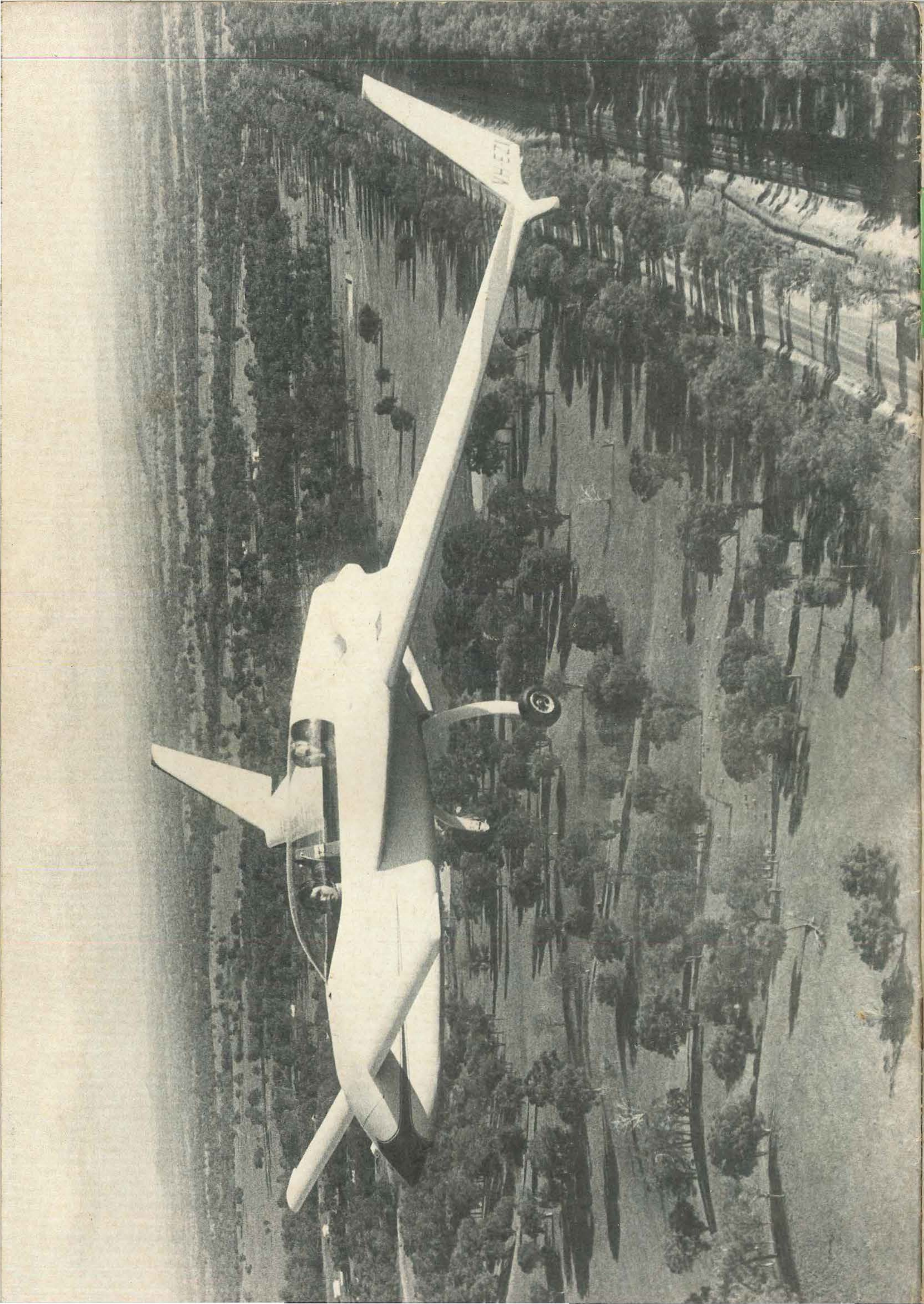

Department of Transport - Australia

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Aviation Safety Digest

Contents

COVER
The first Rutan Vari-Eze to be built in this country (back cover) is an interesting variation of the results of Man's aspirations to imitate the graceful creature on the front page.
— Vari-Eze photograph courtesy of Aircraft.

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

Storm mission

The aim of this article, courtesy of the USAF MAC Flyer, is not to advocate the intentional transition of severe weather patterns. In fact, the opposite is true. This description of a weather reconnaissance mission does, however, contain a message for all aviators.

'There is always a little bit of fear whenever anyone flies into a hurricane . . . keeping you on edge, always alert, always cautious. The most dangerous part of any storm mission is flying into the wall of thunderstorms that rings the centre of a hurricane . . . we try to find the weakest link in the wall cloud to go through, and if we can't, we must penetrate the wall anyway.'

The commander of the 53rd Weather Reconnaissance Squadron (WRS) — also known as the 'Hurricane Hunters' — was talking about his job. Difficult, dangerous, sometimes terrifying — but necessary. And for years, the weather reconnaissance crews of the Aerospace Rescue and Recovery Service have been doing that job successfully — and considering the hazards they face, with an amazingly good safety record.

Why do units like the 53rd pit the relative frailty of man and machine against the overwhelming ferocity of nature's worst weather? The simple answer is the ARRS business: saving lives. Since the 1940s weather reconnaissance units have been tracking tropical storms, providing early warning of their movements, and buying priceless time for those in the path of a storm. The men who do it feel it's well worth the risk.

The techniques of storm reconnaissance have changed considerably since 1943, when Major Joe Duckworth took off with a navigator in the back seat of his T-6, flew into a hurricane off the Texas coast, then came back and did it again with a weather observer on board. New aircraft and equipment have made the job somewhat easier and considerably more productive since those early days, but the challenge is still very much there.

A typical storm mission might be born in the National Hurricane Centre in Miami. From satellite photographs and other weather data, meteorologists locate a possible storm area. The co-ordinates are relayed to the Chief Aerial Reconnaissance Co-ordinator All Hurricanes (CARCAH), where target times are determined. After the details of the mission are laid on, the rest is up to the crew.

As you might expect, a weather reconnaissance crew is a little different. A WC-130 carries two pilots, a navigator, and an engineer — but in place of the loadmasters, there's a weather officer and a dropsonde operator. The weather officer, ensconced in a cubicle with some very specialised and sophisticated equipment, acts as the Mission Director. Although the aircraft commander has overall responsibility for the aircraft and crew, the weather officer is the expert who must assure that the technical requirements of the mission are completed.

On the way to the suspected storm area, the Hercules cruises at normal en-route altitudes. Then, about 160 kilometres from the reported co-ordinates, the aircraft descends to about 10000 feet — the altitude at which the storm will be penetrated. The object now is to penetrate to the eye of the storm — and to do this, the eye must be located.

Since a tropical storm in the northern hemisphere is a closed circle of winds blowing counterclockwise around the centre, flying with the wind at a 90 degree angle from the left will bring the aircraft to the eye. Working together, the weather officer and navigator keep the aircraft on course, moving steadily towards the point of lowest atmospheric pressure. As the aircraft penetrates the spiral bands of rain surrounding the storm the turbulence increases; rain spews against the aluminium skin with almost machine-gun intensity. Then, as the Herc nears the eye wall and the navigator searches for a 'weak' spot on radar, things really begin to get tough. Again, the words of the 53rd squadron commander:

'The whole thing has to be done in a very professional manner and with precise, co-ordinated moves. Throttles and yokes, airspeed, rudders, and even communication with other crew members must be as smooth and efficient as a ballet. Each crew member has to know his or her exact duties — when and how. You never know how the aircraft is going to react to the raging tantrums of a hurricane. You can be pinned in your seat one moment and the very next be hanging on to your seat belt and shoulder straps . . . Most of the time it seems as if someone has turned a dozen fire hoses on you . . . even with earplugs and headsets and the noise of the engines, it sounds as if you are inside a popcorn popper from the noise the rain makes.

All of a sudden, even though the few minutes we took to pass through the wall cloud seem like eternity, it is extremely quiet except for the drone of the engines. It's so quiet, it's almost spooky. After fighting the turbulence, the rain, and the lightning, we've hit the eye of the storm . . . the serenity and beauty within the centre will literally cause your jaw to drop in awe. There you are, in the middle of nature's fiercest storm, with white, almost ice-like clouds surrounding you, towering above you to a crystal-blue hole in a shrouded sky. You can look below at the churning white and emerald green waters that suddenly, almost abruptly, form into a calm, almost rippleless surface at the very centre of the storm. In that one particular moment inside the eye, all of the fear and anxiety momentarily leave your body. But then you realize that you have to fly out into the wall of thunderstorms . . . in a precious few minutes.'

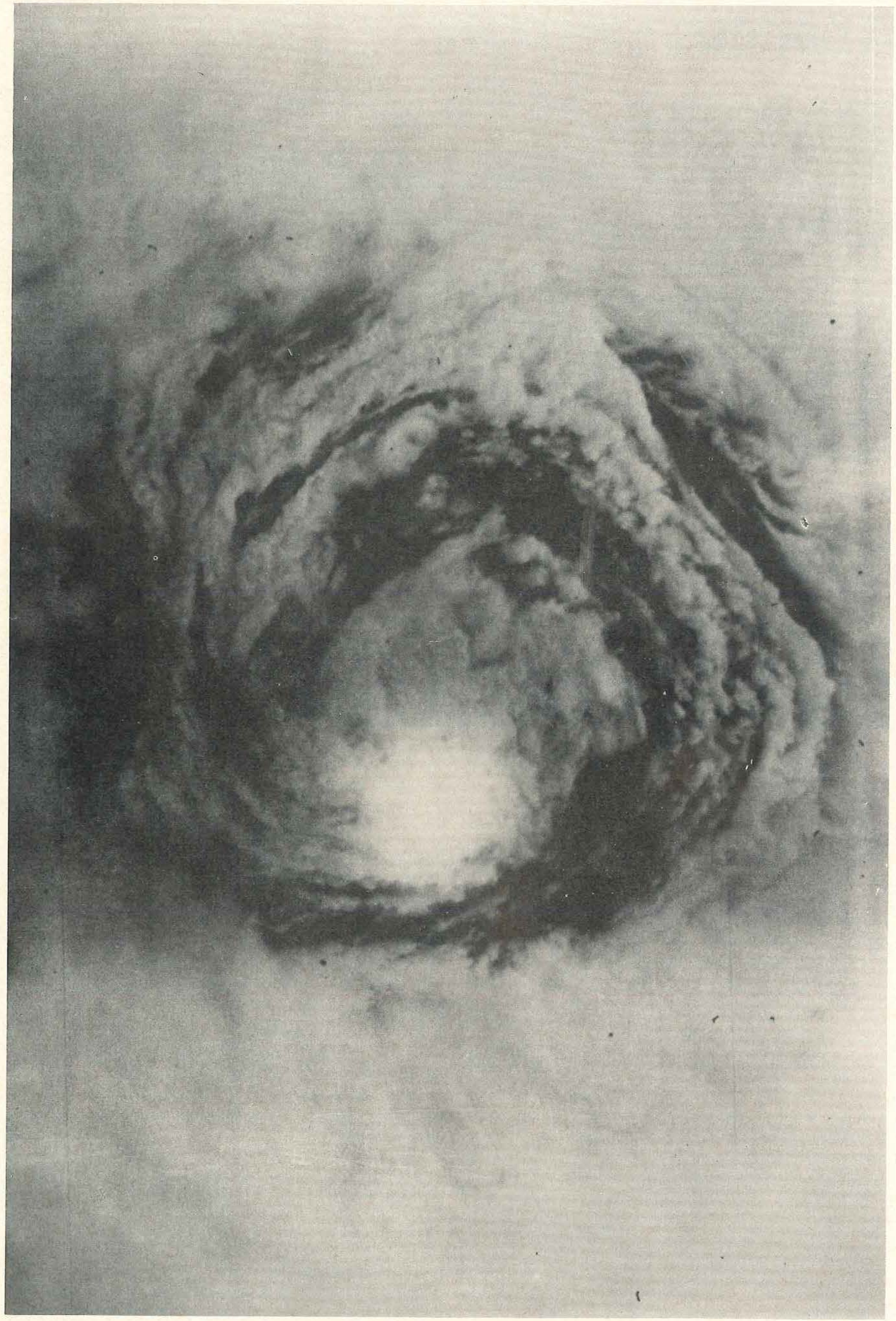
Those precious minutes in the calm of the eye are busy ones for the crew. While the navigator gets a fix on the position of the storm centre, the dropsonde operator releases a small radio transmitter; as the dropsonde falls, slowed and stabilised by a small parachute, it transmits data on atmospheric conditions within the storm. The weather officer then transmits this and other data directly to the National Hurricane Centre by HF radio, where the information will be used to predict the possible future track of the storm.

Now the crew must push the WC-130 back through the eye wall, through the pounding turbulence and slashing rain, until they're clear — and then go back and do it again from a different direction. Four penetrations in six hours, and then back home and into crew rest until the next call comes. And when a storm is on the move, that call may come very soon.

Despite the extreme hazards of this sort of flying, MAC's stormchasers have compiled an enviable safety record. At Keesler AFB, the 53 WRS has been accident-free for 11 years and over 70000 hours of flying time; another Keesler unit, the Air Force Reserve's 920 Weather Reconnaissance Group, has had no accidents in its four-year history. And the 54 WRS at Anderson AFB, Guam, where hurricanes are known as typhoons, has lost only one aircraft in 15 years and more than 120000 hours; the accident was not charged to the squadron.

