about half an hour after departing. The aircraft was identified on radar 14 miles south-east of Mangalore and was instructed to climb to 10 500 feet clear of cloud. The aircraft was then vectored to an area which was clear of cloud where it could descend visually and the pilot landed safely at Essendon.

Well then, what do you think? All the help possible is there for the asking when you need it. When trouble looms *you're not on your own*. But it's up to you to take the initiative – ATC and Flight Service staff are not clairvoyant and they cannot know what your situation is unless you tell them.

Will you be like the pilots of the aircraft mentioned and take advantage of what is available when you need it? Or would you prefer to follow the example of others, many of whom are no longer with us, and persist with your own efforts to extricate yourself from your problem — perhaps until it is too late?

It's up to you! ●



What meets the the eye . . . real or illusion?

This article discusses the physiological, psychological and environmental factors that affect visual efficiency.

'Human error' and 'approach and landing' are phrases frequently used in describing causes of aircraft accidents. Statistics reveal that about 85 per cent of aircraft accidents involve human error as a contributing factor. In addition, about 50 per cent of all accidents occur during the approach and landing phase.

Your primary role in the cockpit is making decisions. In order to do this you must sense and process information. Potential sources of error range from limitations in your senses and perceptual mechanisms to inadequacies in procedures and methods prescribed for the flight crew. This article will briefly present some characteristics related to sources of information-processing error during the approach and landing.

Your senses receive physical stimuli and encode information; perception interprets information and attaches meaning to it. Most of the information which you receive comes to you through your eyes; some comes from instrument displays in the cockpit, but a large amount is obtained from outside the cockpit, often under conditions which may be far from ideal. Indeed, certain conditions may prevent the necessary information from even reaching the eye. More often a signal reaches the eye but the brain misinterprets and you 'see' something else; in other words you experience a visual illusion. We will discuss only the illusions, or false perceptions, associated with direct vision.

Visual illusions are potentially common in flying and result from the incorrect interpretation of what you see. This may be due to there being too few visual cues so that you have to fill in the rest of the picture by drawing on your preconception of the situation, by 'seeing' what you think you 'ought' to see, or simply by guessing. They may also occur when cues presented to the normally master sense, vision, are weak and are in conflict with relatively strong responses by other senses, particularly those of balance and orientation, which have sensors in the inner ears.

The purpose of this article is to draw your attention to some of the circumstances in which visual illusions may be experienced and to the hazards which the illusions may introduce on the approach to land. Increased awareness of these factors will enable you to recognize and compensate for most visual illusions and so reduce the risk of an accident.

Visual illusions during the landing approach may be caused by one or any combination of the following features:

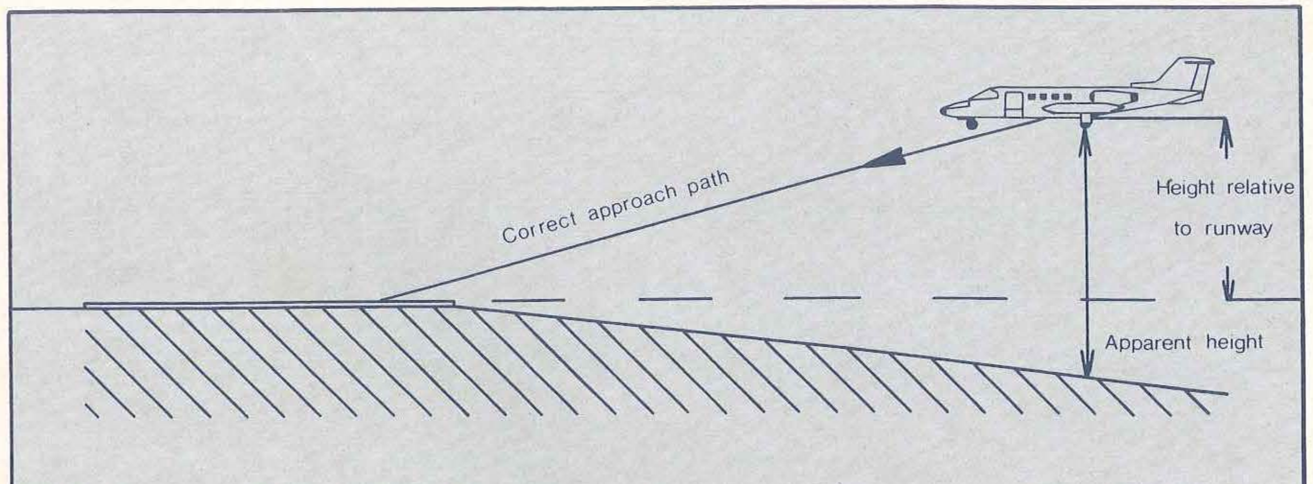
- sloping approach terrain
- sloping runways
- runway width
- rain on the windscreen
- featureless approach terrain
- runway lighting intensity
- shallow fog
- rain showers
- darkness
- black hole effect

Sloping approach terrain. Normally, when a pilot makes a visual approach he subconsciously judges the approach path from a combination of the apparent distance of the aircraft from the runway and its apparent height above the approach terrain. If the ground under the aircraft slopes upwards towards the threshold an illusion may be created, particularly during the early stages of the approach, that the aircraft is too high (see Figure 1). Conversely, ground which slopes downwards towards the threshold gives the impression that the approach path is too flat (see Figure 2).

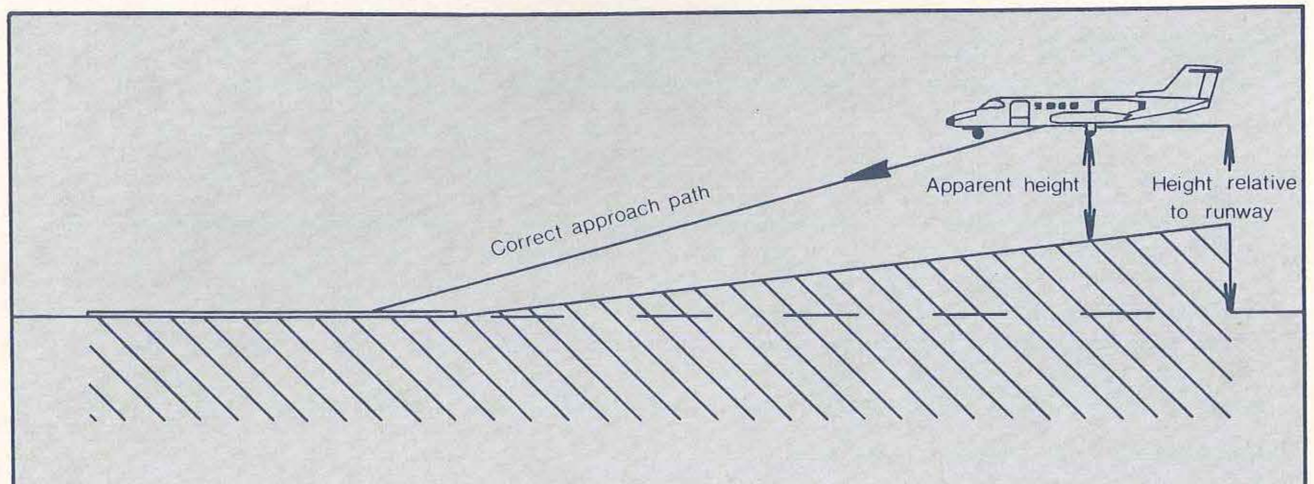
Sloping runways. Through the regular use of ILS glide paths and VASIS, with three degree glide slopes, pilots become accustomed to the complementary angle of 177 degrees between the runway and the approach path (see Figure 3). Additionally, from experience, pilots come to know with considerable accuracy the amount of power required to maintain the correct approach path to the point of touchdown. If, however, the runway slopes upwards from the landing threshold and the 177 degree relative angle is maintained, a visual approach will be lower than it should be, by about the same amount as the runway upslope, and the 'usual' power setting will be inadequate to meet the requirements of the flatter approach. If the runway has a downslope, the converse applies, so that by maintaining the 177 degree angle relative to the down-sloping runway, the approach to the touchdown point will be steeper and the 'usual' power setting in excess of that required.

Runway width. The ability to use the apparent convergence — due to perspective — of two parallel lines to estimate their length is well known. Increasing or decreasing the distance between the lines, however, can create the illusion of shortening or lengthening them. On the approach, a pilot bases part of his judgment on a mental comparison of the runway before him with the 'normal' view of the runway to which he is accustomed. Variations in the runway width, therefore, can be misleading. For example, the wider the runway, the shorter it appears; moreover, the width can also have an effect upon the apparent height of the aircraft in relation to the runway, a wider runway making an aircraft appear lower than it is.

Rain. Heavy rain can affect the pilot's perception of distance from the approach or runway lights by diffusing the glow of the lights and causing them to appear less intense. This may lead him to suppose that the lights are farther away than in fact they are. On the other hand, only a little scattering due to water on the windscreen can cause runway lights to bloom and double their apparent size, with the result that the pilot believes that he is closer to the runway that he actually is, leading possibly to a premature descent. Similarly, rain on the windscreen can cause illusions as a result of light ray refraction. For instance, even though an aircraft is correctly aligned on the approach path it can appear to the pilot to be above or below the correct glide slope, or left or right of the runway centre line, depending upon the slope of the windscreen and other circumstances. The apparent error might be as much as 200 feet at a distance of one mile from the runway threshold.



