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Aviation Safety Digest

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Scenes from general aviation maintenance workshops

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Note: Metric units are used except for airspeed and wind speed which are given in knots; and for elevation, height and altitude where measurements are given in feet.

Vision 2 — sunglare

The second article in a series concerning the physiological, psychological and environmental factors that affect visual efficiency.

Below: A good example of the sunglare hazard. This photograph was taken at the location of the accident involving the Cessna 182, at the same time on the following day.

It was late afternoon when a Cessna 182 was landing at an aerodrome in Western Australia. The pilot had flown a full circuit and decided to land on the 300 degree strip, into the five knot wind. During the approach the passenger, who was also a pilot and endorsed on the C182, suggested that landing towards the north-west may be troublesome because of sunglare. The pilot decided to continue with the approach. Just off the north-western end of the strip was a sawmill and the smoke from the sawdust fire was drifting over the aerodrome and adding further to the visibility problems.

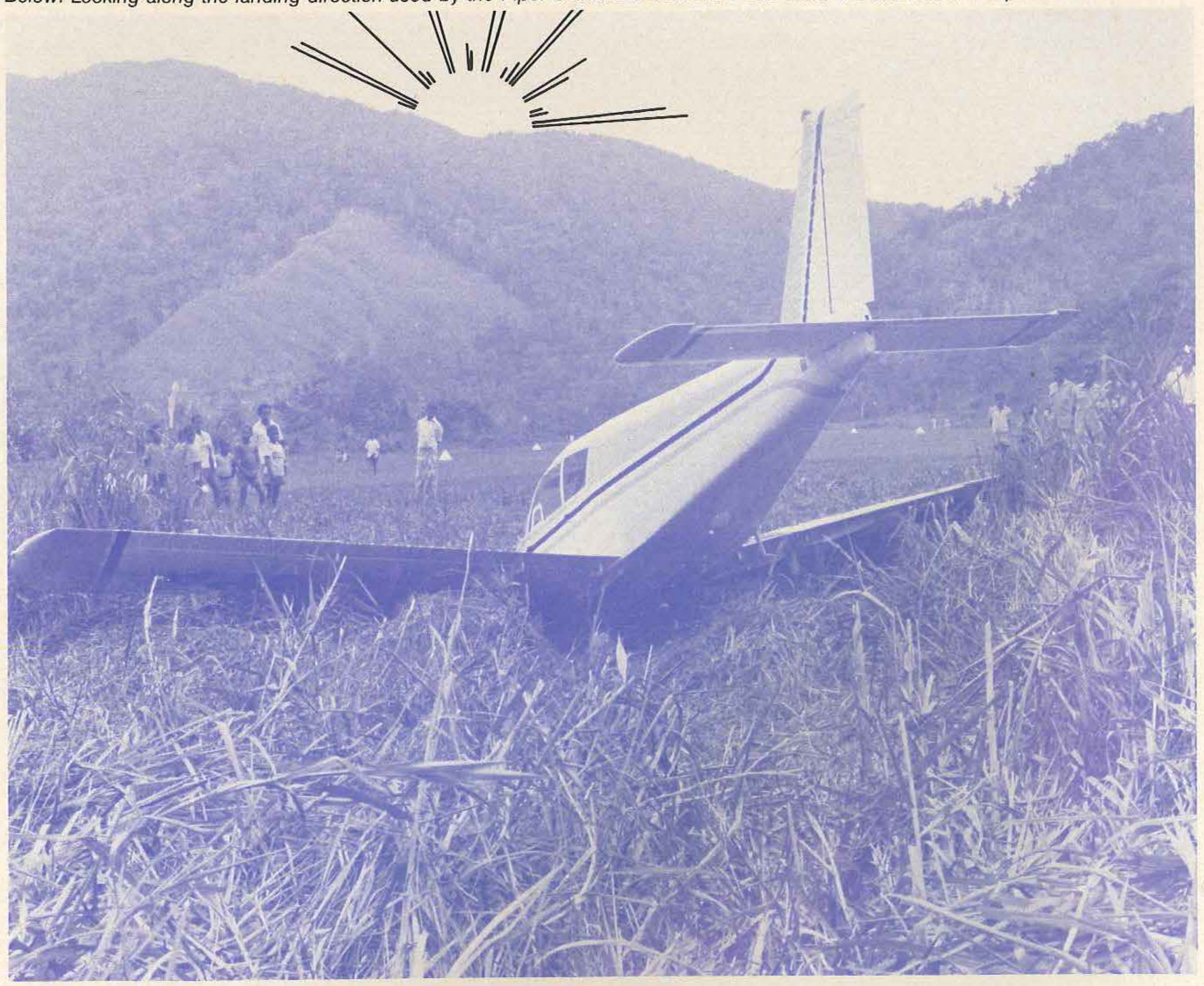
On final approach with 30 degrees of flap selected and 70 knots airspeed, the pilot assessed the situation and decided to continue the approach. The sun was in line with the strip and about ten degrees above the horizon. All appeared normal until just after the roundout and touchdown when the landing gear struck a mound of earth about 30 metres before the marked threshold. The nose gear was detached and the aircraft slowly overturned. The two occupants were not seriously injured.

A Piper PA28-235 was on an early morning flight to an aerodrome in Papua New Guinea. On board, besides the pilot, were a LAME and another pilot who were to repair and fly out another aircraft stranded at the aerodrome.

The pilot of the Cherokee had gained most of his flying experience in Papua New Guinea. He had not previously operated into this aerodrome but had sought information on the strip from other pilots. It was a licensed aerodrome with a one-way landing direction of 120 degrees.

Descending into the circuit, the pilot cancelled his SARWATCH at 0706 hours and made a continuous base leg descending turn on to a short, low final approach. While he was manoeuvring to align the aircraft with the strip the rising sun broke over the top of the hills, obscuring all forward vision. The pilot did not initiate a go-around, however, because he believed the aircraft was settled on the proper descent profile and was near the threshold. The aircraft continued its descent into tall cane grass, stopping on soft ground 25 metres short of the threshold, with the gear collapsed.

Below: Looking along the landing direction used by the Piper Cherokee. Witnesses estimated the sun was in the position shown.



In each of the above accidents the pilot's judgment of distance and height was significantly affected by sunglare. Flying against the sun, when it is low on the horizon, can block out a high percentage of normal cockpit visibility, especially in the presence of atmospheric debris such as dust, haze, smoke, etc. This becomes particularly hazardous when flying in areas of high traffic density. In some circumstances, runway surfaces may also reflect sunglare in a manner that will seriously interfere with forward vision.

As well as the problem of direct sunglare, visibility can also be reduced by veiling glare arising from the reflection of sunlight from dirt particles or scratches and crazing of the windscreen.

The remedy for the problems consists firstly of planning, if possible, to fly with the sun. When westbound, start early and set down by mid-afternoon; if eastbound, start later in the morning and set down before last light. If there is a choice of take-off and landing directions carefully consider the effects of sunglare before the final decision is made. If unavoidable, direct glare can be partly blocked by a sunvisor. The use of sunglasses can also be of slight benefit.

Pilots operating with the sun behind them should be alert to converging traffic from ahead and, notwithstanding the rules of the air, be prepared to give way on the assumption that the pilot of the other aircraft may not see you.

Veiling glare can be reduced by ensuring that dirt and surface scratches are removed in accordance with the instructions in the Owner's Manual or Pilots Operating Handbook for your aircraft. If the windscreen has more than a minor degree of crazing, serious thought should be given to having it replaced. While this may be costly, the benefit that could be gained is the prevention of an accident involving a far greater cost ●

Aerodromes — government, licensed or authorised landing area?

A recent incident report, submitted by the manager of a licensed aerodrome, concerned a PA23 aircraft landing there when the aerodrome was closed by NOTAM to aircraft above 1300 kg MTOW, because of a soft, wet surface. The aircraft was on a NOSAR flight to the licensed aerodrome and other landing areas around a primary control zone. The two private pilots on board were flying leg-for-leg but neither had contacted an Airways Operations Unit or the aerodromes directly to check on the serviceability status. One of the pilots suggested that, as it was a NOSAR flight to very familiar aerodromes, he, 'like the majority of the other pilots flying around the traps, neglected to check the NOTAMS for that day.'

While the above incident would appear to have resulted from a degree of that contemptible disease 'complacency', there are enough occurrences on record to suggest that some pilots are unfamiliar with the different kinds of aerodromes and the correct methods in establishing their serviceability. There are three kinds of aerodromes and these are described below with the different procedures applicable to each.

Government aerodromes (G)

These are owned by the Commonwealth of Australia and administered by the Department of Transport and/or the Department of Defence in some cases. Responsibility for aerodrome inspections and serviceability reports rests with the officer-in-charge; unserviceabilities are notified by NOTAM. There are no individual landing charges at government aerodromes as these costs are covered by Air Navigation Charges and prior permission to use them is not required except in the case of some Defence aerodromes, though of course the flight notification and air traffic clearance requirements have to be met. Government aerodromes are indicated by '(G)' after the aerodrome name in AIP AGA and are included in VFG AGA.

Licensed aerodromes (L)

These are aerodromes normally owned by local shire councils and sometimes by private owners, which meet minimum standards set by the Department. The licensee nominates an Aerodrome Reporting Officer who is responsible for ensuring the aerodrome continues to meet the applicable standards. If it does not and immediate rectification is not possible, he will report the unserviceability to an Airways Operations Unit which will raise a NOTAM. Licensees are permitted to charge landing fees approved by the Department. The aerodromes where fees are payable are listed in AIP GEN and the VFG. Prior permission from the licence holder to land at these aerodromes is not required. Licensed aerodromes are indicated by '(L)' after the aerodrome name in AIP AGA and are also included in VFG AGA.

Authorised Landing Areas (ALA)

Under the provisions of ANR 85, any place may be used as an aerodrome provided it complies with the descriptions and conditions specified by the Secretary to the Department of Transport and outlined in AIP AGA-6 and VFG aerodromes section. The responsibility for compliance with these requirements rests with the pilot in command. Compliance should be ensured before undertaking a flight to or from the proposed ALA.

The majority of ALAs are on private property and although there is no longer a DoT requirement to obtain the owner's permission to operate from the ALA, there is an obligation to so do under common law. In many cases, contacting the occupier or controlling authority is the only way that the pilot can obtain a report on the serviceability of the aerodrome.

Throughout this country there are numerous ALAs which have been raised to a high standard and are used as bases for DoT approved flying schools. Authorised landing areas which are approved for use by flying schools are required to meet standards additional to the normal ALA standards. Often these higher standards tend to suggest that the aerodrome is something more than it is and visiting pilots tend to overlook the courtesy of seeking the occupier's consent prior to using the ALA. It is only pilots operating within the authorisation given to the flying school who are exempt. Other pilots are still obliged to obtain consent from the occupier or controlling authority before landing at such locations.

Do not be misled into believing that because a certain aerodrome is regularly used by many aircraft, it is automatically available for general operations. If the aerodrome is not listed as a government or licensed aerodrome in the AIP, VFG or associated NOTAMS, it is an ALA and the responsibility for the operation rests with the pilot in command. Ensure that you know the status of your destination aerodrome and that you obtain all the current information on its serviceability state.

A recent accident and a contribution from one of our readers further help to illustrate the degree of care required to ensure that all the details likely to affect an aircraft's operation are obtained prior to a proposed landing at an ALA. They highlight the responsibility that general aviation pilots must exercise when planning such flights.

The accident report shows that, although not required by Departmental regulations except for ALAs used by training organisations, marking the boundaries of ALAs can be of paramount importance in ensuring that the pilot uses the correct area. If there is no permanent marking of the area, the pilot should ensure that he is adequately briefed on the correct recognition of the area or else arrange for some temporary marking to prevent mis-identification.

The pilot of a Cessna 206 intended to land at an ALA situated in a large paddock on a Queensland property. The dimensions of the area were more than adequate for this operation but there were no markers and the growth of grass made it difficult to discern the strip from the air. The pilot had last landed there about three years previously and knew that the strip was on a sandy ridge and considered to be 'all weather'. He recalled it was about 750 metres long and aligned north/south. On the morning of the flight the pilot had been contacted by telephone and had arranged for a local resident to inspect the strip in his vehicle and ensure that it was serviceable.

On his arrival at the strip the local resident saw a Cessna 182 parked near the end of it and he considered that, if that aircraft had used the strip, it should be satisfactory. Adjacent and parallel to the strip was a 27 metre wide section of the paddock which had recently been disc-ploughed.

The Cessna 206 arrived overhead and proceeded to join the circuit on the crosswind leg for a landing towards the north. The weather at the time was fine and calm. As the people on the ground watched, the 206 touched down on the ploughed area. After a short ground roll, the nose leg detached and the aircraft overturned. The pilot was not injured.

The pilot later said that on flying over the area he had observed the ploughed section, with the Cessna 182 parked adjacent to it, and had concluded that this was the strip which had been harrowed as an improvement, and that the 182 had used it. Knowing that the 206 had larger wheels than the 182 and would handle the furrows better he proceeded to land on the ploughed area.

The pilot chose the highest part of the strip and approached with full flaps for a normal landing. During the landing roll the nose leg snapped at about 20 knots and the aircraft overturned. The pilot immediately turned off both switches and left the aircraft. Only then did he realise that the ground had been ploughed.

The uneven surface had been slightly flattened by recent heavy rain and the pilot did not detect its unsuitable nature. He made a normal touchdown but, as the weight settled on to the wheels, the nose wheel dug in and kicked to the left in the soft, moist soil. The resultant loads caused the nose wheel fork to break. The nose gear strut then dug in, causing the aircraft to decelerate rapidly and overturn 69 metres from the initial touchdown point.

Our reader's story demonstrates that despite the care taken to procure information, details obtained from a non-pilot layman are subject to misinterpretation. It reiterates the difficulty of assessing the suitability of a landing strip from the air with the consequent importance of ensuring that all relevant details on ALAs are obtained before flight.

'In 1975, with 300 hours of aeronautical experience over two years, mainly in the far west of NSW, I planned a trip with my family in a Cessna 172 to a small town in the Riverina area of NSW.

'I had never been there before, so I asked the friend we were to visit to post details of the nearest place we could land. He advised me there was a strip on a nearby farm, obtained the owner's permission to use it and sent what I felt was a very detailed map, with the warning I may have to buzz the strip to clear it of sheep. The relationship of the strip to power lines, roads, fences, buildings and silos was clearly shown and the length was just sufficient.

'Feeling adequately prepared we set off and after an uneventful flight arrived over the town, identified the strip, noted our friend's car there and cancelled Sarwatch. The wind was very light from the west and, as the strip ran east/west, I decided to land in a westerly direction. I had to overfly twice to move the sheep and noticed quite a hill about half a kilometre to the east of the strip.

'On my first attempt to land, keeping well above the hill, I hopelessly overshot the strip and went around. Realising now that there was not much room I tried to fly a more accurate approach. Missing the hill by only about fifty feet, with power off and full flap selected, all looked fine as I crossed the threshold and began to round out. However with half the strip gone and still no touchdown I decided to go around again. The wheels actually touched the ground and the small amount of strip remaining made it a fairly short-field take-off, but I was sure it was the safest course of action and was glad to note clear approaches to the strip from the west. Once safely climbing I thought about the problem and could see no way of doing a steeper approach after clearing the hill, so with almost nil wind I decided to land the other way, towards the east, using the easy approach from the west to set myself up for a short field landing.