What's the secret of this kind of performance, and what can the rest of us learn from it? Maybe the 53rd's commander said it best: 'The whole thing has to be done in a very professional manner . . . each crew member has to know his or her exact duties'.

Professionalism, discipline and crew co-ordination. If they can keep you safe in the middle of a storm's violence, they can keep you safe anywhere ●



Opposite: This photograph of the eye of Hurricane Beulah was taken by a U.S. Air Force Weather Service RB-57F aircraft when Beulah was approximately 150 miles off Tampico, Mexico. The photograph was taken from an altitude above 60000 feet. The reconnaissance aircraft was from the 58th Weather Reconnaissance Squadron.

A serious oversight

A party of five people, intending to go on a weekend hunting trip to an island in Bass Strait, organised a charter flight from a Victorian country airfield. The group said they would be taking with them three hunting dogs and a small amount of overnight camping baggage.

The operator arranged for a Senior Commercial pilot who worked for him part time as a flying instructor to make the flight. Before setting out for the airfield, the pilot lodged an IFR category flight plan. It was intended that the aircraft depart at 1300 hours and, if possible, return to base before last light the same day.

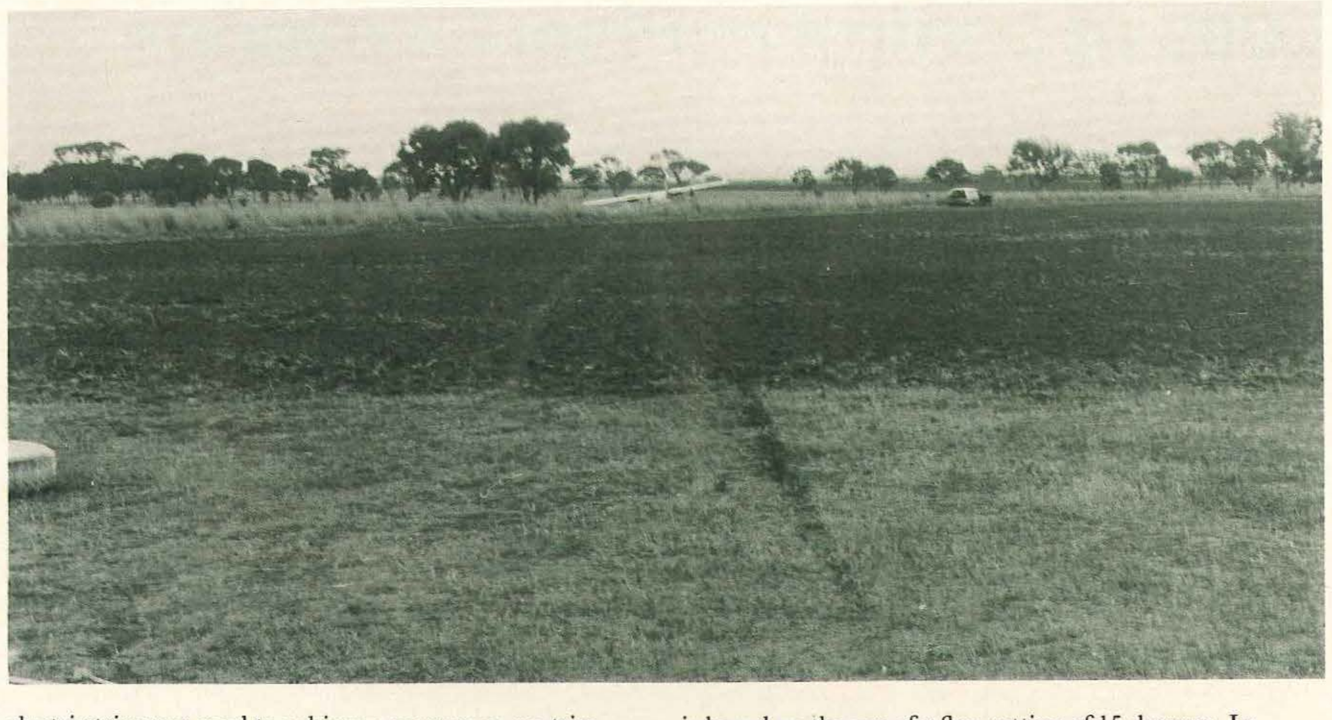
The aircraft to be used, a Partenavia P68B, was on cross hire to another organisation. Arrangements had been made to have it returned for the charter but it became unserviceable. An hour and a half after the planned departure time, the aircraft was eventually returned to the operator's base.

By now the passengers, who had been waiting for the aircraft to return, were anxious to depart. They backed up a utility truck to the aircraft, and the pilot and passengers began transferring baggage from the truck to the aircraft. About 80 kg was loaded in the rear baggage compartment and the remainder of the baggage was placed under the passenger seats. Five shot guns were stowed loosely in the aisle and, when the passengers were seated, the pilot positioned two dogs between the rear seats and a third dog in the aisle between the centre row of seats.

The investigation did not establish the pilot's knowledge of the aircraft's loading limitations beyond all doubt. It is possible that he mis-interpreted the placard which refers to a maximum floor load intensity of '200 lbs per sq. ft.' for the rear locker, as being the maximum permissible weight which could be carried there. In fact the maximum permissible load in the rear locker is 400 kg. If all the freight had been carried in the rear locker the centre of gravity would have been better located in the permissible range rather than near the forward limit — the pilot incorrectly believed he had an aft c.g.

When all was ready, the pilot started the engines and taxied to the holding point. He ran up the engines to about 1800 rpm and carried out a pre-take-off cockpit check but did not select the flaps to the normal take-off setting of 15 degrees. After what seemed to the passengers and another witness to have been a very short time, the pilot taxied the aircraft on to the strip and almost immediately opened both throttles to full power for a rolling take-off.

The aircraft accelerated more slowly than the pilot expected. On reaching the normal rotation speed of 80 knots he attempted to raise the nose using normal back pressure on the control column but found no response. As he was aware of the possibility that the weight of the aircaft might have been in excess of its permissible maximum, and associating this with the slow acceleration, he decided to leave the aircraft on the ground to obtain a higher airspeed. In addition the



electric trim was used to achieve a more nose-up trim setting. At 90 knots he again attempted to rotate the aircraft. The force used was not excessive but more than he thought was necessary to lift the aircraft off the ground. The pilot then decided to abandon the take-off and, closing both throttles, applied braking. As the aircraft approached the end of the grass strip, the pilot realised it would over-run.

The surface of the airfield outside the strip markers had been ploughed and, though the boundary fence lay across the aircraft's path, the pilot decided not to try and turn on the ploughed ground while the aircraft was still travelling at high speed. The aircraft continued straight ahead, broke through the fence, crossed a shallow drainage ditch and came to rest badly damaged about 130 metres beyond the end of the strip and only a few metres from a large tree. Finding the main passenger door jammed, the pilot and the passengers scrambled unhurt from the aircraft through the starboard emergency exit.

The pilot held a Senior Commercial licence and had a total of 1925 hours aeronautical experience. He had flown about 20 hours in the Partenavia and knew that a flap setting of 15 degrees was normal for take-off on this aircraft. He had recently been flying other types of twin-engine aircraft in which take-offs are normally made with the flaps up, and it seems that he had not mentally 'caught up' with the Partenavia. The pilot did not use a printed check list but relied instead on a standard mnemonic to do the pre-take-off checks. The investigation did reveal that the aircraft was overloaded. When the baggage and occupants were weighed, it was found that the loaded weight of the aircraft exceeded the maximum permissible take-off weight by a factor of about 10 per cent. This would certainly have caused the acceleration on take-off to be sluggish and, had the flight gone ahead as planned, would have resulted in an overweight landing at the destination.

Because the aircraft was overloaded and the pilot did not select the flap to 15 degrees for take-off, the aircraft's actual take-off distance in the prevailing conditions would have been longer than that shown on the take-off weight chart in the approved flight manual. This chart is based on the use of a flap setting of 15 degrees. In general, the use of zero flap will increase the required take-off distance because, without flap, the aircraft has a higher stalling speed and, consequently, a higher take-off safety speed. While this usually makes very little difference to the total distance to reach a height of 50 feet, it does quite significantly increase the ground run. Obviously, the amount of increase depends on the difference between the two stalling speeds. In this case, the difference had the effect of increasing the take-off safety speed from 79 knots with 15 degrees of flap to 90 knots without flap.

Calculations showed that, at the maximum permissible take-off weight and in the prevailing conditions at the time of the accident, the basic distance to a height of 50 feet with 15 degrees of flap would have been increased by 147 metres if flap was not used. With the aircraft overloaded, this distance would have been further increased by 109 metres. Thus, the zero flap setting had a significantly greater effect on the aircraft's take-off performance than the overweight situation. As it happened, even when the extra distances are taken into account, the total take-off distance to 50 feet could have been accommodated within the available strip length.

After the accident it was calculated that the centre of gravity of the aircraft had been virtually at the forward limit. Heavier than normal control forces would therefore have been required to rotate.

The development of this accident can be traced through a succession of hasty and ill-considered decisions. The haste of the pilot and passengers to depart, the inadequate loading procedures and the rushed cockpit checks all played their part in bringing the intended flight to a premature conclusion. It was fortunate that the consequences were not more serious.

Haste and slip-shod procedures never pay off in the long run, though at times their use might seem to bring about short term benefits. Any pilot forced to hasten his pre-flight preparations by circumstances outside his control, or as a result of his own actions, should exercise caution and start taking his time from that point onwards ●

Loss of control in Piper Cheyenne

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

Shortly after taking off from Capital City Airport, New Cumberland, Pennsylvania, USA, a Piper PA-31T Cheyenne crashed in a suburban street. The aircraft was destroyed by impact forces and fire, and all occupants — six passengers and two pilots — were killed. Another person on the ground was killed when the blazing wreckage struck a house, demolishing the building and setting it on fire.

The aircraft was to conduct a one day trip, starting from and terminating at Capital City Airport, with intermediate landings.

At 0729 hours local time the pilots were briefed by telephone on the en-route weather conditions and 26 minutes later the co-pilot called again to enquire about the height of the cloud tops. At approximately 0900 hours the six passengers, some carrying cameras and light briefcases, boarded the aircraft.

At 0905 the flight was cleared to taxi to runway 08 and was passed departure instructions which included '. . . maintain runway heading, vectors on course' with a clearance to climb to 6000 feet. This was acknowledged by the crew and, at 0921 hours, after a delay caused by other traffic, the aircraft was cleared for take-off. About one minute later the tower controller instructed the flight to transfer to the departures frequency and, 30 seconds later again, the departures controller advised the aircraft that radar contact had been established. The pilot was instructed to turn the aircraft left on to a heading of 360 degrees. The acknowledgement of this instruction was the last radio transmission received from the aircraft.

According to witnesses who watched the take-off, the aircraft lifted off the runway in a 'flat' attitude. They saw the landing gear retract and the aircraft continue a shallow climb on what seemed to be the runway heading until it disappeared in the haze covering the airport area. Witnesses north and east of the departure end of runway 08 confirmed that the aircraft turned left after take-off, but said it then turned right through about 270 degrees and then left again through about 180 degrees. These witnesses also described a series of shallow climbs and descents during the turns. The last witness to see the aircraft before it crashed said that it appeared to come out of the overcast in a steep descent which continued to the ground. Just before impact the aircraft disappeared from sight behind a house and then he saw the smoke and fire which followed the crash.

Examination of the airframe, power plants and systems revealed no evidence of any malfunction which would have been a factor in the accident.

Both pilots had accumulated over 4000 flying hours, held Airline Transport Pilot Licences and were qualified flying instructors. Although both had considerable experience in the piston-engine version of the Piper PA-31 series aircraft, they were relatively inexperienced in the turbo-prop PA-31T. Both pilots had completed a ground training course on the Cheyenne at the manufacturer's school a month before the accident, which included instruction in PA-31T weight and balance. The pilot in command, who occupied the right-hand pilot seat, had 32 hours total flight time on the PA-31T and had also attended flight check-out training. The pilot in the left-hand seat had less than two hours on the PA-31T and was scheduled to undertake check-out training the following week. No determination could be made as to which pilot was flying the aircraft at the time of the accident.

According to witnesses who saw the crew on the morning of the accident, a PA-31T Weight and Balance Visual Plotter was used to determine the loading of the aircraft before flight. The plotter, which is supplied with the aircraft, is an accepted means to determine this information and consists of an imprinted transparent face behind which is a movable slide. By matching information on the face of the plotter with information on the slide, weight and balance information can be obtained for specific aircraft loading situations.

Instructions for use and general loading recommendations are given on the reverse side of the plotter. Step three of the instructions contains a caution that the proper portion of the plotter must be used for either aft or forward facing third and fourth passenger seats. This aircraft had aft facing third and fourth seats and when other pilots employed by the operator were asked to solve problems using the plotter, they invariably made computation errors involving these seat positions. Loading recommendation number five states: 'When carrying eight occupants, front compartment must be loaded to bring c.g. within 138.00 in. (3505 mm) rearward limit. Fuel must be reduced to keep total weight within 9000 lb limit (4082 kg). Locate heaviest occupants forward'.