Upsloping approach terrain (Figure 1)



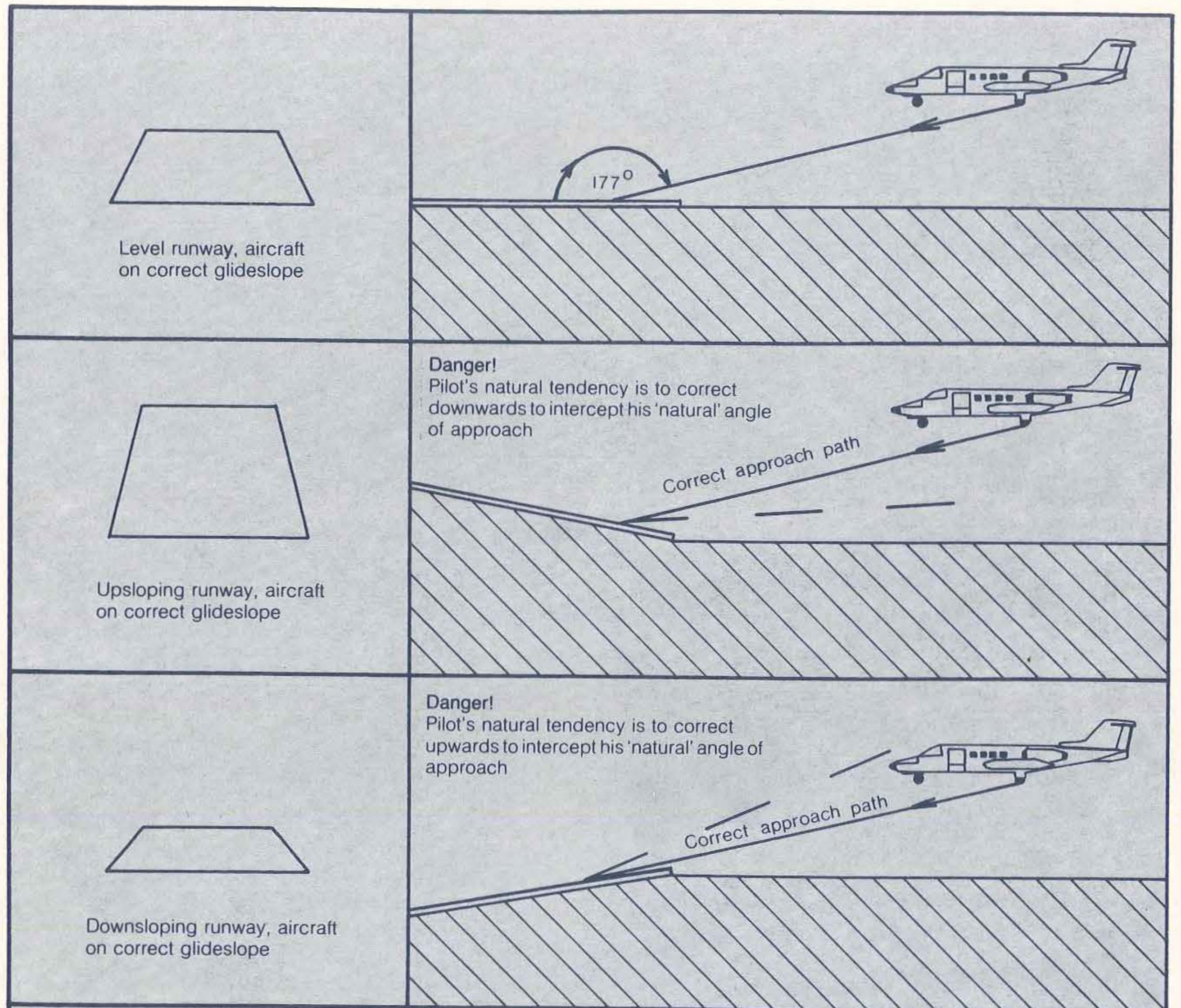
Downsloping approach terrain (Figure 2)

Featureless terrain. Visual descents over calm seas, deserts or snow, or over unlit terrain at night, can be hazardous even in good visibility. The absence of external vertical references makes judgment of height difficult and the pilot may have the illusion of being at a greater height that is actually the case, leading to a premature or too rapid descent. Height above the runway is also made more difficult to judge if, because of snow for example, there is no contrast between the runway surface and surrounding terrain. The problem is compounded if the descent is made into the sun or in any conditions which reduce forward visibility.

Runway lighting intensity. Because bright lights appear closer to the observer and dimmer lights farther away, the intensity of the approach and runway lighting can create illusions. Thus, on a clear night, the runway lights may appear closer than they actually are, particularly when there are no lights in the surrounding area.

Shallow fog, haze. In shallow fog or hazy conditions, especially at night, the whole of the approach and/or runway lighting may be visible from a considerable distance on the approach even though Runway Visual Range or meteorological reports indicate the presence of fog. On descent into such a fog or haze layer, the visual reference available is likely to diminish rapidly, in extreme cases reducing from the full length of the approach lights to a very small segment. This is likely to cause an illusion that the aircraft has pitched nose up, which may induce a pilot to make a corrective movement in the opposite direction. The risk of striking the ground with a high rate of descent as a result of this erroneous correction is very real.

Rain showers. A weather feature which may reinforce a pilot's visual indications that he need not apply power to reach the runway or to arrest a high rate of descent is an isolated rain shower. A heavy rainstorm moving towards an aircraft can cause a shortening of the pilot's



Sloping runways (Figure 3)

visual segment — that distance along the surface visible to the pilot over the nose of the aircraft. This can produce the illusion that the horizon is moving lower and, as a result, is often misinterpreted as an aircraft pitch change in the nose up direction. A natural response by a pilot would be to lower the nose or to decrease, not increase, power.

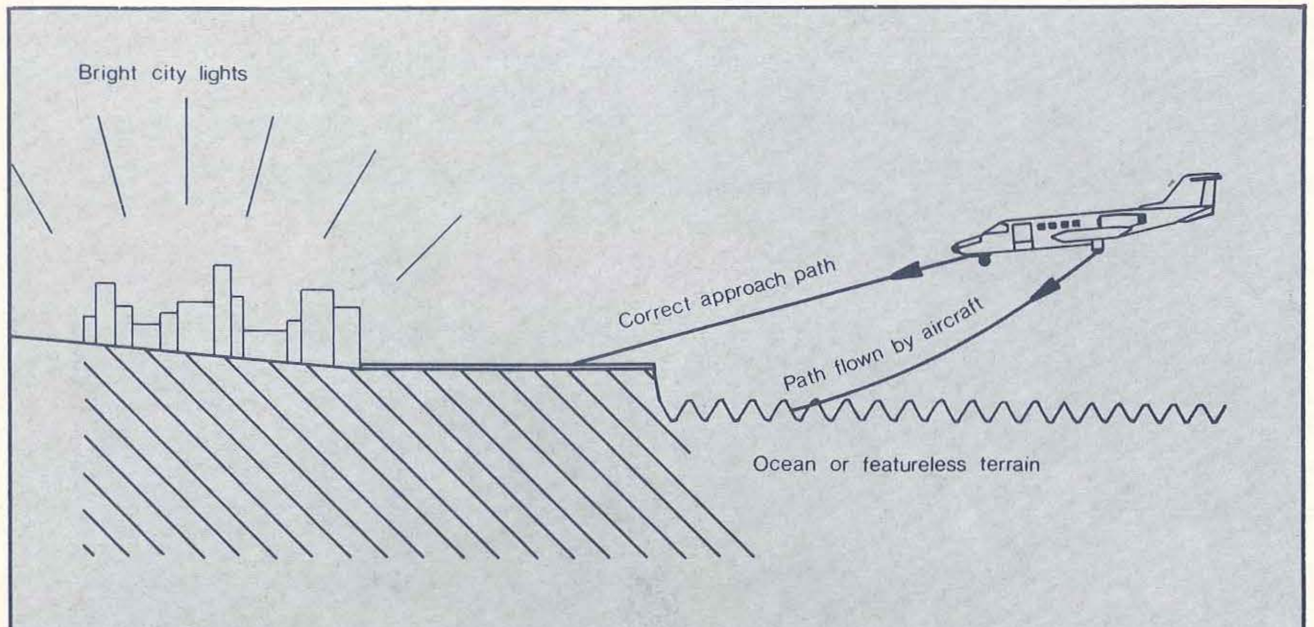
Darkness. The greatest illusion potential exists at night. Darkness provides excellent camouflage and the eye loses much of its efficiency. Normally used cues such as shadows, colour and detail are not available. Lights must compensate for this loss, but lights usually lack sufficient definition to provide more than an outline, an incomplete stimulus to which the pilot may or may not react correctly. At the other end of the scale we have a profusion of lights. Large airfield complexes have so many lights that frequently there is considerable difficulty experienced in just finding the runway.

