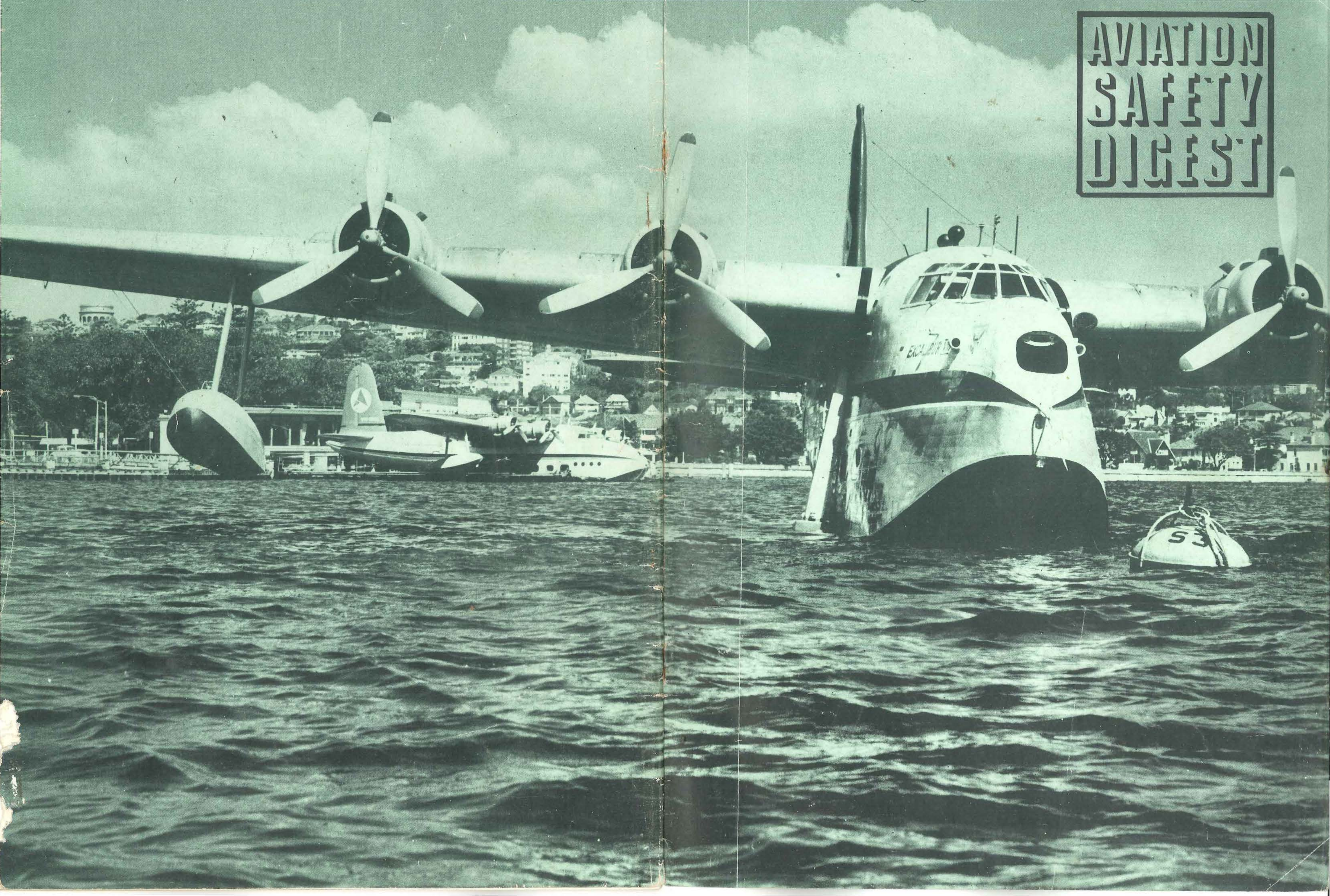