According to witnesses who saw the aircraft being loaded, no baggage was placed in the front compartment and no evidence was found at the accident site to indicate that any baggage had been loaded in that compartment. The seat location of only one passenger was positively established. Using actual weights of crew and passengers taken from recent documents the weight and c.g. position of the aircraft was calculated for a conservative loading case in which the heaviest passengers were seated forward in accordance with the prescribed loading instructions. The exact weight of the items carried on board by the passengers was unknown, but assuming that 23 kg of such luggage had been stowed in the rear luggage compartment, the calculations showed that the aircraft was near the maximum take-off weight, and the c.g. would have been 3558 mm aft of the datum point, or 53 mm outside the certificated rear limit. It was learned however, that some of the passengers on board the aircraft usually preferred to sit in certain seats. Their preferences did not place the heaviest passengers forward in the cabin but, rather, resulted in the heaviest loads being towards the back. Under these conditions, and with 23 kg of baggage in the rear compartment, the c.g. would have been 3586 mm aft of the datum, or 81 mm outside the rear limit.

At the time of the accident, the stability and control characteristics of the Cheyenne at c.g. locations so far behind the aft limit were not known. Arrangements were made for a series of flight tests to evaluate the longitudinal flying qualities of the Cheyenne at various c.g. locations. These were conducted using a specially equipped B-26 test aircraft in which the characteristics governing aircraft stability and pilot control forces could be varied electronically. This variable stability system was programmed to simulate the pitch responses and the elevator control forces of the Cheyenne at the speed and engine power used for normal climb.

Three pilots, none of whom had significant experience in the Cheyenne, took part in the evaluation. In addition, the simulation was sampled by a qualified Cheyenne pilot from Piper Aircraft Corporation and engineering pilots from another source. The evaluation pilots were asked to fly a flight profile similar to that on which the accident occurred. Realistic radio clearances and peripheral tasks were included in an attempt to simulate a normal distraction level.

Summarizing the pilot's comments relative to the evaluation flight at the c.g. position considered to have existed at the time of the accident, namely 81 mm aft of the rear limit, the NTSB Report states:

'Characteristics

- c.g. aft of stick-fixed and stick-free neutral points: position and force gradients with changes in speed from trim airspeed are unstable
- two seconds to double the amplitude of each divergency with stick fixed
- c.g. at stick-free manoeuvre point: stick force per 'g' is zero.

All the pilots commented that the aircraft was unstable and oversensitive in pitch. The aircraft was difficult to trim, tended to wander off in pitch attitude and airspeed with any pilot inattention and corrections were difficult to make. This c.g. location was considered unsafe for normal operations by all the evaluation pilots. Performance was poor with large, uncomfortable excursions from the desired pitch attitude and speed. Excursions of $\pm 3/4\, g$ in normal acceleration and -20 kn up to $+40$ kn of airspeed deviations from trim airspeed were common.

At this c.g., the aircraft is essentially at the stick-free manoeuvre point where the aircraft has neutral manoeuvring stability. At trim speed, the stick force per g in accelerated flight is zero. Pilot control feel in manoeuvres is typically poor and is reversed for manoeuvres off the trim speed. One pilot commented that in IFR weather conditions he "could imagine losing control of the aircraft".'

In respect of the accident aircraft, the flight tests indicated that it was both statically and dynamically unstable. A stable aircraft, when disturbed from its trimmed flight attitude, will tend to return to its original attitude without any corrective action by the pilot. An unstable aircraft with an extreme aft c.g. will, on the other hand, continue to diverge in the direction of the initial disturbance until the pilot reacts to stop the motion. The stick forces which the pilot would have experienced in his attempt to control the aircraft would have differed from the normal in such a manner that his ability to control the aircraft would have been impaired. While pilot inputs to initiate a manoeuvre or to change airspeed would have been normal, stick force-airspeed gradients would have been reversed; that is, to stabilize the aircraft at a reduced airspeed would probably have required a push force instead of the normal pull force, and to stabilize it at an increased airspeed would have probably required a pull force instead of the normal push force. Moreover, the manoeuvring stick force-load factor gradient would have been essentially zero, which would have resulted in poor aircraft control 'feel'. As a result, over-control in pitch to stop any divergence would have probably occurred and the resulting pilot-induced oscillation could have eventually caused complete loss of control.

Although the pilot, under relatively favourable conditions, could have adjusted his control inputs to maintain a steady flight path, the attention and workload required to do so might have been compromised by the performance of other necessary flight duties in an IFR environment. Any slight inattention to controlling the aircraft would have quickly precipitated a divergence, which would have increased rapidly as airspeed reduced. The flight tests showed that with a c.g. position 81 mm aft of the permissible rear limit, the time taken for the amplitude of the pitch divergence to double was about two seconds.

In this accident, since the manoeuvring stick force gradient was zero, overcontrol of the aircraft or a pilot-induced oscillation would have resulted from a divergence since the pilot would have found it difficult to avoid unwanted inputs. Consequently, the probability of recovery after the divergence was recognized would have been problematical. The pilot probably was not able to trim the aircraft in the short time following take-off. He may have merely modulated the divergence of the aircraft for a brief time before matters became uncontrollable, by periodically pushing and pulling on the control wheel in an attempt to set pitch attitude.

On this take-off, the crew probably ignored the misloading of their aircraft. Though they may have been aware that certain degraded flight characteristics should be expected with an extreme aft c.g., the sudden departure from normal aircraft performance would have, in this case, caught them unawares. The extra workload imposed by the instrument meteorological conditions with no visible horizon, the limited experience of both pilots in this aircraft, and a turn shortly after take-off would have added to the confusion caused by the aircraft's erratic deviations from expected standard climb characteristics. The Safety Board concluded that, because of the confusion brought about by these conditions, the pilots allowed the aircraft to diverge from the normal departure profile and then overcontrolled the aircraft into an unsafe condition during recovery attempts. This overcontrol then increased in amplitude until the aircraft crashed.

The National Transportation Safety Board determined that the probable cause of the accident was the flight crew's failure to ensure that the aircraft was loaded properly and that its centre of gravity was within certificated limits. As a result, the aircraft's control characteristics were degraded significantly by a centre of gravity position well aft of the certificated limits. This imbalance led to the pilot's inability to control a longitudinally unstable aircraft during a climbing turn in instrument meteorological conditions ●

Food poisoning

The pilot of a Cessna 206 was returning in the late afternoon from a round robin flight with a medical team in the Northern Territory. Approaching 50 km from destination he started to feel bilious and actually began vomiting while in the circuit. This lasted for a minute or two, the front seat passenger giving what assistance he could. The pilot then made a normal landing.

The day's flying had commenced at 0630 hours and during the morning the aircraft had spent a considerable time on the ground at various locations. Ground temperature was approximately 30°C and at lunchtime the pilot had noticed that the food which he had carried in a plastic container in the cockpit was quite warm. The meal consisted of cold meat and vegetables left over from a baked dinner the previous night.

After the incident, the doctor in the medical team checked the pilot's pulse, heart and blood pressure but could find nothing wrong. The doctor concluded that the illness was caused by toxic contamination of the food the pilot had eaten earlier in the day.

* * *

The pilot of a PA31 departed from Adelaide for Melbourne at 2015 hours. At 2040 hours he advised over Lake Albert that he felt ill and was returning to Adelaide where a normal landing was made.

The pilot said that on the evening prior to the flight he had eaten at a restaurant with friends. He woke up the following morning feeling a little queasy and the feeling persisted all day. He ate lunch and dinner and felt neither worse nor better when he took off. However in flight he became suddenly and violently ill and broke out in a cold sweat. The pilot stated that had this condition continued he doubted his ability to have landed safely, but fortunately the attack had passed by the time he returned to Adelaide.

Several of the people who had eaten with the pilot the previous evening also experienced varying degrees of illness over the next three days. So far as the pilot could remember they had all started their meal with oysters. Remember the oyster scare?

* * *

There are a number of different organisms which can cause food poisoning and the time of onset of symptoms after eating contaminated food can range from two to 48 hours depending on the particular organism responsible.

The most common type of food poisoning is due to the *staphylococcus* bacillus, which produces an enterotoxin which is extremely distressful to the human intestine. Although fatalities are rare, incapacitation may cause a pilot to lose control of his aircraft.

Foods which are most subject to *staphylococcus* bacteria infestation are custards, cream soups and sauces, cream pastries, cake fillings, and mayonnaise. In summertime it is frequently not possible to keep these foods under proper refrigeration at all times. A few hours of exposure at room temperatures or higher is sufficient to permit a toxic condition to develop. Symptoms usually appear from two to six hours after eating. These can occur in various combinations of nausea, faintness, vomiting, headache, abdominal cramps and diarrhoea. The victim may suffer severe collapse and prostration, although recovery, when it begins, is usually quite rapid.

Salmonella bacteria, another common cause of food poisoning, prefer the leaner foods, such as improperly cooked chicken, turkey, salmon, eggs, ham, etc. Unless meat is thoroughly cooked *salmonella* may be only temporarily weakened by exposure to the heat, and may regain their vigor and proliferate in a warm, moist environment such as under a waterproof wrapper in a warm cockpit. Symptoms, similar to those associated with *staphylococcus*, are slower to appear; the first signs of distress may occur 12 to 24 hours after eating contaminated meat.

A third form of bacterial food poisoning, botulism, is rarely encountered, which is all to the good, since mortality may be as high as 65 percent. Botulism occurs mainly from eating improperly canned or preserved non-acid foods. Bulged or swollen cans, or the appearance of spoilage in glass containers, discoloration or pronounced odour are danger signals. Such food containers should be discarded. 'Staph' and *salmonella*, incidentally, give no warning whatever as regards taste or appearance.

Victims of suspected food poisoning need professional medical attention; in severe cases acid imbalance, prostration or shock may take place. Complete recovery may take several days; flying during the recovery period is not recommended. The anti-spasmodics and sedatives used in controlling the ailment could seriously interfere with pilot performance.

The pilot operating in isolated areas during the summer months is particularly vulnerable to food poisoning. Hot humid days provide the ideal climate for rapid growth of bacteria and the pilot may be forced to eat at a remote stopover point where he has no knowledge of how the food was prepared or under what conditions it was stored.

The introduction of bacteria to food does not itself represent a hazard. The danger arises when contaminated food is subjected to improper handling, thus allowing the bacteria present to proliferate. In general, bacteria will multiply at temperatures between 10°C and 60°C, so that the period of time during which risky foods are held in this temperature range should be minimised. Many cases of food poisoning outbreaks have been recorded where the food responsible has been kept warm or reheated, providing excellent growth conditions for the bacteria already present.

To reduce the threat of food poisoning, the pilot should therefore endeavour to eat only fresh foods, and if consuming hot meals, to eat only those dishes which have been thoroughly cooked at a sufficiently high temperature just prior to consumption. If this is not possible and it is necessary to eat reheated dishes, these should have been initially well cooked and then immediately transferred to a refrigerator, so that the minimum time is spent in the danger temperature range of 10°C to 60°C.

Where possible, the airline precautionary measure of never serving both pilots the same meal could well be adopted in general aviation●

Wake turbulence from heavy helicopters

In a north-westerly wind of five to ten knots, a Sikorsky S-61N helicopter had made an approach to runway 35 and subsequently had moved off to the west side of the runway to allow a Chipmunk to land. The helicopter was hovering at an estimated height of 10-20 feet about 100 metres from the runway edge when the Chipmunk, 100 feet above the runway and over the centreline, experienced turbulence of sufficient severity to make control difficult. It was concluded that the Chipmunk was affected by the helicopter's downwash being deflected obliquely from the surface by the wind.

We are all aware of the hazards created by fixed-wing aircraft wake turbulence and the separation standards that have been recommended. When we think of helicopters however, normally we think only of the rotor wash hazard created by a hovering helicopter. But during forward flight, the rotor wash also creates wake turbulence and there have been several cases overseas where helicopter wake turbulence has caused an accident.

In one case, a light aeroplane turned on to final approach about a kilometre behind a large helicopter. As the light aeroplane neared the runway, it pitched down abruptly and crashed short of the runway. The pilot claimed that he had been caught in the landing helicopter's wake turbulence.

Several years ago the US Army made a study to determine helicopter rotor wash velocities. They found that rotor wash velocity was 29 knots or 15 metres per second for medium helicopters, 51 knots or 26 metres per second for large size helicopters, and for very large helicopters the velocity was as high as 98 knots or 50 metres per second. These velocities are present at less than 30 metres from a low hovering aircraft and, naturally, will be greatly reduced further away from the aircraft and in forward flight. The wake turbulence that results from such velocities should not pose a problem for large fixed-wing aircraft but for light aeroplanes and small helicopters it can be a serious hazard.

Generally, an approach should never be flown below a preceding helicopter's approach path because of the downward deflection of the wake turbulence/downwash. The displacement effect of any wind on the turbulent wake should also be considered.

One overseas Aviation Safety Committee has recommended one minute separation between a heavy helicopter and any following landing aircraft, but we believe that this may not be adequate to cover all circumstances. Until more definitive information is available and appropriate standards are developed, it is recommended that extreme care be taken in making approaches behind helicopters or when crossing helicopter approach paths.

General aviation pilots operating regularly in northern Queensland and north western Australia will be aware that large helicopters such as Wessex and S61's are also flying in these areas. It should be noted however, that these aircraft occasionally fly to the capital cities and could present a hazard at primary and secondary aerodromes. Additional large helicopters such as the Chinook, Sea King and Wessex are also operated by the military and could be encountered at any locality.

Pilots of light aircraft and small helicopters, and air traffic controllers, should be aware of the potential hazard ●

(Adapted from an article in the Flight Safety Bulletin.)