Black hole effect. This illusion can occur on a clear night with no visible horizon. The aircraft approaches the runway over the sea or other featureless, unlit terrain towards an aerodrome with bright city lights behind it. Visibility is so good that there is little need to rely on the instruments except to check the airspeed. The straight-in approach is totally uneventful until the aircraft lands short of the runway, possibly by several miles. What could have gone wrong?

Tests have shown that under these circumstances a pilot relying on a visual approach will tend to fly along the arc of a circle centred above the pattern of city lights with its circumference contacting the terrain. Such a path results from maintaining a constant visual angle subtended at the eye by the nearest and farthest city lights. When deceptive conditions are present, such as up-sloping city terrain, this kind of approach path can go to critically low altitudes. The lack of foreground lighting results in the pilot being denied important closure information without his awareness and consequently the aircraft lands short.

Avoiding the problem

Be aware of the circumstances in which visual illusions may occur and be prepared to take corrective or alternative action. Learn to recognise impending



Black hole effect (Figure 4)

situations which may place the safety of the aircraft and its occupants in jeopardy.

Study aerodrome charts, maps and other applicable reference material to determine runway slope, the slope of terrain around the aerodrome, the relative position of the aerodrome and surrounding features, the aerodrome approach and runway lighting in use, etc.

Wherever available use ILS or VASIS to monitor the glide scope. If a DME is located at the aerodrome use the 'rule-of-thumb' 300 feet per nautical mile for your descent profile, but remember to take into account the relationship of the DME beacon to the threshold of the runway in use.

If the nominated runway has no precision approach aids, consider the need to request an alternative runway with precision aids. When no precision aids are available fly a full circuit, never a straight-in approach. The aircraft can be more accurately positioned at 600 feet on a two mile final having flown a full circuit than on a straight-in approach without aids. It may also be possible to position the aircraft at a known point, such as over a locator, at the correct altitude and approach configuration. The pilot should then obtain a visual image of the runway and maintain this image throughout the approach. If none of the foregoing procedures are possible, consideration should be given to diverting to a more suitable aerodrome.

On two-pilot operations use the monitored approach technique. One pilot flies the instrument approach while the pilot who is to land the aircraft monitors the approach and gains 'experience' of the ambient conditions before taking over control.

During single-pilot IFR operations, the pilot should use the autopilot as the pilot flying the approach. While flying a coupled approach, the 'real' pilot should try to gain experience of the conditions. The autopilot should remain engaged as long as possible until the pilot has obtained a good visual picture, and a safe landing is assured.

On all operations, avoid landing expectancy; be prepared to go around or carry out a missed approach if there is any doubt about the safety of the landing.

Wherever possible, pilots should receive training flights to aerodromes where it is known that conditions can be conducive to visual illusions.

In conclusion, remember that illusions must be expected in flying. Also that it is human nature to want to believe our own senses rather than instrument indications. Knowledge of illusory sensations will help because our responses are determined more by the meaning we attach to stimuli than by the stimuli themselves. It is ultimately on the basis of knowledge and self discipline that we make decisions and select our responses.

How sharp are your eyes? Did they catch *the the* title? ●

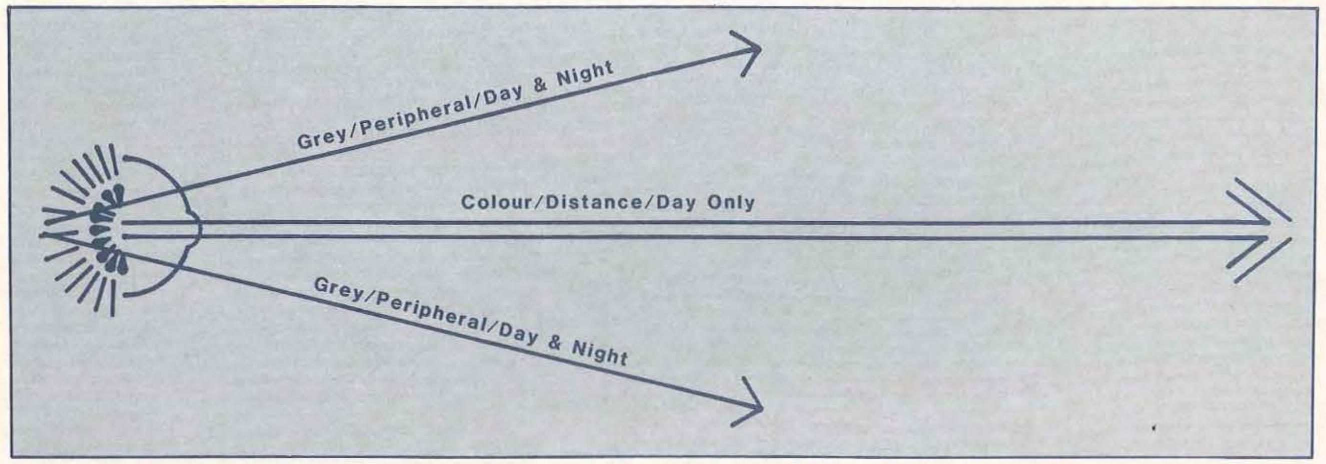
The best time and place to educate a pilot is on the Biennial Flight Review (BFR), during which I recommend instruction in interpreting ARFOR, TAF, TTF/METAR-SPECI, SHORT AIREPS, MSL synoptic situations and the 2000, 5000, 7000 and 10 000 foot level charts. Most pilots with a licence more than three years old really need it. Discuss the available meteorological services with a met. forecaster. Review the effects a specific weather pattern will have on the proposed flight. Stress the influence local effects such as sea, coast, and terrain can have . . . the time of the day must also be considered in relation to weather effects and conditions. In the course of the BFR have the pilot assess the accuracy of the forecast and send a short AIREP.

* * *

If I am given an unfavourable weather forecast, I often find it very useful, before flight planning, to telephone reliable people at en route points and the destination to get an actual report.

Night vision

A veteran pilot once remarked that night flying is no different from day flying — it is just that at night you cannot see anything. Although there is a lot of truth in his statement, you can usually see *something*. To compensate for what you cannot see, you need proper instrumentation. To make the most of your vision at night you need to understand how the eye operates in darkness.



Cones and rods

There are two kinds of light-sensitive nerve endings at the back of your eye; a dual structure of cones and rods. Cones provide precise vision and colour differentiation; they are much less sensitive to light than rods. Rods are much more light sensitive than cones, but are incapable of precise vision.

The cones, because they need greater intensity of light to function, are used in day vision. In fact, the cones stop working altogether in semi-darkness. Millions of these tiny structures are clustered at the back of the eyeball, directly behind the pupil. They not only distinguish colours but pick up distant objects as well.

The rods are concentrated in a ring around the cones. Being colour-blind, they see only in greys and are used in peripheral vision during the day — that is, they perceive objects in motion out of the corner of the eye. Because the rods can still function in light of 1/5000, the intensity at which the cones cease to function, they are used for night vision. These structures are 100 000 times as sensitive in the dark as they are in sunlight. However, they do need more time to adjust to darkness than the cones do to bright light. Your eyes become adapted to sunlight in 10 seconds, whereas they need 30 minutes to fully adjust to a dark night. Bright lights (such as landing lights) knock out night vision, requiring you to 'night adapt' all over again to regain maximum night vision.

The fact that rods are distributed in a band around the cones and, therefore, do not lie directly behind the pupils, makes 'off centre' viewing important to the pilot during night flight. That is, night flying requires a different visual technique to day flying. You can see an object best during daylight by looking directly at it. At night, however, a scanning procedure is more effective — you will find after some practice that you can see things more clearly and definitely at night by looking slightly to one side of them, rather than straight at them. If, during your attempts to practise the scanning procedure, you find that your eyes have a tendency to swing directly towards the target, force them to swing past it so that the rods on the opposite side of the eyeball pick up the object.

Rhodopsin

The underlying factor governing dark adaptation sensitivity is the quantity of rhodopsin available in the back of the eye. Rhodopsin is the light-capturing substance carried in the rod receptors of the retina. When light strikes the retina, the rhodopsin is bleached and must regenerate.

It has been estimated that a pilot can experience a 30-50 per cent reduction in his night vision as a result of several hours exposure to bright sunlight, especially in a light-covered environment such as sand, sea or snow. The effect is cumulative, and repeated exposure may leave you with poor night vision for as long as a week.

Recovery normally follows simply as a result of resting the eyes or protecting them from bright light, but restoration of visual powers is a gradual process. Don't expect good night vision after a day on the beach or the ski slopes.

In any event, if you are a pilot who flies at night occasionally, you will do well to form the habit of carrying sunglasses at all times and wearing them whenever the sunlight is strong.

The selection of sunglass lenses is important. The wearing of neutral density anti-glare glasses with an average transmission of 15 per cent is recommended. Only with a true neutral filter is colour vision entirely normal and it has been determined that a lens with 15 per cent transmission is most suitable for the level of brightness encountered in flying.

Hypoxia

Hypoxia occurring during flight has a deleterious effect on night vision and for this reason pilots are advised to use supplementary oxygen during night flights. Some sources state that the decrease in night vision is 5 per cent for every 2000 feet, between 4000 feet and 12 000 feet above sea level. It has been shown that a 25 per cent improvement in night vision occurs at a height of 5000 feet above sea level with the administration of oxygen.

