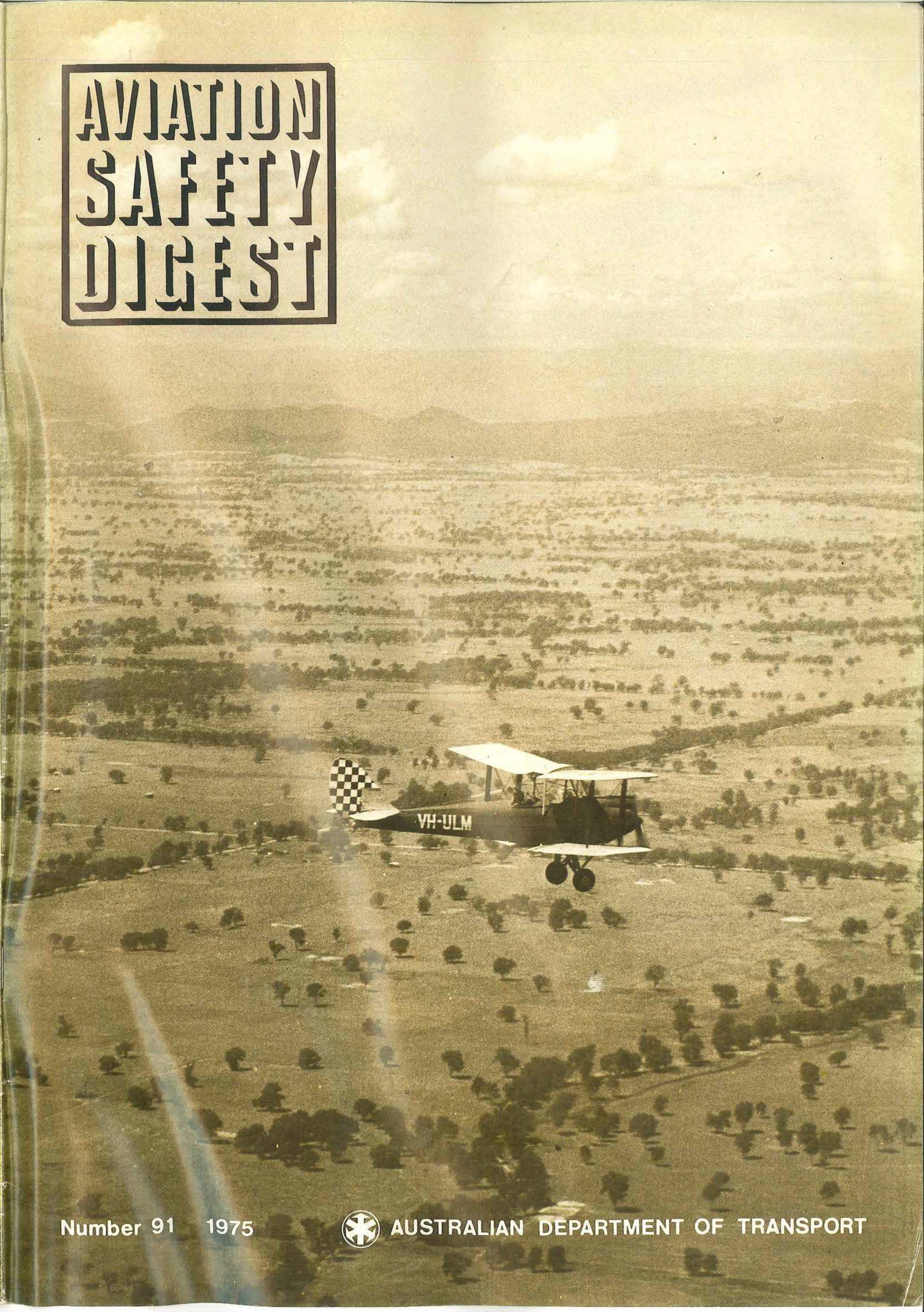
AVIATION SAFETY DIGEST



Number 91 1975 AUSTRALIAN DEPARTMENT OF TRANSPORT

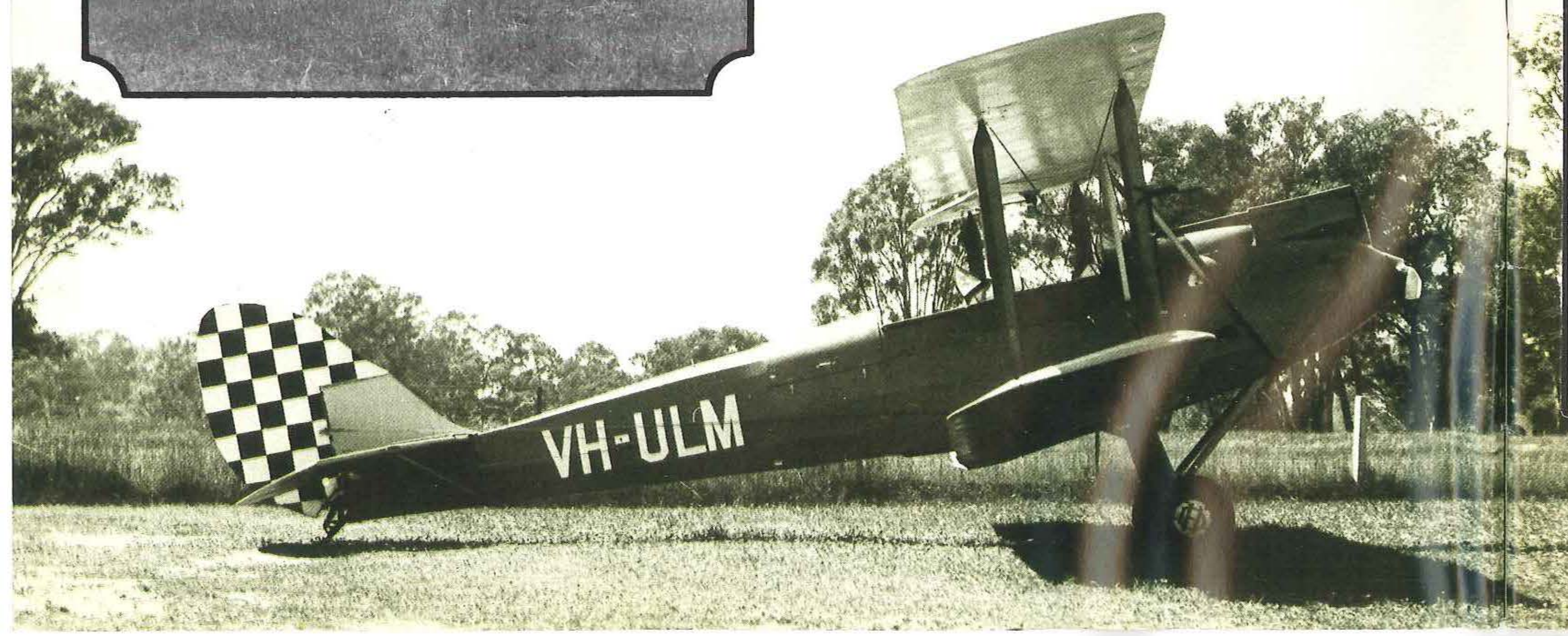
THE GOLDEN YEAR OF THE MOTH

Sir Geoffrey De Havilland's famous Moth is 50. Fifty years — an infinitesimal moment of time in mankind's history; an eternity to the very young; only yesterday to many of the not-so-young. Indeed, just how short is this time, is brought home by the happy fact that Sir Geoffrey's famous brother Hereward, who founded the De Havilland works in Australia with the introduction of the Moth in 1925, is still with us! Yet how vast have been the changes in the aviation scene in that time. In a real sense it is not only the 50th anniversary of the DH-60 that this year celebrates, almost inevitably it also commemorates the 50th year of General Aviation. For it could truly be said that the DH-60 was the world's first successful general aviation aeroplane. Certainly that is so in Australia, where pre-war the word "Moth" was a synonym for "light aeroplane".

And not only was the DH-60 the backbone of the aero club movement; its many and various derivatives — the Puss, the Leopard, the Tiger, the Hornet, the Minor, the Fox, the twin-engined Dragon, Dragonfly and Dragon Rapide, and the stately four-engined DH-86, formed the mainstay of Australian civil aviation up to the outbreak of World War II. In fact, as far as general aviation is concerned, some of these types continued to earn a serious living until well into the late fifties. And who can forget the unique contribution of the Tiger during the war years, providing thousands of Empire Air Training Scheme pupils with their first taste of flying?

Our cover story pays tribute, not only to the original Moth, now celebrating its 50th birthday, but also to the other members of its distinguished family which did so much to establish Australian aviation on a sound footing. The aircraft depicted in these recently-taken photographs remain in airworthy condition in the hands of their enthusiast owners, and were present at the highly successful "Moth Day" celebrations which the Aviation Historical Society of Australia held at Casey Field, Victoria, in February.

— Photographs by courtesy of J. Vella and D. Prossor.



DEPARTMENT OF TRANSPORT AUSTRALIA

AVIATION SAFETY DIGEST

Number 91 1975

CONTENTS

Aviation Safety Digest is prepared in the Air Safety Investigation Branch and published for the Department of Transport through the Australian Government Publishing Service, in pursuance of Regulation 283 of the Air Navigation Regulations. It is distribtued free of charge to Australian licence holders (except student pilots), registered aircraft owners, and certain other persons and organisations having a vested operational interest in Australian civil aviation. Aviation Safety Digest is also available on subscription from the Australian Government Publishing Service as shown on the order form below.

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

Editor: G. Macarthur Job, Assistant Editor: R.J. Maclean, Design: N. Wintrip and P. Gill.

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

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.

AVIATION SAFETY DIGEST

A Serious Problem

One of general aviation's safety problems, and one which is an underlying cause of many fatal light aircraft accidents in Australia, is that of the pilot who exceeds his ability and finds himself in a situation that is too much for him to handle. What makes these tragedies so much worse of course, is that so often, unsuspecting passengers are carried to their deaths with the unfortunate pilot.

One type of accident in this category is known only too well to the majority of readers of the Digest — the sort that inevitably develops when a pilot with no instrument flying training presses on too far into deteriorating weather conditions.

Another accident pattern within this group is the one that results when a pilot, whose skill is not equal to his exuberance, is unable to resist the temptation to perform aerobatic manoeuvres at a dangerously low level.

Still a further variation on this theme is the catastrophe that takes place at an air show or pageant, where the particular combination of circumstances — the crowd, the excitement, the desire to please, together with the opportunity the occasion provides for spectacular but otherwise unauthorised manoeuvres in the circuit area — encourage the pilot to try just a little too hard. Right throughout the history of aviation, this sort of situation has led to disaster again and again, even with pilots of some skill.

Although the same principle holds true at the opposite end of the skill spectrum, student pilots are usually a cautious lot and, at least at this stage of their flying careers, tend to be conservative in their attitude to handling an aircraft. Of course, there is always a minority inclined to be over-confident, but while their progress remains very much subject to the eagle eye of their chief flying instructor, no great harm is likely to accrue.

Very occasionally however, there are students who not only think they know better than their chief flying instructor, but who, by one means or another, have access to an aeroplane well away from any form of supervision or authority. As the article on page 8 points out, a combination of this sort can only mean trouble and sooner or later is bound to culminate in a serious accident. The story that follows attests to the truth of this statement.

The circumstances of this accident clearly demonstrate the way in which seemingly minor infringements successfully 'got away with', can generate a completely false sense of confidence in an inadequately trained pilot. As a result he can be led to a final moment of truth at which his own lack of capacity and ability become patently and tragically obvious.

Perhaps to some it might seem harsh to be critical of a person who has paid the supreme penalty for his mistakes. But mere criticism is far from the intention of safety education, and in order that similar situations can be avoided in the future, it is important that others know something of pitfalls that abound for the unwary in aviation. It is for this reason that this particularly sorry train of events is given prominence in this issue of the Digest.

A TRAGEDY of ERRORS

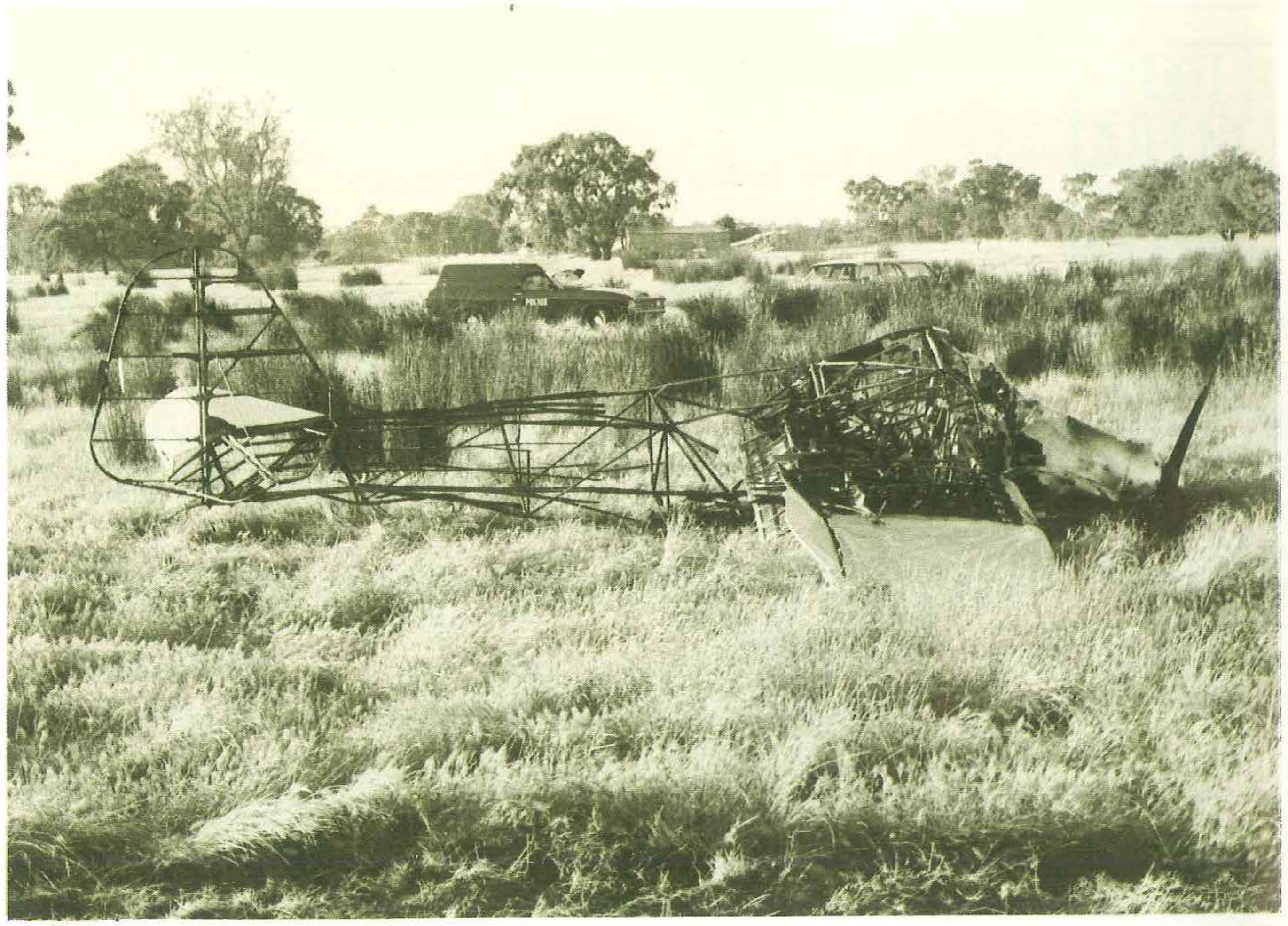
During an unauthorised local flight from a private airstrip with two passengers, the engine of a student pilot's Auster began to misfire. He attempted to position the aircraft for a landing, but lost control at low level and the aircraft dived to the ground. A fierce fire broke out immediately and all three occupants perished. The pilot had received no formal training on the aircraft type. Investigation revealed that the fuel filter was blocked and similar contaminants were found in the aircraft's long range fuel tank. The tank, which was of unknown history, had been fitted by the student pilot without authorisation and the modification had not been recorded in the aircraft's log book.