'I remembered that hill to the east and resolved that any decision to go around would have to be made well out on the final leg. It was only after a successful landing, using only about half the strip, that I realised the strip had a steep slope, falling away to the west. I remember looking at the slope, and the hill, and deciding that a take-off to the east would be impossible.

'Later my friend told me, "They always take off from the west and land to the east, I thought you would work that out." In the map he had drawn he had not mentioned the gradient or the hill, no doubt being unaware how such things are not as obvious from the air as from the ground.

'It was only some time later, after reading the *Aviation Safety Digest* and then turning to carefully consider the VFG section on Authorised Landing Areas that I realised I had landed on a strip suitable only for agricultural operations. Almost all my experience was west of the Darling where cropdusting and agricultural strips are rarely seen, and most strips exist for light aircraft and are suitable for them to use.

'During my flying training I cannot remember being taught or examined on physical requirements of ALAs. I notice in the *Air Legislation Examination Guide for General Aviation Pilots* there is a question about ALAs, but not about physical requirements. I would suggest the inclusion of a question that tests the pilot's awareness of the need for an obstruction-free go-around area on an ALA.

'Furthermore I suggest in the VFG section on ALAs an initial note, in large dark print, reading something like the following:

"WARNING — Throughout Australia there are many strips used for agricultural operations which are unsuitable for private operations as they do not meet the physical requirements for private operation from Authorised Landing Areas, e.g. they may have an obstacle free take-off and approach area at only one end of the strip, leaving no safe go-around area".'

This pilot's lack of training in ALA operations is relevant and probably widespread. Few pilots are properly introduced to the ALA requirements until they have obtained their unrestricted private licence when they are able to operate into these areas without the benefit of instructor supervision. It is recommended that prior to any operation into an ALA, pilots refresh their memories of the requirements by reading the appropriate sections of the AIP or VFG. If you are still in any doubt about application of the criteria consult your local training organisation or a DoT officer.

The suggestion from our reader about a warning in the VFG will be incorporated in the next edition ●

More about pre-flights

From the United Kingdom we heard of an incident involving a privately owned Stampe SV4C aircraft. The message in the incident did not concern the aircraft type but the fact that it was privately owned and flown by the one pilot most of the time.

The owner/pilot reported that he had noticed for some time a slightly excessive degree of side-to-side movement of the fin leading edge, but he thought the movement was normal. It was only when another Stampe owner carried out a pre-flight inspection on the aircraft and remarked on the amount of movement, that the owner checked other Stampe fins and found them to be more rigid. Further inspection of his own aircraft revealed a broken fin attachment plate.

As pointed out by the owner, the incident highlights the inherent danger in the owner always being the only one to conduct the pre-flight inspection. (This could also be extended to a pilot who is usually the only person to fly a particular aircraft). This owner had arranged for another Stampe owner to do the pre-flight because, notwithstanding first class maintenance, he felt it was all too easy for an owner to get so used to a defect of this nature that he does not realise the significance of it.

Makes interesting food for thought, doesn't it ●

Beach operation of aircraft

Page 11: The Royal Australian Air Force takes no chances with salt water corrosion. At the completion of each low-level maritime reconnaissance mission, its Orion aircraft are washed in a 'bird-bath' to remove any corrosive substances.

'Let's have some fun and operate our aircraft from a beach!' Why not? Well, just remember the owner will have to pay the price eventually.

Few people would drive their car in salt water yet it is not uncommon to see both single- and twin-engine aircraft worth up to $250,000 taking off and landing on beaches running with salt water.

Consider — very few modern light aircraft or their engines or propellers have any form of special salt water corrosion control applied during manufacture; therefore, once initiated, salt water-induced corrosion will propagate very rapidly.

People who may be impressed by advertising material concerning the high resistance of aluminium to corrosion should note that this applies only to *pure* aluminium in isolation from all other substances. In an aircraft there are very few places where *pure* aluminium is used. Similarly, there are virtually no places where any one material is used exclusively. Often parts made from dissimilar materials are fastened together. For example, unprotected steel brake drums are bolted to aluminium or magnesium wheel halves in most light aircraft. Corrosion is rapid when this combination of parts is exposed to sea water.

You may believe that one can readily wash down the aircraft inside and out to remove the salt. In practice this is seldom attempted inside the aircraft and, if done, is usually not effective. In fact it could well be that the dried salt products may be forced further into areas to which they did not originally penetrate. Use of a damp sponge or cloth could be more effective for aircraft interior surfaces.

Inspection of general aviation aircraft known to have been used in beach operations has disclosed corrosion and sand-induced disintegration of:

—aileron and flap support arms
—wheel brake discs
—wheel bearings
—propeller blades — showing split leading edges and eroded rear faces
—spar webs — holed and with skin corrosion
—control cables
—bolts, nuts, locking devices
—landing gear spring legs
—engine cylinder barrel cooling fins etc.

There is a tendency to sell off aircraft after beach operations and prospective new owners should make quite sure they are not purchasing aircraft which in a short time will reveal expensive evidence of salt water-induced corrosion.

Apart from the corrosion aspects of beach operations, there is the matter of accelerated mechanical deterioration. This can show up in the form of premature failure of landing gear assemblies and their attachments because of increased wear or impact damage caused by operating in loose sand or across those washes or small water runs which cross many beaches.

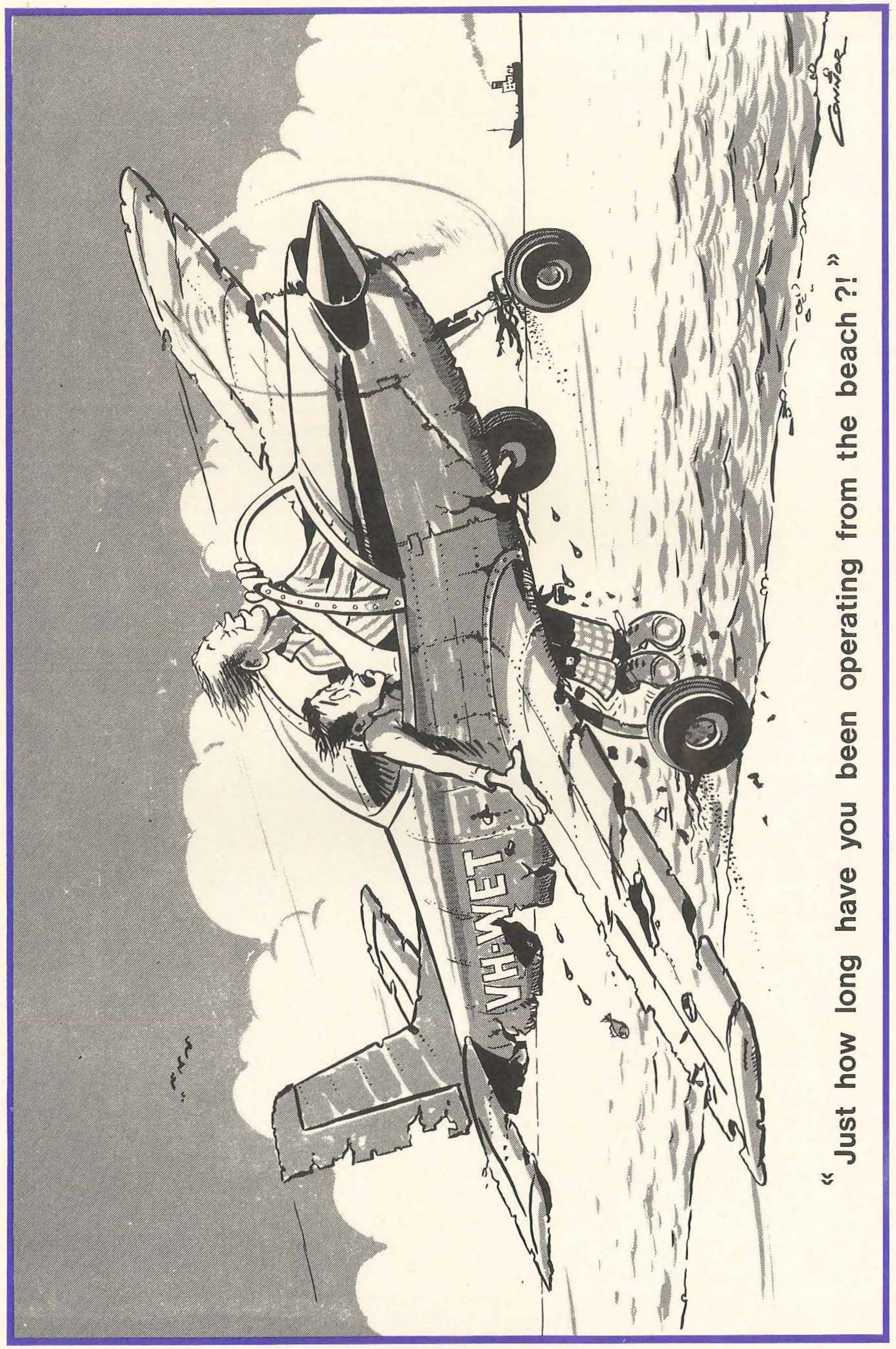
Owners should realise they will only get the maintenance they request. If no Maintenance Release reference is made to unusual operations or occurrences then the LAME will proceed as though none has occurred unless he is alerted by obvious damage or corrosion. Eventually the owner will pay a greater price as a result of more rapid wear-out of parts or a malfunction which could have been avoided. LAMEs are not required to preserve your aircraft; they are responsible for ensuring it will be safe for the next 100 hours or one year subject to normal conditions.

It is simply a matter of where does the LAME stop. Corrosion, once started in riveted assemblies such as the airframe and wings of most light aircraft, cannot be stopped except by de-riveting the assemblies and using mechanical methods followed by chemical treatment and special paint application, a costly procedure.

—Think before you engage in beach operations or rough strip operations and in your own interests advise your LAME fully when ordering subsequent work to be done on your aircraft.
—Try to establish the operating history of aircraft you may be considering for purchase and have a detailed inspection carried out by an experienced LAME before buying any aircraft.
—Take some action, between periodic inspections, to prevent the onset of corrosion, e.g. spray oil or an approved corrosion-inhibiting spray on to cylinder fins, exposed nuts, cables, etc. before operating on the beach; clean your carburettor air filter of sand; and sponge or wash down the aircraft immediately afterwards. In other words treat your aircraft as a marine aircraft, carry out the seaplane/amphibian inspection called up in ANO 100.5.1 Appendix 4 but add the undercarriage as an item in lieu of floats. This action will help to protect your aircraft but if the basic structure is not corrosion-proofed to marine aircraft standards at assembly you will still have a corrosion problem in that area. No guaranteed protection can be applied to an aircraft after assembly or after exposure to salt water.

If you are not the owner of the aircraft then you should seek the approval of the owner or hiring agency before engaging in beach operations. This will give the owner the option of deciding whether or not he wishes to expose his aircraft to the hazards of this kind of operation.

These procedures also apply to aircraft stationed at airports such as Coolangatta and Mackay which are situated within the salt water haze zone often apparent at the seaside ●



Pilot landing expectancy and the missed approach

Pilot experience substantiates the fact that an actual IFR missed approach is an infrequent event. Pilots have difficulty recalling any past actual IFR missed approaches. They also have difficulty recalling the missed approach procedures for approaches that are so familiar they are committed to memory.

A possible reason may be that we are so used to operating in a radar environment, in controlled airspace, we expect air traffic control to take care of us with radar vectoring if a missed approach becomes necessary. Another reason may be that under the Australian operational control system ATC will not clear an aircraft for an approach when the weather is observed to be below minima; thus the possibility of a missed approach is considerably reduced. Outside controlled airspace, however, we must remember that the pilot-in-command makes the decision to attempt an approach and, if a missed approach becomes necessary, it will be strictly procedural.

Pilot landing expectancy

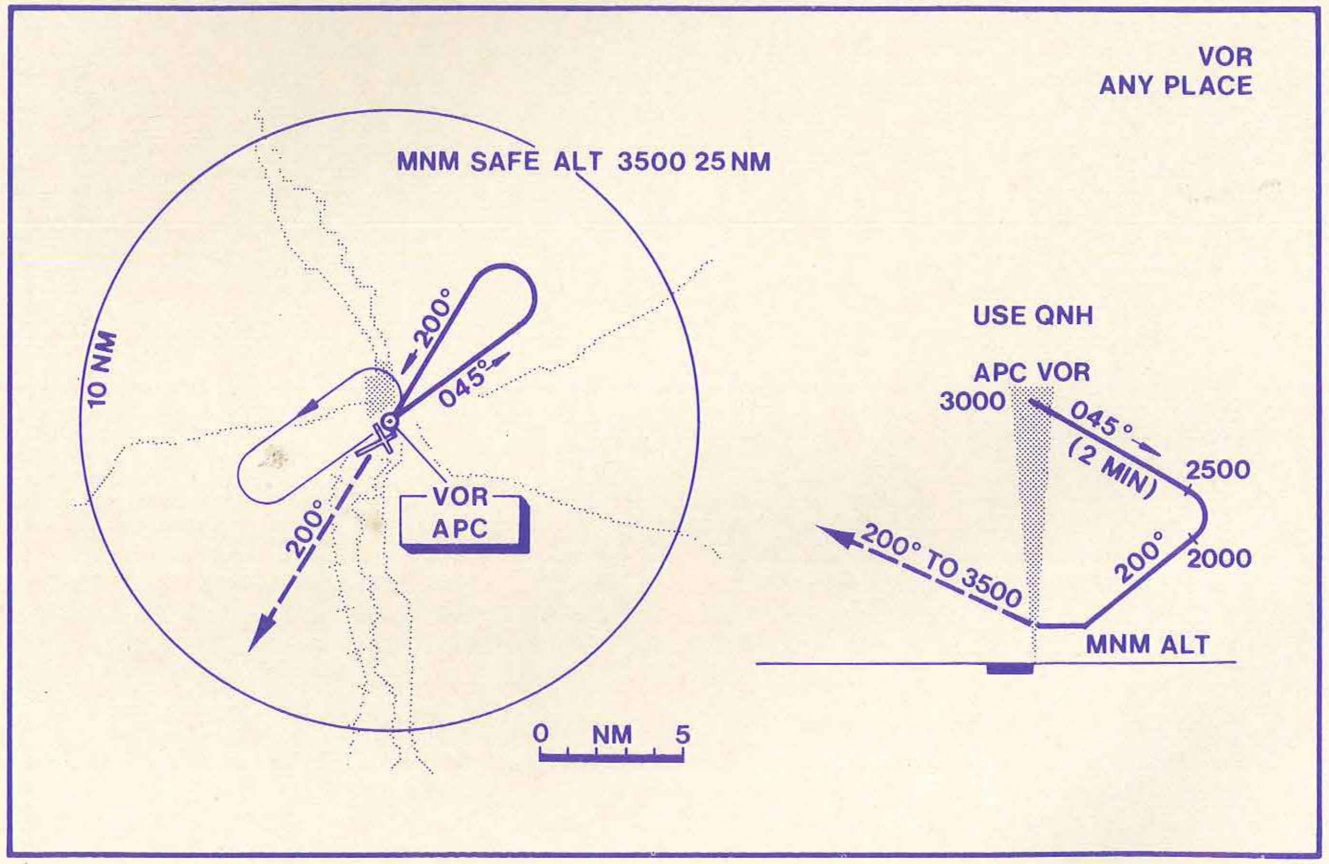
There is apparently an underlying phenomenon prevalent in pilots called 'landing expectancy'. Expectancy or set can be defined as an anticipatory belief or desire. Certainly a pilot anticipates he will land off an approach and he has a desire to do so. Unfortunately, his landing expectancy, which operates at a subconscious level, may affect his decision-making processes to the point where he overlooks some safety procedures.