Photograph courtesy of Mr James Staddon.

Carbon monoxide (smoking)

Excessive carbon monoxide produces the same decreased night vision capability and increased time for dark adaptation as hypoxia from increased altitude.

For example, a 5 per cent blood saturation with carbon monoxide gives an effect on the visual threshold equal to 8000-10 000 feet of altitude. Smoking three cigarettes can cause a CO saturation of approximately 4 per cent. Pilots should therefore observe the 'No smoking within 60 metres of the aircraft' sign at all times.

Tinted windscreens

Another precaution is to avoid the use of aircraft with tinted windscreens when flying at night, particularly in Night VMC operations. This kind of flight, which is usually carried out in small general aviation aircraft, is the most critical visual task of a pilot. In visual flights by day a pilot can see what he needs under conditions of relatively high illumination. In instrument flight by day or night he does not have to depend upon external vision at all, except in the takeoff and landing phases when he is not usually required to depend on seeing low contrast objects, because the key items of information are presented in high contrast by self-illuminated devices, for example patterns of light. However, in Night VMC, by definition, the pilot has to be able to navigate by visual reference to the ground. He must keep clear of cloud or obstructions by visual reference and it is a great advantage to be able to make use of the natural horizon whenever possible.

Except in fairly bright moonlight, the ground-referenced navigation is based largely on recognizable collections of ground lights which are seen in high contrast. However, keeping clear of obstructions or cloud requires that the object to be avoided must be seen in low contrast under conditions of very low illumination. The natural horizon may, and usually does, present a similar viewing situation.

Since in these circumstances, the pilot's ability to see is being pushed to its limit, any factor which tends to impair this performance is highly undesirable. One such factor is lowered light transmission in the windscreen, deliberately introduced by tinting.

If you have a choice of aircraft available for your Night VMC flight, increase your odds and select the one with the clear windscreen. It may just make the difference ●

Reader contribution

'The pilot continued flight into weather conditions . . .'

The above title introduced the article on page 7 of *Aviation Safety Digest* 117/1983. That article is similar to several which have appeared in the *Digest* over a number of years. Unfortunately, few positive suggestions have been offered in these articles on the following issues: the adequacy of our regulations in this area; which pilots are at risk for this type of occurrence; what can be done to help pilots recognise this situation at or before the incipient stage; and what pilots might do when it happens. The following thoughts are offered as some possible answers.

However, first, let me tell my own 'weather-related' incident. I hold a SCPL and a first class instrument rating, and was on a VFR flight in a VFR aeroplane (no radio navigation aids) which 'continued into weather conditions . . .' My incident took place on the New South Wales central coast and is a classic when viewed through the passage of time with the wisdom of hindsight (not to mention more experience).

The forecast has been for deteriorating weather but not so bad as to justify trip cancellation. As the flight progressed the forecast proved accurate. As I approached a large aerodrome I assessed the weather beyond as very possibly deteriorating rapidly to considerably less than VMC. At that point I monitoried radio transmissions from VFR operations 20 nm down track and on the other side of the weather. Had I misjudged the weather? Owing to the proximity of the very suitable aerodrome I elected to continue a short distance, 'have a look' and, if necessary, return and land. 15 nm on from the aerodrome I decided to return, but found that the on-shore stream had closed that option. I was trapped in rain under a low ceiling, by the coastal range immediately to the west, a line of hills to the coast in front, and inadequate visibility in every other direction. The rain was increasing and I was in a pocket of rapidly reducing visibility. I was a current instrument pilot but the aircraft had no navigation aids. Rather than take a chance which I could not adequately assess and proceed in IMC, I executed a precautionary landing on a length of road while I was still in control of the situation. I accepted that this may mean damage to the aircraft. The result — a successful landing, an undamaged aircraft, a relieved pilot and an ecstatic passenger.

Later, after analysing the incident, I decided that my main mistakes had been: an inaccurate assessment of the rate of movement of the weather; not appreciating how the rapidly changing conditions would affect my escape route back to the aerodrome; and not appreciating which weather (cloud base, rain, reducing visibility) was most important to assess in relation to my 'look' and my escape route. I also came up with some thoughts regarding flight in marginal weather conditions generally:

The regulations. The regulations are adequate. However, the VMC criteria are the minimum necessary to ensure only the immediate safety of the flight. The final VMC escape route may be a normal (30 degree bank angle) 180 degree turn. In this event you need to ensure that there are no obstacles on the other side of the proposed turn. Therefore, the minimum distance you need to see is twice your turn radius adjusted for wind.

The following table considers a 30 degree bank angle turn in 30 knots of wind:

Altitude	*IAS*	*TAS (ISA)*	*2 × radius + wind*
5000'	210	226	3.14 nm
"	150	162	2.22 nm
"	120	129	1.87 nm
10,000'	250	291	4.96 nm

When the table is compared with VMC visibility criteria of 5000 metres (2.70 nm) and 8000 metres (4.32 nm) we see that the immediate safety of most VFR flights is protected most of the time, but that the criteria should be increased in some situations.

The other regulatory element is the responsibility for operational control which is vested in the pilot for OCTA operations. That is the responsibility for the continuation of the flight. This means that the pilot must assess the weather, its rate of change and how it affects his operations. The following example demonstrates this point. If a flight from point A to point B, a distance of 60 nm, has a groundspeed of 120 knots and it proceeds to the midway point and then returns to A, then the weather experienced on arrival back at A has undergone 30 minutes of change from that which the pilot initially saw at A. Now, if the weather over A has a speed of 20 knots, then the weather which the pilot needs to consider when he chooses to return to A is not that which he experienced at A but that which as some 10 nm from A when he first passed there. This example points out that safe VFR operation may require significantly more awareness than merely that necessary for the maintenance of VMC.

Who is at risk? We all are. The inexperienced are particularly vulnerable because it is doubtful that they will have the depth of background which allows confident and timely decisions to be made. These pilots must operate conservatively even if this means aborting before more experienced pilots do. The senior pilot may be wrong or his experience may give him other options.

Neither is the instrument-rated pilot immune. Unless he is frequently involved in VFR operations his judgment of marginal conditions will deteriorate. This deterioration may not be acknowledged because of the false sense of security caused by the instrument rating 'always giving a way out'. The rating is not a panacea. Firstly, the VFR aeroplane's instrumentation may not be adequate for IFR flight — when did you last note the gyro drift rate and the attitude indicator precession rate in a VFR aircraft, and when did you last maintain heading IFR solely by reference to a direct reading compass? Secondly, the pitot/static sources may not be protected from icing. Thirdly, how far below lowest safe altitude are you and in what direction may you climb to it in safety? Finally, the situation is not analogous to circling from an instrument approach. During circling, your position should be known and the minimum altitude, derived from an obstacle survey, provides a safe obstacle clearance for the circling manoeuvre. You are unlikely to have information of the calibre of that provided for IFR circling operations when you inadvertently lose VMC.

Training. Most of us would have a poor idea of what we can expect to see with only 5000 metres of visibility. A way to improve our judgment and to get an appreciation of operating in these conditions is as follows:

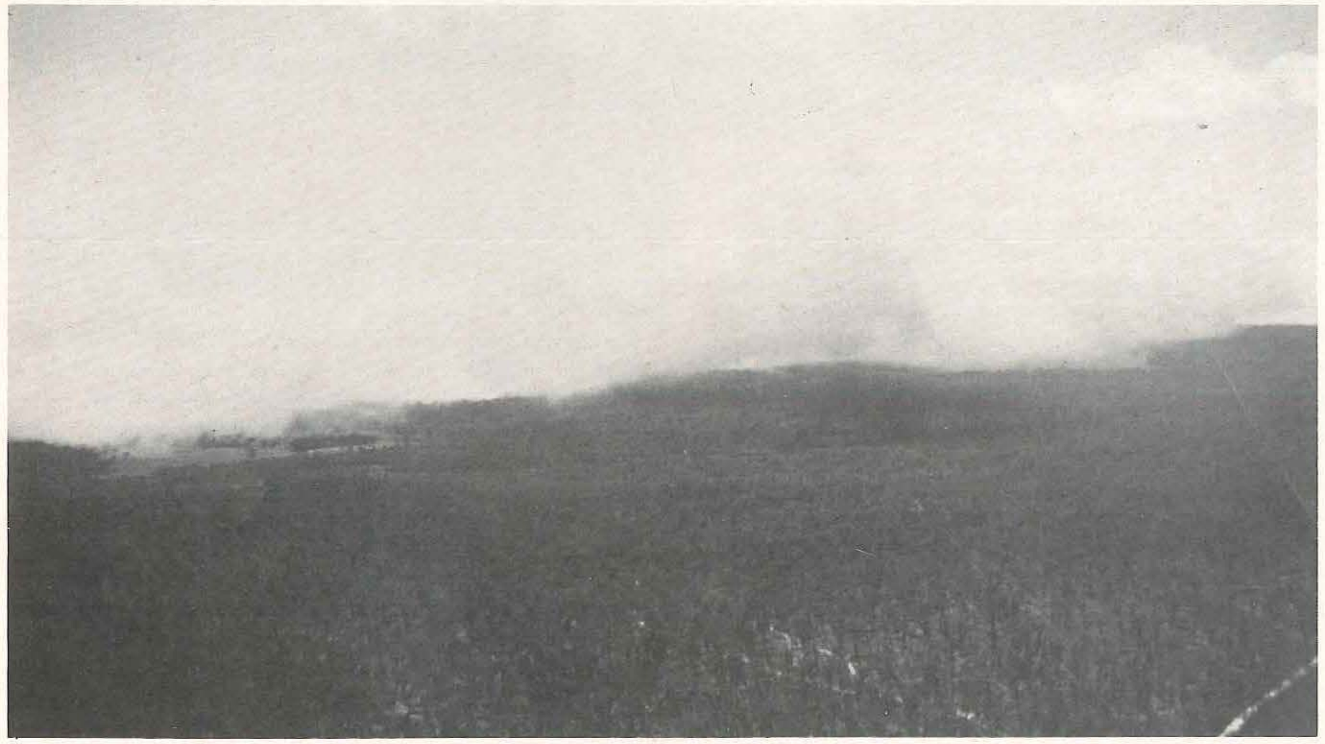
(a) Enlist the aid of a competent safety pilot.
(b) Plan a track and identify readily distinguished features 5000 metres from that track and on either side of it.
(c) Fly the track at 500 AGL and again at 1000 feet AGL and note where the pre-planned features pass in relation to cockpit references.
A similar technique may be used to calibrate the front windscreen, except you will have to fly across your reference points rather than along a track.
(d) Finally, having established reference lines in the windows, use a screen on only one window at a time to blank out all above the line. You may be surprised at how little is left and by the effect of losing your familiar horizon.