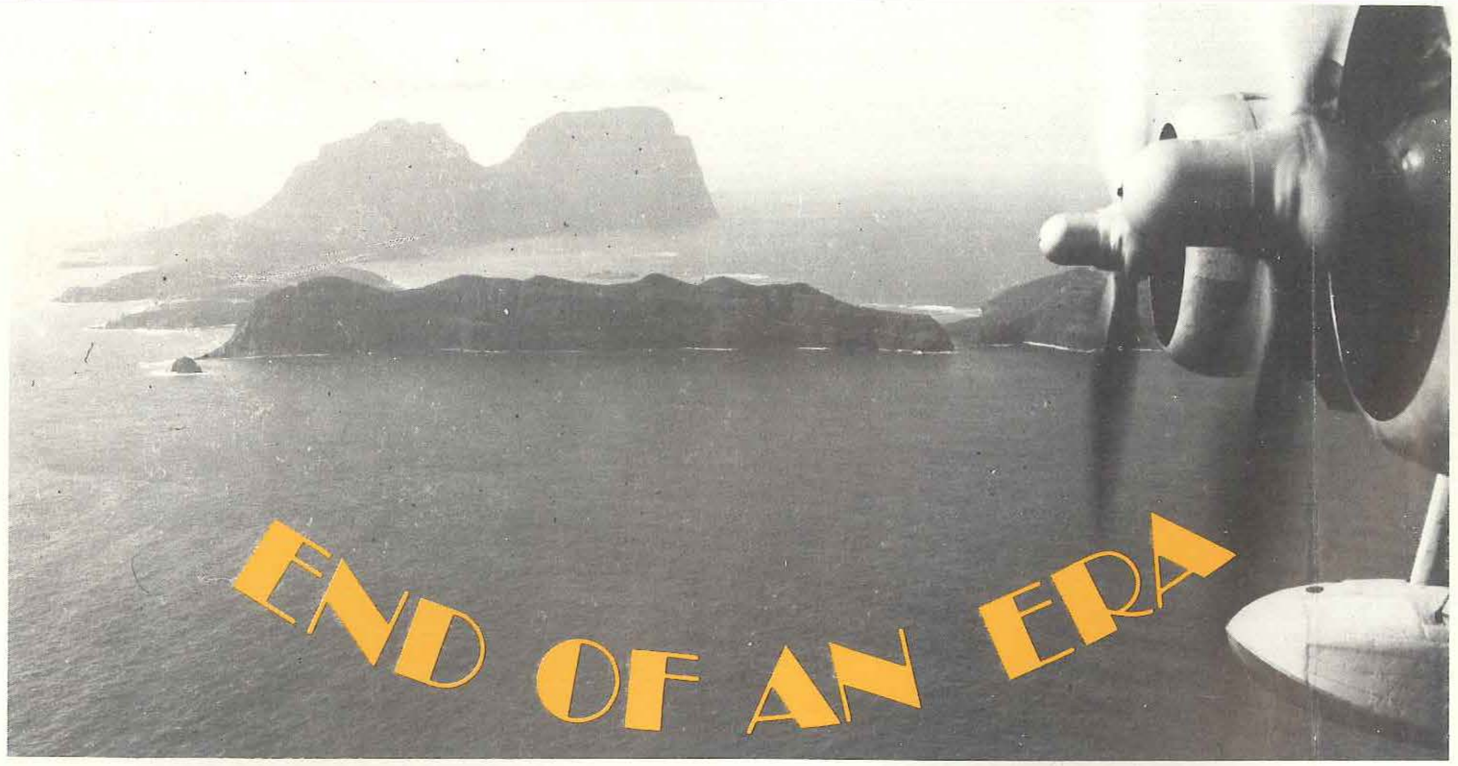
Number 90 1975