This phenomenon is derived from experience and is probably a result of the infrequency of missed approaches when compared with successful landings. An individual expectation could result in the perception of a situation different from the actual circumstances. Thus a decision could be based on how a pilot would like the circumstances to be rather than what is reality. This can lead to accidents.

A similar situation can exist with air traffic controllers and this will be discussed at another time.

A landing expectancy incident?

The circumstances of a recent Australian occurrence suggest that pilot landing expectancy might have been a factor. The following situation is occasionally encountered and worthy of consideration by all IFR pilots. Study the simplified landing chart then read on.



Two IFR aircraft were inbound at night to an aerodrome outside controlled airspace. They maintained adequate separation during their descents to overhead the field and each had elected to carry out a VOR approach. Special weather conditions existed with the base of the layered stratus cloud reported to be 500 feet.

The leading aircraft descended to the initial approach altitude of 3000 feet and the second aircraft descended to arrive overhead at 4000 feet. After the first aircraft had left 3000 feet on the approach, the other aircraft descended in the holding pattern to 3000 feet.

Because of the low cloud base the first aircraft was unable to sight the aerodrome at the minima and commenced the missed approach procedure, on climb to 3500 feet. As the aircraft approached the top of a layer of stratus, its lights were seen by the pilot of the second aircraft which was inbound in the holding pattern and now at 3000 feet.

R/T liaison resulted in the climbing aircraft maintaining 2500 feet on the missed approach heading while the other aircraft climbed back to 4000 feet. Both aircraft eventually diverted to an alternate aerodrome after missing out on two approach attempts.

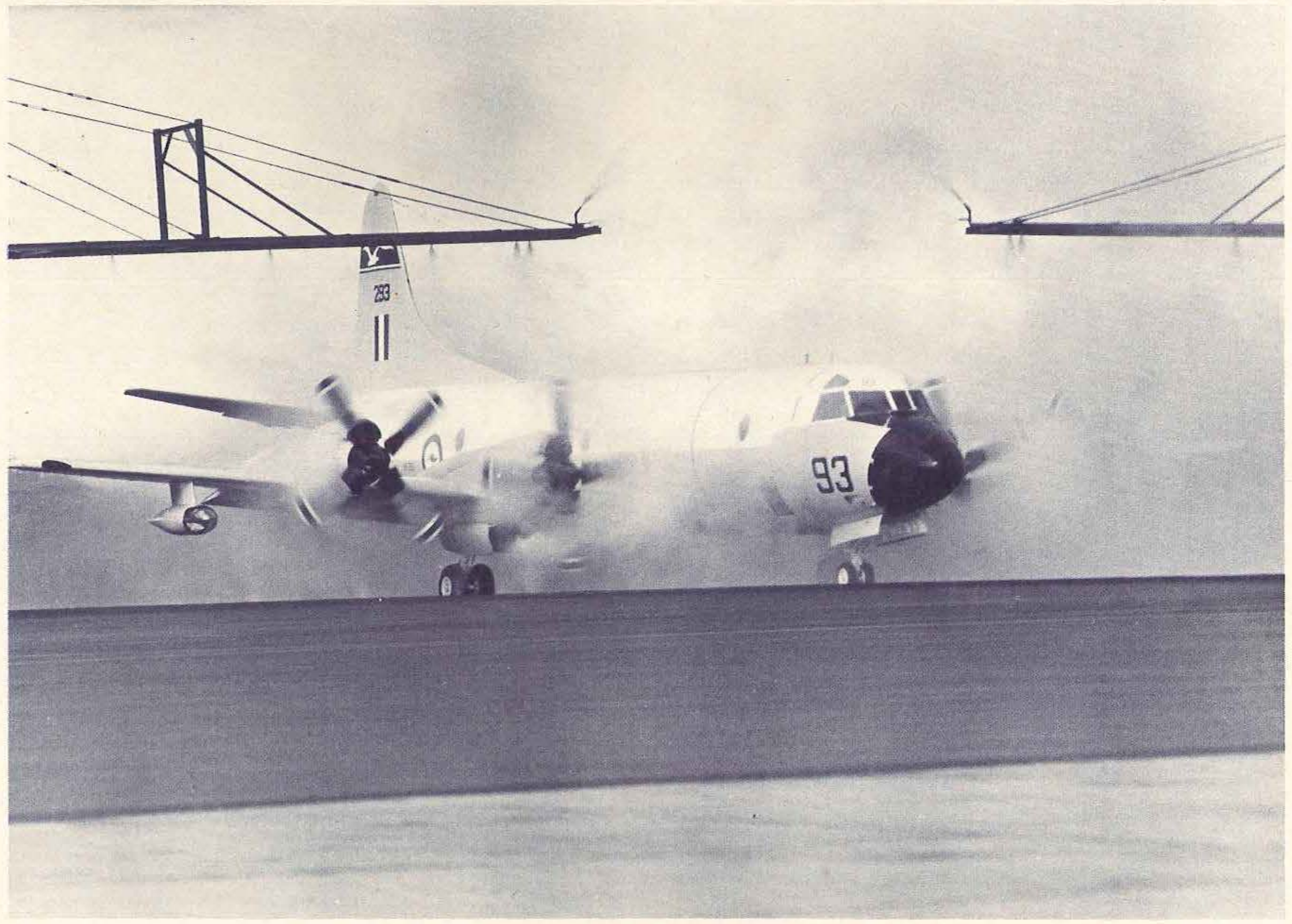
Was the pilot of the second aircraft subconsciously expecting the other aircraft to make a successful approach and landing? We will never know for sure but it remains a distinct possibility.

The message from this particular occurrence is obvious — when an actual instrument approach to the minima is required at an uncontrolled aerodrome, a following aircraft should hold at an altitude which provides vertical separation above the lowest holding altitude (or the missed approach altitude if this is higher) and not descend until the preceding aircraft making an approach has reported 'visual' and its landing is assured. This procedure is even more valid when the missed approach track conflicts with the area provided for holding, as in the example described here.

As a broader consideration, we should recognise the phenomenon of landing expectancy and counteract it on a conscious level. There appear to be three things a pilot can do in this regard:

- —Become familiar with the missed approach environment. This can be done in the simulator where missed approach decisions can be practised under varied conditions and during various parts of the approach profile. Learn what can and cannot be done in this environment to reduce uncertainty and place landing expectancy in its proper place.
- —Prepare for the missed approach as well as for the approach. This will help reduce the uncertainty of 'go' and 'no go' situations.
- —Adhere to established procedures with regard to approach limits and have as many decisions pre-planned as possible.

The prudent pilot, through adequate planning, is able to prevent landing expectancy from adversely affecting his decision-making while on final approach, thus improving his own safety as well as the safety of his passengers ●



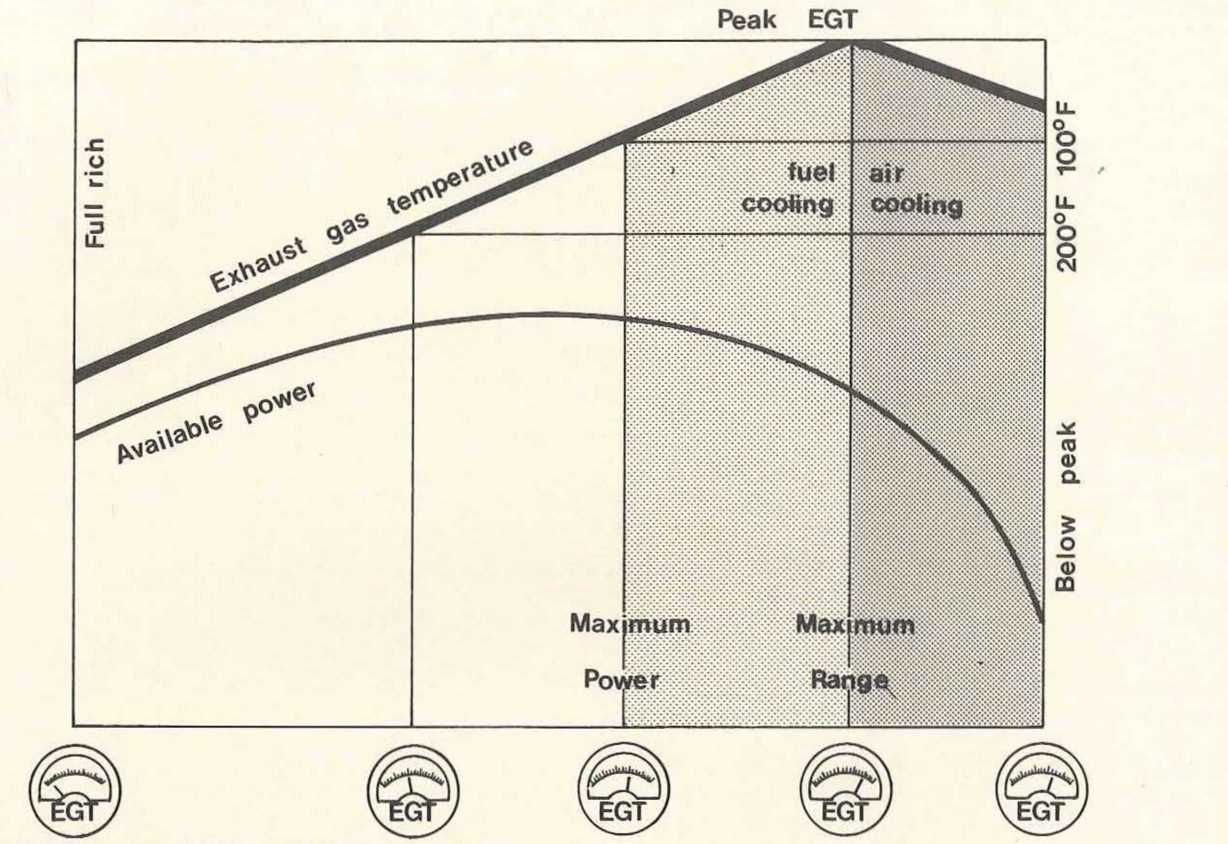
The Engine Doctor on gauges

In *Aviation Safety Digest 106* we reprinted an article from the U.S. Federal Aviation Agency *General Aviation News* concerning fuel consumption and the use of the mixture control. In this issue we present the follow-up article from the same source concerning the correct use of the engine monitoring gauges, namely the cylinder head and exhaust gas temperature gauges, and what their indications mean to the pilot.

Doctor: Well, here you are back again, right on schedule. I believe we were going to talk about cylinder head temperature gauges and —
Owner: Doc, you can save your breath to cool your porridge, as my dad used to say. I've already got a CHT, and I feel a lot better. I can fine-tune the mixture without worrying about overheating the engine, just like you said. Saving me a bundle on fuel.
Doctor: That is not quite what I said. The cylinder head temperature gauge is an excellent instrument for helping to safeguard your engine, but for fine-tuning the mixture you would need an EGT.
Owner: What is that?
Doctor: The EGT is the exhaust gas temperature gauge. It's an instrument which indicates the temperature of your exhaust gas, by means of a heat-sensing probe in the exhaust stack. Very simple, really.
Owner: Why would I want to know about the temperature of my exhaust?
Doctor: Because it is related directly to the combustion temperature. And so is the fuel/air mixture as we explained before. Leaning the mixture increases combustion temperatures up to peak; enriching it brings that temperature down. These temperature changes also show up in the exhaust gas.
Owner: Are you telling me I went out and bought the wrong gauge?
Doctor: Not at all. The CHT is the primary instrument — if I couldn't afford both a CHT and an EGT gauge on my aeroplane I'd choose the CHT every time. Safeguarding the engine is more important than saving fuel.
Owner: Can't I use my CHT to lean right up to peak?
Doctor: Not precisely. Remember, the CHT measures the temperature of the cylinder head — which is a mass of metal — not the combustion inside the cylinder. It takes a little time for any change in the mixture — and the combustion — to register on the CHT gauge. We estimate it takes about five minutes for a new temperature point to stabilise. On the other hand, the EGT gauge, which has a probe right in the exhaust stack, tells you immediately whether the combustion is at peak temperature, or approaching it, or declining. If you move the mixture control knob slowly, the EGT gauge needle will move right along with you. The cruise temperature readings range up to 1700 degrees Fahrenheit and they are usually calibrated in increments of 25 degrees, so proportionally you have a much closer watch on temperature movement.
Owner: If I had one of those, why would I need a CHT gauge?
Doctor: The CHT is the overriding instrument. Whenever it approaches redline, you have to enrich the mixture — regardless of EGT gauge readings — and take other measurements as appropriate to reduce cylinder temperature: enrich mixture, open cowl flaps, reduce power, or any combination of these. We like to keep the CHT in the green arc at all times — between approximately 200 and 400 degrees Fahrenheit. If it gets much hotter, you could damage valves or foul the spark plugs. If it gets much cooler, you are also apt to foul the plugs — especially with the high lead content in some fuels we use today. Any time you observe a temperature trend in either direction, without a change in mixture or power setting, you should suspect an engine problem.
Owner: Are you saying that the CHT is just for protecting the engine, and the EGT is for accurate leaning?
Doctor: Well no, not exactly. The EGT gauge can be used for fine-tuning the mixture, of course. But it can also give you an early warning of engine trouble, and help you sometimes to cope with that trouble in flight. This is especially true if you go to a multi-probe installation, with a heat sensor for each cylinder.
Owner: Why? Don't they all run at the same temperature.
Doctor: Oh, no. Even under normal conditions the cylinder temperatures vary appreciably. In a light, fuel-injection engine like yours they may vary as much as 100 degrees Fahrenheit just during cruise. With a small, carburettor-type engine, that difference could amount to 200 degrees Fahrenheit. One reason is that fuel flow is not precisely equal in these small engines and usually the cylinder getting the least amount of fuel will run hottest.

That, incidentally, is why we see a limited gain from installing a single-probe EGT gauge in these engines — the variance is too great. All we can really do is adjust the mixture for whatever is the hottest cylinder at the time. But with a multi-probe system we can spot trouble in a hurry because we know — from prior calibrations — just about what temperature to expect in each cylinder. The CHT can only tell us about an overall rise or decline in engine temperature (unless it too has probes in all cylinders, which is not a common installation). The multi-probe EGT gauge will tell us if the change is in all of the cylinders, or in certain cylinders only. In flight it may even help the pilot determine what adjustments he could make that would enable him to land safely. You look sceptical, but listen to this.