Birdstrikes continue

In Issue 102 of the Digest we announced a campaign aimed at reducing the occurrence of birdstrikes. The Department is prepared to extend throughout the country the kind of bird control techniques which have been used successfully at Sydney Airport. As a first stage in this project, information is required from a local level on the species of birds which are causing trouble and their behaviour patterns. Pilots are therefore invited to report immediately all birdstrikes. Special forms have been printed for this purpose and are available at flight briefing offices.

In order to illustrate the extent of the problem presented to aviation by the bird population, we have decided to include in this issue a number of recent accounts of birdstrikes. It can be seen that light aircraft are as vulnerable as RPT jets.

On final approach to Kowanyama, Qld, the captain of a DC3 observed a number of hawks over the end of the runway, apparently a common sight on a warm autumn morning. As the aircraft touched down, a number of birds took flight and one collided with the right hand windscreen which shattered, showering the pilots with glass slivers. The landing was completed normally and one of the pilots received medical aid for a minor cut above his eye.

On descent below 5000 feet, near Wonthaggi, Victoria, the left wing of a Beech 36 struck a large, unidentified bird. Aircraft control was not affected and the flight was terminated at Moorabbin without further incident. The leading edge of the left wing was buckled near the wing root.

While mustering along the Nullagine river in Western Australia, the pilot of a Cessna 172 was assisting some stockmen to move cattle out of the river when the aircraft's left wing hit a duck. Damage was confined to a dented leading edge, about half a metre from the wing root.

A Beech 36 aircraft arrived in the circuit area of a Queensland station at about 1815 EST on Boxing Day. The pilot saw some horses on the strip and commenced a low pass to move them and to alert the station staff. After passing the horses at about 60 feet AGL and 130 knots the pilot looked ahead and saw a flock of geese. Avoiding action was not possible and as the aircraft passed through the flock, the pilot heard two loud impacts from the tail section. Control of the aircraft checked out normally, and a circuit and landing were made without further incident.

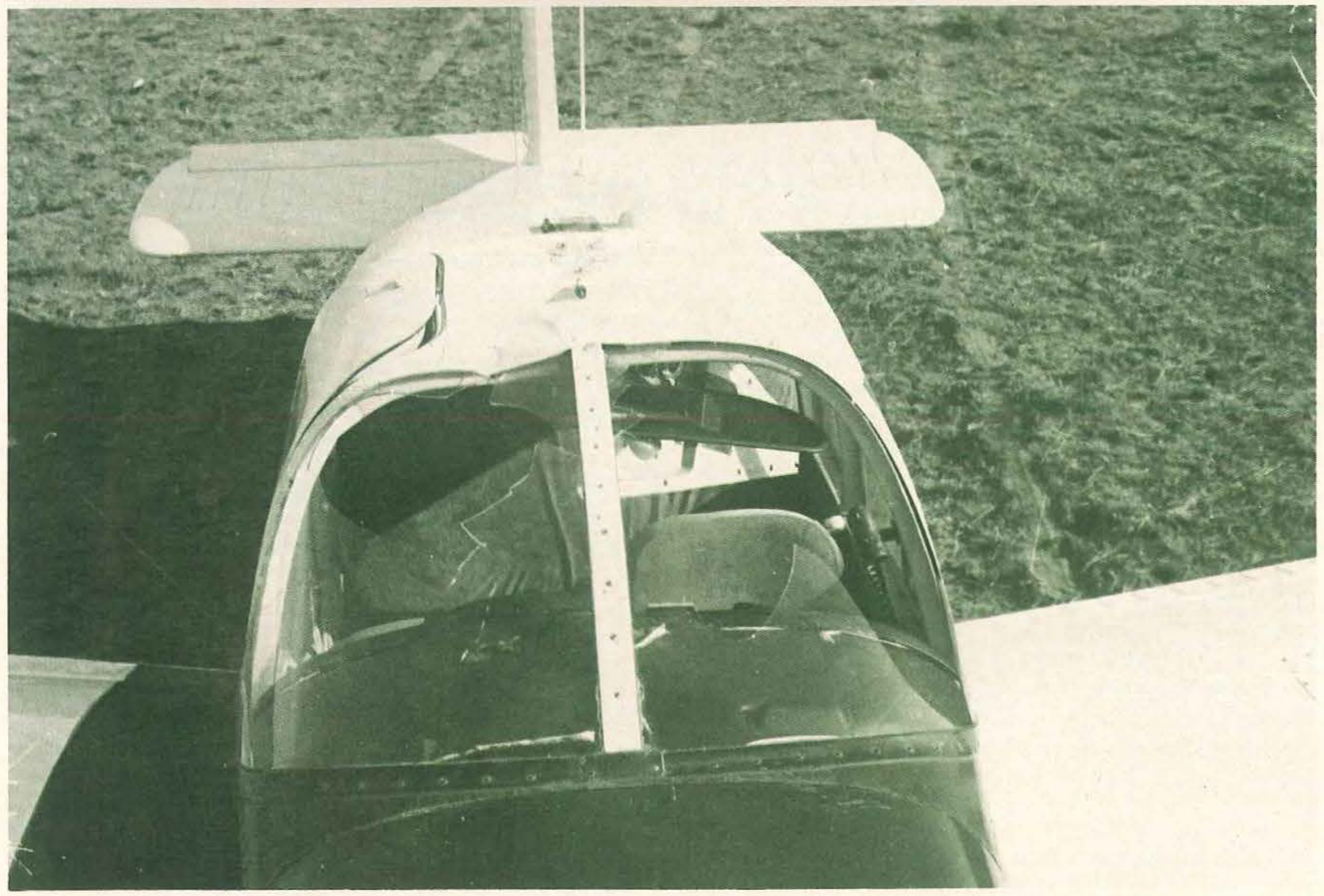
After landing, the pilot found part of a bird embedded in the fin with buckling back as far as the spar. The right hand stabiliser was similarly buckled.

Climbing through 6000 feet after departing Port Hedland, W.A., a Fokker F28 struck an unindentified bird. After the next scheduled landing the crew found damage near the left wing root. The aircraft was ferried to Perth for repair.

A Boeing 747 was landing at Darwin in the afternoon when a number of black kites rose from the runway in front of the aircraft. After shutting down, the crew found that a right inboard wing flap was damaged, requiring skin repairs. Several dead birds were removed from the runway.

While cruising at 2000 feet en-route Mitchell River mission to Edward River mission in Queensland, a Beech Queenair struck a hawk which was apparently riding a thermal and ascending in front of the aircraft. The right wing leading edge was dented and the aircraft returned to its departure point.

It was early afternoon in late summer when a Learjet 24D was taking off from Essendon airport with only two pilots on board. The aircraft had reached about 110 knots with a Vr of 130 knots, when the captain saw a white 'flash', the co-pilot called out 'a bird', there was a 'thump' and the left engine stopped. The aircraft veered left but the pilot corrected with heavy rudder and abandoned the take-off, stopping the aircraft on the runway using heavy braking and the drag chute. After shutdown the left engine was found to have the first two stages of the compressor damaged (see photo). The bird was identified as a banded plover.



The pilot of a PA-28-180 had flight planned from Mildura to Broken Hill, via Menindee, below 5000 feet, so that his passengers could photograph the area. Approaching Menindee, he descended to 1000 feet altitude. After a short while as he was preparing to climb the aircraft back to 3000 feet, the pilot noticed some large birds ahead. He delayed the climb to avoid them but one of the birds dived towards the aircraft. The pilot tried to avoid the bird by diving also, but they collided. The bird hit the top of the windscreen and the cabin roof, pieces of broken perspex entered the aircraft and the structure supporting the trim controls was distorted. After checking that there were no control difficulties, the pilot landed at a nearby station strip. It was concluded that the bird was probably a pelican.

A Piper Pawnee agricultural aircraft was engaged in spraying a crop of linseed at a western Victorian property. During the pull up at the end of a spraying run, the pilot saw two large eagles approaching from the port bow. They appeared to be attacking the aircraft but the pilot was committed to the procedure turn because of some trees and could not take avoiding action. The left wing of the aircraft struck the leading eagle and was extensively damaged. The pilot dumped the remaining spray and immediately landed at the nearby agricultural strip. The eagle (see photos) was fatally injured in the collision!

A Piper PA-28-140 was taking off from runway 23 at Walgett on a May afternoon and just after becoming airborne it flew into a flock of galahs. There were numerous birdstrikes but operations appeared to be normal until the aircraft crossed the upwind end of the runway when the engine lost power. A forced landing was made straight ahead and the aircraft finished up substantially damaged on a roadway outside the aerodrome boundary. Fortunately neither of the pilots was injured.

Following the accident 22 dead galahs were found on the runway!

Subsequent investigation revealed that the fuel filter drain had suffered a strike and the bowl became loose allowing fuel to leak out. During the investigation the engine ran normally after the filter bowl had been tightened.

Your continued co-operation in reporting attacks by these feathered 'kamikazes' is imperative if the problem is to be overcome.

Any suggestions for improvements in the reporting system itself would be welcome •

Boeing 747 takes off from the wrong runway

At Australian airports, air traffic control is required to select preferred runways in consideration of the meteorological conditions and local requirements including noise abatement. At all times, however, the ultimate decision as to the suitability of the nominated runway with regard to length, crosswind or any other safety reason, rests with the pilot-in-command.

It was a warm, summer afternoon in Melbourne when the jumbo jet arrived from Sydney. The next sector was direct to Singapore and, following a crew change, 381 passengers boarded the aircraft.

Scheduled departure time was 1500 hours Eastern Summer Time (ESuT) and at 1507 hours the aircraft was pushed back from its parking bay at the international terminal. Air traffic control cleared the aircraft to depart from runway 27, climbing to flight level 310.

At 1521 hours the aircraft was given clearance for an immediate take-off from runway 27 and it commenced rolling. All appeared normal until approaching decision speed when it became obvious to the crew, from the limited runway remaining, that the aircraft was using a runway of inadequate length for this take-off.

The captain took over the controls from the first officer and initiated rotation. The heavily laden aircraft lifted off about 10 knots below the target rotation speed but not before several of the 16 main wheels had rolled through the grass for nearly 50 metres beyond the end of the sealed stopway.

Witnesses to the take-off, some of them close to the western end of the runway, reported that rotation did not begin until nearing the upwind threshold. Shortly after the 747 did rotate there were clouds of dust and grass cuttings blown up by jet blast. The gable markers at the end of the flight strip were blown flat and several hay bales in the over-run area were destroyed.

Subsequent inspection of the area revealed tyre marks visible over the threshold markings and sealed stopway, continuing into gouges up to 46 metres long and three centimetres deep in the over-run. There was no evidence to suggest that the aircraft sustained damage.

ATC advised the crew of the incident and, as there were no in-flight abnormalities, the flight continued to Singapore. After landing, an examination of the aircraft confirmed that it had not sustained any damage.

How did this situation arise?

Meteorological information

At the time of the occurrence the Automatic Terminal Information Service (ATIS) was reporting the following conditions, '. . . information Quebec, wind 290 degrees, 15 to 25 knots, QNH 1004, temperature 28, cloud one okta at four thousand'. Immediately following the incident the actual wind, as indicated by the anemometer in the tower, was recorded as 290 degrees 18 knots. This gave headwind components of + 16 knots for runway 27 and + 11 knots for runway 34.

Aircraft loading

The maximum take-off weight (MTOW) with regard to structural limitations was 351 533 kg. This aircraft was fitted with a fifth engine ferry pod attached to the underside of the left wing between the inboard engine and the fuselage, which reduced the MTOW to 342 462 kg, as well as imposing a take-off performance penalty.

There were 126 000 kg of fuel and 381 passengers on board bringing the calculated brakes release weight (BRW) to 336 887 kg. Take-off speeds computed for the flight were V_1 (decision speed) 161 knots, Vr (rotation speed) 171 knots and V_2 (take-off safety speed) 177 knots.

Airport details

The lengths of runways 09/27 and 16/34 at Melbourne were 2286 and 3657 metres respectively. There were 60 metre sealed stopways at the ends of the runways and all surfaces were dry and in good condition.

Beyond the western end of the runway 27 stopway there were several hundred metres of firm, level ground covered in recently mown grass and baled hay. Past the airport boundary fence the terrain fell away sharply into a rocky gorge.

Flight recorder

Analysis of the Digital Flight Data Recorder information indicated that rotation commenced 112 metres from the western end of runway 27. The computed Vr speed was achieved when the aircraft had been airborne for about 350 metres. It was calculated that Vr could not have been achieved in the take-off run available.

Take-off performance

From the specific performance charts in the aircraft flight manual the following weights were obtained for the given conditions—

Runway 27
- Temperature 28°C
- Wind component + 16 knots
- Flap 20 degrees (field length limited)
- Fifth engine ferry pod decrement − 5830 kg.
- *Maximum BRW 305 650 kg.*

Runway 34
- Temperature 28°C
- Wind component + 11 knots
- Flap 10 degrees (field length limited)
- Fifth engine ferry pod decrement − 8910 kg.
- *Maximum BRW 336 610 kg.*

As the load sheet brakes release weight was 336 887 kg, the aircraft was more than 31 000 kg above the maximum BRW for runway 27 and also slightly above the BRW for take-off from the most suitable runway.

Flight crew information

All flight crew members held appropriate licences endorsed for Boeing 747 aircraft and were experienced on the type.