The student pilot was a farmer who had bought the aircraft originally because he was interested in learning to fly. Though he had no aeronautical experience at the time, he was influenced in his decision by friends who were both pilots and aircraft owners. It was his intention to use the Auster for his flying training, obtaining instruction at the local aero club.

After he had bought the Auster however, he found, somewhat to his disappointment, that the aero club was not prepared to instruct him in his own aeroplane, because its operations were geared to training in their own Cessna 150 aircraft. The club's chief flying instructor had also told the student that he was unwilling to give him endorsement training on the Auster until he had obtained his restricted Private Pilot Licence.

Soon after this time, the student pilot entered into a business arrangement with an agricultural operator for his Auster to be used as a crop spraying aircraft. The Auster was accordingly modified at an approved workshop for this work, and the long range fuel tank on the underside of the fuselage was converted to become the reservoir for the spraying equipment.

Throughout the following four months, the aircraft was away from the student pilot's property being operated on aerial spraying contracts. When it was finally returned to its owner it was in poor condition and, following a Departmental survey, an order was issued under Air Navigation Regulation 43(1), requiring that, before the aircraft was flown again, it was to be inspected and given the



maintenance necessary to undertake a ferry flight to an authorised workshop for further work.

So distressed was the student pilot at the condition of his aircraft when returned to him, that he resolved not to allow it to be used for spraying again. He and an employee therefore removed the spraying equipment, including the modified belly tank, from the aircraft, which then remained at his property. Some four weeks later, the student pilot commenced his flying training on Cessna 150 aircraft at the local aero club. He continued this training spasmodically over the following seven months, accumulating just over 14 hours dual instruction and 11 hours solo experience.

Meanwhile, the student pilot arranged for a licensed aircraft maintenance engineer, who conducted an authorised workshop at a country centre, to fly down to his property to inspect the Auster and assess the work necessary to restore it to an airworthy condition. The LAME examined the Auster in company with another local Auster owner, a friend of the student pilot, and arranged for him to carry out some minor items of maintenance before flying the aircraft to the LAME's workshop. Although this man had no formal aircraft maintenance engineering qualifications, the LAME believed he was quite competent to undertake the work by virtue of his long experience as both owner and pilot of Auster aircraft.

In preparation for the flight to the workshop, the work specified by the LAME was carried out, but as well, the student pilot, assisted by his friend, fitted the aircraft with another belly-type long range fuel tank which had been obtained second-hand. The aircraft was then flown to the LAME's workshop and left there.

☆ ☆ ☆

Almost six months later, when the work on the Auster was nearing completion, the owner-pilot friend returned to the workshop to assist the LAME to assemble the aircraft. In the course of this work, he refitted the second-hand long range tank, assuring the LAME that it was clean because he had flushed it out with kerosene himself before bringing the aircraft to the workshop earlier in the year. The LAME, under the impression that the tank was in fact the same one previously fitted to the aircraft and subsequently modified as an agricultural spraying reservoir, accepted this assurance and did not check the condition of the tank himself.

By this stage, the student pilot had decided to hire his aircraft out again, but this time only for communications duties in connection with aerial agricultural work. The pilot who was to fly the aircraft during this period, took delivery of the Auster when the work on it was completed and, for the next six weeks, used the aeroplane for calling on farming properties, canvassing, and arranging aerial spraying contracts. During the first week of this flying, the owner of the Auster accompanied the other pilot with the intention of gaining experience in the handling of this type of aircraft. He told the pilot that he had logged about 17 hours flying training, but because the flying involved many landings and take-offs in paddocks, he did not ask to handle the controls himself.

At the conclusion of the spraying season, when the Auster was due to be returned, the student pilot travelled by car with friends to the operator's home base, some 200 kilometres away and accompanied the pilot on the ferry flight back to the property.

On their arrival the student pilot asked the other to demonstrate various Auster landing techniques to him. Under the impression that the student pilot had by this time gained his restricted private licence, the pilot did so, but warned him not to attempt to fly any tail-wheel type aircraft without first undergoing proper training with an instructor.

After the two men had completed this flying and parked the aircraft at the airstrip, they received a message to the effect that the car in which the student pilot's friends had driven him to meet the aircraft, had broken down, and that they were still at the operator's base. The student pilot therefore asked the pilot to fly him back in the Auster so he could help his friends get the car going.

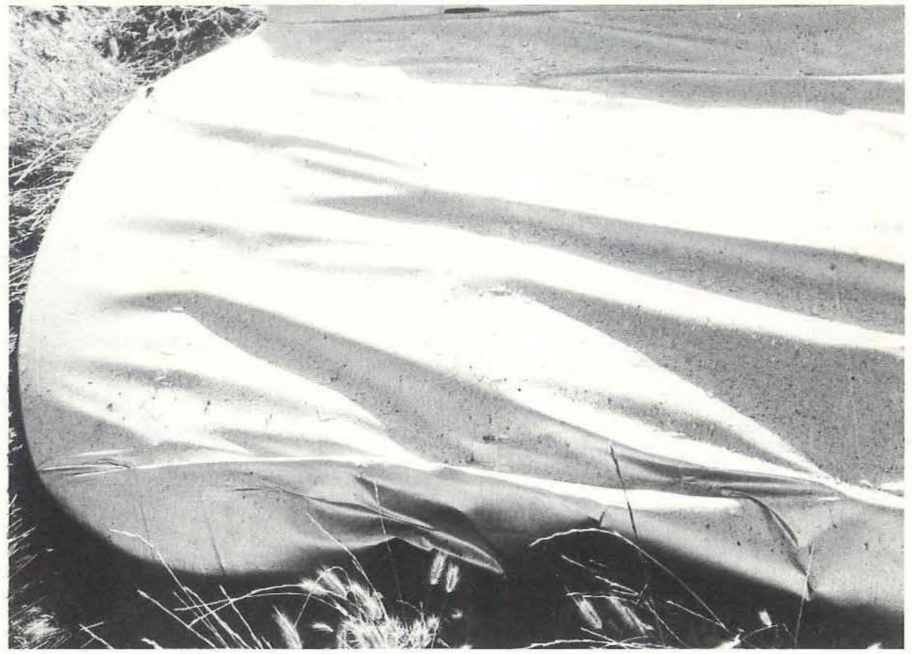
The flight was uneventful, but after the student pilot had succeeded in repairing the car, the other pilot realised that he intended flying the Auster back to his property himself. The pilot again warned him against attempting to do so, telling him that he would 'kill himself', but the student pilot shrugged off this advice with a casual remark. He subsequently took off in the Auster on his own.

The circumstances of his lone flight back to his property, as well as the local solo flights that he evidently made in the weeks that ensued can, at this late stage, only be a matter for conjecture. It is sufficient to say that throughout the following three months, the student pilot continued to fly his Auster, unauthorised and unsupervised, two or three times a week.

All that is known in regard to this period is that he had apparently taught himself to take the aeroplane off and put it down again with a reasonable degree of assurance and competence. For on a seemingly ordinary morning some 12 weeks after he had first flown the Auster solo, the aeroplane was still flyable.

On this particular day, a lad on holidays from school was assisting the student pilot to move some irrigation pipes on his property. After the work was completed, he asked the boy if he would like a ride in his aeroplane. The boy gladly accepted and they arranged to meet at the airstrip immediately after lunch.

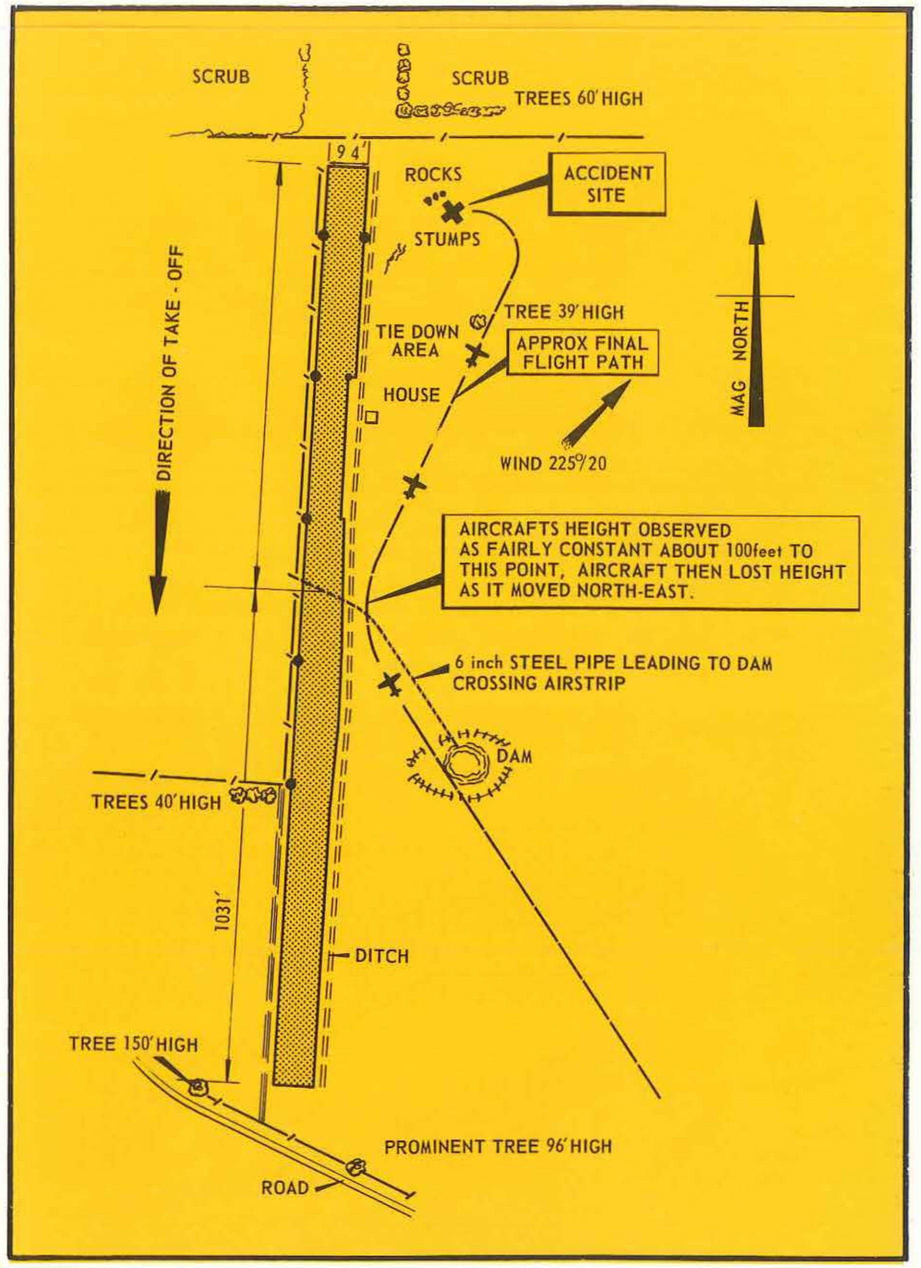
After helping to refuel the aircraft from a drum, the boy boarded the aircraft and the student pilot swung the propeller. After a little difficulty, ap-



Opposite page: The burnt-out wreckage looking back in the direction from which the aircraft approached. The deformation of the forward fuselage and the fact that the engine was not under power are clearly evident.

Above right: The violence of the aircraft's impact with the ground can be gauged from the chordwise compression of the starboard wing.

Below right: The aircraft's fuel filter after it had been dismantled showing the sediment found and the clogged filter screen. On examination the sediment proved to be weevil remains.



Left: Diagram of airstrip showing final flight path and accident site.

Opposite page: General view of airstrip showing the irrigation pipe which crossed the strip at about its mid-point.

parently because of a sticking impulse magneto, the engine started, and they taxied to the northern end of the strip.

The student pilot completed his checks and began the take-off into the south and the aircraft quickly became airborne. They flew locally for about 15 minutes, then made a straight-in-approach to land into the south. The wind at the time was a fresh southerly, blowing at about 20 knots. The landing was uneventful, and they taxied back and tied the aircraft down where it was previously.

While they were doing so however, two more young men arrived to see the student pilot on business and asked if they too could have a ride in the aeroplane. The student pilot seemed reluctant to fly again that day because of the windy conditions, and tried to discourage them, mentioning that it would be a bit rough, but finally he agreed.

The Auster was not fitted with a rear seat, but the student pilot had one of the passengers sit unrestrained on the floor in the rear compartment while the other occupied the right hand seat. The engine started normally and, with the schoolboy watching from the ground, the aircraft again taxied to the northern boundary of the strip and took off into the south. It then carried out a right hand circuit at comparatively low level.