AUSTRALIAN DEPARTMENT OF TRANSPORT

AVIATION SAFETY DIGEST





Cover and these pages

A unique style of Australian civil aviation spanning four decades finally came to an end late last year with the closure of the Department's Rose Bay Flying Boat Base on Sydney Harbour.

Built originally in the mid-thirties for the historic London-Sydney Empire Air Route, the base was Australia's first truly international airport terminal. At that time, the future of large flying boats seemed assured — undoubtedly they were the answer to regular, long range, trans-oceanic passenger services, and the graceful, luxuriously appointed, four-engined Empire boats, developed especially by Short Bros. Ltd. for the London-Sydney route, were but the forerunners of flying ships of the future. At least that's what many people thought when the first of the Empire boats, Imperial Airways "Centaurus", arrived at Rose Bay in 1936.

Yet within three years, aircraft design was to take a dramatically different turn under the impetus of World War II. Future development was now to be sought by increased speed and reduced drag, a design philosophy which rendered obsolete most previous concepts and led, step by step, to the giant swept-wing landplanes that ply the world's air routes today.

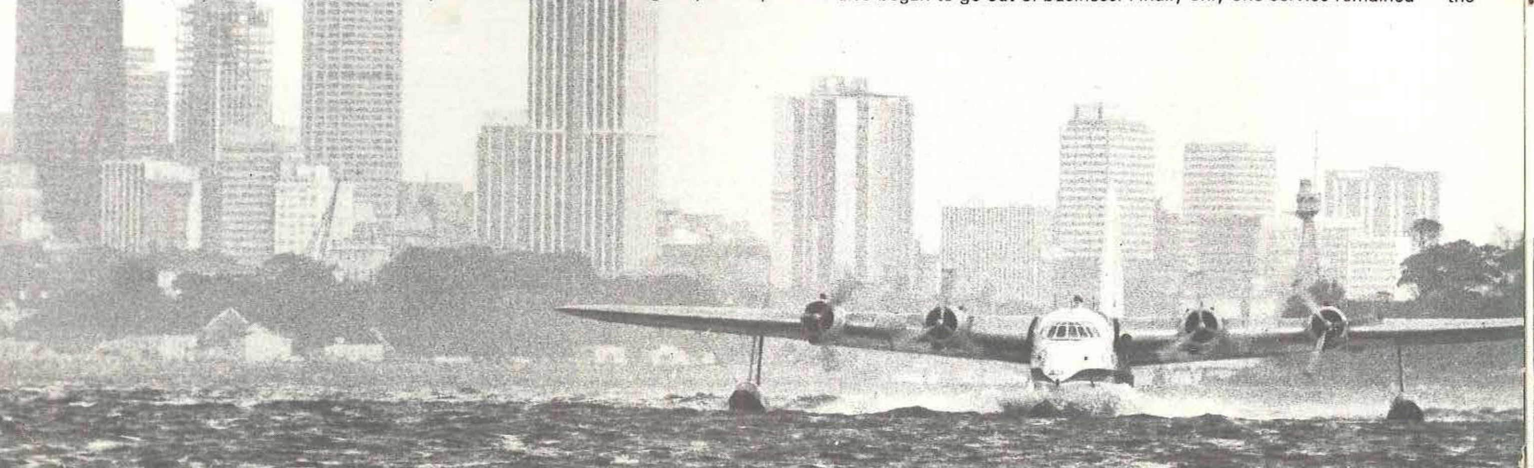
But all this was to take time. In the meanwhile, the extensive wartime use of the flying boat had provided a low-cost source of equipment for airline operations in the early post-war years. Thus it was that Rose Bay saw its heyday in this period, becoming the focal point, not only for the resumed London-Sydney and Tasman Sea routes, but also for numerous local flying boat services. Often, at this time, a veritable fleet of four-engined flying boats could be seen riding at anchor in the Bay.

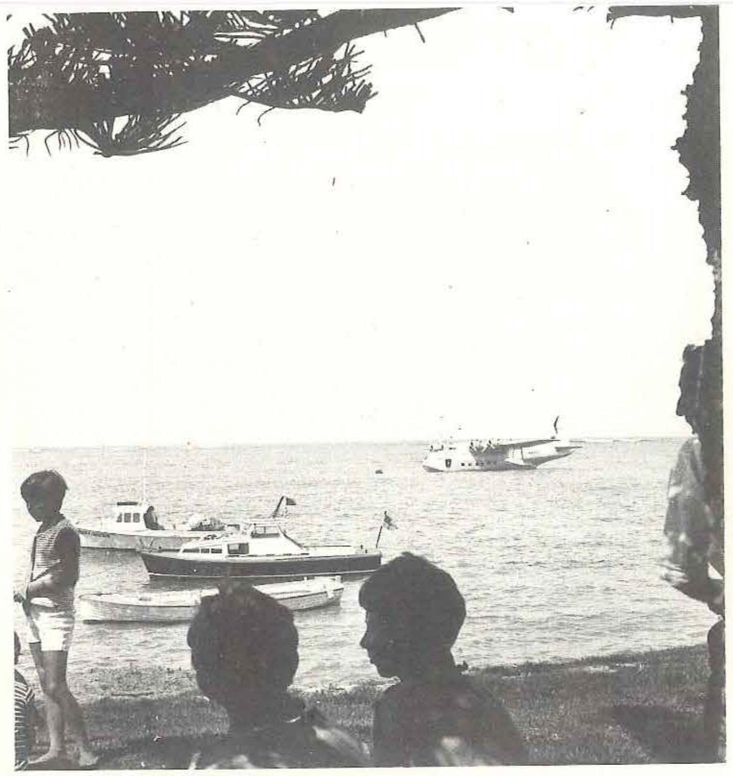
Yet slowly, almost imperceptibly at first, progress began to take its toll. The Empire route to London, already supplemented by Lancastrian landplanes since its resumption after the war, was taken over by Qantas's newly acquired Constellations and the Tasman flying boat service to New Zealand was supplanted by DC-6s. And one by one, for a variety of reasons, most of them economic, the smaller local service operators also began to go out of business. Finally only one service remained — the Ansett operation to Lord Howe Island. The difficulty of developing a land aerodrome at Lord Howe, and the fact that the service provided the island's only regular link with the outside world was to keep this operation going long beyond its economic life, rendering it one of the last regular flying boat services in existence.

But obviously such a situation could not be expected to continue indefinitely, and with the long-awaited completion of the island's runway, on 18th September last, the time of reckoning for the Rose Bay base had come at last.

In outward appearance, the craft using Rose Bay have changed little since "Centaurus's" arrival in 1936 and our cover photograph, taken shortly before Ansett's two remaining Sandringhams left for their new home in the Virgin Islands at the end of November, captures something of the base's atmosphere throughout its 39 years of operation.