Take-off documentation

The take-off data card, which was used to display the appropriate information to the pilots during the take-off phase, was of the type provided by the aircraft manufacturer. There was no provision on the card to annotate the runway or meteorological conditions for which the take-off performance was calculated. For this take off, the data was extracted from the Quick Reference Handbook, not the specific take-off charts in the Flight Manual in accordance with company procedures. Reference to the appropriate flight manual charts should have alerted the crew that no runway would be suitable for take-off at the load sheet BRW.

Selection of the take-off direction

Air traffic control aspects

At the time of this incident the average crosswind on runway 34 was 16 knots with gusts to 20 knots. This runway was therefore unsuitable for ATC to nominate as the preferred runway. AIP TMA noise abatement procedures, Melbourne, states that runway 27 and 34 have equal first preference with runway 16 as second preference. The selection of runway 27 as the preferred runway was therefore in accordance with the appropriate instructions.

AIP RAC/OPS states that ATC will nominate a runway which appears to be most suitable but adds that 'the pilot-in-command shall ensure that there is sufficient length of run . . .'. If the nominated runway is not suitable it follows that the pilot shall advise ATC and request a more suitable runway.

Flight crew aspects

It is normal practice for the flight engineer to complete the take-off data card after the first officer obtains the ATIS information. This apparently occurred in this instance and the captain was informed that runway 27 was in use. Neither pilot however, verified that at the load sheet BRW, the nominated runway was acceptable. If reference had been made to the specific take-off charts in the flight manual then it would have become obvious that runway 27 was of inadequate length for this take-off.

Why did this incident happen?

Probably the combination of a number of factors, each of limited significance in itself. The crew could not offer any positive reason but it was suggested that the late arrival of the aircraft on the previous sector and a minor problem with the flight plan could have contributed. The repeated reference by ATC to the nominated runway certainly was of significance and the crew may have been 'conditioned' into acceptance.

Could it have been avoided?

That the aircraft was on a direct flight to Singapore with a nearly full passenger load and the aerodrome temperature at ISA + 13 should have alerted the crew to the likelihood of a critical take-off. Recognition of the situation should then have lead them to ensuring the adequacy of the nominated runway.

Remember, if you have any concern about using the runway nominated by ATC, and your concern could be alleviated by the use of another runway, advise the tower of your requirements ●

From the incident files

Digest 100 contained a detailed report concerning the loss of control of a Fokker Friendship aircraft when the gust lock was engaged in flight. The investigation established that before take-off the flight manual had been incorrectly stowed. In flight, when the first officer moved his seat, the flight manual was pushed back causing the gust lock to engage. The article concluded by suggesting that 'the likelihood of such a sequence of events is so rare . . .', however, since that article appeared a very similar incident was disclosed via the Incident Reporting System.

Briefly, it was reported that an F27 was on final approach to a NSW aerodrome with full flap selected when, for no apparent reason, the flap retracted to the UP position. A missed approach was conducted and investigation by the flight crew revealed that the flap 'emergency up' selector switch was in the UP position. It transpired that the first officer, while adjusting his seat, had caused a publication resting on the top of his navigation bag to operate the switch.

Fortunately, the outcome on this occasion was much less dramatic than the occurrence involving the gust lock. In other circumstances, such as on late final approach, the results could have been disastrous. The incident prompted the circulation to the industry of a reminder on the essentials of good housekeeping in aircraft cockpits. The old adage relating cleanliness and godliness can be equally important to a pilot in an aircraft as to a surgeon in a hospital. The final effect, if the rule is not adhered to, can be the same.

Remember that loose objects in the cockpit are a serious threat to your maintaining control of an aircraft. The instrument panel coaming is not the place to store maps and charts, especially during take-offs and landings, and the floor is not the proper stowage for flight manuals, etc. If you carry a navigation bag use it correctly, put all publications not being used into the bag; if not, use proper stowage points to keep publications and documents out of the way. If these are not provided, arrange to have them fitted. The rules apply equally to general aviation and regular public transport aircraft ●

Reader contributions

Several times over the years in reviewing 'Below VMC' accidents the Digest has speculated whether the many examples published were having any effect on pilots in educating them to be aware of the dangers, and instilling the correct frame of mind to make timely planning and in-flight decisions to avoid this type of accident. I am confident I speak for many pilots when I say that I am sure such education does have its effect, and is unquestionably worthwhile. A recent personal experience might serve to illustrate the point.

I had planned a VFR flight from Moorabbin to Warrnambool via the western light aircraft lane and Bacchus Marsh, returning via Ocean Grove and the coastal route to Moorabbin. The weather forecast, while indicating some expected shower activity, was by no means unfavourable and indeed the weather east of Bacchus Marsh was virtually CAVOK. However, shortly after passing Bacchus Marsh on a direct track for Warrnambool, the weather began to deteriorate rapidly. The cloud began to thicken and the base lowered from 2500 feet above mean sea level to 2000 feet and then down to 1500 feet. There were frequent rain showers and I was forced to divert several times to miss particularly heavy concentrations. It was at this point that I am sure the Digest paid off.

Your very accurate assessment of the kind of pressures and thinking which operate on a pilot to make him 'press on' came immediately to mind and I realised those same pressures were exerting their influence on me:

'Maybe this stuff is only local.'

'I know there is no high ground on this track so what's the harm in sneaking down a bit lower?'

'I will look a bit of a dummy if I go back and try to explain to the guys at Moorabbin how bad the weather is, when one remembers the beautiful conditions there.'

'Why don't I call Flight Service and request actual weather for Warrnambool, and if the conditions sound okay it is worth the risk to go on.'

Then the Digest came back again. Was there not a Comanche that finished up in a lake down this way after pressing on, reassured by a favourable terminal forecast for Warrnambool?

And wait a minute! With all this ducking and weaving around showers and the current poor visibility I am not at all sure that I can pinpoint my position. So how the hell can I be sure of where the high ground is?

All right, pilot in command! Do VMC conditions exist or don't they? Answer: Yes, but very marginal indeed, with no sign of improvement, in fact the trend is opposite. And Warrnambool is still some 80 nm away. When I did pick up the mike it was to say 'Melbourne, (callsign), unable proceed in VMC, returning to Moorabbin via Bacchus Marsh'.

Did I make the right decision? Was I overcautious? One will never know with any certainty. I later heard other aircraft pressing on in the same area, others were diverting, etc. On reflection I am satisfied the correct decision was made. I am certain I was getting into a situation which my 200 hours experience could well have found beyond its capabilities to handle.

The point of course in relation to the Digest's concern expressed in the opening paragraph of this letter is that you only hear and read of the Digest's failure in its campaign against this type of accident. I hope this story convinces you that the Digest does have its successes too.

I read with interest your report in *Aviation Safety Digest 100*, entitled 'The Price of Inexperience', on the tragic accident which occurred when a Cessna 172 flown by a private pilot attempted to land on an agricultural airstrip. Working as an agricultural pilot I have spread approximately 400 tonnes of super phosphate from the airstrip featured.

As the investigation team would be aware, the number of sharp ridges and spurs in the vicinity make operations quite difficult in even very light winds. The photograph, taken at a considerable height above the strip, may not have given the readers a true idea of how steeply the ridges to the right of and behind the strip do rise. The power line is effectively camouflaged amongst dead trees.

I found during operations from this strip that even in light to moderate winds of normally workable strengths, and especially NE-E-SE winds from behind the strip, turbulence low down around the strip was quite severe. It sounds a little hard to believe, but sometimes cross winds from opposite sides of the strip could be experienced in a single take-off or landing. It was always necessary to 'give up' long before one normally would in operations from a strip in more open country.

I think probably the most important outcome of such an accident and the point I would like to make is reinforced by your comment at the start of the sixth paragraph, where you state 'despite the pilot's earlier impressions'. I have found, as probably every 'ag' pilot has, that it is difficult to convince owners/managers of properties that their strips have any shortcomings, and I believe that through their lack of detailed knowledge of aircraft operations, most would have no hesitation, if asked, in confirming that a light aircraft could land at their strip. Perhaps it is the fact that they watch 'ag' pilots operate off the strips with seemingly little effort; pilots though, with many thousands of hours experience.

They of course may not appreciate the fact that an 'ag' aircraft, landing, is usually empty of payload and in this condition is both a good performer and highly manoeuvrable in the event of a go-around. The pilot is also trained to pick out a go/no-go position for operations on one way strips; a position he does not compromise. It is better to 'get it on the ground' and use the super heap or a ground loop to stop rather than stall into trees or a hill while trying to go-around.

I think it is very important that pilots, during their training, be made aware of the dangers of operations on agricultural strips. They should be very cautious of any suggestions that they make use of a strip established for agricultural flying ●

Non-recovery from a spin

While on a test flight from East Midlands Airport, Gloucestershire, U.K. for the renewal of its Certificate of Airworthiness, a Beech Travel Air entered a spin from an intentional stall. The aircraft continued to spin and struck the ground without recovering. The two occupants were killed and the aircraft was destroyed.

The aircraft, with a pilot and observer on board, was undergoing a series of routine tests in accordance with a standard flight test schedule. These involved, in part, a check of the single-engine climb performance, the power-off stalling speeds and the handling characteristics at the stall. The stalling tests were to be carried out in both the 'clean' configuration and with the undercarriage down and the flaps fully extended.

The pilot booked-out by telephone with Air Traffic Control at East Midlands Airport for a one and a half hour flight. Taking off about mid-afternoon, the aircraft flew to the test area and the pilot arranged by radio for the provision of radar coverage while carrying out the tests.

The aircraft was identified on radar and was cleared to climb to flight level 50 on a heading of 270 degrees. Subsequent radio transmissions by the pilot indicated that, four minutes later, he began the tests with a single-engine climb and then carried out stalls during which the aircraft lost height. At this stage, the pilot requested clearance from the radar controller to turn on to 090 degrees and to climb back to flight level 50, 'to carry on with these tests'. He was cleared to make a right turn and to climb to the requested flight level. About a minute later, the pilot reported climbing through flight level 55 for flight level 60. No further transmissions were received from the aircraft.

According to the radar controller, returns from the aircraft indicated it turned right on to 090 degrees and continued in this direction for about five nautical miles. The controller then lost radar contact with the aircraft. He had not noticed any abnormality or fading of the radar returns from the aircraft before losing contact, but when he called the pilot to advise him he had lost radar contact, he received no reply to this or subsequent calls.

Meanwhile, witnesses on the ground saw the aircraft in the vicinity of a golf course, apparently in level flight, heading in a south-easterly direction. The engine noise was heard to cease, increase momentarily, then cease again and the aircraft appeared to lose speed. Almost immediately, the right wing dropped and the aircraft entered a steep nose-down spin or spiral dive. Witness accounts of the subsequent behaviour of the aircraft varied, but the aircraft appeared to have entered a spin to the right which, after several turns, changed into a spin to the left.

The aircraft did not recover and crashed on a fairway of the golf course. Subsequent examination of the wreckage and impact marks at the accident site showed the aircraft had struck the ground at a high rate of descent with no forward speed while spinning to the left. The landing gear was down and the flaps were fully extended.

The pilot held a private licence and was managing director of an aviation maintenance organisation which undertook the inspection and flight testing of light aircraft for renewal of Certificates of Airworthiness.

In the U.K., a pilot is not entitled to exercise the privileges of his licence unless it includes a valid medical certificate. Entries on the medical certificate contained in the pilot's licence appeared to indicate he had successfully undergone a routine examination a little over a year before the accident and that he had been assessed as fit to exercise the privileges of the licence for a period of 12 months from the date of renewal. The signature on the medical certificate however, was that of an authorised medical examiner who had died before the date on which the examination had supposedly been conducted.

The records of the medical branch of the Civil Aviation Authority (CAA) showed that this examiner had, in fact, conducted a medical examination on the pilot some five years before the accident and, on the basis of this examination, had issued a medical certificate valid for two years. This was the last recorded medical examination for licence renewal purposes the pilot had undergone. The dates on the medical certificate had been altered and forensic examination revealed that the original date of issue coincided with the pilot's last medical examination. According to the pilot's flying log book, since the date of expiry of the certificate, he had flown close to 200 hours as pilot-in-command.

Some 20 months before the accident, the pilot had been admitted to hospital with symptoms subsequently diagnosed as myocardial infarction (heart attack). In the U.K., it is the practice, as recommended by the International Civil Aviation Organisation (ICAO), to withhold a medical certificate, for a period of two years, from any pilot who suffers from heart disease. This precautionary action is based on statistical evidence indicating that a second heart attack, should it occur, is most likely to happen within this period, after which the chances of a recurrence of an attack begin to diminish. The pilot remained in hospital for 15 days. He did not report his illness to the CAA and, according to his flying log book, he resumed flying some three months after the attack.

There is little doubt that the pilot had not fulfilled the medical requirements of his licence in that he had not submitted himself either to the standard medical renewal examination or to the particular procedure that would have been necessary following his heart attack. Had he done so, it is improbable his licence would have been renewed. It is considered that the alteration of the dates on the medical certificate were most probably made by the pilot as the only person to benefit from so doing.

Post mortem histological examination of the pilot's heart revealed a severe degree of longstanding, active and progressive coronary artery disease with evidence of previous coronary thrombosis and myocardial infarction. The severity of his cardiac condition was such that it could have led to incapacitation or death at any time. While there was no pathological evidence to indicate he suffered a sudden incapacitation in flight, he could well have experienced an incapacitation within the last few minutes of flight without this being evident in any subsequent examination.