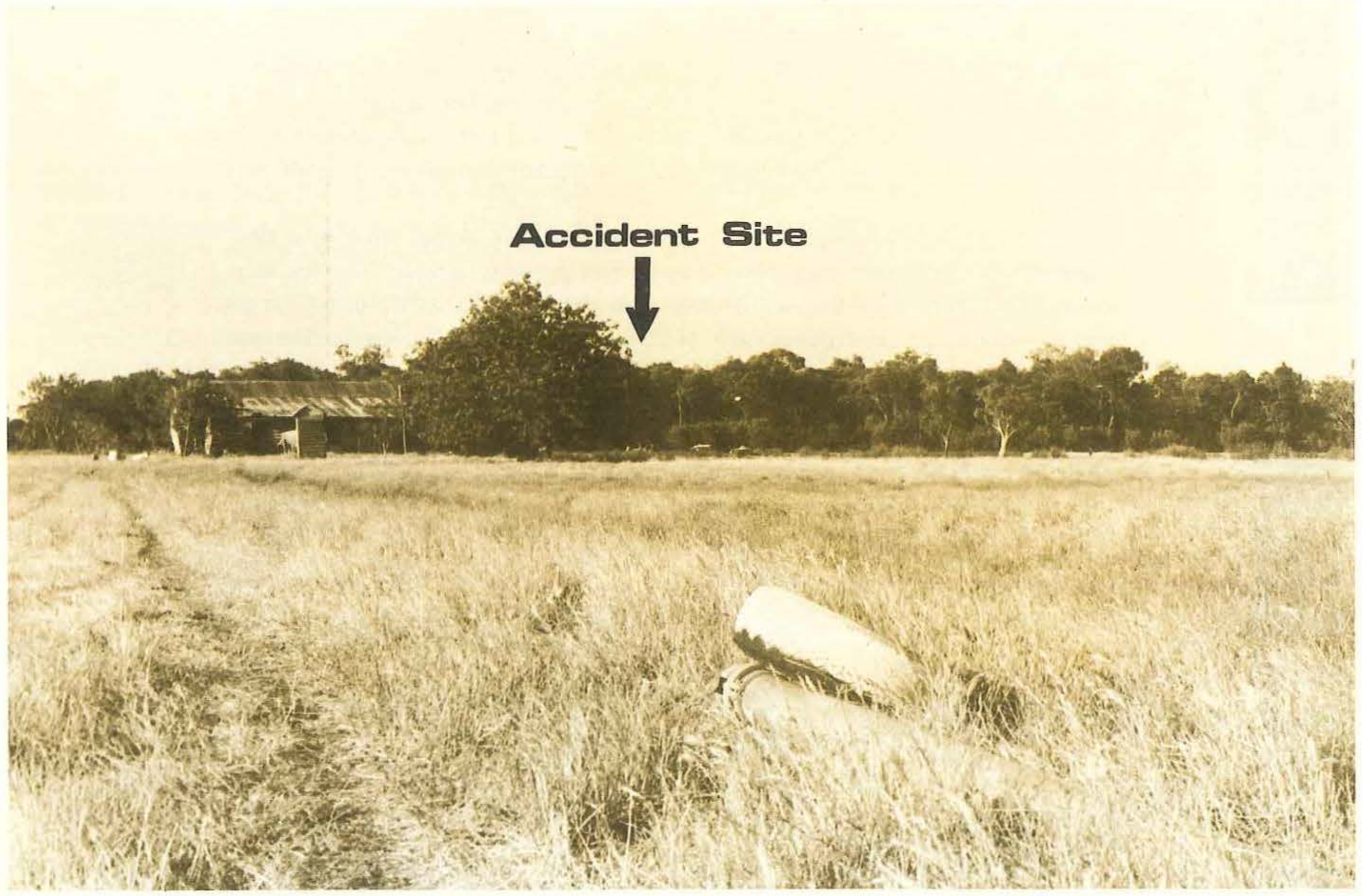
Making a normal approach as though to land, the aircraft descended to about 10 feet above the strip, then power was applied and the Auster climbed away. But as it crossed the upwind end of the strip at a height of about 150 feet, the engine began to misfire badly, emitting puffs of smoke. Immediately the Auster turned left until it was on a northerly heading, losing height slowly to the east of the landing area.

When the Auster had reached a position abeam the northern, upwind end of the strip, at a height of about 100 feet, it turned steeply in towards the strip, losing height rapidly as it did so. Now only about 20 feet up, the aircraft rolled out of the turn, but almost at once the nose dropped and the aircraft plunged to the ground. In an instant it was enveloped in flames and burned fiercely to destruction. There was nothing the schoolboy could do to render assistance.

☆ ☆ ☆

Examination of the wreckage indicated that the aircraft had struck the ground at low forward speed in a nose-down attitude consistent with a stalled condition. The intense fire had been fed by the contents of the almost full main fuel tank, immediately behind the fire-wall, which had ruptured on impact. It was evident that although the airframe and engine were structurally and mechanically sound at the time of the crash, the operation of the engine would have been impaired by the fact that the fuel filter screen was almost completely blocked by compacted insect remains and sand. Expert examination of this foreign matter showed that it was composed principally of weevil remains. Similar remains were found in the long-range fuel tank on the under-side of the fuselage, and which had been found selected ON during the wreckage examination. It was evident that the weevil bodies had been drawn from the tank and had progressively built up on the fuel filter screen during the 80 or so hours the engine had operated since

A TRAGEDY of ERRORS



the aircraft was returned to service. The filter screen had not been checked for cleanliness during that time.

How the weevils came to be in the tank in the first place could not be established, but as the tank had been obtained from an unrecognised source, they probably entered while the tank was stored unsealed in an area accessible to insect pests.

At the stage the student pilot had reached in his flying training, with very little experience in stalling and recovery procedures, he could hardly have been expected to display a level of proficiency that would have enabled him to successfully cope with the manoeuvres he attempted after the engine lost power.

Undoubtedly the student pilot had been frustrated in his plans to learn to fly in his own aircraft. For this reason, his action in taking it upon himself to fly the Auster in the vicinity of his own property, after he had reached solo standard in Cessna 150 aircraft at the aero club, might at first sight seem understandable. Unfortunately however, in choosing to disregard the requirements governing flying training and pilot licensing, the student pilot denied himself the protection that such standards were designed to provide. Precisely the same comment could be made in relation to his unauthorised work on the aircraft, involving the fitting of the contaminated long range fuel tank. Indeed, had the long range tank been fitted to the aircraft in proper circumstances, at least this particular accident would not have happened. The lesson that is so abundantly clear from this accident is that operational and engineering standards embodied in Air Navigation Regulations and Orders are not issued merely to be restrictive, but have a vital and positive role to ensure that flying takes place with an acceptable level of safety.

By its very nature, flying abounds with pitfalls for the unwary. Many of these have been recognised only as a result of costly experience over the years. Our Regulations and Orders today reflect that extremely valuable but hard-earned experience. Where a person chooses to disregard this experience and rely on his own judgement, he exposes himself to the very pitfalls the requirements are intended to avoid. It is all the more tragic when this exposure is extended to passengers who in good faith, place their lives and well-being in his hands.

STUDENTS AND ILLEGAL PASSENGERS

THE LOSERS

On the preceding pages of this issue of the Digest is a detailed account of an accident in which a student pilot, and two of his friends lost their lives.

This is by no means the first time, that a student pilot, making an unauthorised flight with passengers, has been involved in a serious or fatal accident. But perhaps because opportunities for illegal operations of this sort are comparatively few in Australia, it is a problem that does not loom very large on our general aviation scene.

In the United States however, where the sheer size and dispersion of their industry provides much greater scope for the student who thinks he knows better, the problem is sufficiently large for a pattern to be discernible. It is a pattern which clearly fits our own accidents in this category.

The following article, condensed from a recent issue of "FAA News", looks at the problem and discusses the reasons why a serious accident so often results in these circumstances.

Everybody knows that a pilot with only a student licence is not permitted to take passengers when he goes flying. Yet the records abound with accidents involving students carrying passengers. The records also show that when a student with passengers aboard has an accident, it is apt to be very serious. In fact it is twice as likely to be fatal than if it happened to a qualified pilot.

In 1973 the national ratio of fatal accidents to total accidents for all pilots was one in six, but for students with passengers on board it was one in every three. Many of these fatal accidents have more than one passenger along too — sometimes in aeroplanes that were not meant to carry more than two people. Take an accident that happened last summer in South Carolina . . .

Around 2115 hours — late twilight — a woman heard an aircraft flying low over her house. ('Low,' she said, 'like the planes that spray for mosquito control.') A few minutes later there was a crash, so loud that it woke her husband. He went out and looked around, but found nothing. It was not until the next morning that the wreckage was located by a search aircraft. The three occupants were dead. Air safety investigators moved in to find out what had caused the crash. As it turned out there were several causes.

One of the first things they discovered was that the pilot was a student, with neither the right nor the skill to pilot an aircraft carrying passengers. Another very pertinent fact was that three men had been flying in a Cessna 150. One of the passengers was apparently riding in the baggage area. Given the generous weight allowance of this sturdy, if small aircraft, such an unorthodox arrangement would not necessarily have made the aircraft overweight — or even out of balance, depending on the fuel remaining and the positions of the two passengers. But it could certainly have changed the handling characteristics of the aeroplane, with serious consequences for an inexperienced pilot who was used to flying alone. (Most light trainers are affected very noticeably by additional weight in the cockpit.)

Another factor came to light with the toxicology test results. A high alcohol content was found in the blood of all three men, and in the pilot and one passenger there was a drug of the type used for sleeping pills. This could cause a depressed state, impairment of judgment and decreased inhibitions. Either the alcohol or drug would have affected the ability to safely pilot an aircraft; in combination they could be (in this case **were**), fatal.

The flying history of the pilot was revealing, though incomplete. Records indicated he had applied for his second student certificate in January, 1973, about the time he bought the aircraft. At that time he declared nine hours total time logged, with no flying in the previous six months. The instructor who had given him 4.4 hours of dual in January of 1972 and signed him off for solo in a Cherokee 140 also flew 1.2 hours with him in the 150 and signed him off to solo in that aircraft. Those 5.6 hours of instruction were all that the records showed.

The National Transportation Safety Board listed their findings of the probable causes of this accident as: Continuing flight into conditions beyond his experience and ability; physical impairment with alcohol and drugs; and unwarranted low flying. Although extreme, this case exhibits the factors that may be present when student pilots carry passengers illegally — minimal flying experience, ignorance of the dangers of drugs and alcohol, unfamiliarity with weight and balance problems, etc.

☆ ☆ ☆

A less extreme, but perhaps more common, example of this type of accident involved another student who had bought a quarter share in a Cessna 172 and, in realisation of a longstanding dream, had begun his flight training. The night after he soloed, he gathered with some friends to celebrate his achievement. Round after round of drinks were offered up to his success, and toasts to 'the greatest pilot in the world' became more believable with each round. When one of the girls in the group issued a challenge to 'prove it', he headed merrily to the airport with the girl in hand.

Fortunately, he never managed to get the aeroplane off the ground. He lost control while taxi-ing, crashed into several other aircraft parked on the ramp, and virtually destroyed his own — but neither he nor his passenger were hurt. The cost of the aborted joyride? Revocation of his student certificate for a year, charges of several hundred dollars in repairs for the 'deductable' part of the insurance, and a black mark on his record. Very possibly this young pilot and his friend were saved from a fatal accident by the mishap.

The accident rate of students flying with passengers is impossible to determine since there is no way of knowing exactly how widespread the practice is. The only figures are for those who get into trouble. Aside from a lack of experience and pilot skill, there are several unique elements involved in student-with-passenger accidents; one or more of them contribute to almost every one of these crashes.

Tension

Uneasiness is prevalent; the student knows he is flying illegally, and usually realizes that if he gets caught his certificate is at stake. In most cases a student charged with carrying passengers has his licence revoked for a year.

Showoff Tendencies

The exhilaration of having soloed occasionally triggers in the student an uncontrollable impulse to demonstrate his skill, and this is often intensified by alcohol. The student may be convinced he can out-perform the 'Blue Angels' as he buzzes his girlfriend's house, shakes up the sunbathers on the beach, and makes steep turns for the amazement of his captive audience — his passenger.

Unaccustomed Diversions

The student who has previously flown only alone or with an instructor, may find the presence of passengers far more distracting than he expected. At a stage in his pilot career when his full attention is required just to operate the controls, monitor the instruments, navigate and perhaps use the radio, a relatively small complication can become a major emergency. Answering questions about the flight, pointing out landmarks, or comforting a sick or frightened passenger are part of the game for a seasoned pilot, but could easily prove too much for a student trying to remember all he has recently been taught.

Weight and Balance

The student pilot, who has never flown with people in the back seat, is totally unprepared for the difference in the feel of the aircraft. He may not realize that some four-place types are actually overweight or out of balance with full fuel, full seats and baggage. Often the theories of weight and balance are not well understood by student pilots. It may come as a complete surprise that a bag of golf clubs in the baggage compartment can throw some aeroplane's weight and balance out enough to make stalling speeds change and trim settings unfamiliar.

Unfamiliar Landing Areas and Terrain

The student pilot on a joyride is apt to use an out-of-the-way aerodrome, perhaps to escape detection. Complicating his operation may be a different type of runway and approach, different terrain in the form of hills, cliffs, trees or other obstructions. A student who takes his friends to a mountain airport on a summer day is in for real surprise when he encounters density altitude problems for the first time.

Weather and Pride

The ability to turn back when things get rough is not always easy to learn, especially if one is demonstrating a newly acquired prowess to friends. The lifesaving 180 degree turn in the face of deteriorating weather may appear to be a sign of weakness or cowardice, instead of common sense.

The passenger-carrying student is risking financial, as well as personal loss. His insurance almost certainly does not cover passengers, and depending on how it is written it may not cover much of anything during an illegal operation. A whopping lawsuit could wipe him out economically for the rest of his life — a high price to pay for an impulsive joyride. The incident will also leave a blemish on his record, which could be considered in the future when he applies for insurance.

The operator or flying school hiring an aircraft to a student who ends up carrying passengers, becomes — perhaps innocently — a kind of partner in crime. Even if his insurance covers the aircraft, the loss of revenue while it is being repaired or replaced is no small consideration. Often, however, the student is the owner, or part-owner, of his aircraft, which makes the problem more difficult to combat.

Generally it is not a good idea to interfere with other persons' pleasures, and no one likes to inform on his friends, but when it cómes to student pilots carrying passengers, it is another matter. Not only the student but you and everyone else who uses the airspace have a stake in keeping it safe for aviation.

Even if the eventual outcome is a suspension, you can be certain that you have done someone, especially the culprit, a big favour. The old saying that a fool who persists in his folly will eventually become wise does not apply to pilots. They may not live that long!

FATAL MISJUDGEMENT

After making arrangements for a visit to a farming property near Tumby Bay, South Australia, a private pilot, accompanied by a passenger, flew an Airtourer 100 from Mt. Gambier. The airstrip on the property, aligned east-west, consisted of an area of stubble some 920 metres long and 50 metres wide, which had been mown along one side of a mixed crop of oats and wheat. On its northern and western sides, the paddock in which the crop was growing was bounded by a wire fence and the strip ran parallel to and beside the northern fence. After making a normal landing into the east, the pilot taxied back to the western end of the strip where he parked the aircraft overnight.

Early next morning, after the pilot had telephoned his flight plan to the briefing office at Parafield, he and his passenger, accompanied by relatives and friends who were to see them off, were driven back to the aircraft at the strip. The weather was fine and warm with a gusty north-westerly wind of about 20 knots blowing across the strip at about 45 degrees. After carrying out a comprehensive pre-flight inspection, the pilot boarded the aircraft with his passenger, started the engine and began to taxi slowly towards the eastern end of the strip.

Conscious of the crosswind component and the gusty conditions which were buffeting the aircraft as he taxied, the pilot decided to take-off diagonally across the strip towards the northern fence. When he had reached a position he estimated as about 600 metres from the strip's western end, he therefore positioned the aircraft on the southern side of the strip close to the unmown crop and completed his pre-take-off checks. Then, with two stages of flap selected, he lined up diagonally across the strip and held the aircraft on the brakes until he had applied almost full power.

The aircraft seemed to accelerate normally at first and, though still conscious of the buffeting crosswind, the pilot did not expect any difficulty in lifting off in the distance he had selected. But by the time the aircraft had almost reached the northern fence it had still not left the ground and those watching saw the aircraft slew to port and continue close to and parallel with the fence for a short distance. It then lifted off in such a high nose-up attitude that the tail bumper struck the ground. Almost immediately it swung further to the left some 90 degrees out of wind, and the port wing dropped, scraping across the stubble for nearly 30 metres. Recovering momentarily to an almost level attitude, the aircraft then struck the ground heavily on all three wheels, bounced back into the air and, now drifting to port, touched down again heavily in the crop.