Only last month a young pilot I know had a forced landing that turned out rather badly and was quite unnecessary. He was flying in a single-engine retractable something like yours and was already



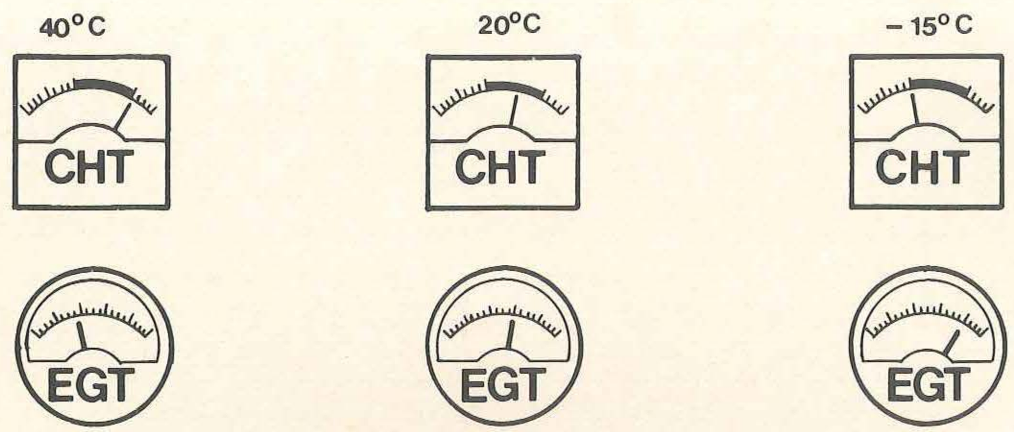
Fuel consumption – gallons per hour
17·8 15·2 13·2 11·0 9·3

Chart shows the relationship between mixture, fuel consumption and exhaust gas temperature for a 260 hp engine at 10,000 feet. Leaning past 'peak' to save fuel is not recommended

letting down for the approach when the engine quit on him. Just faded away. He had noticed a decline in CHT just before he reduced power and he suspected carburettor ice. He pulled on the carburettor heat without result and tried to restart but nothing doing. He attempted to stretch his glide to the runway but ran out of altitude and had to put it down in an open field. Unfortunately he was too busy to notice the power cable in time, and flipped over. Plane was a total wreck, and the pilot spent an uncomfortable month in the hospital.

In the accident investigation we found dried leaf particles that almost totally obstructed the strainer in the fuel tank he was using. Now with an EGT, the restricted fuel flow would have shown up immediately as a sharp temperature change on the gauge. The early warning would have given him time to consider his problem a little more calmly, and to solve it readily by going to alternative fuel tank selection and setting course for the nearest airport. Pity. Practically a new aircraft.
Owner: Yeah. But maybe the pilot didn't know that much about engines. We're not all natural-born mechanical geniuses, you know. Maybe the equipment isn't as good as it should be. How did the pilots make out in the old days, when all they had on the panel was a compass and a laundry list?
Doctor: They landed hard and often. Their equipment wasn't as good as what we have now, by any means. In the really old days every pilot was something of a mechanic, and there was a lot of open land you could put down in, clean off the plugs, re-set the timing or whatever, and take off again. Not many places where we can do that any more.
Owner: So what's the answer?
Doctor: Keep the aircraft flying between airports. Any reasonably priced instrument — and that includes the EGT — that will help me keep the propeller turning over is worth its cost because it makes my flying more relaxed — and safer. Cheaper too, in the long run.
Owner: All these gauges may mean something special to a pro. like you, but what about us pure and simple pilots. You don't want us doctoring a sick engine up in the sky, do you?
Doctor: Not if you can help it. But any pilot, pure and simple or otherwise, is liable to run into an inflight situation with a faltering engine when he has to make a critical decision about going on, turning back, or landing right away. The safety of all on board will depend on his decision. The more knowledge you have about what is going on inside the firebox, the better your chances of making a good decision, no matter how rudimentary your knowledge of engines.

The 'automatic rough' we often think we hear over open water or high mountains may be imagination, or it may actually be the beginnings of an engine problem. How can you tell? You needn't wait until an engine starts shaking you apart before you decide that something is wrong. Engines are like people: the first measurable sign of trouble is usually an abnormal temperature. If you have an



On hotter days, lower EGT is needed to keep cylinder head temperature in the green

EGT gauge and especially if you have multi-probe sensors — you may be able to spot trouble coming, upstream so to speak, before the cylinder head temperature moves out of the normal range. An unusual rise of 50 degrees Fahrenheit on the EGT gauge, with no change in power or mixture, may be worth paying attention to, particularly if it occurs only in one or some of the cylinders. You would want to keep a close eye on those cylinders, and if they continue to heat up you would know you have a real problem.
Owner: You mean long before it showed up on the CHT?
Doctor: If it is a slow temperature rise, certainly. A slow rise in one cylinder may take quite some time to register on the CHT, and it won't show at all on the EGT single probe unit if the probe happens to be in the stack of a cylinder that is functioning normally.
Owner: So in that case I wouldn't know about the problem until the engine actually started to misfire?
Doctor: Right. And by this time you could be a long way from a landing field.
Owner: What about a sudden jump in temperature, doesn't the engine start running really rough right away?
Doctor: It can happen very fast, but with a multi-probe EGT you could have some advance warning. Might give you only a few extra seconds before having to shut down and call for help, but over wild terrain or rough waters those few seconds can mean a difference of life or death.
Owner: What the gauge is doing for you is buying time, is that right?
Doctor: In some cases, yes, but not always. If the problem is confined to some of the cylinders only, there is nothing you can do in flight but look for a landing field. But if there is a general temperature rise, you can try operating on the left or right magneto only. Enriching the mixture may help lower temperatures, likewise opening cowl flaps or reducing power, even if both mags are in poor shape.
Owner: Does the exhaust temperature always go up with engine trouble?
Doctor: Most of the time, but not always. When you see a drop in temperature the situation is rarely critical or beyond in flight remedy. Carburettor icing, faulty valves or certain ignition problems could produce a drop in combustion and exhaust gas temperatures. For example, if you've just had maintenance done on your ignition system, a temperature decline could mean the ignition is too advanced. Noting whether operating on one mag. or the other brings the reading back towards normal, and which cylinders are affected, will save your mechanic a lot of time in diagnosing the problem, once you get back on the ground.
Owner: Is that what you meant, a while back, when you said these EGT gauges could save money in the long run?
Doctor: Partly. Any instrument that helps you keep your engine from overheating or overcooling is going to keep down your repair bills. The EGT gauge is especially helpful on descents, when lower power settings and enriched mixtures can easily lead to excessively low combustion temperatures. This is a common cause of spark plug fouling, and it can be avoided if you watch the gauges on the way down.
Owner: Do you recommend one particular brand of EGT gauge?
Doctor: No, that depends on you. There are several that are built in accordance with FAA Technical Standard Orders —TSO'd, as they say. They are basically the same but with certain individual features. Some have absolute temperature readings, and some have only relative indications. Some have a low range for idling, some do not. Some have an aural warning, for overheating, some have warning lights, some have neither. You pay your money and you take your choice.
Owner: What happens if the gauge itself is off? How would I know?
Doctor: They are designed to give only an abnormally low reading if they become defective. Check any low reading against your CHT gauge, and rely on the latter.
Owner: You mean, for getting out of the aircraft?
Doctor: I beg your pardon?
Owner: Just my little joke.
Doctor: Uh, yes, I see. Ha! Next patient, please! ●

Advice about cables from a LAME

In several recent editions of the *Aviation Safety Digest* you have encouraged those of us in aviation to contribute and share our experiences. Accordingly several pilots have done so. For some time I have been considering taking up the pen for engineering on a particularly serious, though sometimes underestimated subject. Just this afternoon I found another unserviceable control cable using the procedure which I will describe and this finally prompted me to pick up my pen.

As a licensed aircraft maintenance engineer in general aviation I am confronted on a daily basis with decisions which to no small degree are often influenced by that enemy of us all — cost. Quite often a discussion about a doubtful component might go like this:
'Just how bad is it?'
'Is it repairable or *must* we replace it?'
'Will it last another 100 hours?'
'Okay, we'll repair it this time and have a replacement ready at the next periodic', or,
'We'll replace enough to make it safe and replace the associated hardware progressively over the next few periodic inspections'.

The above will affect us in many ways. Some may be aghast, others amused, but it is a fairly realistic presentation of what does happen, which brings me to the reason for writing this article. One area of general aviation maintenance that concerns me greatly is cable inspections. Being airline trained I believe that the only satisfactory method of inspecting cables is to remove them to a *well lit*, if not *daylight* area.

However after being in general aviation for several years I have found that it is more usual for the cables to be merely slackened off, rolled on the pulley (which often is in a narrow wing root, under the floor, behind a cabin headlining, etc.) and *inspected in situ*.

For the last two and a half years I have worked in the servicing division of a large, light aircraft distributor, and in that time have had several instances where I had to thank my airline training and generally cautious nature. For during major inspections, when faced with the decision concerning cable inspections I chose to *remove to daylight* and on three aircraft found that primary flight control cables were unserviceable.

On one aircraft, undergoing its third major inspection since initial C of A, both the forward stabilator cables were unserviceable because of broken strands — not at a pulley or sharp change of direction as you would expect — but at a fairlead in a straight run. The fairlead's location was such that detection during a regular, periodic inspection would have been highly unlikely. The same aircraft also had an unserviceable aileron balance cable as a result of a seized pulley.

Another aircraft of a similar, though larger, variety undergoing its first major since C of A had two unserviceable rudder cables. This was particularly interesting because the unstranding of both cables was *in the middle of nowhere* ie, some distance from any pulley, fairlead, fuselage former, etc. I could only conclude that the failure of the cable was caused by either excessive system tension or a defective cable length at manufacture. One thing though was definite: it *would not* have been discovered had the cable not been removed from its installed location.

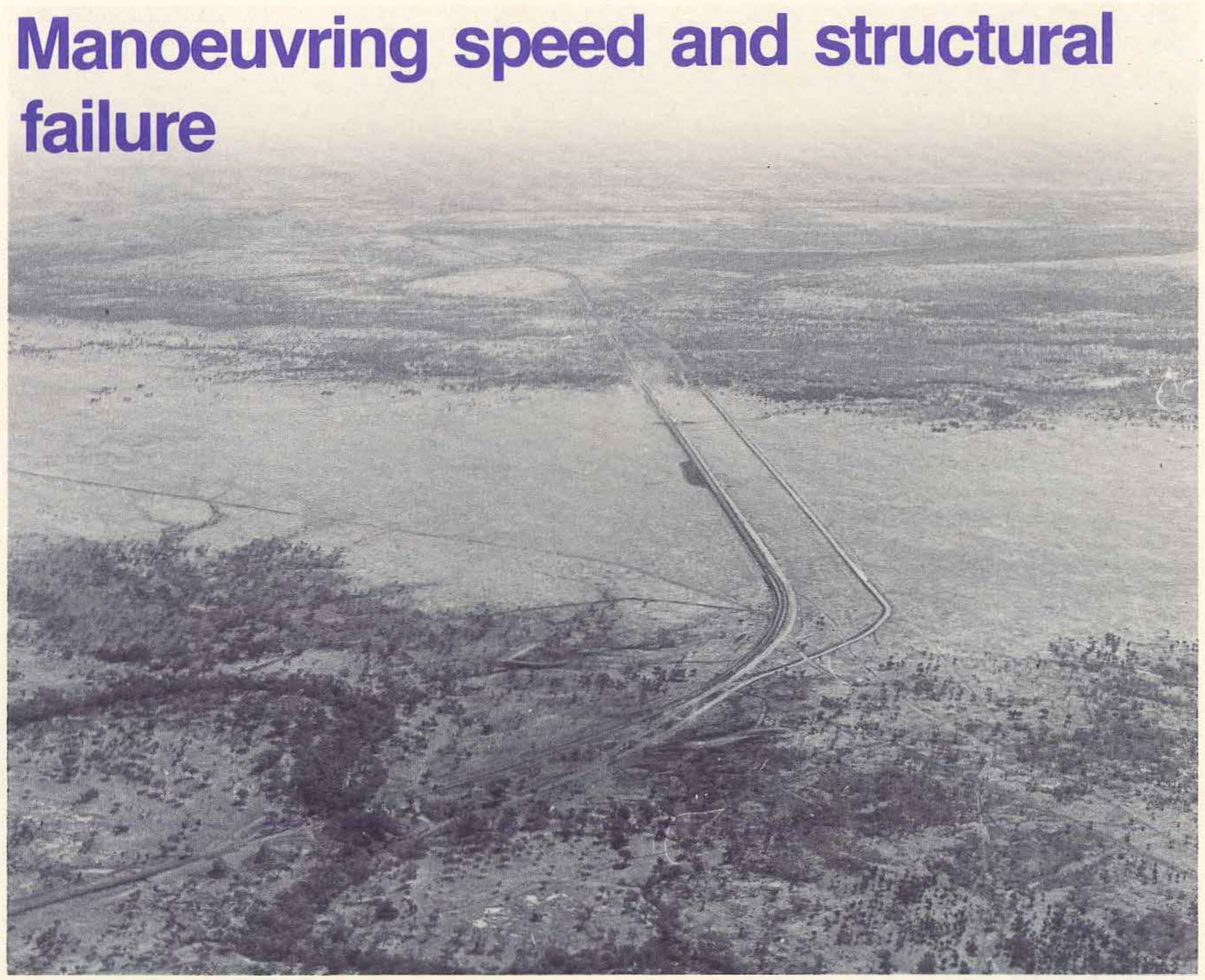
I trust those reading this article have received the thrust of its message. Whether they be LAME, operator or private owner let us all appreciate that the extra dollars spent for a professional job, properly done, are worth it in consideration of the additional degree of safety.

Comment

The Department of Transport has observed a disturbing increase in the incidence of problems with control cables over the last few years. These problems have included in flight failures of cables caused by excessive wear and incorrect installation, incorrect handing, misalignment of trim tab cable runs, etc. The inspection of cables has already been the subject of DoT Airworthiness Advisory Circulars No 41 May 1970, No 61 February 1972 and No 106 November 1978. It is now intended to specify more stringent mandatory inspection coverage of cables in appropriate sections of Air Navigation Orders.

Pilots are once again urged to pay more attention to their pre-flight checks of control systems for smoothness of operation, excessive friction, slackness, noisy operation and movement in the correct sense ●

Manoeuvring speed and structural failure



Planning to fly to Cloncurry, Queensland, with several friends to spend a few days on a fishing and camping holiday, a pilot who was also part owner of a Cessna 210 telephoned the Archerfield briefing office early on the Saturday morning of a long weekend to notify flight plan details. The flight was to be non-stop from Redcliffe direct to Cloncurry, with an expected departure time of 0730 hours, a cruising altitude of 8500 feet and an estimated flight time of 289 minutes. The pilot had calculated the aircraft's total fuel endurance as 396 minutes. The flight plan indicated the aircraft would be operating VFR and the meteorological forecasts the pilot obtained predicted fine conditions over the proposed route.

Four adult passengers and one child were to travel in the aircraft, and at about 0700 hours the pilot and passengers arrived at Redcliffe aerodrome. The pilot refuelled the aircraft and, though it is not known for certain, he most likely filled the tanks to maximum capacity. He also had the engine oil filled to capacity for the proposed five hour non-stop flight and then supervised the loading of camping equipment and other personal effects. When the aircraft taxied out at Redcliffe, the gross weight was at about the maximum permissible.

While taxiing for take-off, the pilot established radio communication with Brisbane on the appropriate area frequency and, at 0809 hours, he reported airborne. Twenty three minutes later, on changing frequency, he advised he was cruising at 8500 feet and subsequently, as the flight progressed, he made scheduled position reports, all of which were of a routine nature.