The other occupant of the aircraft was employed by the company as a trainee aircraft ground engineer. His duties on the flight were to record the test results. Before joining the company, he had flown as observer on flight tests of light single-engine and twin-engine aircraft and on completion of the tests, had been given handling instruction on a casual basis. Examination of the flight test schedule recovered from the aircraft indicated he was recording data until shortly before the accident.

The aircraft was undergoing inspection for the renewal of its Certificate of Airworthiness. At the time of the flight test however, the inspection had not been completed. Checks of the range of movement of the control surfaces, and fuel flow checks on a replacement fuel cell remained to be done and the compass had not been swung. The pilot was advised by licensed aircraft engineers that the inspection was incomplete but despite their objections and refusal to issue a Certificate of Fitness for Flight, he insisted on carrying out the flight test.

The flight test schedule called for the aircraft to be loaded as near the maximum authorised take-off weight as practicable. So far as could be ascertained, ballast was loaded on board by the pilot and the observer. The ballast consisted of a canvas bag of gravel and stones contained in a cardboard box, 68 litres of water in three 25 litre drums and two 25 litre sealed drums of iso-propyl alcohol (de-icing fluid). The pilot insisted on using the drums of iso-propyl alcohol to make up a shortfall in the total weight of ballast required and over-ruled protests by licensed engineers that it was an unsuitable ballast material.

At the accident site, all five drums which had contained liquid ballast were found to have ruptured on impact and were outside the aircraft. Although the seals on the two drums which had contained iso-propyl alcohol were still intact, the body tissues of both occupants had been contaminated with this liquid when the drums ruptured.

The CAA flight test schedule for light twin-engine unpressurised aircraft requires, in part, a check to be made of the aircraft's stalling speed and handling characteristics at the stall, both in the clean configuration and with the landing gear down, and with the flaps fully extended. It calls for the stalls to be carried out clear of cloud, with the throttles closed and the propeller pitches fully fine, and recommends that each stalling procedure be commenced at an altitude not below 5000 feet above terrain. The flight test schedule recovered from the wreckage contained written entries indicating the aircraft had been stalled in the clean configuration, that the speed and handling characteristics at the stall were satisfactory, and that a further stall was being carried out with the landing gear down and the flaps fully extended.

The investigation determined there was no doubt that the accident was the result of a failure to recover from a spin. The only pre-crash defects found in the aircraft and its systems were excessive 'up' elevator and excessive right rudder travel. Neither of these were considered to be causal factors for the entry into the spin or the failure to recover from it, as the evidence indicated that a test stall and recovery had been carried out satisfactorily on the aircraft in the clean configuration.

There was ample evidence to indicate that when the accident sequence started, the aircraft was being deliberately stalled with the landing gear down and the flaps fully extended. In this configuration, a degree of mishandling by the pilot or his incapacitation could have generated sufficient sideslip to have produced conditions favourable for the development of an inadvertent spin. If a spin had ensued however, a competent and fit pilot should have experienced no difficulty in recovering, provided sufficient altitude was available.

The pathological evidence showed that, though the pilot's death was caused by multiple injuries, his cardiac condition was such that death or incapacitation could have occurred at any time. For stalling tests to be carried out safely, a reasonable degree of pilot competence, as well as prompt and precise control inputs, are required to effect a recovery. Had the pilot suffered a heart attack and become incapacitated during a stall manoeuvre, it is entirely possible that the aircraft could have entered an inadvertent spin. Any incapacitation might have been either subtle or severe; a subtle incapacitation might not have been apparent to the flight test observer though it might have resulted in the pilot being unable to maintain control, whereas a severe incapacitation might have resulted in an application of pro-spin control inputs.

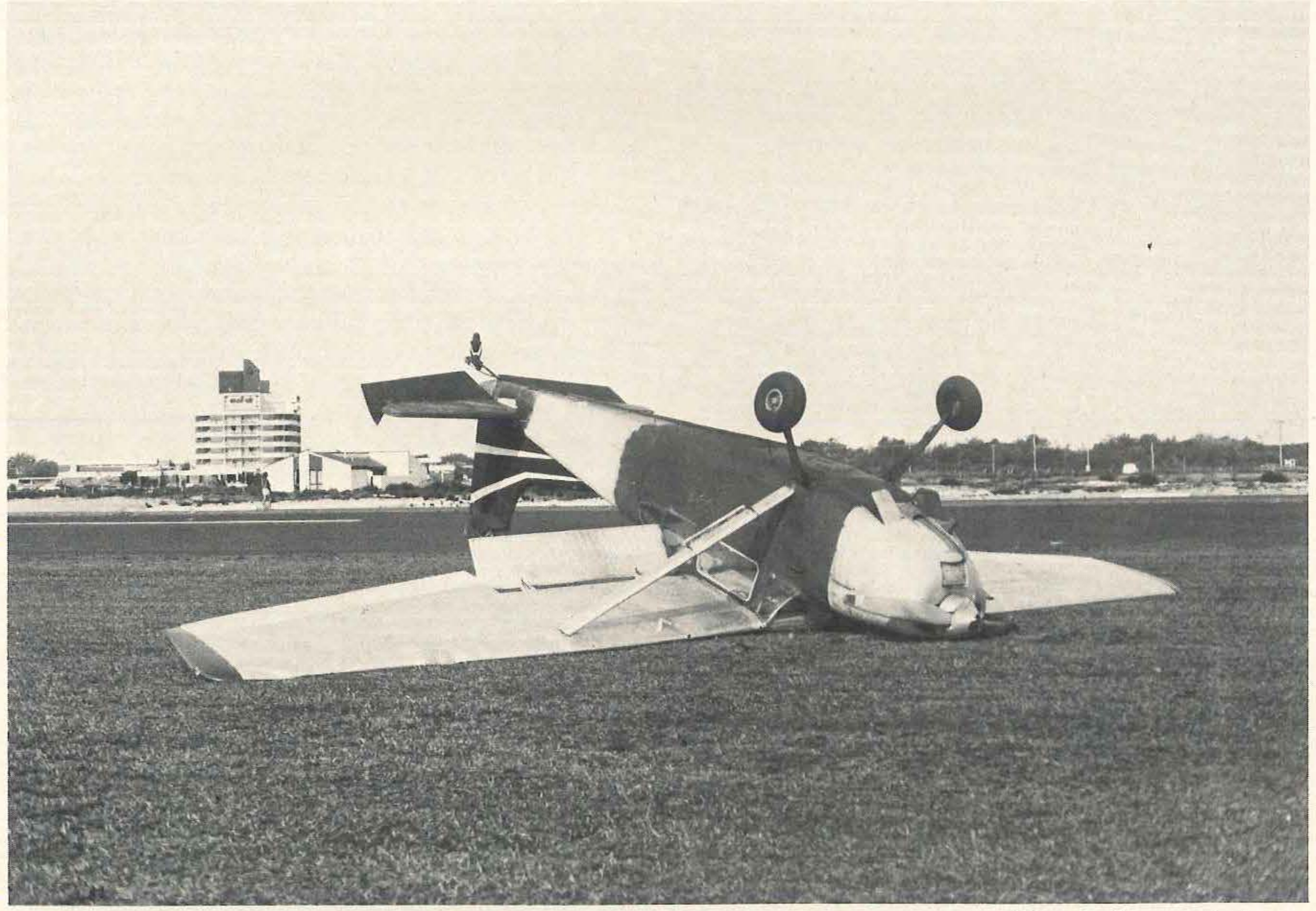
It is apparent that some attempt was made to recover from the spin because a change in the direction of the spin rotation was observed. Although it was not possible to determine whether this action was taken by the pilot or the observer, it was considered unlikely that the flight test observer, with his extremely limited flying experience, would have been able to effect spin recovery.

The investigation determined that the action of the pilot in flying the aircraft before all the mandatory inspections had been completed was high-handed, irresponsible and potentially dangerous. Although the absence of a Certificate of Fitness for Flight was not considered to have been a causal factor in the accident, it was disturbing that such a state of affairs could exist within a professional organisation serving the public. The pilot's selection of iso-propyl alcohol, a material totally unsuitable for use as ballast, was apparently symptomatic of a state of mind in which a determination to complete the test flight, whatever the obstacles, transcended all reason.

The investigation concluded that the accident resulted from the failure to recover from a spin which occurred during a stall. The reason for the spin entry could not be determined but the possibility that the pilot became incapacitated cannot be dismissed●

(Condensed from a report published by the Accidents Investigation Branch, United Kingdom.)

In brief



The pilot of a Cessna 185A tug was glider towing from the grassed flight strip on the left-hand side of a runway aligned 01. The weather was fine and the surface wind was about 030 degrees, 10-15 knots.

After completing an aero tow, the pilot of the tug aircraft approached for a wheeler landing on the flight strip. When conducting wheeler landings in cross wind conditions he had developed the technique of holding the tail up with elevator in order to provide directional control with rudder for as long as possible. He states that, normally, he would not apply brakes until the tail wheel was on the ground but other information suggests that he may have developed a habit of applying some braking at about the time the tail was lowering.

On the first landing attempt from this approach, the aircraft bounced and the pilot conducted a go-around. On the second landing the aircraft touched down smoothly. The pilot applied more than the usual forward pressure to the control wheel in order to keep the main wheels firmly on the ground but, at the stage where the tail usually started to lower with reducing speed, the aircraft started to nose over. The pilot pulled the control column fully back but to no avail. The aircraft tipped on its nose and continued over on to its back, coming to rest 15 metres beyond the first propeller slashmark. Investigation established that the aircraft's centre of gravity was close to the forward limit.

It would have been better to have placed the tail wheel on the ground while elevator and rudder control remained effective, utilising tail-wheel steering and judicious braking to maintain directional control, and holding the stick hard back so as to prevent any possibility of nosing over.

In discussion following the occurrence the pilot said that prior to the accident he had believed it would not be possible to tip a Cessna 185 over on to its back during landing but was not specific regarding the basis for his belief. This accident, and others, clearly indicate that it can be done ●

The pilot of a Bell 47G-5A helicopter was assisting in cattle mustering on a property in Queensland. His specific role was to ferry men and equipment, report on the position and movement of cattle and relay messages under the direction of the head stockman.

During a flight late in the afternoon the pilot noticed a small mob of cattle heading along a fence about 12 kilometres southwest of the homestead. He returned to base where he refuelled the aircraft, topped up the engine oil and took on a passenger to act as observer. The helicopter departed at 1630 hours and, after turning some stray cattle towards the musterers, the pilot continued to check on the movement of the small mob he had seen earlier. The mob was still travelling along the fence but hesitated at the edge of a small swamp. There was a clear area some 180 metres behind the cattle where the pilot decided to land and wait to see whether they could cross the swamp.

The pilot brought the helicopter into a hover but then thought that before landing he should report to the head stockman in case the latter wanted to send men to muster the small mob. A normal take-off from the hover was made into the five to ten knot easterly wind and at a height of 50 feet at about 50 knots the helicopter commenced a gently climbing turn to the left on to a northerly heading.

At a height of about 70 feet the pilot and passenger heard unusual noises emanating from the vicinity of the engine and transmission. The pilot's initial reaction was to slightly reduce the throttle and collective pitch settings, but as he did so he felt a further loss of power and the helicopter began to settle. He prepared for an immediate forced landing, intending to turn 45 degrees to the right to bring the helicopter into wind and clear of some trees. However, at this point the helicopter began to shake violently and the pilot elected to land straight ahead.

At or just before touchdown, at a low forward speed, the main rotor blades struck the branches of one of the trees. The helicopter pitched forward and the blades struck and severed the tail boom, ruptured a fuel tank and struck the ground several times before the helicopter rocked back and came to rest on its skids.

During the investigation it was noted that the oil filler cap/dipstick was missing and the engine oil level barely registered when dipped with a replacement dipstick. There was evidence that oil had been escaping from the filler hole during flight and the damage to the engine was consistent with inadequate lubrication.

The pilot could not specifically remember replacing the oil filler cap/dipstick after topping up the oil at the homestead ●

Fresh air vent or fuel shut-off control?

The following accident occurred in New Zealand and was investigated by the appropriate authorities. The lessons to be learned are applicable anywhere in the aviation world and do not just apply to the type of aircraft involved on this occasion.

(From an article in the N.Z. Flight Safety magazine.)

The pilot, who was the holder of a valid private pilot licence, had a total flight time of 141 hours but during the three months preceding the accident had flown only 35 minutes. This was in a Cessna 177B, the type he had hired on this particular day to take a woman and her two children on a local sightseeing flight. Prior to the aircraft's departure for a nearby airstrip where the pilot had arranged to pick up his passengers, the chief flying instructor of the aero club briefed him on the differences between the 177B and other Cessna types which he usually flew, and also assisted him with the pre-flight inspection.

The short solo flight to the airstrip was uneventful and after the aircraft had been brought to a stop, the passengers climbed aboard. The two children were placed in the rear seat and their mother in the front seat. The aircraft subsequently took-off and proceeded on the local pleasure flight.

This was the first time the passengers had flown in a light aircraft and apart from some discomfort as a result of the warm temperature, they were enjoying the flight immensely. It was shortly after the pilot had pulled a black knob to open the cabin fresh air vent that the engine stopped without warning. He immediately carried out what he considered to be a comprehensive check for the cause of the stoppage but was unable to regain use of the engine.