With the engine still at full throttle the aircraft then crossed another mown section of the crop adjoining the western fence, heading directly towards a clump of trees. Becoming airborne again just before reaching the western fence, the aircraft struck the topmost wires with its undercarriage and crashed to the ground at the base of the trees. The port wing was severed from the fuselage, but the starboard side of the aircraft impacted violently against the trunk of a large tree, killing the passenger sitting on that side. Although the aircraft was destroyed, the pilot suffered only minor injuries.

☆ ☆ ☆

The pilot held an unrestricted private licence and his total aeronautical experience amounted to almost 200 hours, 22 of which had been flown in Airtourers. There was no evidence to suggest he was suffering from any incapacity which could have affected his judgment or ability to fly the aircraft, nor was there any evidence that the passenger had in any way interfered with the controls.

Examination of the wreckage did not reveal any defect in the aircraft or its systems which could have contributed to the accident, and it was apparent that the engine was developing full power throughout the take-off run until the moment of impact.

The strip on the property met the requirements for an authorised landing area for this type of aircraft. The mown portion of the crop was of more than adequate width, as was its total length of about 915 metres. From the eastern end of the strip to about its mid-point, the ground sloped upwards about three quarters of a degree, then the up-slope decreased slightly to half a degree. The stubble surface was dry and reasonably firm.

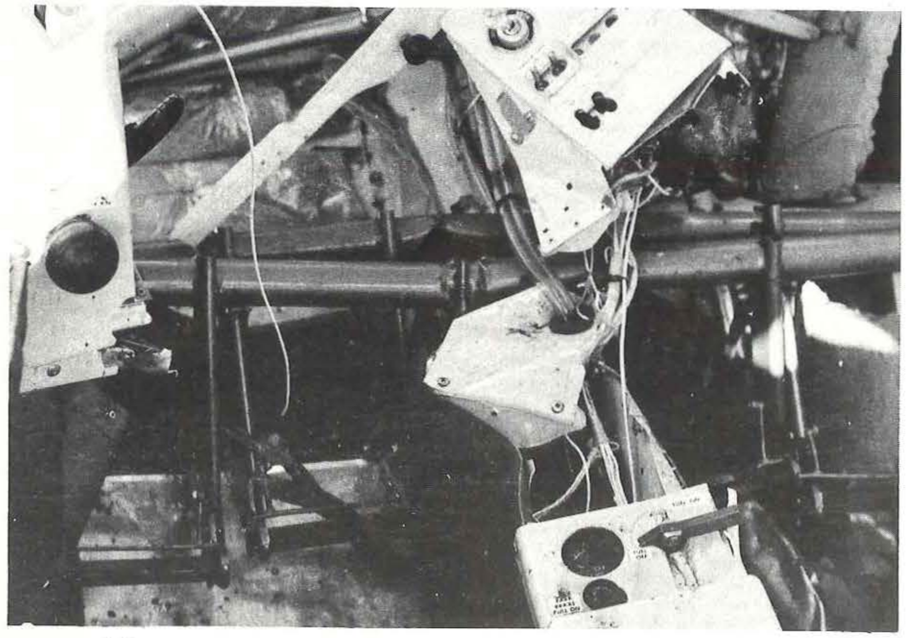
The pilot said after the accident, that he had taxied the aircraft no further east than the rise in the strip in the belief that he had 600 metres of firm stubble available for take-off. In actual fact, the position from which he began the take-off was only 490 metres from the western end of the strip, and the pilot had thus deprived himself of 425 metres of available run. The pilot said he had not used more of the strip because he thought the increased up-slope at its eastern end would have adversely affected the aircraft's performance. As well as this, he had elected to angle his take-off across the strip in an attempt to reduce the effect of the crosswind. This decision further reduced the available distance to only 335 metres.

Above: The final impact site. Note the tree which has penetrated the cockpit area on the starboard side.

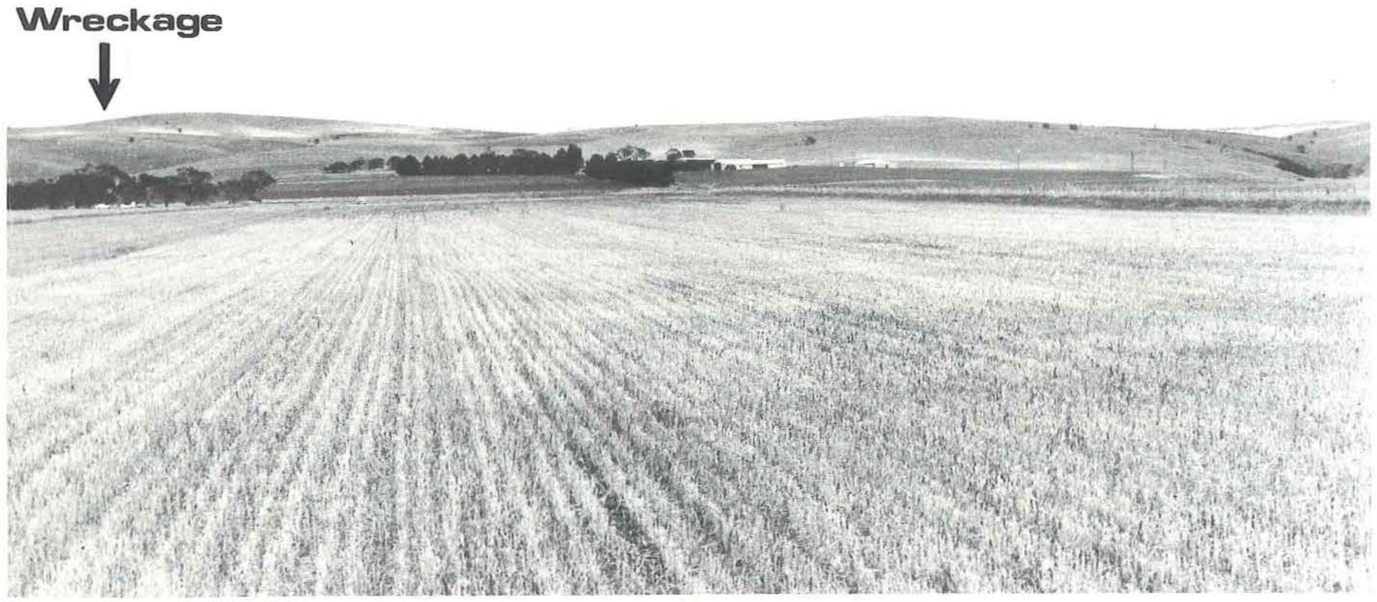
Below: Photograph of cockpit area looking forward showing almost complete destruction of forward section.

Opposite Page, Top: View of airstrip looking west in the direction of take off taken from point at which take off run was commenced. The crosswind component was from the right of the picture and the initial part of the take off run was angled towards the fence at right.

Below: Another view of strip, this time looking east. The length of unused strip can be seen beyond the indicated point from which the take off was commenced. The slight change in slope is also evident.



Calculations based on the take-off weight chart in the aircraft's flight manual showed that, in the conditions existing at the time, a distance of 560 metres would have been required for a take-off to a height of 50 feet. The ground marks made by the aircraft's tail bumper when it first left the ground were 345 metres from where the take-off had begun, a figure consistent with the calculated distance to unstick, taking into account the half degree up-slope and the slightly retarding effect of the stubble surface. The 490 metres of strip available from the point at which the pilot had begun the take-off was 75 metres less than that



required by the performance chart, but it is possible that the aircraft would have cleared the western fence if the pilot had taken off directly down the strip, correcting for the crosswind in the normal way. Other calculations indicated that the crosswind component on the strip, assuming the aircraft had taken off parallel to the centreline, would have been about 15 knots, well within the 20 knot crosswind limitation for the aircraft type. By taking off diagonally across the strip the pilot had reduced the crosswind component by only about two knots.

The pilot was unaware until afterwards that the port wing tip had scraped the ground after the aircraft had become airborne initially. Nevertheless, the intermittent sounding of the stall warning at this time, followed almost immediately by the aircraft's heavy impact with the ground, obviously should have indicated a stalled or semi-stalled condition at a dangerously late stage in the take-off. Abandoning the take-off at that point, would probably have resulted in only minor damage as the aircraft slid into the fence, or was deliberately ground-looped to avoid it.

☆ ☆ ☆

Probably the most significant aspect of this accident is that it contains yet another tragic lesson on the wisdom of using all the available length for take-off. On this occasion there was no reason whatever why the pilot could not have taxied right to the end of the cleared area of the crop and used the full 915 metres available. Instead he began the take-off from a point where the distance to the upwind fence was only a little over half the total length.

In deciding not to use the full distance, the pilot's judgment was influenced by his belief that the upslope on this portion of the strip would have degraded the aircraft's performance. In actual fact, he would have gained 425 metres of strip and, as the increase in upslope over this length was only a quarter of a degree, the effect would have been small indeed compared to the benefits of using the full distance. Had the pilot done this, there is no reason why the aircraft should not have comfortably cleared the boundary fence and the trees beyond.

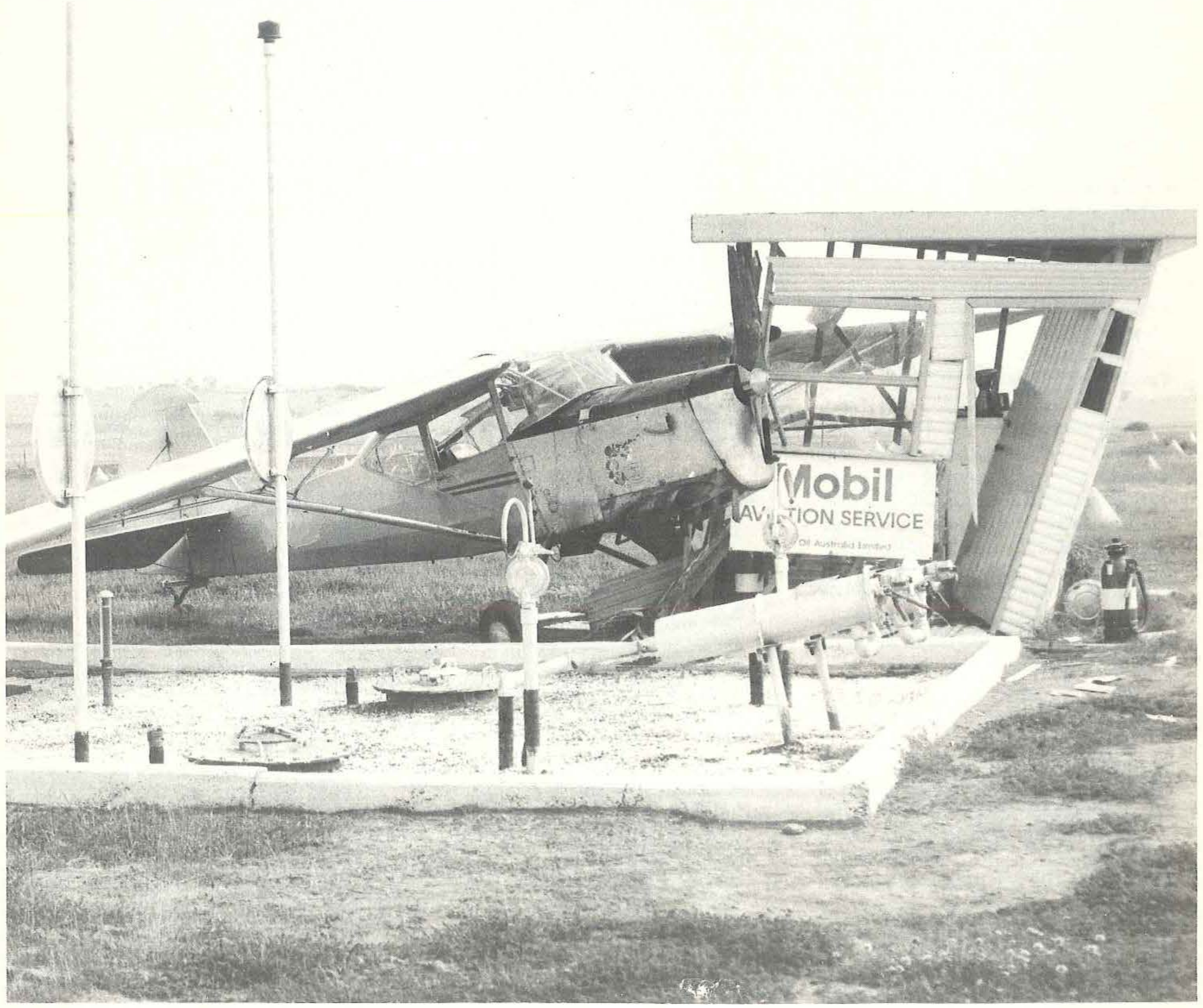
But the factor that finally doomed the take-off was the aircraft's angled path towards the northern boundary of the field. While this had a negligible effect in reducing the crosswind component on the strip it limited the available take-off distance to the point where it was virtually impossible for the aircraft to leave the ground before reaching the northern fence.

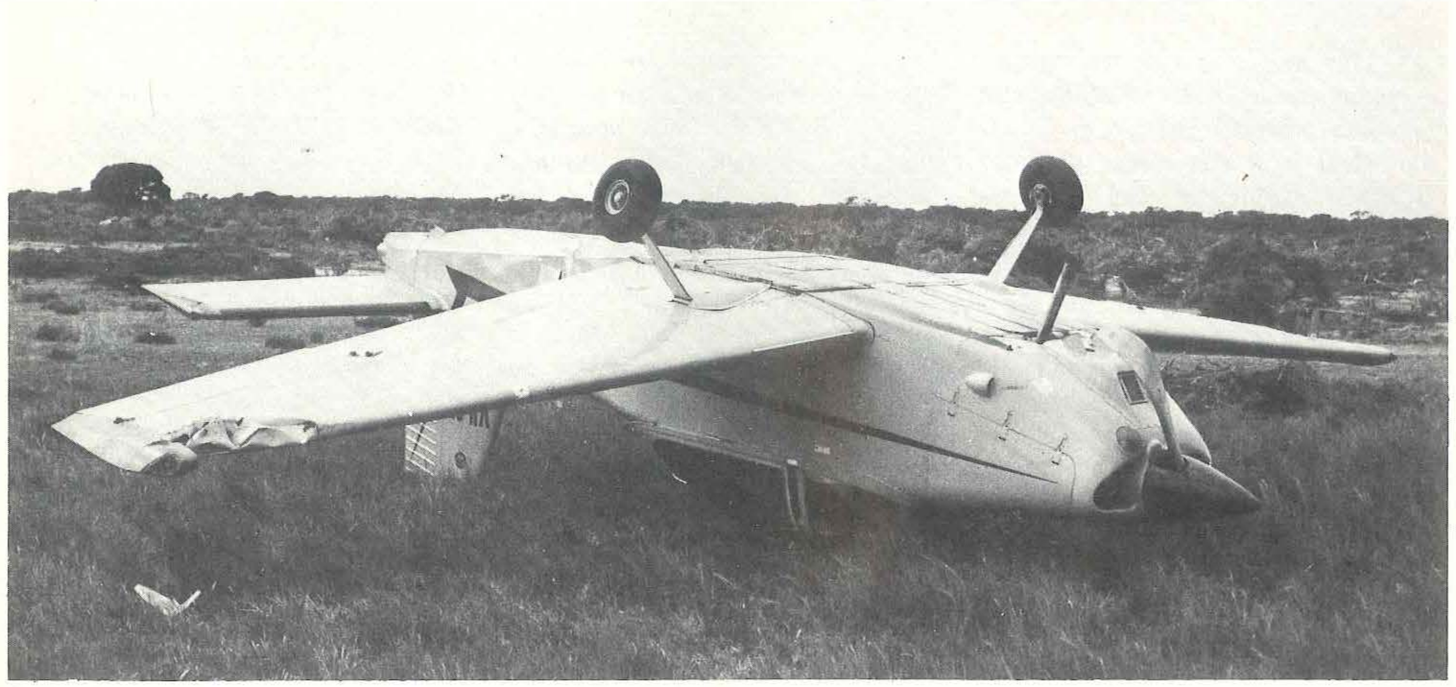
SOME MORE THAT GOT AWAY

The need for care during hand starting has been stressed many times in the Digest.