Photographs by courtesy of Peter Ricketts and Neville Parnell, Aviation Historical Society of Australia and Airlines of New South Wales.





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CONTENTS

Libelle Sheds Wings in Flight 2
Tree Hazards 6
False Alarm — Boeing 707 Over-runs 10
Is Air-Sickness Your Problem? 13
Going Around 14
Hansa Fails to Become Airborne 16
Asymmetric Operation — Can You Handle It? 20
Auto-pilot Disengagement 26
The Real Thing! 27
A Moot Point! 28

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A few minutes after being released from an aero tow at Kingaroy, Queensland, and while apparently thermalling a short distance from the aerodrome, both wings of a Glasflugel Standard Libelle sailplane separated from the fuselage and the aircraft crashed. The pilot was killed.

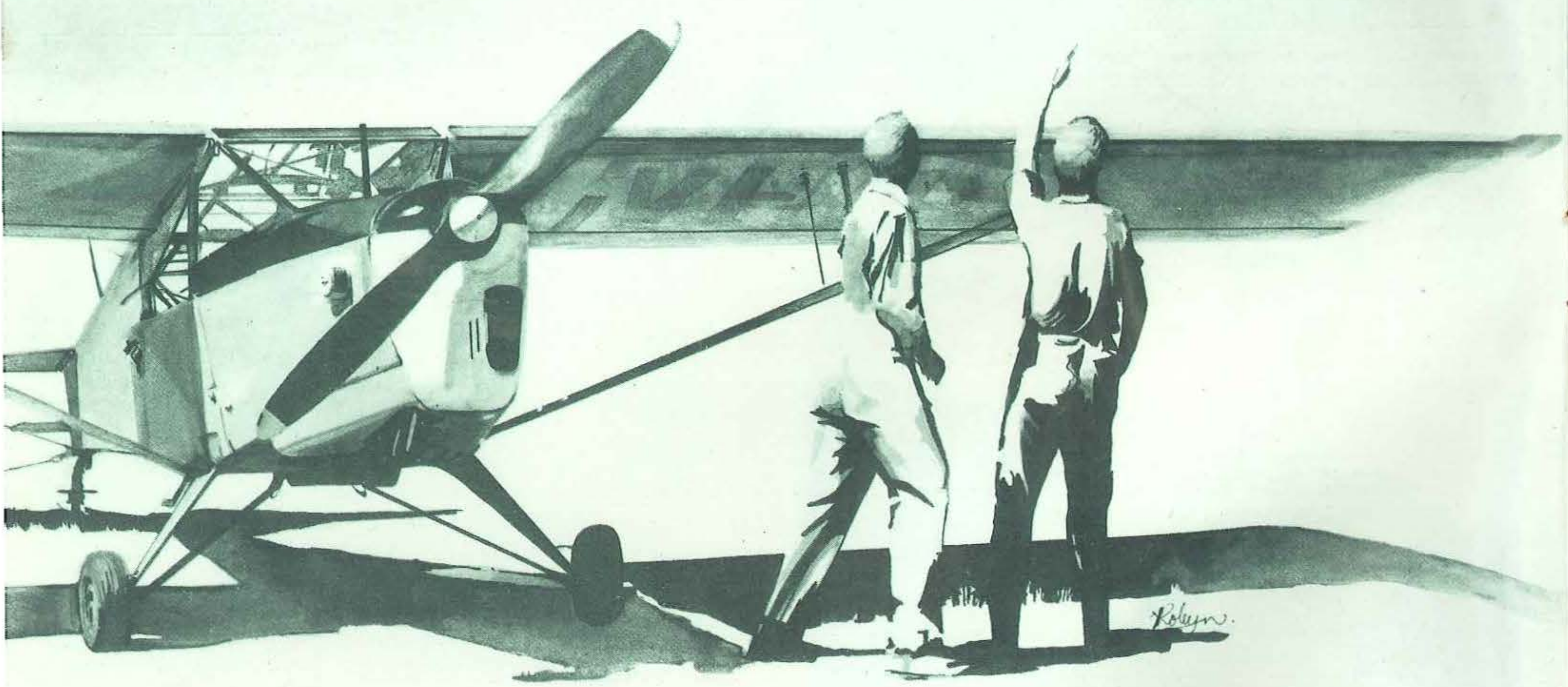
LIBELLE
SHEDS WINGS IN FLIGHT

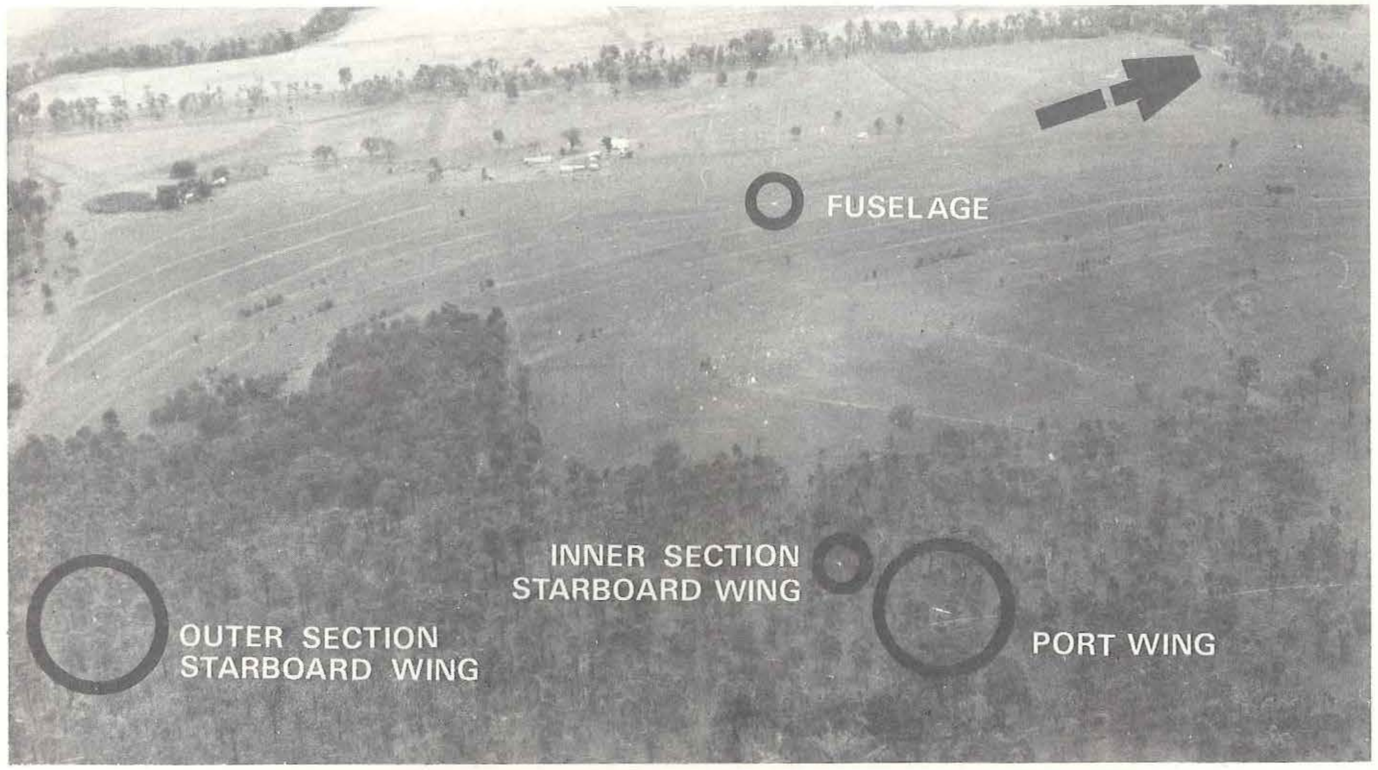
The Libelle belonged to a local soaring Club and was being flown by an experienced glider pilot. At the time of the flight, south-eastern Queensland was under the influence of a cold front, and though conditions were generally favourable for gliding, the turbulence was moderate to severe. There was some cumulus cloud development in the area, with a base of some 4 000 feet, mainly to the west of the aerodrome.