The ground speed achieved by the aircraft was slightly lower than planned and when the aircraft reached a position 50 km north of Longreach it was 16 minutes behind the flight plan estimate. At 1255 hours, the pilot called Mt Isa on HF and reported: 'We're one zero miles north-west McKinlay and leaving eight five zero zero on descent Cloncurry.' This was acknowledged by Mt Isa and was the last known transmission from the aircraft.

The aircraft was later observed approaching, from the direction of McKinlay, a road construction camp on the McKinlay to Cloncurry road at an estimated height of about 1500 feet. The speed of the aircraft at this time was estimated to be at least the normal cruising speed. It was in a normal attitude and the engine noise seemed normal. Suddenly a series of loud sounds, similar to those produced by a misfiring engine, was heard and an object was seen to separate from the aircraft. The aircraft, which had commenced a turn to the right, then entered a steep spiral dive during which white fuel vapour was seen to issue from one of the wings. The spiral dive continued until the aircraft struck the ground at high speed in a steep nose down attitude some 1280 metres north of the construction camp. When two men from the camp reached the crash site, they found the aircraft had been totally demolished and all on board had been killed.

Subsequent examination of the aircraft wreckage was hampered by the gross degree of disintegration. No evidence was found of any pre-existing defect or malfunction which might have contributed to the accident. There was no fire. A two-metre outboard portion of the left wing was located 710 metres south-west of the main wreckage and a smaller portion of that wing was located 61 metres west of the larger portion. It was established that the left wing failed in flight in a manner consistent with the application of a nose down torsional loading to the wing.

The operating limitations section in the flight manual for this aircraft specified a manoeuvring speed of 118 knots indicated airspeed (IAS). The manual defined the term 'manoeuvring speed' as 'maximum for manoeuvres involving an approach to stall conditions or full application of the primary flight controls.' The normal cruising speed of this model Cessna 210 is considerably in excess of the manoeuvring speed. A rapid application of a large amount of right wing down aileron control at speeds in the vicinity of the normal cruising speed could produce torsional loading in the left wing in excess of the design strength of the wing and result in wing failure consistent with that which occurred in this accident.

The en route weather encountered by the aircraft was consistent with the forecast obtained by the pilot and conditions at the time of the accident were fine and cloudless. There was nothing to suggest that the aircraft encountered abnormal turbulence at any time during the flight. Nor was there any evidence to indicate that the pilot suffered any incapacitation which would have affected his ability to control the aircraft. The area in the vicinity of the road construction camp was the habitat of numerous kite-hawks but there was no evidence of the aircraft colliding with birds or of the pilot needing to take any action to avoid them.

Although the circumstances which led to a rapid application of a large amount of aileron control at or near the cruising speed are not known, there is no doubt that the Cessna was subjected to stresses in excess of the design limits as the result of such a control input.

As aeroplanes operate over a wide range of weights and speeds and in a great variety of flight conditions, the structure must be designed to cope with the widest possible range of operating conditions the aeroplane is likely to encounter. The boundaries of the flight envelope are established by a series of points representing values of load factor (*g*) and airspeed. These points define the basic flight design cases for the aeroplane.

The maximum load factor which may be applied to an aeroplane under stipulated conditions without causing permanent deformation of the structure is termed the 'limit' load factor. The point beyond which the structure may actually fail is known as the design 'ultimate' load and aeroplane design requirements demand that the ultimate load factor be at least 150 per cent of the limit load factor.

One of the basic design points on an aeroplane's structural envelope is termed the 'manoeuvring speed.' This is the highest speed at which the aeroplane will stall before the certificated maximum limit load factor is exceeded. The speed is thus established primarily as a function of elevator control but is also the speed at which the structure is justified for full deflection of the other flight controls — the ailerons and the rudder.

To ensure the loads imposed on an aeroplane do not exceed the approved limit load factors, pilots are required to operate their aeroplanes in accordance with the operating limitations specified in the flight manual and the owner's manual. These manuals specify maximum speeds such as flap and undercarriage extension speeds, cruising speed and manoeuvring speed. Values of manoeuvring speed are usually also called up as recommended turbulent air penetration speeds.

Over recent years, the manufacturers of general aviation aircraft in the United States have introduced a standardised, comprehensive owner's or pilot's operating handbook based on a format recommended by the General Aviation Manufacturers' Association. Although at the time of this accident, the handbook in effect for the particular model Cessna 210 involved was the smaller, earlier version, the handbook subsequently prepared by the manufacturer for later production aircraft — but still of the same model — specifies manoeuvring speeds for various weights with the caution 'Do not make full or abrupt control movements above this speed.' The speeds and weights are —

3800 lb (1725 kg) = 119 knots IAS
3150 lb (2043 kg) = 109 knots IAS
2500 lb (1135 kg) = 96 knots IAS

Many pilots may be surprised that the maximum safe manoeuvring speed decreases, in some cases quite markedly, as the aeroplane gross weight is reduced. Basically, for a given speed and control movement the control surface applies a load that is independent of aeroplane weight, but the lighter the aeroplane the more vigorously it responds and this response induces higher stresses in the airframe. A lightly loaded aeroplane is more critical in terms of coarse control application than the same aeroplane operating near its maximum take-off weight.

Airspeed indicators are colour coded to show the never exceed speed and the caution, normal operating and flap operating ranges. Manoeuvring speed, on the other hand, is not marked on the indicator dial but is called up on a separate cockpit placard which may be some distance from the instrument. It is possible that a pilot, unaware of the importance of the manoeuvring speed limitation, could well be lulled into thinking that, so long as he is operating in the green arc on the airspeed indicator, the aeroplane will stall before structural overloading occurs and consequently no serious over-stressing of the structure is possible. This, of course, is incorrect; many types of light aeroplane, especially high performance models such as the Cessna 210, have a normal cruising speed inside the green arc but well in excess of the specified manoeuvring speed. The pilot's operating handbook for the aeroplane involved in this accident indicates that, at the maximum take-off weight and 75 per cent power, a cruising speed of 163 knots can be expected at 2000 feet in standard atmospheric conditions. This is 44 knots above the manoeuvring speed at the maximum weight, and as much as 67 knots at light weight.

For these types of aeroplanes therefore, the coarse or rapid application of full control deflection at speeds in the vicinity of the normal cruising speed will lead to almost certain structural damage and possibly total failure. At even higher speeds, such as on descent, less than full control deflection could cause the same damage. An overload condition and/or the dynamic effect of very rapid control application could result in structural failure at a lower speed.

The refined design techniques used for modern light aeroplanes mean that structural margins of safety have been reduced to a minimum. Because of this, only a slight degree of mishandling may cause damage or structural failure in these aeroplanes, even under normal operating conditions. This is especially true of the more sophisticated, high performance types, which require the very highest standards of airmanship and the strictest possible adherance to all specified limitations ●

In brief

At a country aerodrome in South Australia, the pilot of a Piper Seneca was preparing to take a group of Boy Scouts on a scenic flight as part of their Air Activities Course. Earlier in the day, the pilot and a small group of Scouts had walked the length of the strip to straighten some of the tyre markers and remove any tobacco bushes. Nothing unusual was noticed during the inspection.

The aerodrome was also used for glider flying and at the time a glider was operating on winch launches from a cross strip. Before starting up, the pilot of the Seneca checked that he would be clear of the glider, which was airborne, and that the launching cable had been wound back on the winch. After starting the engines, he taxied out and lined up but in the meantime the glider had returned to the circuit and was now landing on the cross strip, so the pilot waited until it had passed the intersection and then began to take off.

He opened the throttles wide and after a ground roll of about 150 metres, and at a speed of about 30 to 35 knots, he heard a loud bang as something hit the windscreen and he saw a piece of fibreglass fly up from the nose. Thinking the aircraft had hit a stone, he closed the throttles and the aircraft rolled to a stop about three-quarters of the way along the strip. He shut down both engines and then saw a length of wire hanging from the left propeller.

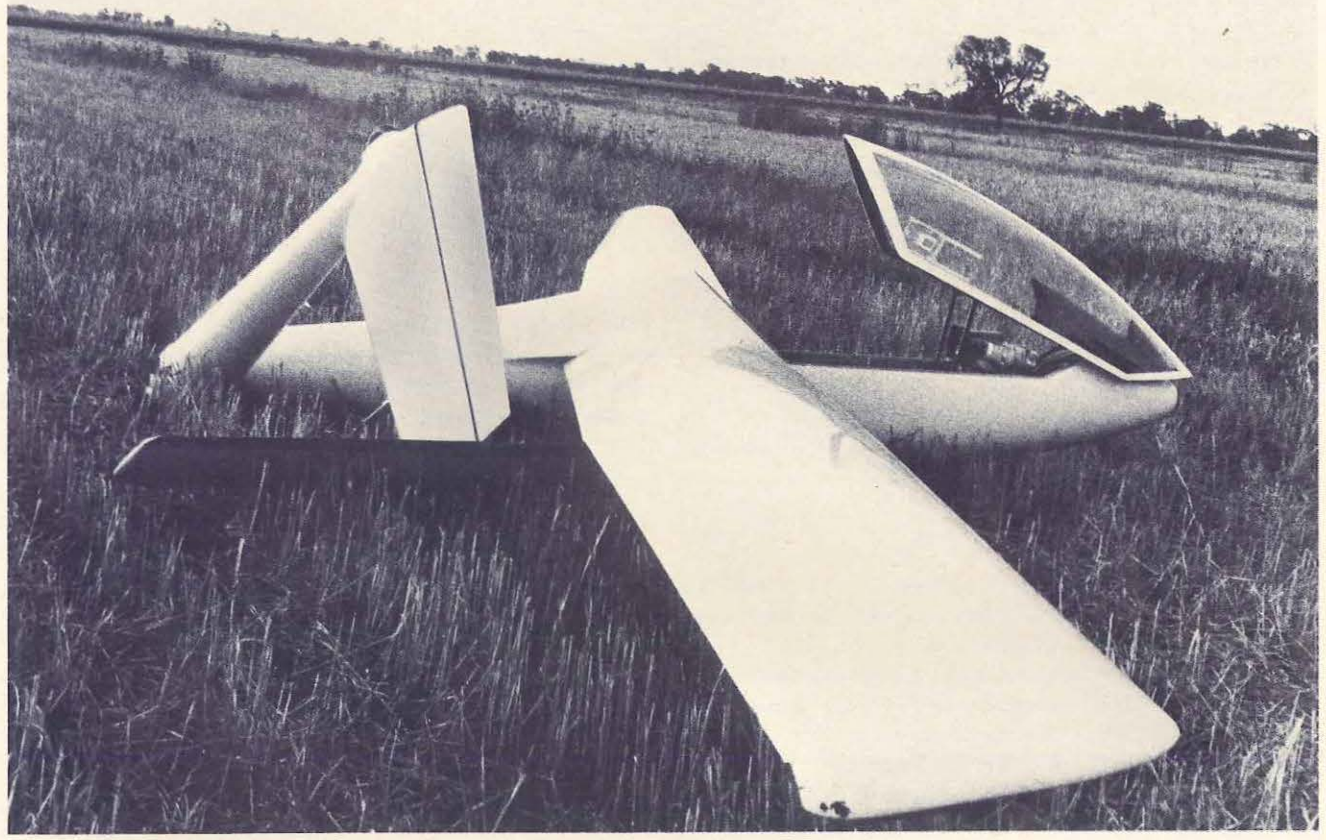
After removing the wire, the pilot taxied the aircraft slowly back to the hangar. Shortly afterwards, a party of Scouts went out to check the strip and returned with two more lengths of wire, each about 30 metres long, which they had found near the intersection of the strip the Seneca was using and the strip being used by the glider.

The wire proved to be launching cable and, during the attempted take-off, it had been caught up in the aircraft's nose landing gear. The flailing cable had nicked both propellers, slashed the left engine cowling, the nose and the nose locker door, and dented both nosewheel doors. The gliding operations log showed that, on the morning of the previous day, the winch cable had broken during a launch and it was this break which probably accounted for the pieces of cable being found where they were. Although the retrieval crew recovered both ends of the cable, it seems that the cable had broken in at least two places and the piece or pieces which had come away completely had fallen alongside the intersection of the two strips and remained undetected until snagged by the Seneca's nose wheel.

There are several human errors associated with this occurrence but it seems the pilot did all he could reasonably be expected to do in the circumstances. He was unaware of the cable break the previous day, the broken section of cable was not readily discernible, and the pilot had made a reasonable effort to inspect the proposed take-off area. On the other hand, at the time of the accident, there was no procedure at the aerodrome for carrying out a routine daily inspection of the other strips before operations commenced and the retrieval crew had not been supervised during the cable recovery the previous day.

As a result of this accident, procedures have been introduced at this particular aerodrome which require a daily inspection of every strip before operations commence. But the lesson for pilots is clear — nothing should ever be taken for granted. A mixture of glider and power operations requires extra caution at any time — especially when winch launches are being used — and it is essential that pilots realise that the responsibility for ensuring the surface of a strip is clear of obstructions rests solely with themselves ●

Channelised attention



A factor often apparent in aircraft accidents is the pilot's pre-occupation with one particular aspect of a flight to the exclusion of other tasks vital to the safety of the operation. This 'channelised attention' is frequently evident in the various forms of competitive flying, where concentration on the task in hand and the desire to succeed can be so overwhelming as to override good judgment and the fundamentals of sound airmanship.

An example of this can be seen in the circumstances of an accident involving an experienced glider pilot competing in the Australian national gliding championships. On the third day of the competitions, a four-leg cross country task had been set. The pilot completed the first three stages without incident and on the fourth leg, about 30 km north of the destination aerodrome, he decided to attempt a final glide direct to the finishing line.

The glider tracked straight towards the aerodrome on a southerly heading but, late on final approach, the pilot saw the glider was not going to make the distance. He noticed a paddock on the northern boundary of the aerodrome and though it appeared only marginally suitable, he realised he would have to put the glider down. Planning to land into the west, the pilot continued the approach on a heading towards the aerodrome and, at a low height above the ground, he banked the glider to the right. The glider had turned only a few degrees however, before the right wing struck a low contour mound running east-west across the paddock and the glider ground-looped to the right.

While travelling in a southerly direction, the glider slid sideways into the next contour mound and the rear fuselage broke in two. The glider bounced to a halt and the pilot clambered from the wreckage uninjured.

The pilot said later he probably became preoccupied on the final glide with his attempt to make a straight-in approach to the aerodrome and it was not until too late he saw that the paddock he had selected was unsuitable. Obviously when he began the final glide he was too low to reach the aerodrome but by the time he finally realised this he was committed to putting the glider on the ground as best he could.

Probably, had the pilot not been subject to the pressure of competition, he would have adopted normal out-landing procedures and left himself plenty of time to select a field that would have permitted a safe landing. It seems his determination to complete the task coloured his judgment to the extent that the glider virtually flew into the ground.

The pilot was no doubt aware of the dangers in trying to stretch the glide, but seemingly failed to recognise the developing hazard until too late. To ensure competitive flying is based on sound airmanship and remains within the capabilities of both pilot and aircraft, the will to win must be tempered with mature judgment and a proper sense of priorities ●

Emergency landing techniques in small fixed-wing aircraft

A special study prepared by Gerard M. Bruggink, Air Safety Investigator with the Bureau of Aviation Safety, National Transportation Safety Board, U.S.A.