This sorry collection of aircraft is a further reminder that nothing should be left to chance when starting an engine by hand. All of these accidents might have been avoided if the pilots concerned had used the correct starting technique and taken adequate precautions to prevent the aircraft rolling forward.

It's too late once the horse has bolted!





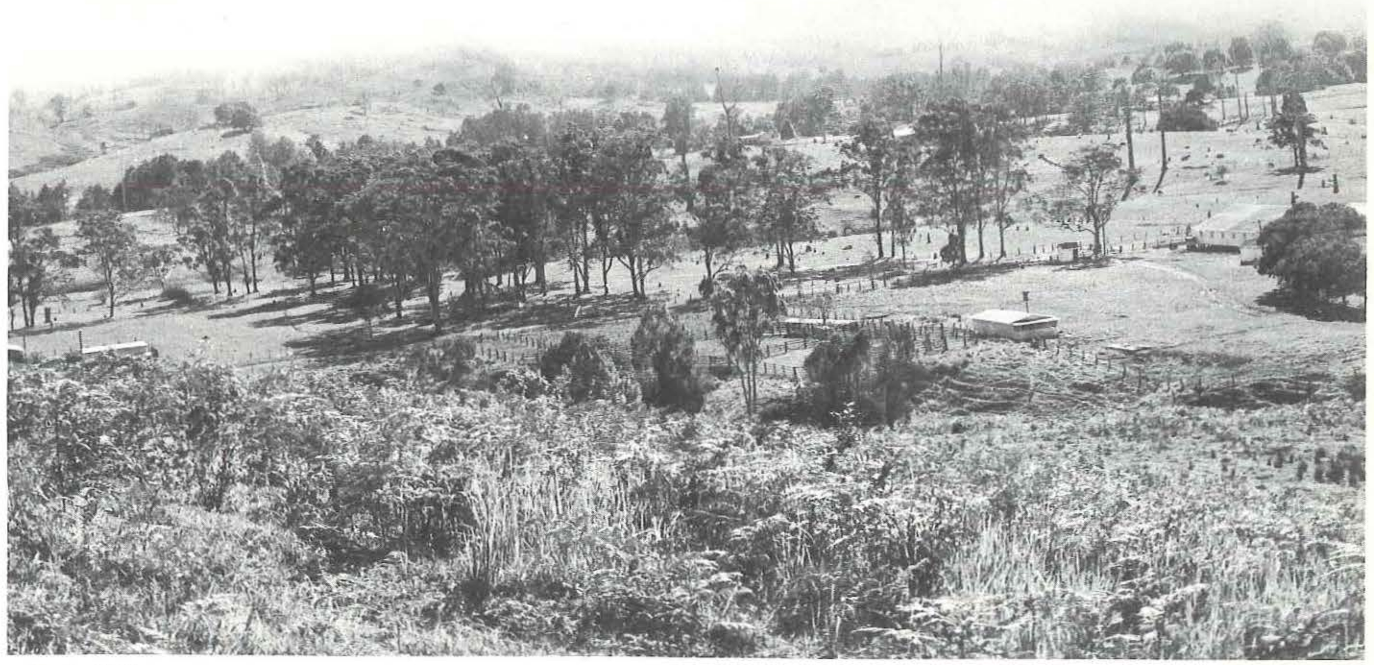
Why does a normal, well-balanced person suddenly do something completely unpredictable?

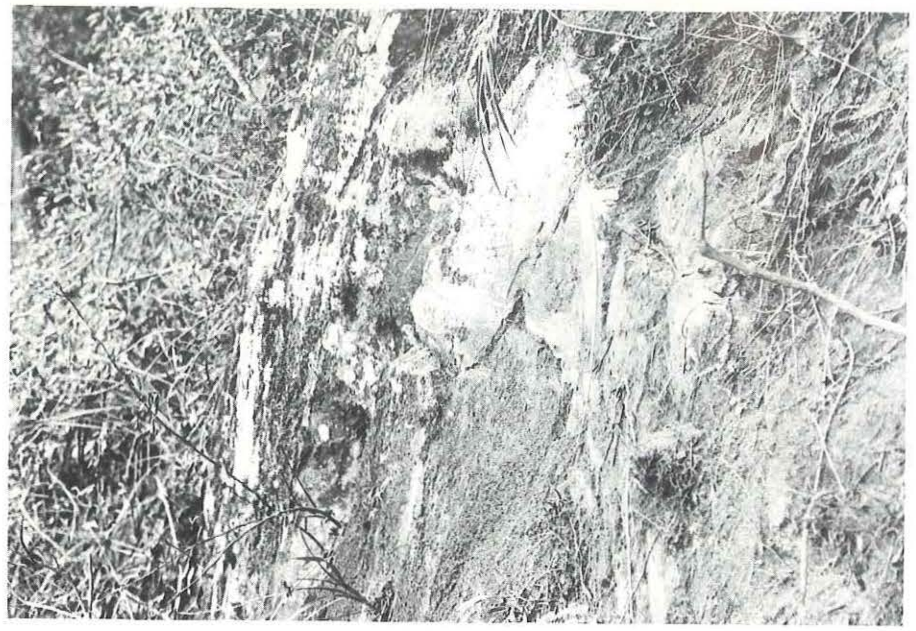
What is it that makes a mature, highly experienced and competent private pilot decide on the spur of the moment to bid his aircraft, reputation, career, and indeed his very life, as well as those of his passengers, in exchange for the chance of completing a flight? A flight for which the only motivation is the keeping of a business appointment?

Examined coldly and clinically, a 'deal' like this makes no sense at all — it appears in fact to be bordering on lunacy. Yet it happens so comparatively often to normally responsible people in general aviation that there must be a great deal more to its explanation than meets the eye. As the digest has observed before, at least part of the reason seems to be bound up in that belief, so illogical yet deeply ingrained within us all, that 'it won't happen to me'. Because on the one hand, the enclosed, comfortable cabin of a modern light aeroplane seems so snug and secure, yet in reality, aviation remains such an alien environment for man, it is perhaps hard for our innermost being to accept that a comparatively minor error of judgement in flying can be totally unforgiving.

The Digest does not pretend to have the answers to these obviously very searching questions. All it can reasonably do within its limited resources is to keep bringing the facts before its readers. It continues to do this in the hope that, even if not in every case, pilots generally will learn from the sorry mistakes of others and be able to apply this knowledge to furthering the safety of their own operations.

WHY?





Above: The near vertical rock face against which the aircraft crashed. Following the main impact the wreckage fell down the slope and caught fire.

Opposite page: The terrain north of Nimbin as it would have been seen by the pilot as he attempted to continue the flight at low level beneath the cloudbase.

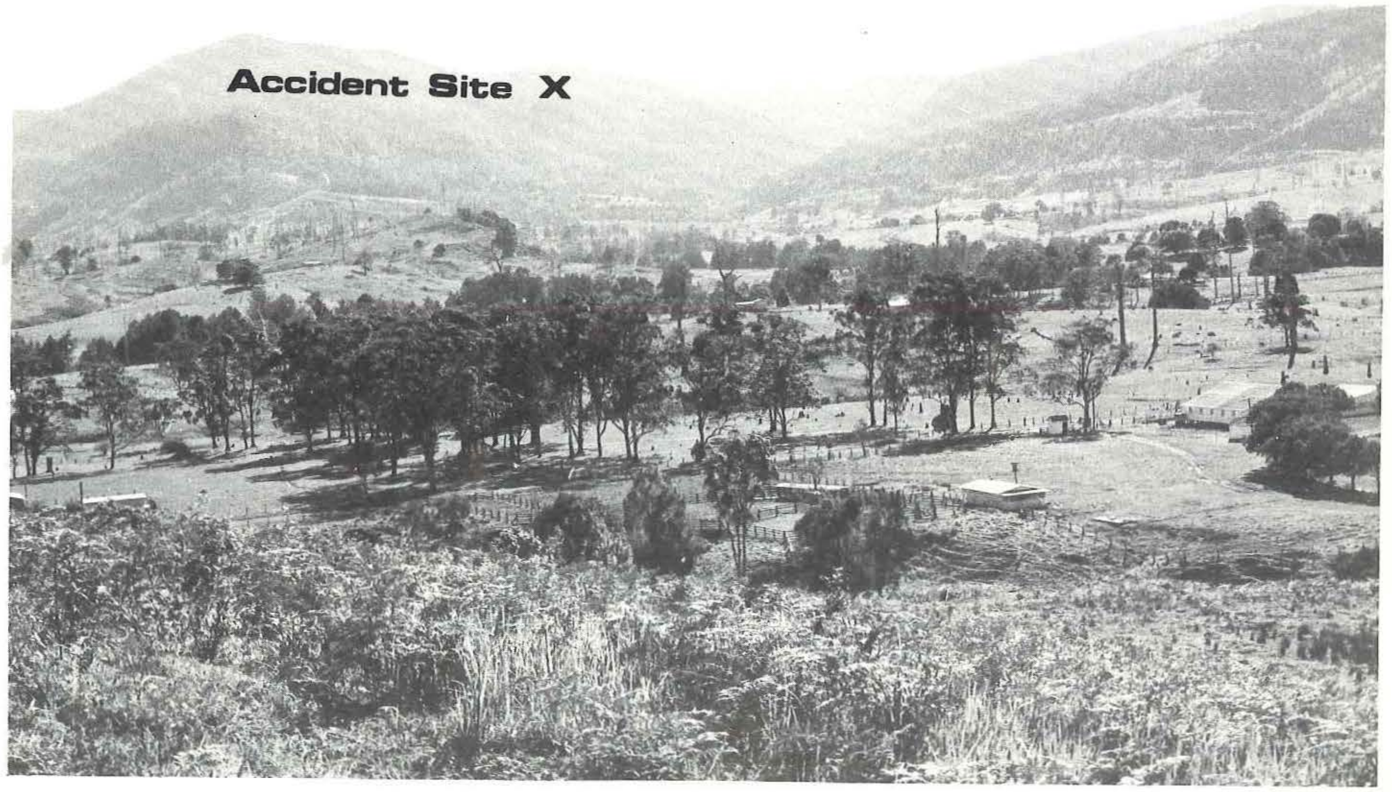
Below: The same terrain as it really is, as seen on a clear day. Mt. Neville, elevation 2950 feet, can be seen in the left background and the accident site on its southern slope is indicated.

The most recent catastrophe of this type which it is the Digest's duty to report, concerns a Piper Twin Comanche that was making an ostensibly VFR flight from Branxton (near Maitland N.S.W.) to Archerfield Airport, Brisbane. The trip was a business one and the aircraft was being flown by a director of the company that owned it. This private pilot had been flying for 14 years, had accumulated well over 2500 hours, 2000 of it on the PA30, and held a Fourth Class Instrument Rating. With him on board the aircraft were three passengers, none of whom were aeronautically qualified.

Early on the morning of the flight, the pilot had obtained a weather briefing which indicated that visual flight might be possible over his proposed route and the aircraft had departed from Branxton at 0712 hours. All apparently went well with the flight until it had passed Grafton at 0837 but, by this stage, the pilot had been forced by gradually deteriorating weather conditions, to descend from his original cruising level of 7000 feet, to below 2000. At about this time also, four other aircraft which happened to be flying VFR in the area, reported to Coffs Harbour Flight Service Unit that they were diverting because of adverse weather.

At 0859 hours however, the pilot of the Twin Comanche reported over Casino and requested a clearance to track through the Coolangatta Control Zone at 1500 feet. The aircraft was informed that Archerfield was closed to VFR operations, and that it would be advised about its clearance. The sky at Casino at this time was covered by eight oktas of cloud at about 1000 feet and there were extensive rain showers on the hills and ranges to the north.

Two minutes later, Brisbane Flight Service Unit called the aircraft to offer it a choice of two routes of entry to the Coolangatta Control Zone. The reply from the aircraft was almost impossible to read, apparently because of the low altitude at which it was now flying, and it was therefore instructed to report again at Murwillumbah.



Soon afterwards the aircraft was seen passing slightly to the east of Kyogle, still flying a northerly heading. Its height was below the level of nearby Fairy Mountain, elevation 1131 feet, the top of which was in cloud. After passing Kyogle, the aircraft turned north-east and was soon lost to view behind a ridge. A few minutes later, at 0910 hours the aircraft was sighted some 16 kilometres further to the north-east, flying quite low between the ridges on the same north-easterly heading. There were extensive rain showers in the area at the time.

At 0915 hours it was again seen, but this time on a south-easterly heading, flying extremely low and almost in the base of the cloud, apparently following the road into Nimbin, 21 km almost due east of Kyogle. The cloud base at Nimbin at this time was only about 100 feet above the ground. After passing over the township itself, the aircraft turned left on to a north-easterly heading again and followed a road leading up a valley in the direction of Mt. Neville, elevation 2950 feet, only 10 km away. The mountain was totally obscured by cloud and at this stage the aircraft was flying just above the tree tops. Five km north of Nimbin, when the aircraft had almost reached the foothills of the mountain where the terrain and cloud base met, it made a low level turn through 360 degrees. As it resumed its former heading, power was applied and the aircraft climbed into the cloud. With its engines at high power, it was then heard passing over a property further up the valley but it could not be seen because of the low cloud. Very soon afterwards there was a loud noise of an explosion.

☆ ☆ ☆

Search and rescue procedures commenced as soon as it became evident that the aircraft was overdue at its Murwillumbah reporting point. An air search, using several fixed wing aircraft and three helicopters, commenced as quickly as possible, and reliable sighting and hearing reports were soon received from the area in which the aircraft had apparently crashed. But the weather and terrain in which the accident had occurred rendered the operation so difficult that it was almost 24 hours before the wreckage could be positively located.

When a ground party finally reached the site it was found that the aircraft had impacted against the steeply-sloping, heavily timbered southern face of Mt. Neville, at an elevation of 1670 feet AMSL. The aircraft had been destroyed by impact and fire and all four occupants had been killed instantly.

Examination of the wreckage failed to reveal evidence of any defect or malfunction which could have contributed to the accident. At the moment of impact, the aircraft was in a climbing configuration. The height of the aircraft at its last sighting, the distance it had travelled from this point, and the elevation of the impact site were consistent with the aircraft's normal climb capability. It was thus obvious that the pilot could not have appreciated the proximity of the mountain immediately ahead on his intended flight path when he commenced the climb into cloud.