The pilot elected to attempt a forced landing on a nearby beach but it soon became apparent that it was beyond gliding range of the aircraft. He therefore selected an alternative landing site in a paddock which was sometimes used as an agricultural strip.

After touch down, the aircraft over-ran the paddock and tore through a light fence. This resulted in failure of the nosewheel attachment causing the aircraft to tip forward and come to rest inverted. Although the pilot and the two children were uninjured, the woman received minor fractures and severe bruising. She was not restrained by the full safety harness provided in the aircraft.

Shortly after the accident the pilot re-entered the aircraft to render it safe by switching off the electrical supply. Pondering why there had been no fresh air after he had operated the black knob, he again moved the control to and fro a number of times to check its action, then left it pushed forward in its original position.

Investigation

Subsequent examination of the engine and components, which included a ground test run, failed to reveal anything wrong with the power plant or any of the aircraft's systems. Why, then, did the engine stop in flight, and why did the pilot's checks fail to establish the cause of the stoppage?

The answer to the first part of the question finally became clear on the day after the engine ground test had been performed. While giving an account of his actions in the air, the pilot mentioned that it had been a warm day and the cockpit conditions soon became rather stuffy for his inexperienced passengers. To make them more comfortable, he looked about for an additional source of fresh air. Sighting a black knob below the instrument panel, he pulled it out, assuming it to be the control for an air vent. He was feeling for the inflow of air when the engine stopped. Little wonder, for unbeknown to the pilot, he had operated the fuel shut-off control.

The answer to the second, and equally important part of the question, is not quite so clear cut and one that is often described indifferently as 'an unfortunate combination of circumstances'. But this is precisely how a great number of aircraft accidents occur, therefore the 'circumstances' of this particular mishap bear revealing.

The investigation into the cause of this accident was made difficult as a result of the aircraft being tampered with prior to the arrival of an investigator. In accordance with the New Zealand Regulations no person is authorised to alter any control or remove any item from an aircraft following an accident — other than to facilitate the removal of the occupants and to ensure the aircraft is rendered safe.

On this occasion, the aircraft's life jackets, fuel dip stick, approved flight manual, compass, fire extinguisher, medical kit, radios, and the nose wheel, had all been removed without authority. Although the pilot had acted promptly and correctly in releasing his passengers and disconnecting the power supply, his tampering with the fuel shut-off control resulted in a considerable waste of time and expense in the subsequent investigation of the engine failure. Ironically, it was only through his disclosure of operating the fuel shut-off control for another purpose, both in the air and after the accident, that the investigation was fore-shortened.

Contributing factors

The chief flying instructor of the aero club did not stress the location of the fuel shut-off control in the 177B when briefing the pilot prior to initial take-off. Apparently it was club practice not to draw the attention of pilots to the existence of the knob since experience had shown that many used it as part of the normal engine shut down procedure. As a result, other pilots who subsequently attempted to start the engine were unsuccessful until it became apparent that the control had been left in the OFF position.

The control itself in that particular aircraft bore no identifying marks or signs and the placarding 'FUEL SHUT OFF-PULL OFF' could be misleading, being printed on the face of the main centre panel 'around the corner' from the control knob. Furthermore, the control was not safetied in the ON position with lock wire to prevent inadvertent operation, as specified in the manufacturer's service manual.

The Pilot's Operating Handbook, produced by the aircraft manufacturer, advises in the Emergency Procedures Section under engine failure during flight, 'fuel shut-off valve — ON'. In the procedures for engine fires, it states, 'fuel shut-off valve — OFF (pull sharply to break safety wire)'. However, while the emergency drills involving use of the fuel shut-off are quite clear, the pilot could be excused to some extent for not applying them correctly since there was no handbook for that particular aircraft, despite the fact that the operator had received an official warning of its absence some time prior to the accident. Although the pilot's immediate actions following the engine failure included selection of left and right tanks, returning the selector to both tanks, then switching ON the electric fuel pump, he did not check fuel pressure. Had he done so, it might have alerted him to the fact that he had cut off the fuel supply to the engine. This omission could also be excusable since that particular check is not called up in the handbook. Finally — and most importantly — the pilot should not have been experimenting with a control in the air without being fully aware of its purpose. A longer time spent on the ground getting to know each and every knob, switch, handle, control, etc., particularly their application during emergency drills, could have prevented the accident.

Conclusions

This was an avoidable accident caused by a misjudged forced landing approach after the pilot had unknowingly closed the fuel shut-off control in flight. Lessons to be learned from the factors which contributed to the accident can be summarised as follows:

- Make sure you know your aircraft before you fly. If you are at all uncertain about any control knob, lever, or any switch or instrument, find out while you are still on the ground.
- Make sure you know the emergency procedures in detail for each aircraft you fly. Insist that a copy of the Pilot's Operating Handbook or Owner's Manual be made available for study.
- Vital controls in the cockpit, particularly those which may be operated inadvertently, must not only be safetied if required by the servicing manual, but should also be clearly marked as an added safeguard.
- Ensure that all passengers are properly briefed on safety procedures, and insist on the use of upper-torso restraint equipment when fitted in the aircraft. Set an example by always using it yourself.
- Finally, if you are fortunate enough to survive an aircraft accident, give the investigators the best chance of establishing the cause by leaving everything alone. Only move those items essential to the evacuation of persons from the aircraft, or when taking precautions to ensure the aircraft is safe from further damage ●

From the incident files

The pilot of an Australian-registered Piper PA32/300 aircraft recently reported that during his pre-take-off control checks only about half the normal control column travel could be obtained. Investigation by the pilot revealed that an eight centimetre long screw had dropped through a hole in the lower rear corner of the glove compartment and was restricting the travel of the aileron/elevator 'T' bar, located below the glove compartment area.

On receipt of the pilot's incident report, a check with the local Piper agent established that the problem was common to several models of this range of aircraft. The holes had been made in the lower corners of the glove compartment during manufacture to allow bending of the sheet metal without cracking the material. A subsequent check of the Piper Service Bulletins revealed that the problem had been recognised by Piper and affected PA32/260, PA32/300 and PA34/200 aircraft in a range of serial numbers. The corrective action required was to insert restrictor plugs in the holes.

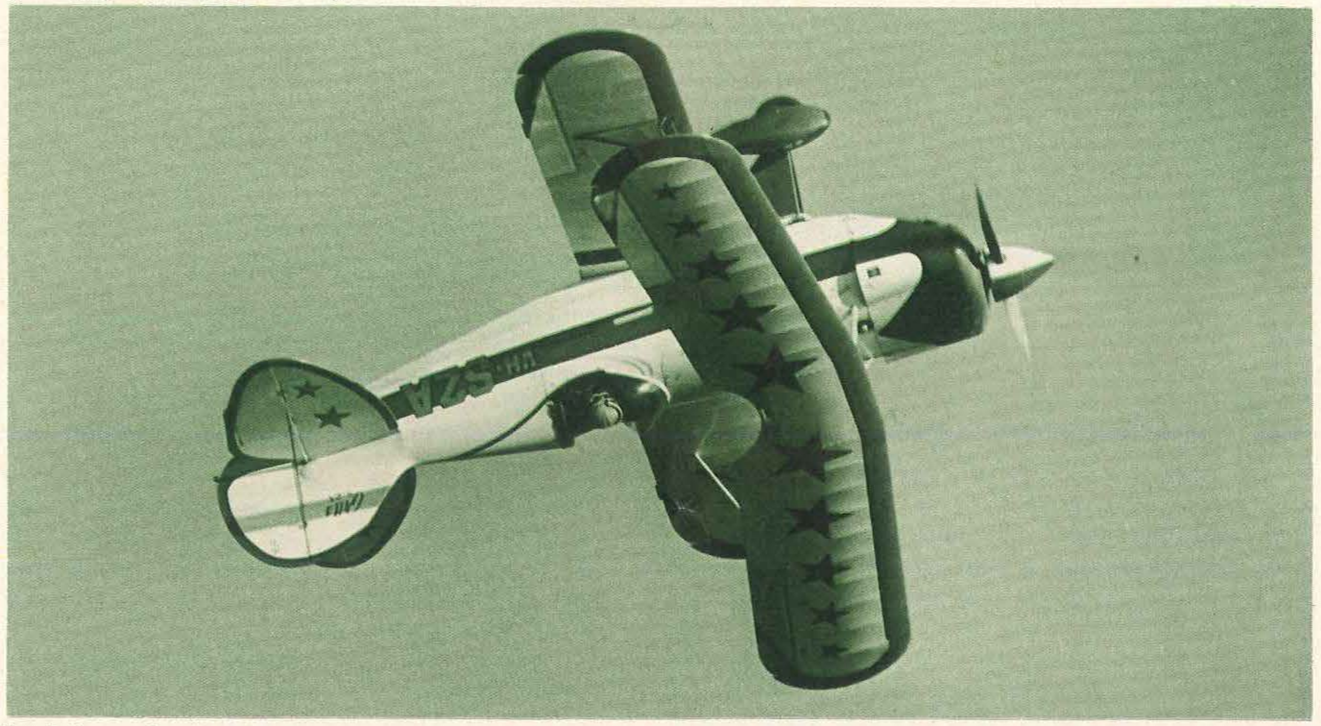
Many service bulletins issued by manufacturers are not made mandatory by airworthiness authorities. However on this occasion experience has shown the above problem to be of such a serious nature that Australian Airworthiness Directives DCA/PA32-58 and DCA/PA34-28 have been issued with effect from 31 October, 1978.

Until all affected aircraft have been modified it would be advisable for pilots to ensure that the glove compartment of the types mentioned contains no items which could fall through the holes. If inspection of the glove compartment reveals that the aircraft has not been modified, you should refer the aircraft owner, hiring agency or your servicing organisation to Piper Service Bulletin No 412 ●

Double harnesses for aerobatic aircraft

It is only comparatively recently that we have seen the introduction into this country of aircraft such as the Pitts Special which are capable of performing advanced aerobatic manoeuvres of the type flown in international competition.

(Photograph courtesy of Aircraft.*)*



In their standard configuration, these aircraft usually have provision for the installation of an extra lap-type seat belt in addition to the normal four or five point symmetric safety harness. When the aircraft were first registered in Australia however, these extra belts were not fitted, as the Department did not permit the use of restraint systems in aircraft which required the operation of two release devices to free an occupant. The philosophy in not permitting two restraints to be installed was that the need to operate two separate releases may cause a delay in the evacuation of an aircraft after an accident and that a second restraint, if left unfastened, introduces the very real hazard of possible interference with controls.

On the other hand, aerobatic pilots claim that a normal harness, on its own, can allow the inverted occupant to partially sag from his seat, with the result that the main restraining force is taken on the shoulders. An additional lap belt helps maintain the thighs firmly in place. Furthermore, and this point is made very strongly by the pilots concerned, there is additional 'peace of mind' to be derived from the use of an extra lap belt, thus allowing better concentration for the performance of the piloting task itself during competition flying and training.

The points made by the pilots are valid, especially when consideration is given to the type of aerobatic flying carried out by aircraft such as the Pitts, and to the frequency and duration of the sustained negative *g* manoeuvres involved. As a consequence, the Department has reviewed its policy and will now, in certain cases, permit the installation of an additional restraint under an Air Navigation Order concession process. Any such concession is confined to a lap belt only, and its installation is subject to the following conditions—

- The aircraft must be in the acrobatic category and of a type used in advanced aerobatic competition or in training for this type of competition — that is, flying involving sustained high negative *g* manoeuvres. At the present time, those aircraft on the Australian register which would be eligible are all models of the Pitts, the Bellanca Decathlon and the Stampe SV4.
- The aircraft must already be fitted with a symmetric four or five point safety harness. The additional lap belt will not be considered for approval in association with a harness which is only of the three point variety.

With this change in policy, it is essential that pilots bear in mind the requirement that harnesses and belts, whether in occupied or unoccupied seats, must always be secured before flight to prevent interference with the controls. The possible consequences of such interference, especially if aerobatics are being performed at low level such as during displays or competitions, need no elaboration ●

Search and rescue, part 4

Procedures used to determine the search area were covered in a previous article in this series on the Search and Rescue organisation. Having decided upon the precise area to be searched, the next step to be taken by a SAR Mission Co-ordinator (SMC) is to form a plan which will ensure adequate coverage of this area.

Suitability of aircraft

The plan is directly related to the suitability and number of search aircraft available and the area each individual aircraft can adequately cover. Factors such as endurance, distance from base to the search area, alternate requirements for the recovery aerodrome, flight time limitations and hours of daylight available for visual searching must be taken into account.

Selection of aircraft type is based on suitability for the particular task. High speed, long endurance aircraft with good navigational capability are better used in large areas far removed from bases, while for contour searches aircraft must be manoeuvrable at relatively slow speeds, capable of small turning circles and adequately powered to provide a relatively high rate of climb. In general terms, the high wing light aircraft is best suited for this purpose. The special flight characteristics of helicopters make them extremely useful for SAR purposes since their slow flight and hover capabilities permit close scanning of forest areas. Helicopter pilots can effect rescues in difficult terrain or from the sea, whereas pilots of conventional aircraft are usually restricted to directing surface rescue units and supply dropping.

Light twin-engine general aviation aircraft are available along almost the entire Australian coastline and because they are often closer to the search scene than more sophisticated aircraft they are frequently utilised in the early stages of a search. General aviation aircraft are reasonably effective up to approximately 80 kilometres from the shore. They may prove useful at greater distances but the required navigational accuracy as well as search integrity degenerates rapidly beyond 80 kilometres.