The National Transportation Safety Board

The National Transportation Safety Board was created by the Department of Transportation Act of 1966. It is headed by five Members appointed by the President and approved by the Senate.

The Safety Board was established to improve safety in United States transportation extending to civil aviation, marine, pipeline, railroad, and highway modes of transportation. It has broad powers in the investigation and cause determination of transportation accidents. Through recommendations it is continuously involved in accident prevention and safety promotion. It is also responsible for reviewing on appeal the suspension, amendment, revocation, or denial of any certificate or licence issued by the Secretary of Transportation or any modal Administrator.

In the field of civil aviation, the Safety Board conducts its own investigations of all air carrier and air taxi accidents, accidents involving large aircraft, mid air collisions, and most fatal accidents. The Federal Aviation Administration, under delegation from the Safety Board, investigates all other accidents; however, as required by the Act the Safety Board determines the cause of all aircraft accidents and reports the accidents to the public.

As well as preparing reports of aircraft accidents, the Safety Board undertakes special studies of the many factors involved in aviation safety.

This study consolidates the lessons learned from past emergency landing experience in small, fixed-wing aircraft. The guidelines that are presented apply to the more adverse terrain conditions for which no practical training is possible. The need for this undertaking became apparent from the Safety Board's statistical data which showed that about 25 per cent of all general aviation accidents are associated with emergency landings.

It appears that the reliability of the modern aircraft plays less of a role as a causal factor in emergency landings than pilot-induced factors such as flight planning, fuel management, and marginal weather. This comment is not intended as a reflection on the quality of training schools and regulatory provisions. The nature of general aviation is such that most pilots are on their own, once they are certificated; this means that they gain most of their later experience on a trial-and-error basis. Therefore, it is not unusual for a general aviation pilot to find himself in situations where his experience level provides no alternative but an emergency landing. Unfortunately, so much stress is being placed on 'a suitable landing area' that some pilots will not even entertain the thought of a precautionary landing unless they can save the aircraft. Too many fatal weather accidents, classified as 'maintained VFR in IFR conditions', undoubtedly resulted from desperate attempts to get through because the underlying terrain did not fit the pilot's mental picture of an emergency landing area.

It is the purpose of this study to explain how almost any terrain can be considered suitable for a survivable crash landing if the pilot knows how to use the aircraft structure to protect himself and his passengers. Hopefully, this knowledge will increase the number of those who can walk away from a difficult situation and benefit from the experience.

The guidelines in this study are intended to supplement rather than replace the emergency instructions in textbooks and aircraft owners' manuals; in case of conflict, the manufacturer's recommendations should be followed.

Types of emergency landings

For the purpose of this study the different types of emergency landings are defined as follows:

Forced landing. An immediate landing, on or off an aerodrome, necessitated by the inability to continue further flight. Typical example: an aircraft forced down by engine failure.

Precautionary landing. A premeditated landing, on or off an aerodrome, when further flight is possible but inadvisable. Examples of conditions that may call for a precautionary landing: deteriorating weather, being lost, fuel shortage, gradually developing engine trouble.

Ditching. A forced, or precautionary, landing on water.

A precautionary landing, generally, is less hazardous than a forced landing because the pilot has more time for terrain selection and the planning of his approach. In addition, he can use power to compensate for errors in judgment or technique. Unfortunately, too many situations calling for a precautionary landing are allowed to develop into immediate forced landings when the pilot uses wishful thinking instead of reason, especially when dealing with a self-inflicted predicament. Such thinking probably played a role in some of the fatal accidents attributed to continued VFR flight into marginal weather. A low-flying pilot who is trapped in weather and does not give any thought to the feasibility of a precautionary landing, accepts an extremely hazardous alternative: inadvertent flight into an obstacle. He can improve his chances to survive an uncontrolled encounter only by timely slowing down.

Psychological hazards

There are several factors that may interfere with a pilot's ability to act promptly and properly when faced with an emergency:

Reluctance to accept the emergency situation

A pilot who allows his mind to become paralysed at the thought that his aircraft will be on the ground in a very short time, regardless of what he does or hopes, severely handicaps himself in the handling of the emergency. An unconscious desire to delay this dreaded moment may lead to such errors as: failure to lower the nose to maintain flying speed, failure to lower collective to maintain rotor rpm (in helicopters), delay in the selection of the most suitable touchdown area within reach, and indecision in general. Desperate attempts to correct whatever went wrong, at the expense of aircraft control, fall into the same category.

Desire to save the aircraft

A pilot who has been conditioned during his training to expect to find a relatively safe landing area, whenever his instructor closed the throttle for a simulated forced landing, may ignore all basic rules of airmanship to avoid a touchdown in terrain where aircraft damage is unavoidable. Typical consequences: making a 180 degree turn back to the runway when available altitude is insufficient; stretching the glide without regard for minimum control speed in order to get into a better-looking field; accepting an approach and touchdown situation that leaves no margin for error. The desire to save the aircraft, regardless of the risks involved, may be influenced by two other factors: the pilot's financial stake in the aircraft and the certainty that an undamaged aircraft implies no bodily harm. As will be explained in this study, there are times when a pilot should be more interested in sacrificing the aircraft so that he and his passengers can safely walk away from it.

Undue concern about getting hurt

Fear is a vital part of our self-preservation mechanism. However, when fear leads to panic we invite that which we want most to avoid. A pilot who allows himself some choice in the selection of a touchdown point for a fully controlled crash has no reason to despair. The survival records favour those who maintain their composure and know how to apply the general concepts and techniques that have been developed throughout the years.

To summarise the role played by psychological hazards: it appears that the success of an emergency landing under adverse conditions is as much a matter of the mind as of skills.

Basic crash safety concepts

A pilot who is faced with an emergency landing in terrain that makes extensive aircraft damage inevitable should keep in mind that the avoidance of crash injuries is largely a matter of:

—Keeping vital structure (cockpit/cabin area) relatively intact by using dispensable structure (wings, landing gear, fuselage bottom, etc.) to absorb the violence of the stopping process before it affects the occupants.

—Avoiding forceful bodily contact with interior structure.

Energy absorption

The advantage of sacrificing dispensable structure is demonstrated daily on the highways; a head-on car impact against a tree is less hazardous for a properly restrained driver than a similar impact against the driver's door. Accident experience shows that the extent of crushable structure between the occupants and the principal point of impact on the aircraft has a direct bearing on the severity of the transmitted crash forces and, therefore, on survivability.

Dispensable aircraft structure is not the only available energy absorbing medium in an emergency situation. Vegetation, trees, and even man-made structures, may be used for this purpose. Cultivated fields with dense crops, such as mature corn and grain, are almost as effective in bringing an aircraft to a stop with repairable damage as an emergency arresting device on a runway. Brush and small trees provide considerable cushioning and braking effect without destroying the aircraft. When dealing with natural and man-made obstacles with a greater strength than the dispensable aircraft structure, the pilot has to plan the touchdown in such a manner that only non-essential structure is 'used up' in the principal slowing down process.

Occupant restraint

The second requirement — avoiding forcible contact with interior structure — is a matter of seat and body security (seat belt and shoulder harness). Unless the occupant decelerates at the same rate as the structure surrounding him, he will not benefit from its relative intactness but will be brought to a stop in the form of a so-called second collision. In a case of partial restraint, such as the use of a seat belt only, the same reasoning applies to the unrestrained body portions. A classic example in this respect is the frequency of head and chest injuries of car occupants who jack-knife over the seat belt in a severe front-end collision. The same injury mechanism has been responsible for fatalities in survivable aircraft accidents. Since some light aircraft seats are not equipped with shoulder harnesses, the pilot should try to minimize this hazard by avoiding a nose-first impact against solid obstacles; he should also make it a habit to insist on the routine use of seat belts in his aeroplane.

Speed and stopping distance

The overall severity of a deceleration process is governed by speed (groundspeed) and stopping distance. The most critical of these is speed; doubling the groundspeed means quadrupling the total destructive energy, and vice versa. Even a small change in groundspeed at touchdown — be it as a result of wind or pilot technique — will affect the outcome of a controlled crash. For example: an impact at 70 knots is about twice as hazardous as one at 50 knots. This is the main reason that pilots who are flying at treetop level in marginal weather are advised to slow to a comfortable airspeed when forward visibility is less than the minimum required for obstacle avoidance. It is also obvious that the actual touchdown during an emergency landing should be made at the lowest possible *controllable* airspeed, using all available aerodynamic devices (flaps, etc.).

Most pilots will instinctively — and correctly — look for the largest available flat and open field for an emergency landing. Actually, very little stopping distance is required if the speed can be dissipated uniformly, that is, if the deceleration forces can be spread evenly over the available distance. This concept is designed into the arresting gear of aircraft carriers that provides a nearly constant stopping force from the moment of hook-up.

Since the typical general aviation aircraft is designed to provide protection in crash landings that expose the occupants to nine times the acceleration of gravity (nine g) in a forward direction, it is interesting to compare the minimum required stopping distances at various speeds, assuming that the crash deceleration takes place at a uniform nine g. At 45 knots the required distance is three metres while at 90 knots it is 12 metres (four times as long). Although these figures are based on an ideal deceleration process, it is comforting to know what can be accomplished in an effectively used short stopping distance. Understanding the need for a firm but uniform deceleration process in very poor terrain enables a pilot to select touchdown conditions that will spread the breakup of dispensable structure over a short distance, thereby reducing the peak deceleration of the cockpit/cabin area.

Attitude and sink rate control

The most critical — and often the most inexcusable — error that can be made in the planning and execution of an emergency landing, even in ideal terrain, is the loss of initiative over the aircraft's attitude and sink rate at touchdown. When the touchdown is made on flat, open terrain, an excessive nose-low pitch attitude brings the risk of 'sticking' the nose in the ground. (Extreme examples of the destructiveness of such an occurrence are stall/spin accidents). Steep bank angles just before touchdown should also be avoided; they increase the stalling speed and the likelihood of a wingtip strike.

Since the aircraft's vertical component of velocity will immediately be reduced to zero upon ground contact, it should be kept well under control. A flat touchdown at a high sink rate (well in excess of 500 feet per minute) on a hard surface can be injurious without destroying the cockpit/cabin structure, especially during gear-up landings in low-wing aeroplanes. A rigid bottom construction of these aeroplanes may preclude adequate cushioning by structural deformation. This characteristic, in combination with the rather limited human tolerance to vertical g, has led to spinal injuries in extremely hard 'pancake' landings. On the other hand, similar impact conditions may cause structural collapse of the overhead structure in high-wing aircraft. On soft terrain an excessive sink rate may cause digging-in of the lower nose structure and a severe forward deceleration.

Simulated forced landings, occasionally, lead to actual forced landings at a high sink rate when the engine fails to respond as anticipated. The habit of automatically raising the nose when the throttle is advanced for a go-around, without waiting for engine acceleration, can lead to destructive sink rates. It is advisable to maintain the proper approach speed and attitude until engine response is assured; this also applies to go-arounds from baulked landings.

Techniques

The 'school solution' to an emergency that calls for a forced landing requires the following sequence of immediate actions:

—Maintain aircraft control (establish a glide at the proper speed).

—Select a field and plan an approach.

These actions may be combined with attempts to correct the emergency, especially when the pilot surmises the nature of the problem (carburettor heat, mixture, fuel selector, etc.). However, attempts to troubleshoot the cause of the emergency should be made only on a time-available basis. Under certain conditions the pilot may have a full-time job just controlling the aircraft. When losing one engine of a light twin during the critical take-off phase, a pilot may not have more than a split second to decide what is best: relying on the performance charts, or his impulse to reduce power on the good engine to maintain controllability.

Concerning the controversial subject of turning back to the runway following an engine failure on take-off, each pilot should determine the minimum altitude at which he would attempt such a manoeuvre in his particular aircraft. Experimentation at a safe altitude should give the pilot an approximation of height lost in a descending 180 degree turn at idle power. By adding a safety factor of about 25 per cent he should arrive at a practical 'decision height'. It speaks for itself that the ability to make a '180' does not necessarily mean that the departure runway can be reached in a power-off glide; this depends on the wind, the distance travelled during the climb, the height reached and the glide distance without power.

Terrain selection

A pilot's choice of emergency landing sites is governed by:

—The route he selects during the pre-flight planning.

—His height above the ground when the emergency occurs.

—His airspeed (excess airspeed can be converted into distance and/or altitude).

The only time that he has a very limited choice is during the low-and-slow portion of the take-off; he should realise, however, that even under those conditions the ability to change the impact heading only a few degrees may ensure a survivable crash.

When he is beyond gliding distance of a suitable open area, the pilot should judge the available terrain for its energy-absorbing capability, as explained earlier. If the emergency starts at a considerable height above the ground he should be more concerned about first selecting the desired general area than a specific spot. Terrain appearances from altitude can be very misleading and considerable altitude may be lost before the best spot can be pinpointed. For this reason, the pilot should not hesitate to discard his original plan for one that is obviously better. However, as a general rule, he should not change his mind more than once; a well-executed crash landing in bad terrain can be less hazardous than an uncontrolled touchdown on an established field.

Aircraft configuration

Since flaps improve manoeuvrability at slow speed, and lower the stalling speed, their use during final approach is recommended when time and circumstances permit it. However, the associated increase in drag and decrease in gliding distance call for caution in the timing and the extent of their application; premature use of flap, and dissipation of altitude, may jeopardise an otherwise sound plan.

A hard-and-fast rule concerning the desired position of a retractable landing gear at touchdown cannot be given. In rugged terrain and trees, or during impacts at a high sink rate, an extended gear would definitely have a protective effect on the cockpit/cabin area. However, this advantage has to be weighed against the possible side effects of a collapsing gear, such as a ruptured fuel tank. Manufacturer's instructions — if given — should be followed.

When a normal touchdown is assured, and ample stopping distance is available, a 'gear up' landing on level, but soft terrain, or across a ploughed field, may result in less aircraft damage than a 'gear down' landing.

De-activation of the aircraft's electrical system before touchdown reduces the likelihood of a post-crash fire. However, the battery master switch should not be turned off until the pilot no longer has any need for electrical power to operate vital systems (flaps, hydraulics, etc.). Positive aircraft control during the final part of the approach has priority over all other considerations, including aircraft configuration and cockpit checks. The pilot should try to exploit the power available from an irregularly running engine; however, to avoid unpleasant surprises during the touchdown phase it might be best to switch the engine and the fuel off just before touchdown. This not only ensures the pilot's initiative over the situation but a cooled-down engine reduces the fire hazard considerably.

Approach

When the pilot has time to manoeuvre, the planning of the approach should be governed by three factors:

—Wind direction and velocity.

—Dimensions and slope of the chosen field.

—Obstacles in the final approach path.

These three factors are seldom compatible. When compromises have to be made the pilot should aim for a wind/obstacle/terrain combination that permits a final approach with some margin for error in judgment or technique. A pilot who over-estimates his gliding range may be tempted to stretch the glide across obstacles in the approach path (trees, powerlines, etc.). For this reason it is sometimes better to plan the approach over an unobstructed area, regardless of wind direction. Experience shows that a collision with obstacles at the end of a ground roll, or slide, is much less hazardous than striking an obstacle at flying speed before the touchdown point is reached.

No specific rules can be given for the pattern to be flown; there may not even be time to set up a pattern. The most important consideration is to get into such a position with regard to the selected spot that it can be reached by using normal techniques such as playing the final turn (turning in early or late, depending on altitude), slipping, and moderate S-turns. If considerable altitude has to be lost while over or near the chosen field, it should be done so that the field remains within gliding distance; speed control during all manoeuvres is vital.