☆ ☆ ☆

Though the foregoing discussion explains the mechanics of the accident, it does not really deal with the motivating forces which brought it all about.

Why for example did the pilot not realise that this mountain range lay directly in his flight path? Certainly with the cloud base as low as it was in this area, there was little or no visual indication that it did (see photographs). But as well as the fact that the existence of this particular mountain is clearly indicated on both the World Aeronautical Series Chart for the area and the Coolangatta Visual Terminal Chart, the whole area which the pilot was attempting to penetrate abounds in steep-sided ridges and precipitous ranges. For this reason, any attempt to continue into the area at extremely low level beneath a very low cloud base, would be fraught with danger.

Why, it is also necessary to be asked, did the pilot not divert towards the much lower terrain on the coast when

Opposite page: The remains of the burnt-out fuselage suspended in the dense undergrowth.

Above: The aircraft's port engine wedged between trees some 400 metres below the main impact site.

Below: The port wing lying on the slope below the trees first struck by the aircraft.

he could see the conditions were progressively deteriorating as he continued north past Casino and, more particularly, Kyogle?

The real answer to these questions cannot be known of course, but it seems that by the time the pilot had contined the flight northwards to the point where he was forced to fly low

through valleys, he was no longer able, because of the workload involved, to continuously and accurately plot his aircraft's progress on his charts. In the circumstances, it is likely that at this stage the pilot was simply following a trial and error means of penetrating the terrain beneath the cloud base. It is conceivable that the forecast the pilot had received before departing led him to believe that the weather he was encountering was not extensive and that he might soon be through to better conditions.

Unfortunately for the pilot, and the passengers he was carrying, by the time he had reached the position where he finally saw he would be unable to continue visually, it was already very difficult, if not impossible to turn back and still remain visual. By this stage too, the pilot, in attempting to navigate at low level by following valleys and roads, had probably lost track of the aircraft's true position, and evidently did not appreciate that climbing straight ahead would take the aircraft directly into the face of the mountain.

Once again, this accident vindicates the margin of safety that is so necessary in both VFR and IFR operations and which is built into these respective procedures. As this and other accidents have shown time and again, any attempt to short-cut or compromise these procedures by a type of flying that is neither one thing or the other, is inviting disaster. And surely, in the light of all this accumulated experience, responsible pilot peer groups today would never regard a decision to turn back in adverse conditions as anything but sound operational practice.

As the official cause prescription puts it in this case, 'the cause of the accident was the pilot's decision to continue towards his destination, climbing through cloud, in circumstances where there was no assurance that a safe clearance above terrain could be maintained.'

Rescue — VSB was the key

'Madang, this is Foxtrot November Golf ... it's thirty two and a half DME ... bearing two six one from the Momote NDB ...'. This transmission from a Fokker Friendship at Madang pinpointed the position of a helicopter which had crashed on Manus Island, one of the northernmost islands of Papua New Guinea, only a few hours earlier.

The helicopter had been engaged in oil exploration operations when it lost power and crashed in dense jungle. Fortunately, the pilot and his passenger sustained only minor injuries and immediately activated their VHF Survival Beacon. Search aircraft homed on to the VSB signal, a successful supply drop was made and the survivors were uplifted to safety the following day.

On the day of the crash the helicopter had been operating in and out of helipads cut from the jungle on the northern side of the island, reporting 'operations normal' every thirty minutes. After completing several flights in this survey area, the pilot transferred his operations to the southern side of the island but neglected to advise the Airways Operations Unit at Madang of the fact. The illfated flight was one carrying empty fuel drums from a helipad back to a base camp on the coast. The helicopter's payload consisted of one passenger and seven empty 200 litre fuel drums. Two of the drums were carried internally and the rest were in a cargo net slung underneath the aircraft. Shortly after take-off there was a loud metallic 'clank'. The pilot immediately jettisoned the sling and made a precautionary landing at a rather small pad nearby, where he inspected the helicopter but no damage or malfunction was evident and he assumed that the noise was caused by the drums shifting in the cargo net. The flight was resumed but only two minutes after this second take-off, the engine failed.

Immediately the pilot transmitted a MAYDAY call, which was acknowledged, and began an autorotational descent towards a bend in the river below — the only possible place in the dense jungle for an emergency landing. Even so, it was surrounded by heavy timber and very far from ideal. Unavoidably during the final stages of the descent, the helicopter struck a large tree, and crashed, coming to rest on its side with its nose partly submerged in the river. Both occupants evacuated the aircraft quickly. Neither was badly hurt.

Though the pilot's injuries were not serious, they were such that he found it difficult to move. When the passenger returned to the aircraft to retrieve the survival kit, he was dismayed to find that it had burst open on impact, spilling its contents, including the first aid kit, into the river. The passenger was able to recover only a few items, but fortunately these included the aircraft's VHF survival beacon. At the pilot's suggestion, the passenger also recovered one of the fuel drums from the wrecked helicopter. After placing the drum on end in a suitable position, he set up the survival beacon on top of it and activated its transmitter.

The two men now realised the seriousness of their predicament. They had crashed in a remote and inhospitable area, and one in which they had not notified they were operating. And even if they were found soon, access to them would surely prove most difficult. As well as all this, nightfall was only two hours away. There seemed every prospect of an extended stay in the jungle with very limited supplies, and the real possibility that their minor injuries without the benefit of treatment, could develop into something worse. Their only ray of hope lay in their acknowledged MAYDAY call, and in the now radiating survival beacon.

At the time that the helicopter's MAYDAY call was heard, the nearest available aircraft were at Madang, 370 kilometres distant. But within the hour a Cessna 402 was on its way to Manus Island across the Bismark Sea. The pilot's brief was to conduct a VSB search for as long as possible before last light, as the aircraft would have to land at Momote before dark. Approaching the search area, the aircraft picked up a VSB signal, but it was not possible to complete the homing procedure in the time available.

Meanwhile however, an airline Fokker Friendship had landed at Madang, and with the positive knowledge that a survival beacon was radiating, its crew was alerted for a night VSB search. Because the Friendship's pilots were unfamiliar with the VSB homing procedure, it was decided, in addition to a thorough briefing, to supplement the crew with an air traffic controller who was familiar with both VSB homing procedures and supply dropping.

The aircraft in the meantime was being prepared for the search operation. Heliboxes, supplies, a portable SAR kit (which included maps and charts) and other essential items were placed on board. Life rafts and marine supply containers were also loaded as there was a slight possibility that the aircraft could have crashed in the sea.

In another section of the Rescue Co-ordination Centre, other staff were busy organising back-up facilities for the search aircraft. Arrangements were made for the new runway lights at Momote, commissioned just a week earlier, to be turned on, two patrol vessels were despatched from the Naval Base at Lorengau on Manus Island — one to cover the north coast, the other the south, the national radio station was requested to broadcast a message to villages in the area and, through various organisations, ground parties were readied for the following day. At this stage, information was received from the oil exploration company that the helicopter had been operating on the southern side of the island and the primary probability area was altered accordingly.

Long before reaching the search area, the Friendship, flying at 15 000 feet, picked up the VSB signal. A standard VSB homing procedure was flown and information on 'signal heard' and 'signal fade' was radioed back to the Rescue Co-ordination Centre for plotting. By repeating the procedure at low level, the crash site was more accurately determined. The accuracy of the homing procedure was finally verified when torch signals were sighted in the suspect area. But as it was now after midnight and nothing further could be achieved before dawn, the Friendship was instructed to land at Momote.

The location of the crash site confirmed the worst fears of the SAR team — the difficulty of effecting a speedy rescue. It was obvious that only another helicopter could uplift the survivors and although there was a Hughes 500 at Madang, the long over-water flight to Manus Island precluded its immediate use. An RAAF Hercules was therefore made available from Port Moresby, 750 kilometres away, to transport the helicopter to Momote and as the operator had no pilot available, an Examiner of Airmen to fly it as well.

Early the following morning, at first light, the Cessna 402 took off from Momote to assess the scene of the crash. A smoke flare was sighted but the crew could see only one survivor. It was obvious that a pad would have to be cut to enable the rescue helicopter to land and, because the crash site was in such an inaccessible position, even a supply drop could only be made with difficulty. Neither the Friendship nor the Cessna 402 was suitable for supply dropping in such a confined area so although not ideal, it was decided to use a Piper Aztec which had arrived at Momote by this time. The dropping run was flown at 300 feet, following a curved flight path. Four heliboxes containing medical supplies and food, were dropped, three of them landing within 20 metres of the crash site. During the drop, the crew of the Aztec were able to sight the second survivor.

By 1000 hours that morning the RAAF Hercules, with the Hughes 500 on board, had arrived at Momote. The helicopter was unloaded, the rotor blades were refitted and a little over an hour later it was airborne and on its way to the crash site. Arriving over the area, the pilot confirmed there was no suitable landing area. The helicopter was not equipped with a winch, but the helicopter's engineer volunteered to go down a rope and clear a pad. The engineer was able to clear only a small area in the time available, and it says much for the skill and resourcefulness of both pilot and engineer that a landing was made and that, by 1300 hours, both survivors had been uplifted from the crash site and flown to the Naval Hospital at Manus Island.

The successful outcome of this extremely well organised rescue operation should not be allowed to cloud the fact that it contains several valuable SAR lessons. These could probably be summarised as follows:

- The need to keep the nearest Airways Operations Unit informed of any changes to a flight plan — whether operating on a Full Reporting, Sartime, or even a Nosar basis.
- Survival kits need to be well stocked and adequately maintained. Their containers should be secure and strong enough to withstand a moderate impact without breaking open and spilling the contents. It is also desirable that they be waterproof.
- Although in this case, the pilot sustained only minor injuries, he said later that he would have suffered severe head injuries if he had not been wearing a helmet. It is obviously sound practice for helicopter crews operating in difficult terrain to wear crash helmets as a normal precaution.
- The most significant lesson of all from this whole event, is the importance of always carrying an approved type, serviceable VHF survival beacon. Care should be taken to ensure that its batteries are renewed at frequent intervals and, of course, its method of operation should be understood by all on board the aircraft. This knowledge should include some understanding of how the best results can be obtained from its radiation characteristics.

Several years ago, when a Cherokee was forced down in the Simpson Desert, some difficulty was experienced in homing on its VSB. It was subsequently found that the beacon had been placed on top of a sand dune and that the soil had insufficient conductivity to act as a satisfactory 'ground mat' for the beacon's antenna. Its propagation characteristics suffered accordingly, making it difficult for search aircraft to pin-point the source of the signal.

By contrast, in the case of the helicopter accident, a good 'ground mat' with correspondingly good propagation was achieved by placing the beacon on top of a steel fuel drum. Standing the beacon on the metal wing of an aircraft, or on a space blanket will achieve a similar effect. If all else fails, even wrapping a piece of metal foil around the plastic case of the beacon (keeping free from contact with the antenna) will enhance its performance and thus the chances of rescue.

The captain of the Fokker Friendship which located the position of the crashed helicopter so quickly, also had some comment to offer which could be of value to other pilots who find themselves called upon to undertake a VSB search. In the light of his own experience, the captain suggested that search aircraft should carry a crew of three. After the signal is heard initially, the actual flying of the aircraft is transferred to the co-pilot, while the captain monitors the flying (and the radar if the aircraft is so equipped) assists in listening for the beacon, and calls out the bearings and distances to the third member of the crew. This third crew member logs the times, bearings and distances, monitors the pilots' navigation of the aircraft, and maintains communication with the Rescue Co-ordination Centre.

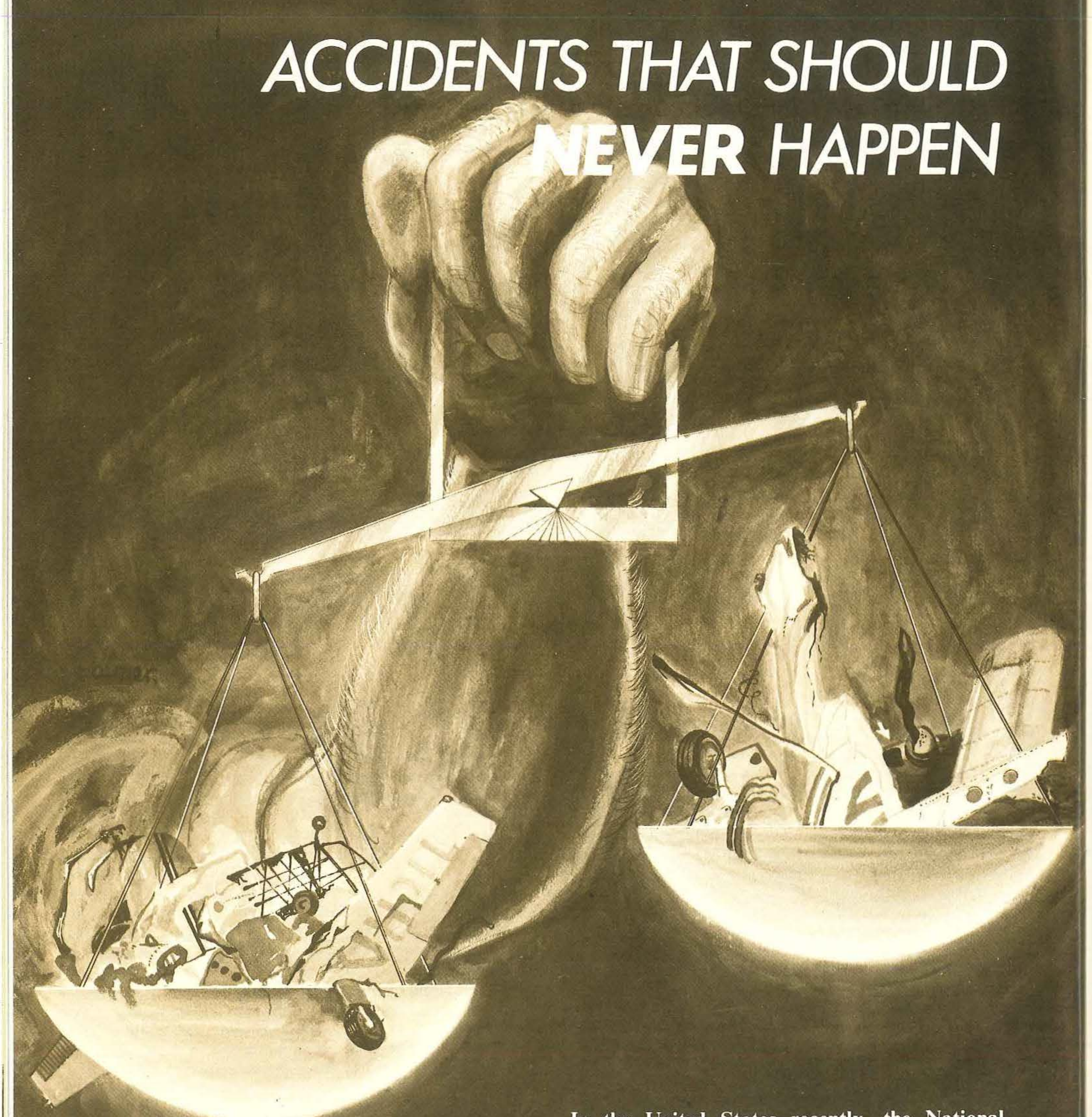
The captain also said that he found ground mapping, using the aircraft's radar, was a very useful aid to positioning the aircraft in this case, as the ADF was subjected to night effect.