The Libelle was towed aloft by the Club's Auster tug, and encountered moderate turbulence soon after they had become airborne. This increased in intensity as the two aircraft climbed towards the cloud on a westerly heading. At a height of about 1 600 feet, the combination flew into good lift and the glider pilot released the tow. Shortly afterwards, just before the tug pilot returned towards the aerodrome to land, he caught sight of the Libelle orbiting in a left turn in the vicinity of the cloud and apparently climbing.

Meanwhile, on a hilltop lookout immediately to the west of the town, some five km north of the aerodrome, a tourist was viewing the surrounding area. Noticing several gliders in the air, he studied them for a time with his binoculars. As he was watching one particular glider, which was apparently flying quite normally, the wings suddenly separated from it, and the fuselage plummeted straight down, disappearing behind some trees in the distance. He heard a distinct 'bang' at the time the fuselage struck the ground.

Several gliding club members at the launching point at the aerodrome also heard a report at about this time and, looking in the direction from which the sound had come, they saw the separated wings of the glider fluttering earthwards. They did not see the





Aerial view of accident area showing wide scattering of wreckage. The direction of the aerodrome is indicated.

fuselage. When some of them hurried to the scene, they found the splintered wreckage of the Libelle which had been launched only ten minutes before, lying where it had fallen in a ploughed paddock. The pilot had been killed instantly. The failed wings of the sailplane were later found lying amongst trees, 60 metres apart and 500 metres south of where the fuselage had struck the ground.