What can you do? The best thing to do is to be a little conservative, sacrifice a little regularity of operation and avoid facing the possibility of 'continued flight into weather conditions . . .' However, if you do find yourself in less than VMC, sitting forward on your seat with sweaty palms, you must follow a course of action which allows you to control the situation to the extént that you can forecast the outcome with a considerable degree of certainty. Controlling the situation is largely having sufficient time to assess options and then time and space to execute your course of action — reduce speed and establish a precautionary configuration. This gives more time to see things and reduces turn radius. You now have the following options: proceed IMC, re-establish good VMC, or terminate the flight.

Proceeding in IMC should only be considered by properly trained and current instrument-rated pilots and, even then, this may be imprudent for the reasons given earlier. Regaining VMC is most appropriate and, as you know that a VMC area is behind you, a controlled 180 degree turn and backtrack is usually the best course.

However, it may be prudent to terminate your flight. Flights do not always have to terminate on formal landing fields. We have all practised precautionary landings, now may be the time for the real thing, so have the courage to try. It is unlikely that a formal landing field assessment will be possible and you may have to accept what comes, but a controlled precautionary approach and landing is far more likely to have a survivable outcome than an uncontrolled crash.

This type of advice will be offered for as long as we fly. However, when it happens to you, be prepared to acknowledge that you are the only help available and that you must retain control of the situation within the bounds of your known capabilities ●



Moist easterly airmass forming dense cloud between the coast and Great Dividing Range west of Sydney. Flying conditions beneath the cloud rapidly deteriorated approaching higher ground from the coast.

Become a weather-wise pilot

Australian accident investigation statistics continue to reveal 'continued VFR flight into adverse weather conditions' as a major factor in General Aviation VFR fatal accidents.

Roll cloud at sunset on the north-west shelf off Port Hedland. The cloud continued over the horizon. Photograph courtesy of Miss J. Statham and Dr M.W. Skinner.

Articles in numerous *Aviation Safety Digests* have highlighted the dangers faced by those pilots without instrument ratings who try to maintain visual flight in instrument meteorological conditions. On the credit side of the ledger, over the same period there have been many instances of pilots either cancelling trips or making timely inflight diversions because they assessed that weather conditions were, or had become, unsuitable.

The weather-wise pilot

The basis of safe flying operations is preflight planning, and here, the assessment of the weather forecast is one of the most important aspects.

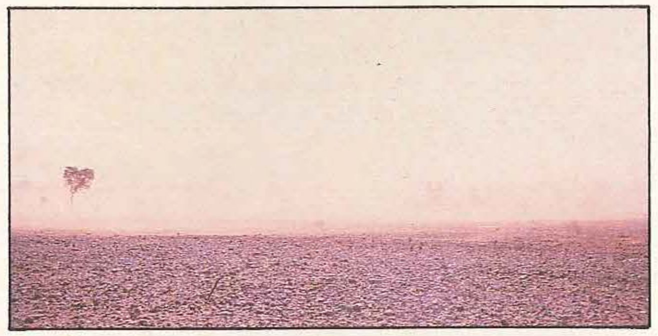
By assessing a forecast thoroughly on the ground, possible courses of action can be considered before takeoff should that forecast indicate that conditions may be marginal for VFR flight. Too often, however, it seems that some pilots either do not know what their forecast means in terms of expected weather conditions or allow external pressures, such as the 'get-home-itis' or 'it-can't-happen-to-me' syndromes, to influence sound judgment. The evidence of this can be seen in the disastrous experiences of those Australian pilots who have had accidents while attempting VFR flight in conditions which clearly did not meet VFR criteria. In other words, it *can* happen to you . . . so read on!

Reduced to the basics, assessing the weather involves two main components. The first is that of being able to understand *all* of the data, terminology, symbology, abbreviations etc. which are used in meteorological forecasts. Additionally, all of the forecast relevant to a flight must be considered so that a comprehensive understanding of prevailing conditions is achieved: a forecast is not something from which selected items can be read in isolation. Once an assessment of the forecast has been made, it must then be related to the circumstances of the planned flight — terrain, aircraft performance, en route facilities, etc. The point here is that it is not enough simply to collect a forecast and look at it: pilots must be able to translate the data it presents into an informed appreciation of its likely effect on their flight.

Pilots who feel that they are not assimilating fully the valuable information contained in flight forecasts are advised to refer to the sections on meteorology in either the VFG or AIP, and to approved texts, particularly the Manual of Meteorology.

The second component of becoming a 'weather-wise' pilot is that of being able to recognise inflight weather signposts and their warnings. Listed below are some of the most common weather phenomena together with their possible associated effects. No pilot can consider himself a safe and competent operator unless he can read, and appreciate the possible consequences of, these signs:

- **A gradual lowering and thickening of the ceiling:** inadequate terrain clearance, possible widespread precipitation, fog.
- **A line of heavy dark clouds:** severe turbulence, dust and poor visibility, hazardous landing conditions, precipitation, hail.
- **Roll-type clouds:** dangerous turbulence, dust and poor visibility, subsequent precipitation, hazardous landing conditions.
- **Ragged cloud base:** turbulence, variations in visibility, possible precipitation.
- **Bulbous cloud base:** turbulence, possible precipitation.
- **An opening in a wall of dark clouds:** this is sometimes referred to as a 'sucker hole', as dangerous turbulence, precipitation and poor visibility may be encountered as the hole is entered.
- **Temperature near freezing:** poor visibility in precipitation, with icing possible on the windscreen and airframe.
- **Low layer of haze:** possible fog or stratus cloud in the early morning or late evening; and poor visibility, especially when looking into the sun.
- **Blowing dust:** turbulence; and poor visibility, particularly when looking into the sun.

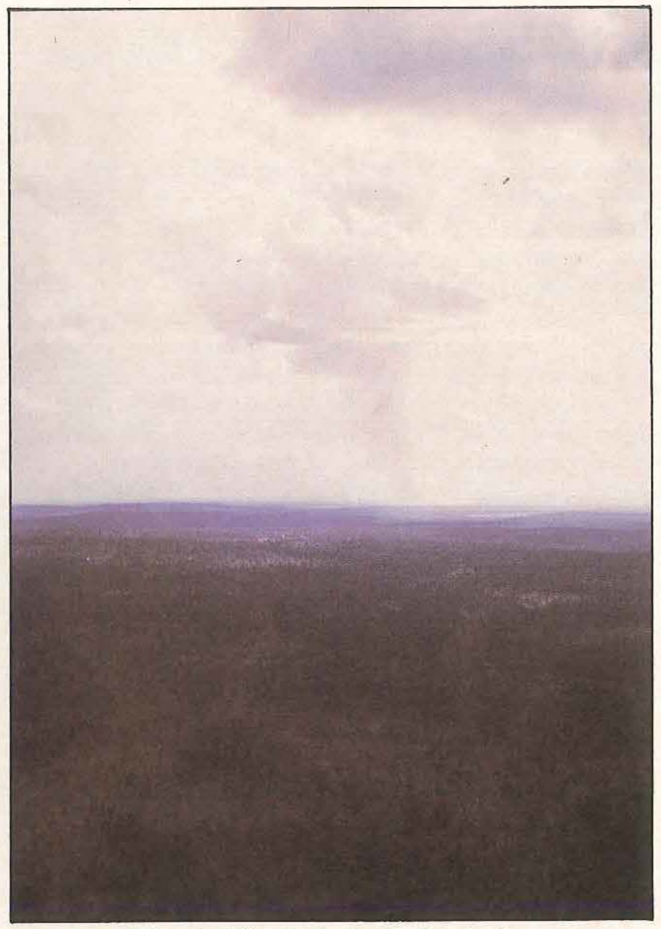


Blowing dust, Boulia aerodrome, Qld.