The role of the general aviation pilot

The general aviation pilot can play an important role as he is usually familiar with his normal area of operations and can provide a valuable service during a search. In particular the light aircraft operator in outback areas may be so well acquainted with the area that he can recognise something unusual at far greater distances than a casual observer. He is usually aware of possible landing areas within the region and on several occasions in the past has been able to locate a downed aircraft far quicker than a normal systematic search. This unorthodox procedure is often used when looking for persons lost in the bush.

Calculating the search effort

Having ascertained the number of suitable aircraft which are available, the SMC must decide the most effective track spacing to be used. This is the distance between adjacent search tracks and varies in relation to the size of the search target. If a wide track spacing is selected a large area will be covered in a set time; conversely, a narrow track spacing will reduce the area searched for the same period of time. As a result, the coverage of the area or quality of the search will differ. In broad terms, the selected track spacing is considered as a measure of search effort.

Obviously a major limiting factor in planning a search is the time which an aircraft can remain in an area. This is calculated by deducting from the known endurance the time interval to and from a search area. From this figure 15 per cent is deducted for IFR category aircraft as well as a standard 45 minute fixed reserve. Alternate aerodrome requirements, if applicable, further reduce available search time. Flight crews will sight many objects that require investigation and five minutes per search hour is deducted for this purpose. The result is that an aircraft which is available in a search area for six hours can be planned to search for only 5.5 hours and the size of the area allocated to it is reduced accordingly.

Time for searching

When the sun is not far above the horizon in the early morning and late afternoon, long shadows and poor light reduce the period available for effective daylight visual searching. This time reduction must also be considered. Periods of 45 minutes after sunrise and before sunset are unsuitable but unfortunately it is sometimes necessary to utilize this time because of local conditions. This is particularly relevant when searching over tropical rain forest or in mountainous country where downpours and cloud build-ups prevent searching at more suitable times.

Track spacing

During a search it is usually necessary to use a wide variety of aircraft types often having different search speeds. In consideration of this factor, a technique has been developed which makes it possible to quickly and accurately ascertain the number of aircraft required to cover a total area, as well as determining individual areas for each specific aircraft.

A mid-range speed of 150 knots is used for comparison purposes and the speeds of all aircraft involved are converted per medium of a formula to this standard speed. A graph known as the Decision Aid Graph (DAG) is constructed on this basis. The DAG is a useful and highly versatile reference guide which compares *size of area* with *track spacing* and *search time* to the base speed of 150 knots. Thus, commencing with any two known factors the other information required is easily determined.

Based on past experiments, a table of figures for both land and sea searches is used to calculate track spacing. The 'search visibility' in this table is related to the size and type of target, meteorological visibility and search altitude. Corrections are also made for effects of cloud coverage, state of the sea (presence of white caps) or type of terrain (vegetation).

Assignment to the search area

Having determined the area an individual aircraft can cover, how is it assigned to that area? Before this can be done, consideration is given to a number of factors concerning the alignment of areas and the track direction in those areas. These factors are vital to the integrity of the search and include:

- navigational capability of the aircraft
- wind direction and speed
- sunglare
- drift direction (marine area)
- topography
- search patterns to be used
- local knowledge of search crews and
- position of departure and recovery bases relative to the search area.

The allocation is completed by giving a thorough and comprehensive briefing to the pilot in command. He is provided with an appropriate map depicting the search area and specifically highlighting the area allocated to his aircraft. The pilot will be informed on all aspects of the operation including the current situation, description of the search object, state of sea or topography to be flown over, weather en-route and in the search area, track spacing, search patterns, signalling and survival equipment carried by survivors, communications to be used and supply dropping techniques, if applicable.

Separation of aircraft

Although the pilot will be made aware of activity in adjacent areas at the planning stage, separation between aircraft is provided. This is achieved by assigning altitude or lateral separation. In the latter case when vertical separation is not possible, points of entry into search areas are selected so that as aircraft move across their designated areas, lateral separation is maintained. In some cases, separation will be achieved by varying the commencement time in adjacent areas.

Use of observers

If the aircraft is large enough, a number of observers are made available. For aircraft such as Fokker Friendships, a trained observer leader will be provided and he will attend the briefing with the pilot. He is then responsible for briefing all observers on board including a review of scanning techniques and methods of reporting sightings.

The method used to sight the target is not unlike that used by aboriginal trackers. Basically this consists of looking for the 'unusual' or foreign signs or objects in the immediate environment. Such things as colour contrast from a yellow life raft against the ocean background, brown foliage in tropical rain forests, glints of silver in arid country, and smoke, often indicate the location of the target.

Irrespective of how well a search is planned, the success of that search is dependent upon the efficiency of the observers. A search can only be regarded as satisfactory if the persons engaged on the actual scanning know what they are doing and how to achieve the best results.

It is important that observers are highly motivated to the task so that their one aim and purpose is to locate the search object as soon as possible. This, of course, could mean the saving of lives and the prevention of a large, prolonged and costly search. The effectiveness of observers depends on the following factors

- number available
- previous experience
- physical condition (alertness)
- suitability of observing positions
- time on task (efficiency is known to deteriorate rapidly after two hours)

When the pilot returns from his sortie a debriefing session is held to determine whether all of the assigned area was searched and how accurately the assigned track spacing was maintained. This information is important to the SAR mission co-ordinator so that he can assess the effectiveness of the search, which in turn influences his future planning decisions.

Probability of detection

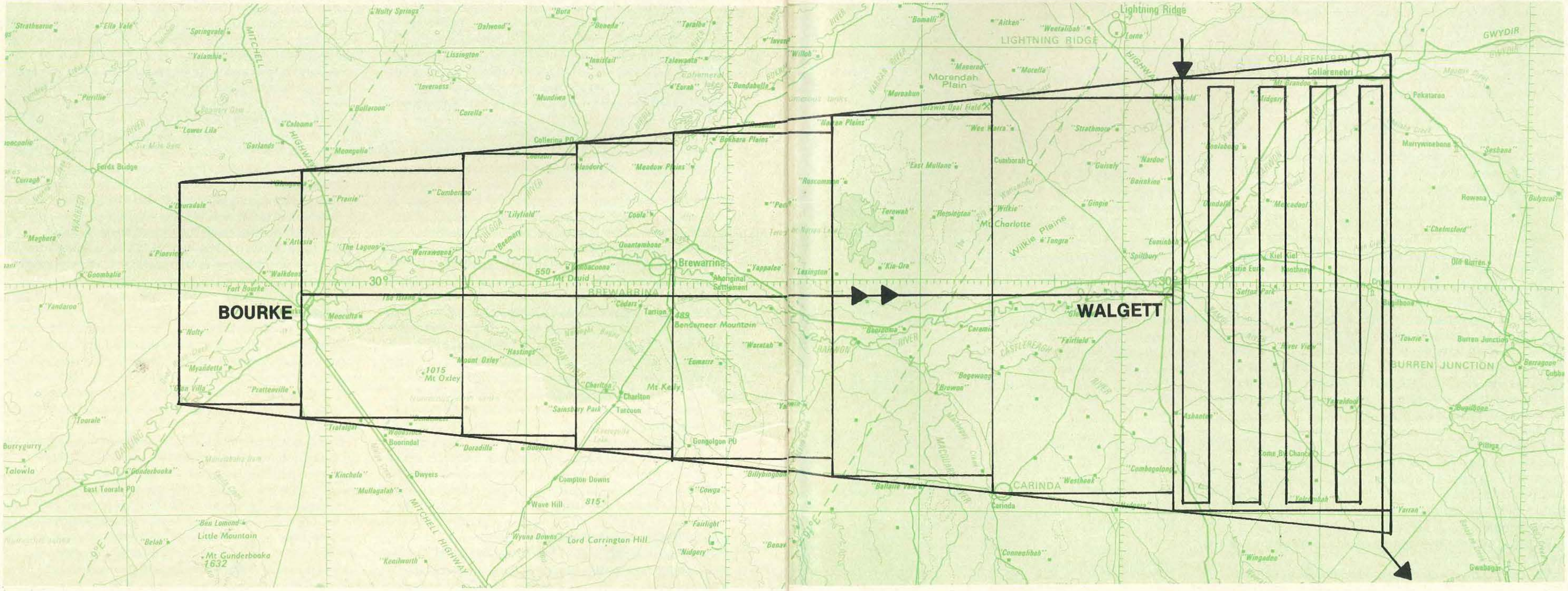
As has already been stated, track spacing is directly related to the search effort or, in other words, coverage of the area. The objective of any SAR mission is a systematic search of selected areas, in order to obtain the maximum probability of detecting survivors. Using a mathematical formula, a 'coverage factor' can be calculated which is a measure of the search results. This is known as the Probability of Detection (POD) and is expressed as a percentage.

For reasons such as shortage of suitable aircraft, or because areas remain unsearched because of aircraft unserviceability or adverse weather, the first search may produce a POD of only 47 per cent. However, if the area is covered five times in suitable conditions the POD can be increased to 96 per cent.

This procedure includes a progressive and systematic enlargement of the area. Based on the datum point, each search will cover a larger area than before. At the end of the fifth search an area equal in size to the original area has been searched five times while the outer edge of the enlarged areas has only been covered once. As the target is more likely to be near the datum rather than at the outer edges, this 'repeated expansion concept' concentrates the greatest POD over the most likely position.

In some SAR actions where the first two or three searches have not produced results, search tracks are often realigned 90 degrees to the original direction allowing scanners to see the area from a different angle.

The final article in this series will deal with supply dropping and the rescue phase of a SAR mission ●



Refuelling from drums

Our Man in the Dustcoat is at it again (did you see him last issue hand-swinging the Aero Commander propeller?). Readers will be interested to know that he is an employee of that well known aviation identity, Murphy. Apart from putting aeroplanes together the wrong way, Murphy is rather haphazard in teaching his staff correct procedures — in this case, refuelling.

We all know what happens when an aircraft engine fails in flight — the aircraft often gets bent and, if the failure was caused by fuel starvation or contamination, the pilot's ego is severely dented as well. Operators are aware that if there is insufficient fuel on board an aircraft before departure the aircraft will not reach its destination and, therefore, they take care to refuel the aircraft. Those who do not, usually become statistics. It is equally as important to put only the right fuel into the aircraft, so quality control checks are vital.

But how much attention is our man paying to correct and safe procedures during refuelling, in this instance from drums?

Air Navigation Orders specify the procedures to be used while refuelling to ensure safety at all times. Contrary to these requirements the scenes on page 19 show the following deficiencies:—

(a) The aircraft and the fuelling equipment should not be closer than nine metres to an unsealed building.
(b) Static leads should be connected to ensure bonding between the drum, the pump and the identified aircraft earthing point. If there is a ground earthing point available, the refuelling equipment and the aircraft should be earthed.
(c) The aircraft should be positioned so that it can be quickly moved to safety in an emergency.
(d) The area in which refuelling operations are being conducted is a 'No Smoking' area. Persons operating fuelling equipment should not carry matches, cigarette lighters or objects which could constitute an ignition hazard and no person should smoke or use naked flame within 15 metres of the aircraft and the ground fuelling equipment.
(e) Fire extinguishers should be positioned in the vicinity of the aircraft and the fuelling equipment.

There are other requirements and reference to ANO Section 20.9 will provide these. Additional to the above, the fuel companies recommend procedures designed to ensure quality control of the fuel. Compliance with these recommendations will ensure that only fuel will be added to the aircraft tanks. Our Man in the Dustcoat obviously failed to comply with an important procedure—

Before pumping, the drum should be stood on end and tilted by placing a piece of wood about 50 mm thick under one side, so that the large bung is on the lower side. With the drum lying on its side as shown, the suction stand pipe, designed so that fuel cannot be drawn from within 80 mm of the drum bottom, cannot function properly. Water or other contaminants could be drawn from the drum.

After tilting the drum it should be allowed to stand as long as possible, preferably one hour, but not less than 15 minutes to let water or other sediment settle to the lowest point.

As well as the above considerations, there are other, equally important precautions which should be observed in handling and storing drum fuel—

— Drums should be stored on their sides with the two bungs level horizontally. If the bungs tend to weep with a drum on its side (as may happen if the drum has been opened previously), the drum may be stored upright but tilted with the bungs away from the low side so moisture cannot accumulate around the openings.
— The drum to be used should be checked before commencing refuelling to ensure that—
  (a) its markings and the contents are consistent;
  (b) it is not aged;
  (c) there has been no obvious contamination during storage;
  (d) it contains no free water. A positive method, such as the use of water detecting paste or paper is a necessity.
— If refuelling from jerry cans, etc., the fuel should be filtered through a mesh strainer, aviation type water trap funnel.
— If refuelling with a pump fitted with a filter, check the filter before and after refuelling for signs of water and other contaminants.
— If possible, drums should be taken to the aircraft on the tray of a vehicle, not rolled along the ground. If it is necessary to roll the drums, they must be given the longest settling period possible before commencing to refuel.

Unlike the Man in the Dustcoat our readers know the importance of employing the correct refuelling procedures, with regards to both safety during refuelling and the quality control of the fuel added to the aircraft. Continue to use the correct procedures and you will avoid becoming another statistic! ●

Guess who's coming to dinner?

In 1977

pilots on private and business flights flew

37% of all general aviation hours

and were involved in

64% of all accidents

68% of the fatal accidents

74% of the fatalities.

WHY?