Touchdown

The importance of having control over the aircraft's attitude and sink rate at touchdown has already been explained. Since an emergency landing on suitable terrain resembles a situation with which the pilot should be familiar through his training, only the more unusual situations will be discussed.

Type of terrain

Confined areas

The natural preference to set the aircraft down on the ground should not lead to the selection of an open spot between trees or obstacles where the ground cannot be reached without making an 'auto-rotative' descent; this option should be left to pilots of rotary-wing, STOL and VTOL aircraft.

Once the intended touchdown point is reached, and the remaining open and unobstructed space is very limited, it may be better to force the aircraft down on the ground than to delay touchdown until it stalls (settles). An aircraft decelerates faster after it is on the ground than while airborne. Thought may also be given to the desirability of ground-looping or retracting the landing gear in certain conditions.

A river or creek can be an inviting alternative in otherwise rugged terrain. The pilot should ensure that he can reach the water or creek-bed level without snagging his wings. The same concept applies to road-landings with one additional reason for caution; man-made obstacles on either side of a road may not be visible until the final portion of the approach. Road traffic must be given priority.

When planning the approach across a road, it should be remembered that most highways, and even rural dirt roads, are paralleled by power or telephone lines. Only a sharp lookout for the supporting structures, or poles, may provide timely warning.

Trees (Forest)

Although a tree landing is not an attractive prospect, the following general guidelines will help to make the experience survivable:

—Use the normal landing configuration (full flaps, gear down).

—Keep the groundspeed low by heading into wind.

—Make contact at minimum indicated airspeed, but not below stall speed and 'hang' the aircraft in the tree branches in a nose-high landing attitude. Involving the underside of the fuselage and both wings in the initial tree contact provides a more even and positive cushioning effect, while preventing penetration of the windshield.

—Avoid direct contact of fuselage with heavy tree trunks.

—Low, closely spaced trees with wide, dense crowns (branches) close to the ground are much better than tall trees with thin tops; the latter allow too much free-fall height. (A free-fall from 75 feet results in an impact speed of about 40 knots, or 4000 feet per minute).

—Ideally, initial tree contact should be symmetrical, that is, both wings should meet equal resistance in

the tree branches. This distribution of the load helps to maintain proper aircraft attitude; it may also preclude the loss of one wing, which invariably leads to a more rapid and less predictable descent to the ground.
—Always aim for the softest and, when possible, the lowest part of a tree or tree line. Judge trees by their ability to slow the aircraft's forward speed in the same manner as a firefighter's safety net catches falling people.
—If heavy tree trunk contact is unavoidable once the aircraft is on the ground, it is best to involve both wings simultaneously by directing the aircraft between two properly spaced trees. Do not attempt this 'manoeuvre' while still airborne, as recommended in some textbooks.

Mountainous terrain
The variety and irregularity of mountainous terrain makes it impossible to list general rules. The pilot should learn to instinctively avoid situations where an emergency would leave him without any choice; flying needlessly low and slow over rugged terrain is an example of such a situation.

In mountainous country, only a short glide may be sufficient to bring the aircraft over lower-lying terrain, thereby increasing effective altitude and terrain choice; maintaining a comfortable cruise speed will assure the pilot of this advantage.

Slope landings should be made upslope whenever possible, with due consideration for the terrain conditions at the end of the slope. Avoid a situation where an excessive roll, or slide, would bring the aircraft to a sharp drop-off. When landing on a pronounced upslope, enough speed should be maintained to change the aircraft's descending flightpath, just before touchdown, into a climbing one that approximately parallels the slope. (Note: A descent at 50 knots and 500 feet per minute results in a six degree flightpath. In combination with an approach to a 24 degree upslope, an uncorrected six degree flightpath would lead to a ground 'impact' angle of six degrees + 24 degrees = 30 degrees).

Water (Ditching)
A well-executed water landing probably involves less deceleration violence than a poor tree landing or a touchdown on extremely rough terrain. The reason for the apparent reluctance of some pilots 'to take to the water' when there are no suitable alternatives may be the certainty of losing the aircraft or the fear of getting trapped. Actually, a fixed-wing aircraft that is ditched at minimum speed and in a normal landing attitude will not sink like a rock upon touchdown. Intact wings and fuel tanks (especially when empty) provide flotation for at least several minutes even if the cockpit may be just below the waterline in a high-wing aircraft.

When considering the feasibility of ditching, the following factors should be taken into account:
—The water temperature and the estimated time to be spent in the water. (The survival time in water with a temperature of zero degrees Celsius is less than one hour for the average person).
—The physical condition of the occupants and their ability to swim.
—The proximity to land.
—The availability of lifejackets and other water-survival equipment.
—The number of occupants and the number of usable exits.

Loss of depth perception may occur when landing on a wide expanse of smooth water, with the risk of flying into the water or stalling-in from excessive altitude. To avoid this hazard, the aircraft should be 'dragged in' when possible. Use no more than intermediate flaps on low-wing aircraft; the water resistance of fully extended flaps may result in asymmetrical flap failure and slewing of the aircraft. Keep a retractable gear up. Insist that all occupants keep their restraint systems fastened until the aircraft has come to a complete stop; this ensures impact protection and prevents disorientation with respect to the nearest exit location, regardless of aircraft attitude and light conditions. Ditching downstream in a swift running river has the same effect as a headwind, it reduces the relative groundspeed.

Snow
A landing in snow should be executed like a ditching, in the same configuration and with the same regard for loss of depth perception (white out) in reduced visibility and on wide open terrain. An even snow layer, several feet thick, may blanket smaller obstructions and make otherwise rough terrain more suitable; pronounced 'humps' that may hide larger obstructions should be avoided.

Survival and rescue
The scope of this study precludes a discussion of the actions to be taken to ensure survival and rescue following an emergency landing; in addition, considerable literature is available on this subject from various sources. For this reason, only some general guidelines are repeated:
—The filing of a flight plan not only ensures prompt response from search organisations but it directs the search towards the most likely area.
—Search efforts are aimed at locating the aircraft; make it as conspicuous as possible and stay near it, unless you have compelling reasons to abandon it. Keep in mind that smoke is an international attention getter.
—If the aircraft is destroyed, or inaccessible, you will have to work with whatever you happen to carry in your pockets; when flying over remote and unfriendly terrain, keep the minimum essentials on your person, such as waterproof matches and a pocketknife.
—Basic life support supplies should be carried in the aircraft as protection against extreme temperatures; when appropriate, warm clothing in the winter, and water when making a summer desert crossing.

Conclusion
A pilot who knows his aircraft and understands the what and why of the techniques that will ensure a survivable emergency landing under adverse conditions has no reason for morbid preoccupation with the possibility of being forced down. The peace of mind associated with this knowledge should improve the pilot's overall performance which, in turn, may prevent an emergency or benefit its outcome ●

In brief from Papua New Guinea

The Pilatus Porter was operated by a charter firm based in Papua New Guinea. On the day of the accident it had been flown on a series of short flights transporting freight into various aerodromes. The pilot, who was very experienced both on type and in total hours, had flown for three and a quarter hours on the day when he departed for the 18 minute flight to his next destination.

The destination aerodrome was a 604 metre long, grass and clay strip, 3900 feet AMSL in the Papua New Guinea Highlands. With a longitudinal slope of nearly seven per cent, the strip is suitable for one-way operations only.

Although the weather in the area was fine when the aircraft arrived on this flight, the pilot could see that rain had fallen since his previous landing there earlier in the day. He also noted that he would have a tailwind component of about 10 knots for landing.

Following a normal circuit, the aircraft crossed the threshold at 60 knots and touched down 180 metres in from it. After rolling for about 150 metres the pilot noticed a dog running across the strip in front of the aircraft. He attempted to steer the aircraft towards the left side of the strip and applied reverse thrust and brakes.

Almost immediately directional control was lost on the slippery clay surface. The aircraft veered off the strip and came to rest with the starboard wheel lodged in a deep ditch. There were no injuries sustained by the dog or the pilot but the aircraft did suffer substantial damage.

During the investigation the pilot stated that there were no mechanical problems with the aircraft nor any personal factors which contributed to the accident. He believed the loss of directional control was due to the combination of the left quartering tailwind, which tended to weathercock the aircraft to the left, and the slippery surface which affected steering and braking effectiveness.

From a human factors viewpoint, it is difficult on this occasion, even with the benefit of hindsight, to say that the pilot's reaction was wrong. It could have easily been a person that crossed the strip instead of an animal. The collision with a dog would probably have resulted in significantly less damage to the aircraft; however, natural instinct is to avoid an obvious collision even though the results of alternative action are uncertain.

The social training to preserve life, in any form, could alsó have been a relevant subconscious factor. **If you had been this pilot, confronted with the situation, what would you have done? ●**

Birds, birds and more birds . . .

Birds continue to be a hazard to both stationary and airborne aircraft with varying degrees of damage and risk resulting.

The *Aviation Safety Digest* has printed two articles recently about the problem of birdstrikes. The response from our readers has made it clear that the problem is of concern to the great majority of practising pilots. While there is no single sure-fire solution, a common sense approach can certainly reduce the frequency of birdstrikes. The following letters from two of our readers illustrate this fact. The first letter is from a pilot living at Mount Isa, Queensland, where large numbers of black kites are to be found.

'Regarding your recent articles about birdstrikes, I remember reading years ago when RPT aircraft began using their landing lights during daylight take-offs and landings, it was said that the lights helped birds (and people, and presumably other animals) to see and avoid the aircraft. At the time a few of the local commercial pilots also tried this procedure, but now it seems to have been almost forgotten in general aviation. While cruising I have seen a calm flock of birds scatter wildly when I flicked on the lights.

'During my early training I had to do numerous take-offs and landings amongst groups of black kites. I was told that the best way to avoid hitting them was to continue on a steady flight path and allow the birds to take evasive action. If you try to dodge the birds they do not know which way you are going and so cannot get out of your way.

'I know there are times when a collision is inevitable but I feel these two methods are fairly effective and would like to see more people trying them. In 10 years and over 3000 hours flying I have hit only two hawks, both on take-off and below 200 feet.'

The second letter is from a pilot who operates from bush strips in the north-west of NSW.

'During last summer, I was operating a Cessna 172 from a well-maintained strip on a private property. Around noon one day, as I was preparing for lunch, I noticed a Cessna 182 joining the circuit for an approach on to the 050 degree strip. Under the approach path there is a fairly large lake where trees and dense foliage abound. As was usually the case during summer, the lake was playing host to something like 300–500 birds of various types.

'It was a cool, tranquil atmosphere for the birds until this idiot in the 182 literally roared the guts out of the engine as the aircraft passed low — almost too low — over the trees in and around the lake. The startled birds rose quickly in a cloud that totally engulfed the 182. How the aircraft didn't prang I'll never know because it was "blood and guts" from one end to the other — the pilot must have been almost IFR at the point of touch down and, although the ensuing motion of the aircraft closely resembled a jazz waltz, the aircraft was undamaged when it stopped at the other end of the strip and backtracked to join me.

'At the first sight of this flying abattoir I promptly lost my appetite and condescended to help the pilot clean up the mess. I later discovered that this pilot was a relative newcomer to flying and this was only his second trip to the bush. And, after all that, he had only dropped in to ask directions as he had become unsure of his position. I worked out that he was 55 kilometres off track.

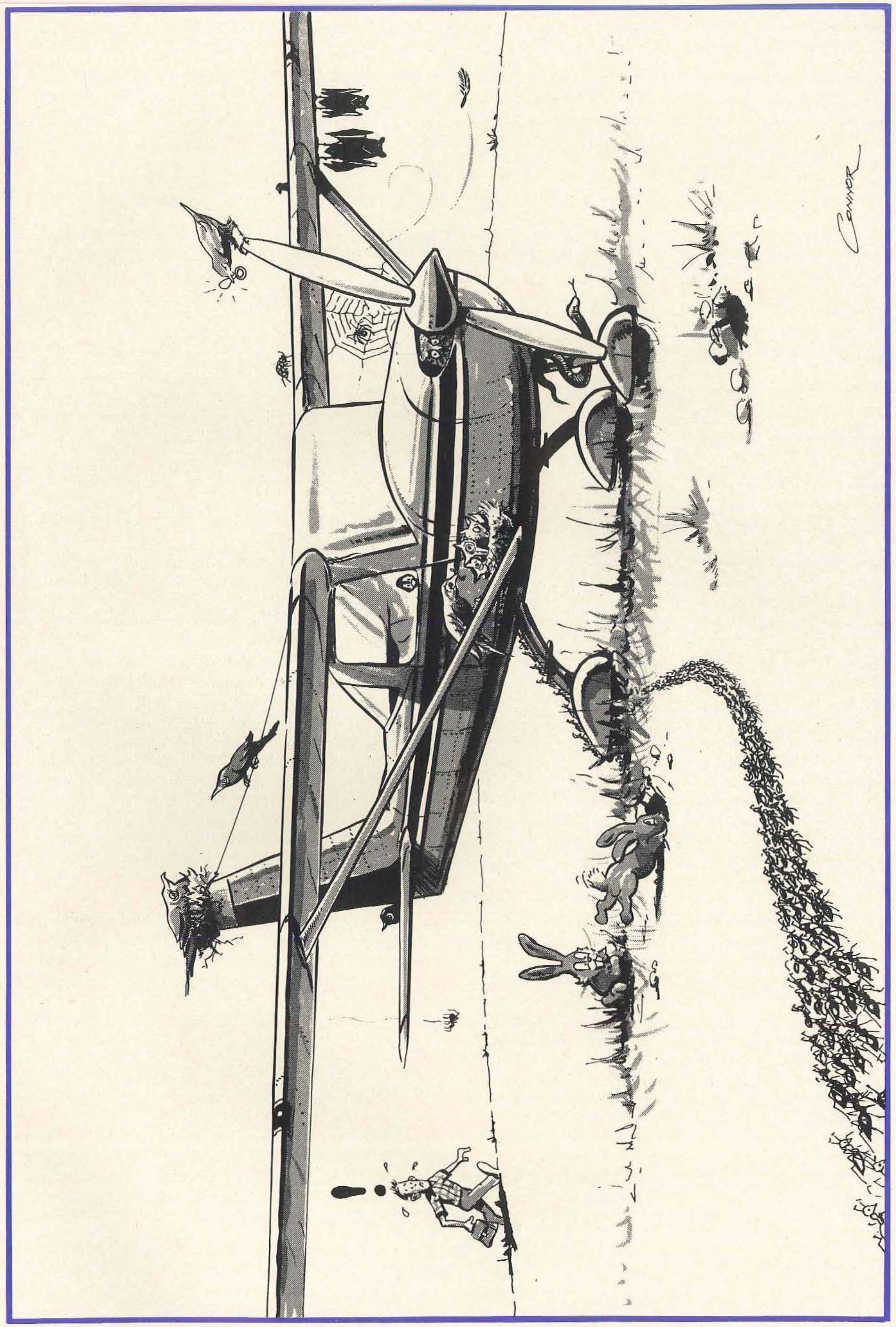
'Ignoring his limited navigational ability, the point I wish to emphasise is that I had been using the same strip myself all morning without raising as much as a murmur from the birds. I have seen similar occurrences time and time again, although none as serious as on this occasion.