* * * *

The nose and forward portion of the fuselage, as far back as the centre section, had been demolished in the impact. The remainder of the fuselage had been broken in two. The detached port wing was substantially intact, but the starboard wing was in two pieces having failed in upward bending at the inboard end of the aileron, as well as becoming detached from the fuselage. The ailerons on both wings were still securely attached.

There was no evidence of aerodynamic flutter having contributed to the failure. The wreckage examination revealed that the aircraft structure had been subjected to a positive aerodynamic overload in excess of its ultimate design strength. This had caused the metal end-fitting on the inboard end of the starboard wing to fail. The horizontal rigging pin which locks the two mainplane assemblies in position had then sheared, allowing both wings to separate from the fuselage. The outboard overload failure in the starboard wing would have occurred almost simultaneously. Despite a most careful inspection of the failed components however, no evidence could be found of any pre-existing defect in the structure.

* * * *

The evidence of the witness who was watching the glider from the ground tended to preclude the possibility that the structural failure had occurred during any violent manoeuvre such as a stall, spin, or steep turn. This witness was also quite definite that the glider was well below the cloud at the time, eliminating the possibility that the pilot had lost visual reference with the ground and become disorientated. In these circumstances, it was evident that the glider's structural failure could only have been brought about by a severe control input, by an encounter with a gust of unusually severe magnitude, or, as seemed more likely, by one or both of these factors in combination with excessive airspeed.

From information provided by the manufacturer of the Libelle, it was learnt that for a structural failure of the wing to occur as a result of control inputs or gusts, it would be necessary for the glider to be flying at an indicated airspeed of at least 112.7 knots. Calculations showed that at this airspeed of 112.7 knots, a gust of about 21 metres per second would be required to cause a structural failure. As with all aircraft structures however, the greater the airspeed, the less the magnitude of the control input or gust required to produce such a failure.

Certainly at the time of the accident, with the area under the influence of frontal conditions and areas of cumulus cloud of large vertical development, a good deal of turbulence could be expected. This in fact, was the case, several pilots who were flying in the Kingaroy area at about the time of the accident reporting patches of quite severe turbulence. This was also the experience of the tug pilot who had launched the Libelle. Even so, it is extremely unlikely that a gust as severe as 21 metres per second could have been experienced at that particular time, especially with no thunderstorm activity present. But, as already pointed out, if the speed of the glider was higher than 112.7 knots, the magnitude of the gust required to produce a structural failure would be proportionately less. Because the 'never exceed' speed (Vne) for the Standard Libelle is only 119 knots, the likelihood of the glider having been flown in excess of this critical speed, either intentionally or unintentionally, was examined.

Above: Wreckage of glider's fuselage. The remains of the cockpit are at right.

Opposite Page —

Top: Libelle centre-section showing how single spar root of starboard wing, mates with forked, double spar root of port wing. Spigotted end fittings on each of the three spar roots insert into matching bushes in the opposite wing section and both wings are held together in position by a single central locking pin which passes through all three spar roots. The complete mainplane thus formed is attached to the fuselage by transverse rods ahead of and behind the three spar roots, which mate with matching fittings in the respective wing sections.

Centre Left: Spigotted end fitting of single starboard wing spar root, showing tearing of structure and shearing of metal side plate at lower attachment bush.

Centre Right: Enlargement of side plate damage showing both shear failure and tensile failure.

Bottom: Opposite side of starboard wing spar root, showing that locking pin had been fully inserted. The bush, still attached to the severely bent pin, was torn from the forward portion of the forked port wing spar root.

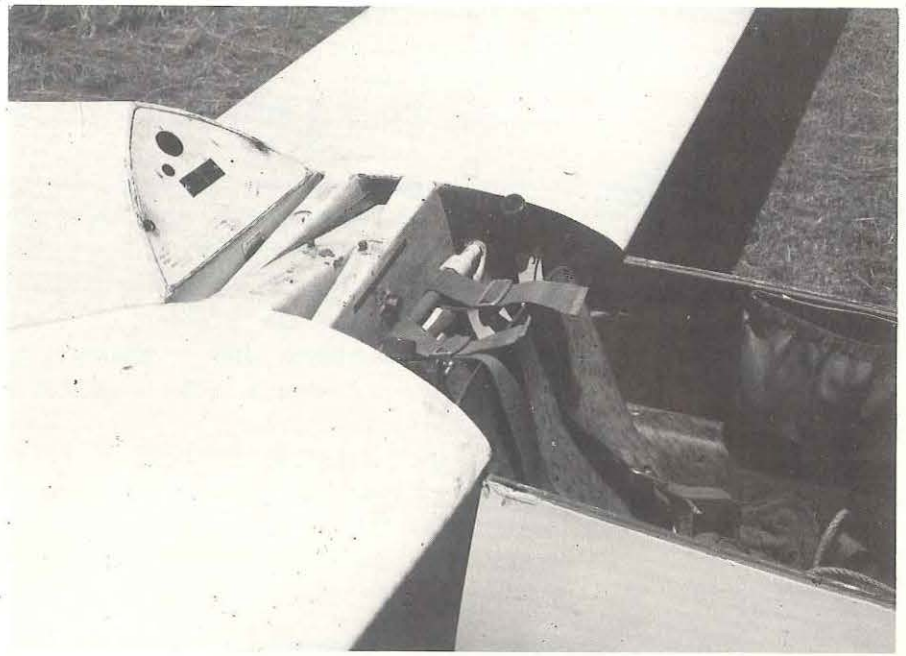
The pilot, who was 59, had been a member of the local gliding club for about four years and had accumulated some 300 hours gliding experience. He was regarded as a level-headed and competent pilot who respected flying discipline and was in current flying practice at the time of the accident. Subsequent to the accident however, it was learned that he had been suffering from a heart condition for some years and was in fact, under treatment at the time of the accident. Altogether, the medical evidence indicated that incapacitation in flight, either partial or complete, was a possibility in this case.