* * *

In addition to the hazards listed above, there are other common dangers in Australia which may not always be so clearly 'signposted', but which can also pose a serious threat to aircraft:

- **Mountain effects.** These are associated with strong winds *across* the crest of a range. Lenticular-type cloud above the mountain and turbulent (broken) cloud on the leeward wide of the mountain *may* be present. These phenomena indicate the wind structure known as 'standing waves' which will generate areas of turbulence and vertical motion downwards at various intervals downstream from the range, especially on leeward slopes.



Warm rising air from bushfire developing into thunderstorm, near Emerald, Qld.

- **Low atmospheric pressure.** Pilots should also be aware of the occurrence of relatively low atmospheric surface pressure downstream from a mountain range. A pressure altimeter not correctly adjusted will tend to over-read in such areas.
- **Low-level wind shear.** This is often experienced in the early morning during winter over inland Australia after a calm clear night which is accompanied by a surface temperature inversion. In some instances low-level 'jetstreams' may be present, in which case the wind strength may change from calm on the runway during takeoff to 50 knots or more at an altitude of only 2000 to 3000 feet AGL.
- **Thunderstorm effects.** It is well known that violent conditions will be encountered inside thunderstorms. However, there are associated phenomena which can occur outside the buildup, such as severe turbulence *beneath* the cloud; while the strong surge of cold air which comes down from the base in the mature stage of the storm and extends outwards from the cell over the surface can cause wind shifts many kilometres from the thunderstorm.

* * *

As a final thought, the weather-wise pilot is also aware that, when inflight weather conditions do deteriorate below VFR minimum, the 180-degree turn is one of aviation's best safety devices — as long as it is made *before* the aircraft is enveloped by bad weather. Pushing on into worsening conditions is a recipe for disaster ●

Pressing on regardless

The Flight Information Service provided to pilots operating outside controlled airspace in Australia is widely regarded as very effective and well suited to the flexible nature of GA operations. Relevant preflight, traffic and operational information is available to all aircraft on request. A fundamental characteristic of this system is the operational freedom it affords pilots who, within certain guidelines, can choose the amount of information they receive and the way in which they use such facilities as airspace, aerodromes and SAR services.

Inherent in the flexibility of this system is the devolution to pilots of the responsibility, first, to obtain all the information applicable to their operations, both before and during a flight; second, to assess the information themselves; and finally, to take action in response to that information. This is a continuum of processes, which therefore makes it essential that pilots recognise their responsibility to take full advantage of inflight information services and to update, if necessary, planned courses of action. That responsibility was not accepted in the accident examined below.

Preflight

Before planning a flight from central New South Wales to Essendon the pilot of a Cherokee Six telephoned a meteorological office for a flight forecast. He was advised that the predicted en route weather generally was good. A cold front, accompanied by strong wind gusts, sharply decreasing visibility and moderate to severe turbulence, was expected to pass through the southern section of the PA32's route later in the day, after the Cherokee's ETA Essendon. In view of the generally favourable forecast, the pilot was confidently able to submit a VFR flight plan.

Inflight

Departure was made on time and the flight initially proceeded smoothly at an altitude above 5000 feet. However, as the Cherokee (shown as Aircraft A on the map) approached about 20 nm north of Bathurst, AIREPs from other aircraft on the same FIS frequency began to indicate that actual weather conditions were different from those predicted.

Reports from two other aircraft were passed to Sydney FIS that the leading edge of the cloud which was associated with the front was lying some 12 nm east of Orange, aligned south-east to north-west. From these reports it was clear that frontal passage had occurred earlier than expected.

Aircraft A's track took it over Bathurst towards Cootamundra. When it was 12 nm south-west of Bathurst, another significant AIREP was passed to Sydney. This was from Aircraft B, which was tracking from Cowra to Young, and which advised that there were substantial dust storms in the area up to 5000 feet, and that he was IMC in dust at 3700 feet (which was the lowest safe altitude). As can be seen from the map, Aircraft B's track was adjacent to Aircraft A's intended track.

Sydney Flight Service contacted Aircraft A as it approached Wyangala Reservoir and repeated Aircraft B's AIREP. At about the same time, other aircraft reported severe turbulence in the Cowra/Young/Yass/Goulburn area generally, and intense dust storms up to 6000 feet around Rugby.

By this stage Aircraft A had descended to 4000 feet to remain VMC because of a lowering cloud base, and had also begun to experience considerable turbulence. The pilot later confirmed that he had been able to see the dust storms for some time as he approached the general Cowra area.

There were, then, clear indications that Aircraft A was entering a region of rapidly deteriorating weather in which VFR flight was most improbable and severe turbulence existed. The pilot, in fact, had considered diverting and had examined the charts for Bathurst and Cootamundra. However, against all the evidence with which he had been presented in flight, he decided to press on to check the dust storms for himself.

Very shortly afterwards, he found that conditions in the dust were precisely as reported, and he had to descend further to retain visual contact with the ground. Extreme turbulence made controlled flight difficult. As usually happens in weather-related accidents, the pilot suddenly realised that he was rapidly losing control of the situation. He found himself below 1000 feet AGL still descending and with the aircraft pitching and rolling violently.

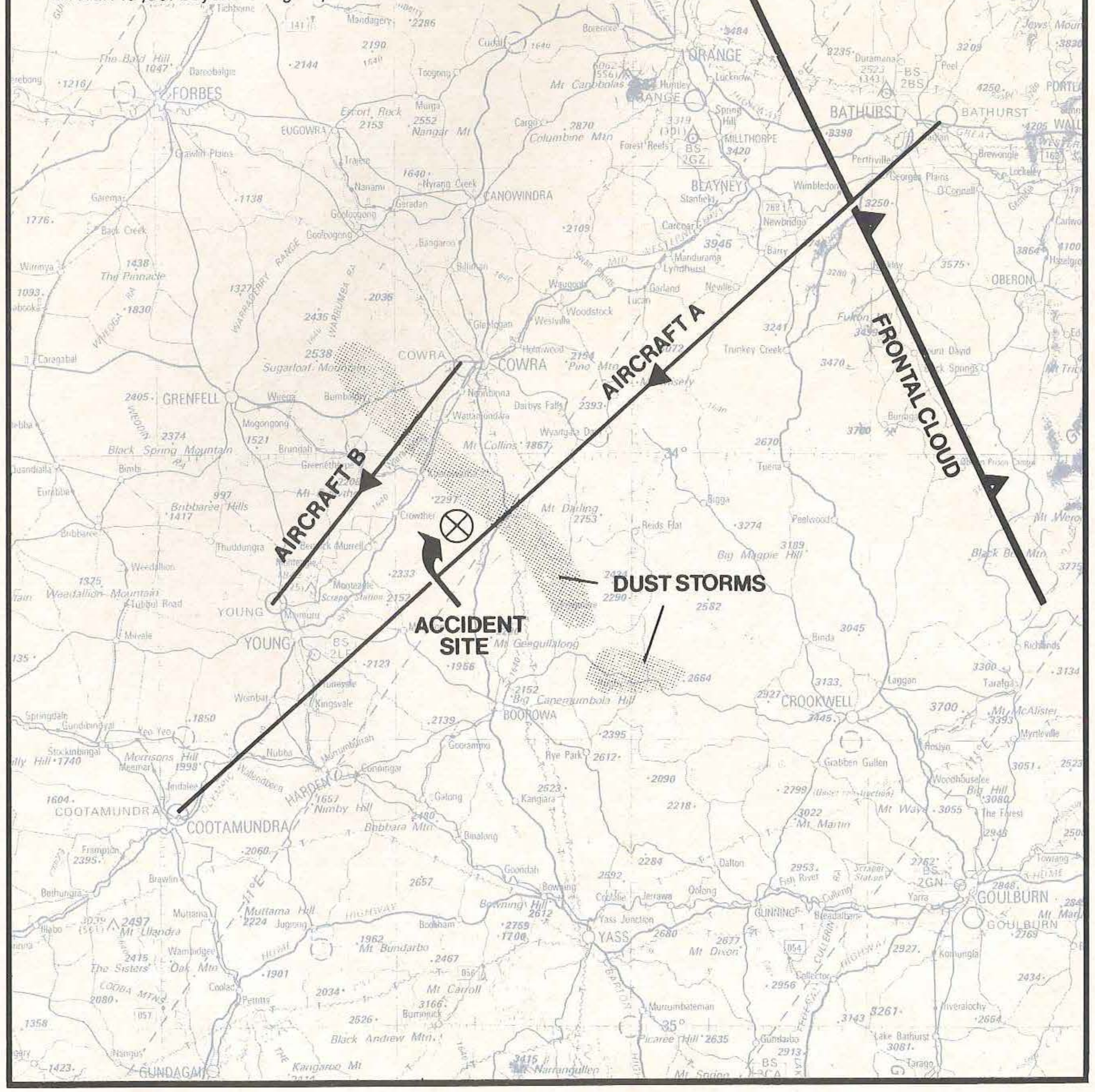
Full power was applied, but it was too late: the pilot no longer had the capability of extricating himself from his frightening situation. With the stall warning horn blowing and 85 knots indicated on the ASI, the pilot called out to his passengers 'I've lost it!'. Shortly afterwards the aircraft sliced through a two-strand power line, hit the ground, bounced over a ditch and a road and slid through a fence before finally coming to rest on its belly. Remarkably, all six occupants escaped unscathed.