'Isn't it time that a pilot's training became practical? Theoretical flying will kill someone in such a situation. And the answer is so simple. I was alternating my own procedures to fit in with the situation — sometimes I would use a tighter base point to keep well away from the trees and at other times I would make a high, non-powered approach if I chose to pass over the trees containing the birds.

'Please Mr Editor, let us try and stop this unnecessary damage to aircraft and risk to human life. Pilots should be aware of the danger and learn to recognise this situation. A little more thought in planning their circuit may save a lot of embarrassment later.'

Although the problem of birdstrikes to airborne aircraft usually results in the greatest obvious damage and risk, there is still considerable danger from birds and other creatures making nests inside stationary aircraft. Two readers recently told us of their problem relating to birds nesting in their aircraft while parked at Archerfield airport in Queensland.

'My Mooney M20 aircraft has had little use recently as I have been overseas and it has been kept tied down in the parking area at Archerfield. During a pre-flight inspection, after my return, I noticed bird droppings and pieces of straw around the tail area. I decided to have a closer look and with the aid of a torch I examined the inside of the lower tail assembly. Much to my surprise I discovered two birds nests containing four eggs. The nests were very damp and apart from the risk of fouling the controls I believe there would be a great risk of corrosion. The aircraft in our parking area often have birds sitting on the fin and rudder so one complacently accepts the situation of the birds using the aircraft as perches.'



The second letter continues:

'Recently, after taking off from Archerfield on a local flight, all operations appeared normal until I endeavoured to turn the aircraft at 500 feet. The ailerons operated normally entering the turn but jammed when I tried to straighten out.

'I was able to maintain level flight by using a combination of power, rudder and elevator. I made immediate preparations to land and, as I made my base turn, the operation of the ailerons returned to normal.

'After a safe landing I inspected the ailerons and found a small piece of metal jammed between the aileron and the wing tip. On further investigation inside the wing tip I discovered a birds nest, which was impossible to see without the aid of a torch. As I walked away from the aircraft several swallows flew into spaces in both wings.

'Before the incident, my pre-take-off checks had indicated that all operations were normal. It was only when the aircraft was banked that the rubbish from the nests became jammed in the ailerons. A short time later I removed the wing tips and found four large nests. The birds had used eleven metal tops from ring-pull cans and a small piece of metal, which I had noticed the previous week, lying near a local repair shed.

'I have now bird-proofed my aircraft with the use of removable wire patches. The wing tips and ailerons have been modified so that objects will not be jammed in the trailing edges.

'Some time ago after taking off I noticed the airspeed indicator was not working. A beetle had crawled into the pitot tube. A month ago I had to poison thousands of ants which were eating the foam rubber seats. On the same day while I endeavoured to inflate the tyres I stood on a live hare lying in short grass underneath the aircraft. It "bolted" on to the runway. All I need now are bats in the belfry and I will give up flying.'

Readers are reminded of the hazards to stationary aircraft wherever they are parked and are advised to ensure that birds and other creatures are not nesting inside them ●

From a pilot in England

The following article is a contribution from a United Kingdom reader of the *Aviation Safety Digest*. Although his story concerns an incident in England, the lessons he learned from it are applicable to aviators throughout the world.

'Some years ago I was asked by friends to fly an Apache 235 to allow them to photograph their farm. The flight was to be from a small grass aerodrome in the west of England. The aerodrome is surrounded by granite walls with two moorland hills, 350 feet AMSL, only three kilometres away to the east.

'Being close to the Atlantic coast, the local weather can change very rapidly with the onset of fog and high winds. On the day of the flight the summer weather was cool and dry with a five knot wind from the north. The forecast obtained at 1000 hours indicated VMC throughout the day with eight oktas of stratus cloud at 8000 feet.

'The aircraft contained about half its maximum fuel load and, with three passengers plus the pilot on board, was well below maximum take-off weight and within c. of g. limits.

'At 1100 hours a normal take-off was completed towards the north and the aircraft was accelerated to 74 knots take-off safety speed. After selecting the gear up and reducing to climb power, I was adjusting the pitch to synchronise the propellers. The gear selection lever had just returned to neutral with an audible 'click' when I abruptly found that the aircraft was in thick cloud.

'My first reaction was to suppose that I had mis-set the altimeter which now read 370 feet above the aerodrome level. The passenger in the right-hand front seat assured me, however, that it was correctly set and that we had encountered coastal fog. The fog was identical in colour and appearance to the stratus cloud 7600 feet above it; none of the aircraft occupants had observed any sign of the fog before taking off.

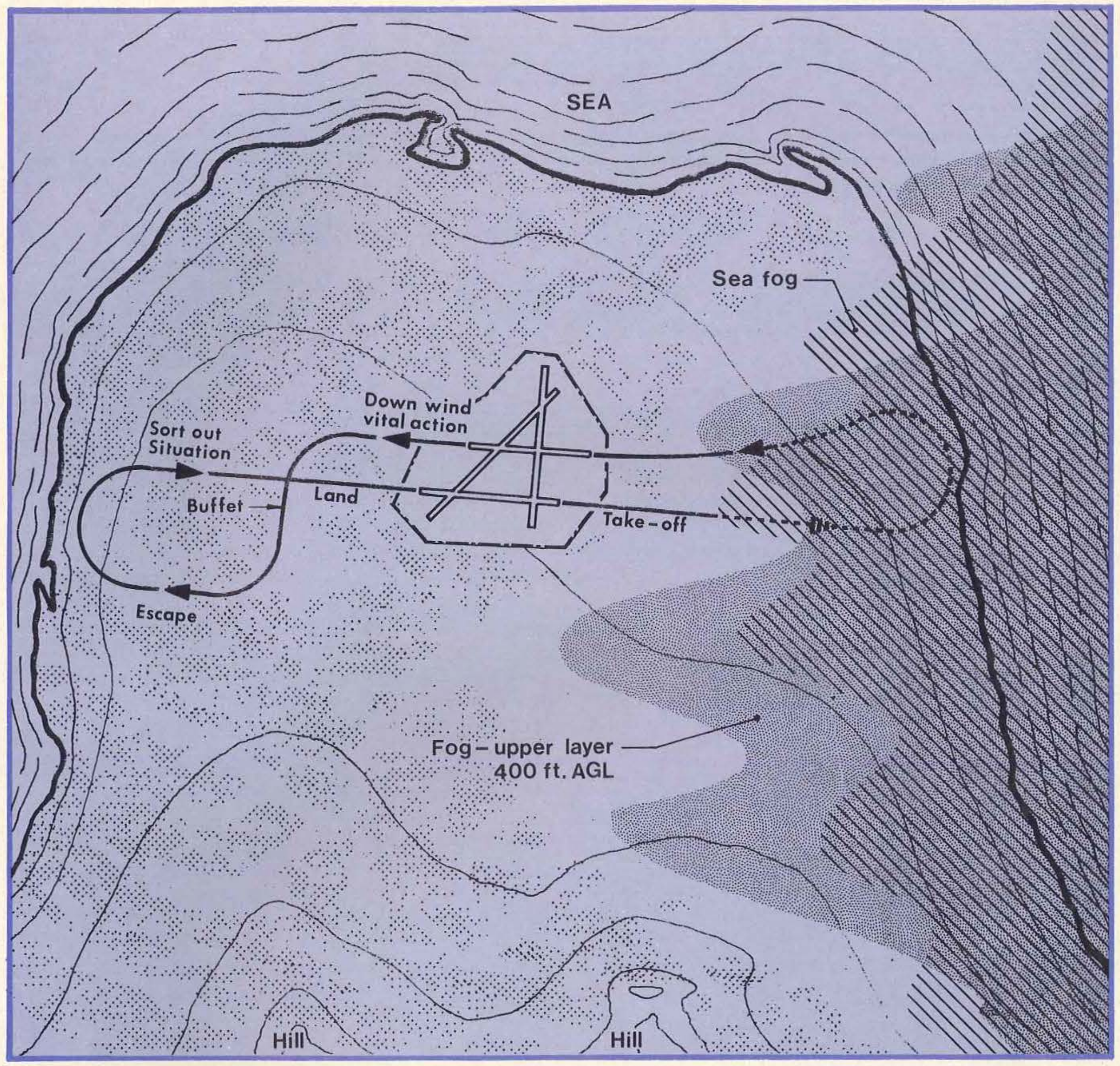
'I was very alarmed as I did not hold a current instrument rating even though I had held a service rating in 1953. From previous experience of the local weather I concluded that the fog bank, which was clearly being generated from a headland on the coast four or five kilometres to the north, was moving with the wind and would shortly obliterate the whole aerodrome. I therefore made a cautious 180 degree left turn on instruments, away from the hills and once established on a southerly heading asked everybody to look for the runway, which duly re-appeared a short time later beneath the left wing.

'Having re-established visual contact my main thought was that I did not want to be messing around in this muck at this dead height in a hot aeroplane that I had only flown for six hours. I also recalled that the aircraft was required at midday for another trip. To save time, I decided to make the southerly overfly into a downwind leg and I carried out the pre-landing checks. Accordingly, with the gear and half flap extended, I began a left turn at 400 feet through 180 degrees on to final approach.

'The aircraft had turned through about 90 degrees when a curious vibration began, like a gentle "nibbling" at the airframe. My passenger in the right-hand front seat, himself a pilot who had recently flown in this Apache, warned me that I should not let the airspeed get below 70 knots. I looked down at the ASI and saw to my horror it was a few knots below 70. Instantly I checked that the pitch was full fine, opened up the throttles to full power, raised the gear and straightened the aircraft. Because we were pointing at one of the moorland hills, about 400 metres away, I turned right to sort out myself, the aircraft and the situation. A few minutes later the aircraft was properly aligned with the runway on final approach and in the correct configuration. A normal landing was made. The sea fog never did reach the aerodrome but stayed to windward all day.

'I have thought about this episode very deeply because, despite my training, my years at studying aircraft behaviour and years of reading warning comments by experts, when a difficult situation developed I very nearly spun a load of passengers into the ground. The "nibbling" I had felt was undoubtedly pre-stall buffet, although I did not recognise it as such and, had it not been for the forgiving, thick Piper wing, the aircraft would probably have stalled and autorotated. There would have been little chance of recovery from that height. Incidentally, I did not hear the stall warning system operate so these devices are not infallible.

'It seems to me there are two instructive points about the incident and the fact that a fatal accident did not result does not detract from their importance. The first important point is the amount of unsuspected drag that landing gear and flaps can produce, with an immediate degradation of airspeed; pilots are not normally aware of this drag increment because the aircraft is at a suitable height and therefore has the energy to restore the airspeed. The second and much more important point in the long term is the shattering effect that an unexpected situation can have upon pilot judgment and performance. Despite years of experience and thought I still allowed that fog to screw up my operating skills!'



About the author

Mr Hugh Scanlan was the editor of *Shell Aviation News* for 14 years until production ceased at the end of 1978. He is an ex-RAF fighter pilot and has been in current flying practice for 28 years. As a student of aerodynamics, his particular interest is light aircraft handling and control. As editor of *Shell Aviation News* he studied numerous papers on that particular subject ●

MD and the taildragger

The following story is based on an accident report from the not-too-distant past. It is a classic example of Murphy's Law and the consequences to which it may lead. Our Man in the Dustcoat (MD) acts out the circumstances.

The old taildragger had sat in the back of Murphy's hangar for a long, long time. Its C of A and registration had expired but every once in a while, when things were slack, Murphy would get the mechanics to do a bit more work on it.

It was basically sound but in need of a major overhaul and after a number of years was just beginning to look like it might fly again. As time progressed MD began to take a special interest in the old girl and one day expressed this interest to Murphy.

'Murphy, how much will she cost when the major is finished?' asked MD.

'Don't know MD. Why, you want to buy it?'

'Well . . .' MD pondered, 'maybe if the price was right.'

'Look MD, we're pretty busy at the moment and I'll need you blokes to work some overtime,' replied Murphy. 'How about you cut out your overtime against the cost. That way you'll save on tax and I won't have to fork out the cash.'

'I'll let you know, boss.' It was only a few days later when MD agreed to Murphy's terms about the purchase of the aircraft.

Over the next few months, which seemed like eternity to MD, he put in many hours overtime for Murphy and every other spare minute working on the taildragger. There were lots of interruptions and MD often had to down tools to look after a customer's problems. Eventually the stage was reached where the major was finished and Murphy completed the necessary paperwork to get the aircraft re-registered.

Murphy took the aircraft for a test flight on a calm, clear morning. The windsock hung limply on the pole and MD watched enviously as his pride and joy was put through its paces. He was joined by a local instructor pilot who had flown the old girl quite a lot before she had been decommissioned.

'She looks good MD,' he remarked as Murphy settled the aeroplane on the strip. 'Mind if I take her for a fly, for old times sake?'

'No fear . . . I'll come with you,' MD responded joyfully, anxious to get into the air. They were soon airborne and during the flight MD arranged with the instructor to get his tailwheel check-out.

A few days later, and a few circuits later, the instructor told MD he was okay to solo in the aircraft. MD had been checked on the use of power and brakes to maintain directional control on the ground but he still had a little trouble in crosswinds.

'Get some more practice MD and you'll soon get the hang of it,' the instructor had told him. 'The tailwheel steering will loosen up with a bit of use,' he added.

MD flew a few circuits whenever he could fit them in and slowly gained more confidence, although occasionally he did feel that all was not well. After a few more hours' practice MD decided he was ready to take his wife and children for a fly. One Friday afternoon at the end of a busy week's work, he flew the aircraft from Murphy's strip to the main airport near the town and left it in the parking area.

The following morning MD's family were excitedly looking forward to their first flight in their own plane. There was only a light wind blowing as MD carried out his daily inspection. He noticed that the rudder was over to one side and realised that he had not fitted the control locks on the previous day. As he was checking the rudder stops for any damage he noticed something strange about the tailwheel and after some further checking concluded that the tailwheel and rudder seemed to work back-to-front to each other.

'Better check with Murphy,' thought MD and he wandered off to the telephone.

After listening to MD describe the problem Murphy replied, 'I think I know what's wrong but I'm too busy to come up there and have a look. Why don't you fly down here. The wind's not too bad and you shouldn't have any trouble getting in.'

Back at the aircraft MD explained what was happening to his wife. 'Not much wind so there shouldn't be any problem taking you and the kids.' They all boarded the aircraft and, after a short flight, were overhead Murphy's strip. The light wind was now about eight knots and straight across the strip. MD set up his approach for a three point landing but on touchdown the aircraft began to swing into the wind. Despite MD's efforts to stop it, the swing continued so he put on the power for a go-around. The main wheels had just left the ground off the side of the strip when the tail struck one of the 'half 44' strip markers. MD closed the throttle and put the aircraft back on the ground with a lot of drift. One main gear leg collapsed and the aircraft slid to a stop on its crumpled wing and broken landing gear.

MD and his family left the aircraft, shaken but unhurt and walked over to the hangar where Murphy was standing, scratching his head and wondering why the heck MD had his family with him.

The moral of the story? Well, apart from another example of Murphy's law at work (the tailwheel steering bellcranks had been installed back-to-front) the most important factor is that MD chose to fly the aircraft with a known defect; and on top of that he risked the safety of his family by taking them along as well. Inconvenience and delay is a small price to pay to ensure the safety of an aircraft and its occupants ●