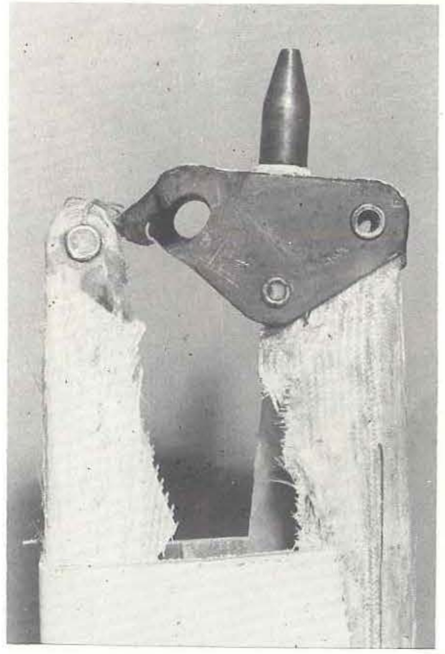
If this had actually happened and the Libelle had been trimmed nose-down at the time, the glider's very clean lines would have enabled the speed to build up very quickly even in a quite shallow dive. Indeed, it seems quite possible that the Vne could have been exceeded in this way without any violent manoeuvre being apparent to an observer on the ground. This was confirmed by an exercise carried out during the investigation, during which it was established that a Libelle glider, when in a shallow dive such that it was rapidly approaching Vne, was not discernible from the ground to be diving. If the Vne had been exceeded in this way and the glider had then encountered a gust of sufficient magnitude, the wing failure could have been the result. Another distinct possibility, in view of the pilot's heart condition, is that he could have temporarily lost consciousness, allowing the speed to build up as already postulated. On recovering himself and noticing the excessive speed, he might have reacted with a violent control column movement. At a speed in excess of Vne, this too could have imposed aerodynamic loads on the structure in excess of its ultimate design strength, especially if gust loadings were present at the same time. It was not possible to establish whether or not such a violent control input would have been detectable from the ground witness's position.