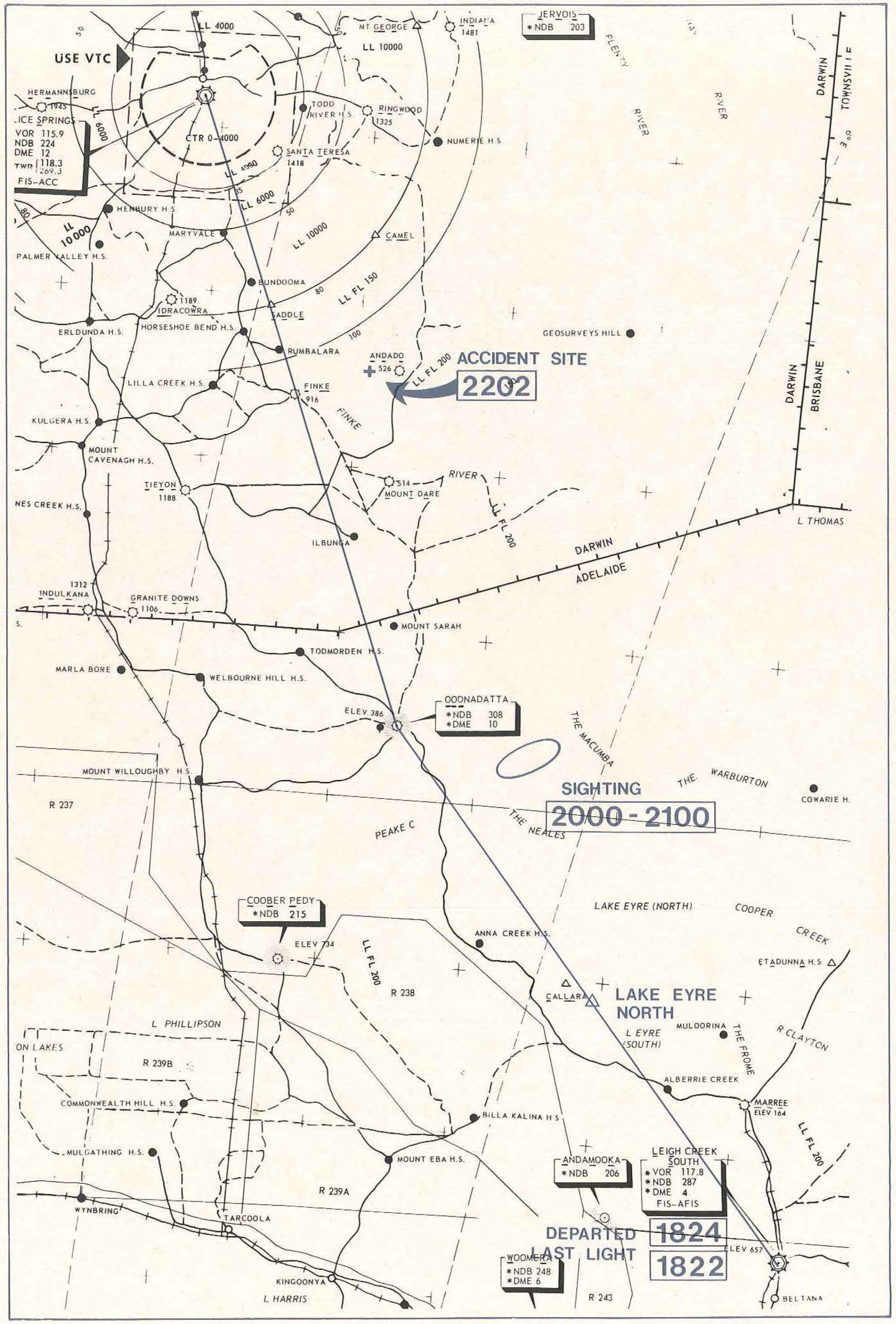
* * *

There is no need to labour the most important safety message here: the details of the accident graphically illustrate the folly of pressing on regardless of conditions. It does need to be said that, by and large, meteorological forecasts in Australia are very good; but this in no way absolves any pilot from reacting to actual rather than predicted conditions.

Two other safety-related points are worth mentioning. It was fortunate that nobody was injured, and even more so for one of the passengers who did not have his seat belt fastened and who was thrown out of the aircraft as the back door flew open on impact. Further, it was later established that the Cherokee had been 187.7 kg overweight on takeoff — a 12 per cent increase over the maximum allowable weight. The aircraft was still 88 kg overweight at the time of the accident, and this would have degraded the aircraft's climb performance when, with full power applied, the pilot was unable to gain altitude when he needed to do so to recover from the dangerous situation in which he had placed himself, his passengers and his aircraft ●

Looking back along flight path — the two-strand power line cut by aircraft is just beyond the group of three men.





Unauthorised Night VMC flight

A pilot holding a private licence without any class of instrument rating was asked to fly three people on a fishing trip from Swan Hill in Victoria to the Northern Territory. The passengers planned to stop at Alice Springs on the northbound flight to attend the Henley-on-Todd Regatta. A Piper PA32-260 was hired for the trip.

The pilot lived in Melbourne and on the day of departure arrived at Moorabbin Briefing Office at about 0830 Eastern Standard Time (EST). Weather conditions to the north were unsuitable for Visual Meteorological Conditions (VMC) flight so he took the Cherokee on a brief local sortie. By 1100 hours the weather to the west of Moorabbin had improved so the pilot decided to depart in that direction and circumnavigate the poor conditions which still existed on the direct track to Swan Hill. He prepared and submitted a flight plan covering all stages of the journey to Alice Springs, operating under the Visual Flight Rules (VFR). Although forecasts of en route winds were available, the pilot chose to plan for nil wind conditions.

When the flight plan was submitted, it was noted by the Briefing Officer that the estimated flight time was 9 hours 42 minutes and the journey would therefore extend beyond the end of daylight. When this was pointed out to the pilot, he stated that the final part of the journey would be completed under Night VMC procedures. The Briefing Officer reminded the pilot that he would need to check the latest weather forecasts at Leigh Creek to ensure that conditions were suitable for this type of operation.

The Cherokee departed Moorabbin at 1134 hours EST and arrived at Swan Hill at 1411. After refuelling and embarking the three passengers and their baggage, it departed at 1447 hours and arrived uneventfully at Leigh Creek at 1819 hours (1749 hours Central Standard Time). The aircraft was again refuelled and the pilot attended the Flight Service Unit (FSU) where he was given copies of the latest weather forecasts. He was observed making a number of calculations, but he did not notify the FSU of any amendments to his original flight plan.

The forecasts provided to the pilot indicated that the wind at the planned cruising altitude of 8500 feet was from the west at 15–20 knots. No cloud was predicted for the part of the route south of Oodnadatta but increasing altocumulus and altostratus, base 12 000 feet, was forecast for the latter part of the journey.

Departure from Leigh Creek was made at 1824 hours (all times are now given in CST), which was about the same time as the end of daylight. The planned route and estimated time intervals were: Lake Eyre North 53 minutes, Oodnadatta 59 minutes, Finke 60 minutes and Alice Springs 54 minutes.

In accordance with this schedule, the pilot reported to Leigh Creek that he had reached Lake Eyre North at 1917 hours, was cruising at 8500 feet and was estimating Oodnadatta at 2016 hours. Subsequently, when in radio contact with Alice Springs, he amended his estimate for Oodnadatta first to 2020 hours and later to 2024 hours. At 2023 the pilot reported his position as Oodnadatta at 2024, cruising at 8500 feet and estimating Finke at 2124 hours. At 2059 he advised that he was now cruising at 7500 feet. Then, at 2124 hours, he reported he was at Finke at 2126, cruising 7500 feet and estimating Alice Springs at 2220 hours.

Five minutes later the pilot called Alice Springs and asked for radar guidance. He was informed that Alice Springs was not equipped with radar and, when asked if he required navigational assistance, replied 'affirmative'. The Uncertainty Phase of Search and Rescue procedures was implemented by air traffic control.

Radio communications with the Cherokee were intermittent and messages were being relayed through other traffic. The pilot was asked to climb to 10 000 feet in an attempt to improve R/T and navaid reception from Alice Springs. Communications did improve, and Alice Springs ascertained from the pilot that:

- his last positive visual fix had been at Oodnadatta;
- he had maintained a heading of 335 degrees magnetic since that position; and
- his true airspeed was 120 knots.

As the aircraft was equipped with VOR and ADF the pilot was asked if he was receiving the Alice Springs facilities. He advised that he was not receiving the VOR but that he could hear the Alice Springs automatic terminal information service on the ADF. At 2145 hours the pilot stated that his remaining fuel endurance was 90 minutes.