Without doubt in this case the success of the whole operation can be attributed to three main factors:

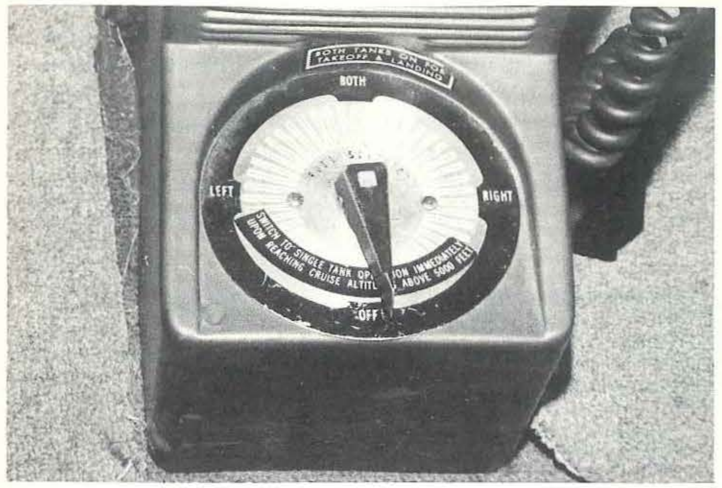
- The fact that the helicopter was carrying a serviceable VSB and the pilot knew how to operate it to the best effect.
- Good teamwork by the entire Search and Rescue organisation.
- The excellent co-operation of all parties taking part in the operation.

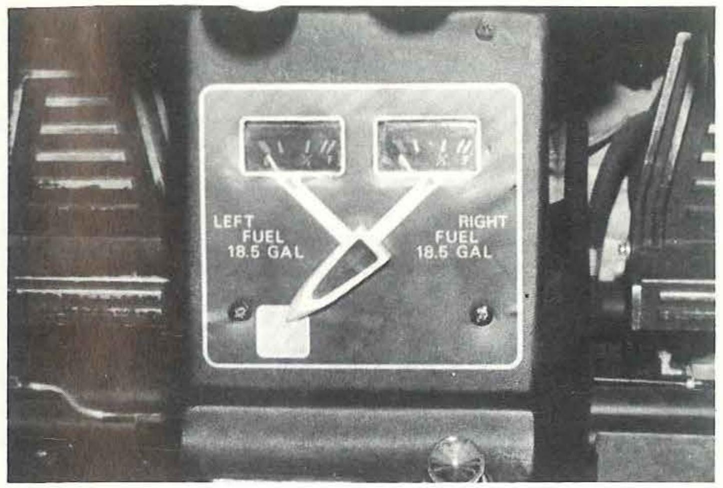
Perhaps the most telling comment of the whole experience was that expressed by the pilot of the helicopter after he and his passenger were rescued: 'I would like to thank all who took part in the search and our subsequent rescue. I've been involved in several searches before, but always looking down! You cannot comprehend the sense of relief when a search aircraft arrives overhead — until it happens to you personally!'

ACCIDENTS THAT SHOULD NEVER HAPPEN



In the United States recently, the National Transportation Safety Board completed a study of general aviation accidents involving fuel starvation. The study covered the years 1970-1972 and followed an earlier one for the years 1965-1969 which had shown that, of 4310 engine power loss accidents during that period, 19.3 per cent had been caused by fuel starvation. The Board's latest study clearly indicates that the problem is a continuing one for, of the 2741 general aviation power loss accidents during the period 1970-1972, 17.9 percent involved fuel starvation.





The study first isolated those aeroplane makes and models most susceptible to fuel starvation accidents, and then compared them with those makes and models least susceptible. In this way, nine makes and models were found to be involved in a higher number of fuel starvation accidents than expected statistically, while three were found to be involved in a lower number than expected. The NTSB study identified these makes and models in the following terms:

'General aviation airplanes involved in a higher number of fuel starvation accidents than expected statistically from 1970-71 were: Callair A-9, Beech 35, Beech 95, Piper PA-12, Piper PA-22, Piper PA-24, Navion A, Bellanca 17-30 and Boeing A-75. General aviation airplanes involved in a lower number of fuel starvation accidents than expected statistically, from 1970-1971, were: Cessna 150, Cessna 172 and Cessna 182.'

The two sets of results were then further analysed. For those aircraft types with a high involvement in fuel starvation accidents, the study found that the most frequently cited causes were:

- Exhaustion of fuel from the tank in use while ample fuel for continued operation remained aboard the aircraft.
- Failure to observe fuel system operational limitations imposed by airworthiness directives.
- Mechanical malfunctions which resulted in fuel starvation.
- Incorrect positioning of the fuel selector valve.
- Contamination of the fuel system.

The first two of these factors accounted for 52 per cent of the accidents in this group and typical problems were as follows:

Exhaustion of fuel from tank in use

(1) Allowing fuel to become exhausted was normal procedure recommended in owner's manuals of some aircraft.

(2) Pilots forgot to switch tanks before exhaustion of fuel from the tank in use.

(3) Engine was not restarted in sufficient time to prevent an accident.

Failure to observe fuel system operational limitations imposed by airworthiness directives

(1) Pilots did not fully comprehend the airworthiness directive requirements (e.g. attempting to take-off using auxiliary tanks or attempting to take-off from a rolling start after a fast turn on to the runway, with the tanks less than full).

(2) They simply ignored them.

In the other group of aircraft, those with a low involvement in fuel starvation accidents, the most frequently cited causes for fuel starvation were:

- Fuel system contamination.
- Instructional engine failure simulation in flight.
- Improper use of power plant controls.
- Incorrect positioning of the fuel selector valve.
- Mechanical malfunction resulting in fuel starvation.

The first three of these causes accounted for 66 percent of the fuel starvation accidents in this group:

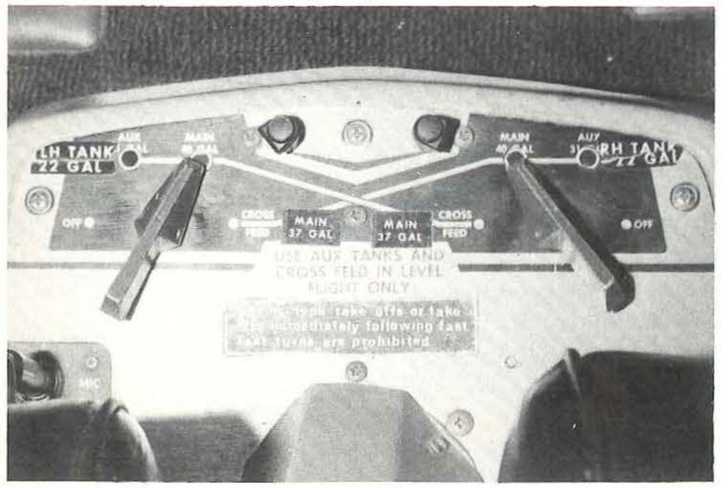
Fuel system contamination

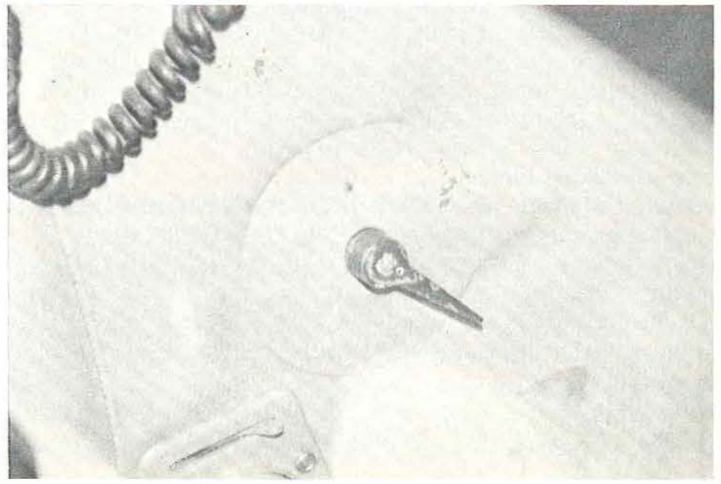
(1) Water was not properly drained from the fuel system.

(2) Foreign objects obstructed fuel tank vent lines.

Instructional engine failure simulation in flight

Instructors attempted a power-loss simulation as a test for student pilots by turning the selector valve 'off', or placing the mixture control in the 'idle cut off' position (three of these simulated emergencies were initiated at less than 1200 feet).





Improper use of power plant controls

Pilots used the mixture control when they intended to apply carburettor heat.

Mechanical malfunctions leading to fuel starvation were a causal factor in both groups, amounting to 11 percent in the first and 13 percent in the second. Generally, the mechanical malfunctions affecting both groups were component failure, such as ruptured flow divider diaphragms, fractured fuel pump gears, sticking needle valves in carburettors, or a broken power plant control cable. Study of these mechanical problems failed to reveal any pattern of chronic failure in either group.

Incorrect positioning of the fuel selector valve was also a causal factor in both groups, 10 percent in the first, and 12 percent in the second. In most instances the pilot was confused as to the mode of valve operation, valve handle design, or fuel selector markings. Many pilots positioned fuel selector valve handles to the 'off' position, or to an empty tank, under the impression they were selecting a tank containing fuel. Difficulties of this sort were common to both groups of aircraft types.

The study also showed that fuel management and fuel system purging procedures as set out in owner's manuals for both aircraft groups often lack detail; that aircraft with fuel systems requiring minimal tank switching were involved in far fewer fuel starvation accidents than aircraft with more complex tank selection systems; and that improper use of an engine control, leading to fuel starvation, appeared to be directly related to insufficient control differentiation.

Pilot-associated factors

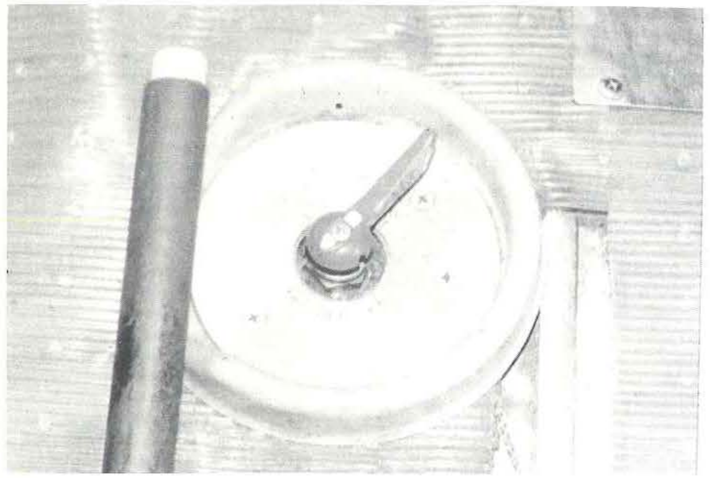
- Instructional techniques for emergency simulation by deliberate fuel starvation at low altitude.
- Lack of knowledge or concern for good fuel management procedures and techniques, including the need for thorough pre-flight fuel system inspection and purging.'

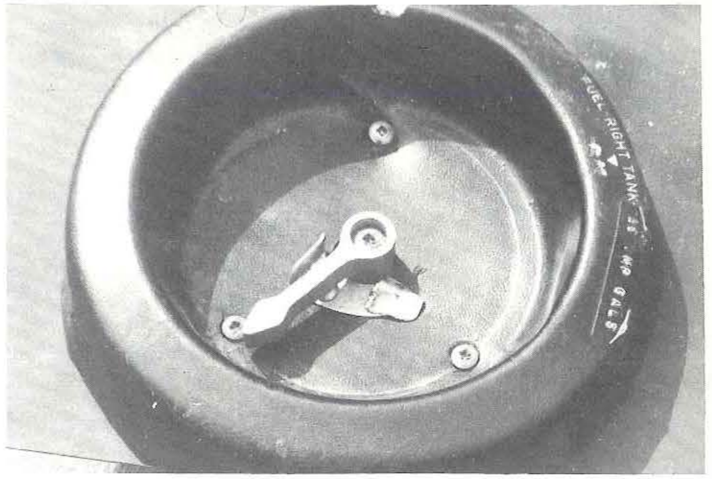
This summary of the National Transportation Safety Board's report on fuel starvation accidents has been included in the Digest in order that Australian pilots might see for themselves the nature of the problem and its causal factors, as indicated statistically from a large number of actual occurrences.

The problem is by no means confined to the United States. In Australia during the same period, 1970-1972, there were no less than 19 accidents and 101 incidents recorded in which fuel starvation was a factor. Our accident and incident figures are not sufficiently large to enable meaningful conclusions to be derived statistically from a similar study, but a brief examination of our records indicates a pattern quite consistent with the results of the United States study.

Is there anything that pilots in Australia can do about the situation?

In respect of the design-associated factors referred to, it is clear that action to remedy the problem needs to be taken at the design and manufacturing stage. Nevertheless, in the course of the U.S. study, it was found that owner's manuals for later model aircraft generally contain much more detailed in-





formation on fuel management and fuel system purging than the manuals for earlier models of the same type. Pilots might therefore gain some advantage from examining later editions of the owner's manual for the type of aircraft they operate.

Taken as a whole, the message to be derived from this study is quite plain: Thorough pre-flight fuel system inspection and draining, complete familiarity with all aspects of power plant control and operation, and proper attention to fuel management, are all absolutely essential to safe flying. The study concluded that:

'Whereas nearly 87 percent of the fuel starvation accidents in this study were attributed to operational problems, these problems are not independent of the factors which influenced or caused them. Therefore, remedial action must be directed at the primary factors which influence fuel system operation. These factors are as follows:

Design-associated factors

- Owner's manuals which often lack detailed information on fuel management and fuel system purging operations.
- Fuel systems which require tank switching in order to manage the fuel supply properly.
- Fuel selector valves with handle design, mode of operation, or tank display which may be conducive to mispositioning.
- Placement of engine controls and similarity of appearance which may be conducive to improper use.

The pilot-associated factors are in quite a different category. Obviously, it is the responsibility and duty of all pilots to ensure that they have the knowledge and capacity for good fuel management procedures and techniques in the type of aircraft they fly. Determination on the part of pilots to measure up to this responsibility could do a great deal towards reducing the incidence of fuel starvation problems resulting from pilot-associated factors. A continuance of the problem at the level experienced so far would indicate that there is still a lack of knowledge or understanding of the subject in certain sections of our general aviation industry. Unfortunately, it might also suggest that some pilots actually need to undergo the alarming and potentially dangerous experience of fuel starvation in flight, before they are prepared to make the effort to improve their knowledge of this vital subject. No doubt such pilots will have their experience — and probably their accident.

Tilt, Roll-Over, Upset!

Originally published in the United States Army Aviation Digest, this article has since been reproduced in the RAAF's flying safety 'Spotlight' circular. Though it deals specifically with the Iroquois helicopter which is unlikely to have the same slope landing limitations as some civil helicopters operating in Australia, the advice it contains is valid for all single rotor helicopters. The article is reprinted in the Aviation Safety Digest for this reason.

The major hazard discussed is a **dynamic** roll-over force — in other words a force which is there because pilots have allowed a **rate** of roll to develop. In military operations under combat conditions, landings and take-offs on slopes obviously have to be conducted in a hurry. But this is not so in civil helicopter operations, where the pilot has time on his side. Safe slope landings and take-offs require co-ordinated and gentle application of all flight controls, with particular care in the use of collective pitch when altering the fuselage attitude laterally about the uphill skid.

How many of us have listened to a fellow pilot give a detailed description of a near-accident experience? These stories always end with a 'Good Show' type manoeuvre that saved the day. They make interesting conversation and lessons can be learned from them.

But how many pilots have been in near-accident situations and can't tell about them because they didn't realise how close they were to having an accident. The number, if it could somehow be computed, would probably astonish everyone.

If you fly single-rotor helicopters, here's an example of a near-accident situation you may have been in without knowing it:

ROLL-OVER CHARACTERISTICS

During normal or slope take-offs with one skid or wheel contacting the ground and with some bank angle or side drift, the helicopter may tilt to a degree of bank where recovery is impossible. Picture yourself about to take-off from sloping terrain. You've just got a little cyclic into the slope to counteract the natural downslope rolling tendency, now add a down hill crosswind, and possibly a laterally offset centre of gravity. At this point you have a significant amount of cyclic displacement into the slope. Now it's time to pull in collective. Holding upslope cyclic, a little collective brings the aircraft to a level horizontal position resting lightly on the upslope skid. You bring in more collective — but rather than rise, the aircraft starts rolling into the slope. You continue to increase collective and the rate of roll increases. Full opposite cyclic response is insufficient to counter the roll — PRANG!

Let's stop there for a minute and analyse the physical forces acting upon the aircraft throughout this lift-off. When the main rotor is tilted laterally, the resultant thrust vector can be broken down into two component vectors. The vertical component is lift-producing and the horizontal is the roll-producing component. The latter component is responsible for dynamic roll-over. Why then was there no apparent cyclic response to counter the rolling moment of the aircraft? Well, when a wheel or skid is in contact with sloping terrain, downslope cyclic response is limited because pendular fuselage rotation is restricted. Simply stated, the fuselage is anchored to the ground and dynamic forces (the lateral component of main rotor thrust, tail rotor thrust, laterally offset centre of gravity and crosswind) act in unison to establish a roll rate of such magnitude that full opposite cyclic cannot overcome the bank angle.

If the bank angle (the angle between the aircraft and the horizon) is allowed to build up past 15 degrees, the helicopter will enter a rolling manoeuvre that cannot be corrected with full cyclic and the helicopter will roll over on its side. In addition, if the acceleration of the rolling motion is rapid, the time available for recovery is significantly reduced. The critical roll-over angle is also reduced by a right-skid-down condition, crosswind, offset lateral centre of gravity and left pedal inputs. In cases where these items are all in their most critical condition and the power available is marginal (high gross weights, high altitudes, hot ambient conditions), hovering on the right skid with thrust (lift) approximately equal to the weight may result in uncontrollable rates for relatively small bank angles.

AVOIDANCE PROCEDURES

When performing manoeuvres with one skid on the ground, care must be taken to keep the aircraft trimmed, especially laterally. For example if a slow take-off is attempted and the tail rotor thrust contribution to rolling moment is not trimmed out with cyclic, the critical recovery angle can be exceeded in less than two seconds.

Control can be maintained if the pilot maintains trim, avoids rapid rolling rates, and keeps the bank angle from getting too large. The pilot must fly the aircraft into the air smoothly, keeping excursions in pitch, roll, and yaw small, and not allowing any untrimmed moments.

When performing normal take-offs and landings on relatively level ground, with one skid on the ground and the thrust (lift) approximately equal to the weight, carefully maintain the aircraft position relative to the ground with the flight controls. If the bank angle increases to an angle of five to eight degrees and full corrective cyclic does not reduce the bank, lower the collective to reduce the unstable rolling moment from the thrust (lift) vector.

When performing slope take-off and landing manoeuvres, follow the published procedures, being careful to keep roll rates small. Slowly raise the downslope skid to bring the aircraft level and then lift off. If landing, land on one skid and slowly lower the downslope skid. If the aircraft rolls to the upslope side (five to eight degrees) reduce collective to correct the bank angle and then start the take-off procedure again.

Collective is much more effective in controlling the rolling motion than lateral cyclic, because it reduces main rotor thrust (lift). A smooth, moderate collective reduction of less than about 40 per cent (at a rate less than full up to full down in two seconds) is adequate to stop the rolling motion with about two degrees bank angle overshoot from where down collective is applied. Care must be taken to not dump collective at too high a rate so as to cause fuselage-rotor blade contact. Additionally, if the helicopter is on a slope and the roll starts to the upslope side, reducing collective too fast creates a high roll rate in the opposite direction. When the downslope skid hits the ground, the dynamics of the motion can cause the helicopter to bounce off the upslope skid and the inertia can cause the aircraft to roll about the downslope skid and over on its side. Do not pull collective suddenly to get airborne as a large and abrupt rolling moment in the opposite direction will result. This moment may be uncontrollable.

CAUTIONS

The following points must also be considered during slope operations.

- Less lateral cyclic control will be available during crosswind operations with the wind coming from the upslope side.
- Slope operations should be avoided with tailwind conditions.
- Less lateral cyclic will be available for left skid-into-slope operations due to the translating tendency of the tail rotor.
- If passengers or additional crew members are picked up or offloaded after landing, the lateral cyclic requirement will change and must be re-evaluated prior to pick-up.
- The interconnecting tanks can cause unbalanced loading laterally due to fuel slosh or gravitational flow of fuel to the downslope tank. This shift of CG varies, depending on fuel load, slope gradient, and length of time the aircraft has been laterally inclined.

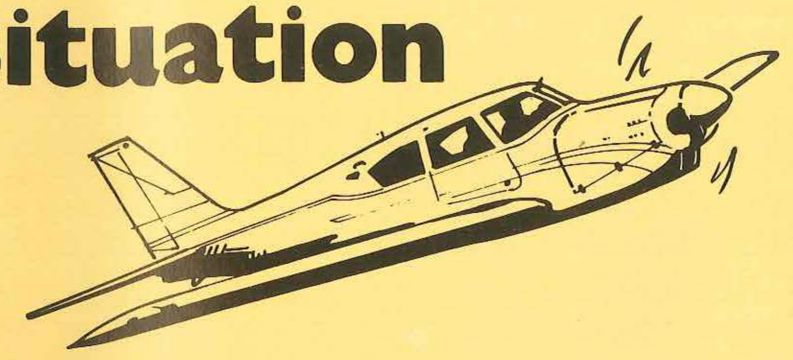
A slope of five to eight degrees can be accommodated safely without encountering mast bumping or reaching lateral cyclic limits. During a slope landing, consideration must be given to the combined effects of slope gradient, wind, load position, and soil stability.

If cyclic limits are reached during slope operations, further lowering of the collective may induce mast bumping. Therefore, if the cyclic control contacts the stop, before the downslope skid is resting firmly on the ground, return to a hover and select a position with a lesser degree of slope.

If during take-off from a slope the upslope skid starts to leave the ground before the downslope skid, smoothly lower the collective and check to see if the downslope skid is stuck or caught on some object. Make the helicopter do what you want it to do before it becomes uncontrollable. Accept nothing less than a vertical ascent.

The dangers of dynamic roll-over are not restricted to slope operations. Several roll-over accidents have occurred on level surfaces. The fact that a skid gets caught or stuck in soft asphalt doesn't necessarily mean that a roll-over is inevitable. The end result depends on the man at the controls and how quickly and accurately he analyses the problem and initiates corrective action.

A Difficult Situation



I have always considered myself a cautious pilot — maybe too cautious. And I have always been puzzled by some inexplicable accidents where the pilot was described as extremely careful, but had somehow got into bad weather and crashed. We've often been told that people don't change and that habits remain with us. But during a trip in America recently I found that what you imagine to be your normal habits can change so radically that, in retrospect, you feel it must have happened to another person.

I had been invited to go along on a flight across the centre of America. I was doing nearly all the flying and the aircraft, a 1958 Comanche, handled pleasantly and was enjoyable to fly. Everything seemed terribly simple — VOR's were everywhere so to navigate all we had to do was simply use our skyways chart, dial up the VOR, wait until we got to it, then dialled up the next one. And so on. Jack, my pilot friend, hadn't brought any low altitude or VOR charts, but it didn't seem important because — well after all, he was experienced even if he hadn't been in these areas before.

I was getting used to mountains up to 12 000 feet, as well as landings in snow, and everything seemed so simple — none of this time-consuming hassle of filling out elaborate flight plans. We just took off when we felt like it! When I told people how we had to fill in plans for flights of more than 80 km and about some of our Regulations, they would tell me I was kidding! Then late one day we took off from Memphis, heading towards Oklahoma City. Another pilot had told us the weather was very turbulent below the cloud, but that at 9 000-10 000 feet it would be clear and we could fly on into the night and still see. So of course off we went — no plan and no weather check.

Half an hour later, with Jack asleep, I was cheerfully looking at the dying sun and wondering where we would stay in Oklahoma City. We were visual on top and the weather was all below us. But suddenly there was a click and the artificial horizon started jumping around madly. Then it settled off the scale. I hadn't looked around the instrument panel that much, so I checked for the back-up horizon — there wasn't one. A little concerned I looked for the turn and bank indicator and found the aeroplane didn't have one of these either! Then I started remembering all the articles in Aviation Safety Digest about what happens to people in clouds at night without instruments. I contacted the weather office and was told the cloud went close to the hills underneath. The turbulence was stated as moderate to severe. Growing more apprehensive I thought I had better keep my torch handy just in case, and then realized I had left it in the luggage compartment. Suddenly all the things I had forgotten seemed to be symptoms of the sort of carelessness that I had always been at pains to avoid before. Now I saw that I had been gradually lulled into thinking this way because, after all, Jack was there. But here we were, in conditions of poor visibility, with no attitude instruments, no forecast, no flight plan, no VSB — not even any water!

Jack woke up and I asked him about the turn and bank indicator. He told me it hadn't been working and had been taken out. It wasn't much consolation. He had flown a lot of hours, but I could see he was concerned. We decided to go back to Memphis and it was then that the awful reality of our situation struck me — we were both good candidates for becoming dead men. There was no moon and it was getting darker. In about half an hour it would be completely black. And if we descended more than about 1000 feet we would be in cloud with a long way to go down.

I wasn't sure whether I was braver than I thought, or it was just that I couldn't comprehend the depth of our predicament, but we just flew on for 35 tense minutes. I wondered how my wife would find out. I kept scanning the cloud below us but it was becoming more and more difficult in the deepening gloom. Then I thought I saw a thin line to the north. I pointed it out to Jack. He said he couldn't see anything there, but I thought better to try it. Another five minutes and there was a hole in the cloud! Jack took over the controls for, apart from the fact that it would be a night landing, the airport was handling jet traffic as well as general aviation and using intersecting runways at the same time — all in turbulent conditions!

But after our experience, even all this seemed terribly simple! After getting on the ground, stretching my tense muscles and generally feeling glad to be still alive, I sat and thought, over a hamburger, how a sequence of events can lead a cautious, low-time pilot like myself into situations that are quite dangerous, and from which the experience of another pilot can offer little protection. I asked Jack later what would have happened if the cloud had gone right down and we'd just had to rely on chasing the compass. His tense reply invited no further comment.

'It would have been a difficult situation'.

Dazzle Difficulties

'The problems, and indeed dangers, of dazzling lights in relation to night driving are well known to all motorists. But how many pilots have ever stopped to consider that a very similar situation can prevail on, or close to the ground when flying at night?

Discussing this subject, an experienced airline captain has written:

'At a number of aerodromes there are many lights that can dazzle pilots during taxi-ing, take-off, approach and landing. Drivers of vehicles on or near tarmac areas do not dip their lights when heading in the direction of oncoming aircraft — and sometimes vehicles are parked facing the aircraft with their lights left full on — instead of being switched to "park". Rotating beacons on vehicles close to an aircraft on the ground can also be a worry.

At Canberra recently, a high intensity beam of light from somewhere in the vicinity of the airport fire service caused concern to the crew of an aircraft approaching to land on runway 17. I have also noticed that vehicles being driven on access roads at Canberra do not dip their lights, even when it must be obvious that an aircraft is approaching to land facing the lights.

Tarmac area lighting, especially on wet nights, can produce a lot of dazzle as a result of reflections. For example, the tarmac lighting for the general aviation area at Sydney Airport, immediately to the right of the threshold of runway 25, can interfere with the night vision of aircraft crews using this runway. And at Adelaide, high-powered flood lights mounted on a tall tower close to the threshold of runway 05 were not until recently shaded to protect approaching aircraft from their glare.

Many pilots themselves do not think to switch off their landing lights when taxi-ing towards another aircraft that is itself taxi-ing or on final approach to land — and this is surely poor airmanship!'

Well, as the old saying puts it ... 'If the cap fits ...'. Obviously a large measure to this whole problem could very easily be remedied by a little care and thought — the answer in fact, lies very much in the hands of people who read the Digest!

Dragging Brakes

From time to time, reports come to hand from various sources, describing situations in which aircraft have failed to accelerate normally during take-off, despite the fact that normal power or thrust has been available. One of the most common reasons for occurrences of this sort is dragging brakes. Just recently, two different and geographically widely separated Australian light aircraft operators have written to describe their own experiences of this conditon producing potentially dangerous situations — during both take-off and landing.

One of the contributors, who operates a PA28-140 from Kununurra, Western Australia, where there is a 1830 metre runway writes: 'I have noticed when releasing the brakes on this aircraft, it is quite easy to place the handbrake lever on the first notch, instead of right home in the "off" position.

If this happens, the aeroplane will move forward and accelerate normally at first, but acceleration becomes slower as take-off speed is approached. It can reach the stage where the aerodynamic drag, plus the drag from the brakes will not allow the aircraft to accelerate past 60 to 65 knots.

Usually, when an acceleration problem is noticed early in the course of a take-off, it is the engine that gets the pilot's attention. For this reason, I would urge that the item "Brakes right off", be included in the take-off check list.'

The other pilot, who operates a single-engined Cessna, describes his experience as follows:

'I was preparing to depart from a bush airstrip which was built on a very smooth hard claypan. The aircraft was checked and all ready to go when I was called away for a brief period. I leaned into the cockpit and pulled the handbrake on lightly in case a little wind came up.

'A few minutes later I returned to the aeroplane and started it. As it warmed and I increased the rpm, it began to move forward and I checked the magnetos and propeller pitch control with the aircraft rolling. It is my custom to do this as I often use strips with a gravel surface which of course can damage the propeller if the run-up is accomplished with the aircraft at rest.

'The take-off was quite normal, as was the subsequent flight of about three hours to my destination, which was also a bush strip covered with green grass. But after touching down and running about 50 yards (46 metres), the aircraft veered violently to starboard and only harsh action with port rudder and brake saved a ground loop that would certainly have been sufficient to heel the aircraft over on its port wing-tip.

'I then found that the handbrake was still on lightly and tests showed that in the position in which it was placed, it was a lot more effective on the starboard wheel than on the port. When I later recounted the experience to several pilot friends they all commented that the handbrake doesn't come into their pre-take-off checks. The same applies to pre-landing checks and I can assure you that it certainly comes into mine now, particularly when I think of what the consequences might be if a similar incident occurred when aircraft are landing on parallel runways such as those at Bankstown.'