From the information provided by the pilot and the forecast winds, it was calculated that the Cherokee was east of track. The pilot was therefore instructed to steer a heading of 320 degrees magnetic. At 2150 hours he reported that the ADF was indicating 030 degrees, but he could not see any lights or ground features. At 2157 hours the pilot was instructed to steer a heading of 300 degrees magnetic, in the hope that he would come within range of the Alice Springs VOR station. Three minutes later he advised that his VOR equipment was receiving Alice Springs and he was on the 320 radial. As this indicated that the aircraft was north-west of Alice Springs, the pilot was asked to confirm that his equipment indicated 320 'to' and not 320 'from' the station. No reply was received to either this or subsequent repeated calls.

Search and Rescue procedures were upgraded to the Distress Phase and an extensive air and ground search initated. The Cherokee was not equipped with an emergency locator beacon and it took about 36 hours to locate the wreckage, which was 29 nm east of the planned and reported position. There were no survivors.

Parts of the aircraft were spread over a considerable area. A trajectory analysis of the various components revealed that the aircraft had broken apart while heading 050 degrees magnetic, in a steep dive of at least 46 degrees, and within the altitude range of 2750–3850 feet. Examination of the wreckage found no evidence of pre-existing defects. The left wing, both left and right stabilators, and the rudder and fin had separated from the aircraft as a result of overload forces in excess of the design strength of the aircraft. Permanent torsional deformation of both stabilators indicated the aircraft speed was in excess of 204 knots prior to break-up. There was evidence that the engine had been operating and the aircraft's electrical system had been powered at the time the fuselage struck the ground.

Analysis

Although the flight from Leigh Creek was conducted at night, the pilot did not hold a Night VMC or any other class of instrument rating. His logbook recorded only 1.5 hours of night flying experience, gained five years previously during training for his private pilot licence. However, documents recovered from the wreckage showed that he had made travel flights at night on other occasions, the most recent being one month before the fatal accident.

By applying 'hindcast' winds (i.e. winds based on aircraft reports and recorded meteorological data for the particular area and time) and the Cherokee's true airspeed to the most probable flight path from Leigh Creek to the accident site, investigators determined that it was highly improbable that the aircraft had been at Lake Eyre North, Oodnadatta and Finke at the reported times. However, even allowing for these calculations, the investigators initially found that there were about 15 minutes of flight for which they could not account. It was here that a witness report came to the fore. A stockman camped in the Mt Robinson/Youltangunna Hill area reported having heard the engine noise, and seen the lights, of what appeared to be a light aircraft, circling in the area for about 15 minutes between 2000 and 2100 hours. This was consistent with the flight path reconstructed by investigators and explained the 'missing' 15 minutes.

Given the known and postulated flight data, it seems probable that, notwithstanding his position reports for Lake Eyre North, Oodnadatta and Finke, the pilot started experiencing navigational difficulties soon after his departure from Leigh Creek. By the time he reached the Mt Robinson/Youltangunna Hill area, he was so concerned that he spent a considerable time circling, searching for an identifiable landmark. His final position report at Finke — which was followed only five minutes later by a request for radar assistance — was obviously little more than a guess, and not a very well informed guess at that.

Comment

The cause of the accident was found to be that, following a loss of control, the aircraft was subjected to aerodynamic loads in excess of its design limit. While the reason for the loss of control could not be determined with complete certainty, several probable factors were apparent.

First, by the time of the accident, the pilot had been on duty for about 14 hours, and out of bed for considerably longer; thus, he would have been fatigued to some extent. Second, the final stages of the flight were conducted under a complete overcast, beneath which it was very dark with no visible horizon. The fatigue and absence of an horizon would have increased the pilot's susceptibility to spatial disorientation.

Finally, and most significantly, there is the matter of a pilot without a Class Four rating attempting a Night VMC flight.

The aeronautical experience and flight proficiency requisites for a Class Four rating are exhaustive and demanding. For example, included among the many requirements Class Four aspirants must satisfy are those of completing 10 hours of night flying, of which at least five must be visual navigation; and a demonstration of proficiency in recovering from unusual attitudes solely by reference to instruments (full details of all requirements are listed in ANOs). It is axiomatic that all of the sequences a pilot must complete for the rating are essential, and are designed to equip an individual to deal with the considerable and varied situations and pressures which can arise during Night VMC flight.

Apparently the pilot involved here had flown at night previously without undertaking any formal Class Four training. Regrettably, it needs to be said that he was foolhardy in the extreme to do so. On this flight, when pressures started to build up on him, he simply did not have the training, knowledge or relevant experience to cope.

The investigation report concluded that the reason for the loss of control could not be determined. However, the report went on to state that, together with fatigue and the prolonged stress arising from navigational difficulties, the pilot's lack of training and experience at maintaining control in the absence of external visual references was probably a contributory factor ●

Smooth, accurate flying will normally result if a pilot is relaxed, familiar with the equipment and has an awareness of body movement. Pilots should appreciate the following points:

- *In IMC or reduced visibility, head movement should be kept to a minimum to reduce the possibility of vertigo. Scanning with eye movement and small head movements is preferred.*
- *Do not automatically bend or swivel to retrieve dropped nav. equipment, documents, etc.*
- *The location and ease of picking up a hand-held microphone is important. A headset with a boom mike and 'press-to-talk' switch on the control column is best.*
- *Communication and nav. equipment frequency changes can add to the workload during stressful conditions. Pilots should know the correct directions to rotate knobs to increase or decrease frequencies.*
- *Optimum power settings and gear/flap configurations for low-speed cruise, turning, and speed/rate-of-descent performance should be known.*
- *Check the flight instruments to ensure that the attitude is correct before diverting attention to other tasks. Continually refer back to those instruments . . . I have flown with pilots who have entered a spiral and lost 1000 feet without being aware of it*

Safety checklist

Aircraft operation

- Am I in current practice on the type?
- Am I completely familiar with its operation?
  Have I an adequate knowledge of:
- The fuel system, fuel pump and mixture control operation?
- Power settings?
- Operation of the cowl flaps?
- Operating ranges of oil temperature and pressure, fuel pressure, and cylinder head temperature?
- How to use the carburettor heat control to best advantage?
- The undercarriage emergency extension system?
- Airspeeds for takeoff, climb, approach and asymmetric operation if applicable.

Aircraft serviceability

- Does the aircraft have a valid maintenance release and will it remain current for the duration of the flight?
- Is the aircraft fully serviceable in every respect?
- Is the oil level correct?
- Are the oil cap and dipstick secure?
- Have I ensured that there are no rags, birds' or wasps' nests, or other foreign matter on or in the engine compartment, air intakes, static and fuel tank vents, or pitot heads?
- Are the cowlings and inspection hatches secure?
- Have the external control locks and pitot covers been removed?
- Is there a need to carry tie-down equipment on the trip?
- Is the windscreen clean?

Radio

- Have I the correct frequencies for the proposed route?
- Have I a serviceable HF radio or a VSB if flying in a remote area?

Emergency equipment

- Is there an adequate quantity of water on board?
- Are emergency rations warranted for the flight?
- Is the aircraft's first aid kit well stocked and in good condition?
- What about survival gear? (See the pink pages of the VFG.)
- If part of the flight is to be over water, is there an approved life-jacket for each person on board?

Load

- Is the load properly secured?
- Is it within the maximum permissible weight?
- Have any ferrous metal or magnetic articles been stowed where they could affect the compass reading?

Fuel

- Have I personally checked the fuel contents?
- Is it really sufficient for the flight including possible diversions and reserves?
- Are the tank caps properly secured?
- Have I allowed sufficiently for variations in fuel consumption with altitude flown and power used?
- Have the tanks and filter bowls been checked for water?

Weather

- Does the forecast I have obtained cover the period in which the flight will take place?
- Will there be adequate cloud clearance above the en route terrain to maintain flight in VMC?
- Will I be able to remain clear of cloud or substandard visibility at all times?
- What is the likelihood of carburettor icing?
- Is an 'escape route' available if I should encounter conditions worse than forecast?

Navigation

- Have I an adequate knowledge of the route to be flown and the airways procedures to be followed — en route? In controlled airspace? At primary airports? Secondary airports? Aerodromes with a Flight Service Unit? Other non-controlled aerodromes?
- Have I the latest VECs, VTCs and FISCOM applicable to the route?
- What Restricted and Danger Areas are there on or close to the proposed track?
- Are my WAC charts current editions?
- Have I checked the NOTAMs relevant to the route?
- Is my flight plan accurate and sufficiently detailed for me to know my position at all times?
- Have I a safe alternative plan in case things don't 'work out'?
- Have I sufficient daylight for the whole operation — including the alternative plan?
- Is my SARTIME realistic?

Destination

- Have I checked the current aerodrome NOTAMs?
- Am I familiar with the local procedures?
- Do I know the location of the landing area in relation to a town or some other prominent landmark?
- Is the landing area adequate for the aircraft type?
- Are there hard-to-see obstructions on the approach — such as power lines?
- Is the likely crosswind component within the limit specified for the aircraft?
- What is the surface like — is it likely to be affected by rain?
- Is the correct grade of fuel available there?
- What about a telephone, transport and accommodation? ●