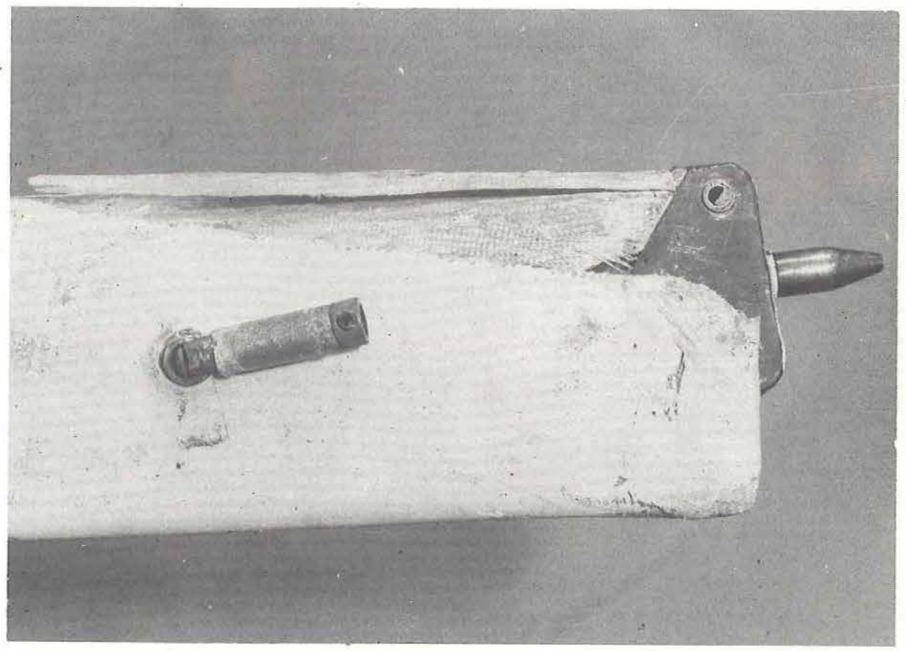
* * * *

Although the precise means by which the structure of the glider was subjected to such a severe positive loading could not be finally determined, the fact that the accident happened at all provides a very unpleasant reminder that operational limitations placed on aircraft are real ones and that they have 'teeth'. This applies not only to gliders of course, but to all aircraft — the same aerodynamic principles remain as true for a 747 as for an ultra-light! Nevertheless, the potential for dangerous excesses is probably greatest with high performance gliders because, despite their aerodynamically very clean design, they are generally limited to comparatively low Vne speeds.

Excessive weight, excessive speed, violent manoeuvres and severe turbulence all have the capacity to place loads on the structure greater than







those for which it was intended. The greatest danger develops when several, or worse still, all these factors are present at the one time, for each compounds the other, subtly reducing the inbuilt margin of safety and loadings needed to exceed them, while at the same time increasing the potential for such loadings. As in this unfortunate case, when two or three of these factors are present in combination, a situation can be reached, even in outwardly normal flight, where the resulting loads on the structure are simply too great, and a catastrophic failure can be the only result. It is well to remember too, that the problem of structural failure in flight is not only a matter of applying a single large load which exceeds the ultimate strength of the airframe. The aircraft is also designed to withstand a certain spectrum of smaller repeated loadings throughout its life. Excessive speed will markedly increase the severity of this loading spectrum, and this can lead to a serious deterioration in structural strength and stiffness. In such cases, the overload required to cause a structural failure becomes progressively less.

The accident to the Libelle stresses the importance of always keeping airspeeds within their placarded limitations for the type of manoeuvre or flight regime being flown, particularly whenever there is a likelihood of an encounter with severe turbulence.

Cause

The cause of the accident was that the glider was subjected to an excessive positive loading in flight. From the available evidence, the circumstances which led to the excessive loading could not be positively determined.

TREE HAZARDS

Throughout the history of agricultural aviation in Australia, the dead or defoliated tree, rising above the general height of surrounding timber or other obstructions, has proved a particular hazard to low-flying agricultural aeroplanes. Though at first sight, the task of avoiding such apparently obvious obstructions would seem to present no difficulty to a normally vigilant agricultural pilot, the problem is clearly much more insidious than it appears. For over the years, quite a number of pilots have fallen victim to this snare, and the fact that hard-to-see obstructions of this type are still a very real hazard, despite all the experience of the years, is only too evident from two comparatively recent fatal agricultural flying accidents.

The first concerns a De Havilland Beaver that was seeding a flooded rice paddy close to the Niemur River in south-western New South Wales. The paddy was rectangular in shape, with its longer dimension aligned east-west. At its western end, its boundary lay only 30 metres from the eastern bank of the river. A line of trees bordered this bank and, across the river, on its western side, there was thick forest with trees a little over 20 metres in height.

The day was fine, with only a light wind and, after inspecting the area from the air, the pilot landed at the agricultural strip from which he was to operate, to load the aircraft and to brief the property owner and an employee who were to act as markers for the seeding operation. The markers then took up their positions at opposite ends of the paddy, ready for the east-west runs which the pilot had arranged to begin from the southern side of the paddy.

The pilot commenced the seeding operation with a run into the east, approaching the paddy from over the forest. As expected, the aircraft then made its second run in the reciprocal direction, at the completion of which the pilot climbed steeply to clear the trees, and carried out a normal agricultural procedure turn above the forest area. The aircraft then descended again, levelling out above the rice paddy at the normal seeding height, but did not drop seed. The third seeding run from east to west towards the trees, was completed normally and once again the aircraft climbed steeply and began a turn on to a reciprocal heading, flying just above the forest. A little more than half way around this turn however, the aircraft climbed suddenly to a height about 30 metres above the trees. Levelling out of the rather tight turn, it then entered a steep descent back towards the rice paddy, apparently in preparation for the next seeding run into the east.

Seconds later however, when still over the far side of the river about 80 metres short of the paddy's western boundary, the aircraft struck the upper branches of a sparsely foliated tree, extending some six metres above the surrounding timber. The impact tore off the starboard elevator and, without any apparent reduction in power, the aircraft continued to descend, rolling steeply to the left as it crossed the river. Here, 50 metres from the point of first impact, it flew directly into another large tree on the very edge of the river. The wings and empennage were torn off and the fuselage plunged through the trees to the ground where it burst into flames and was destroyed. The pilot was killed.

The second of these two accidents involved a Cessna 180, one of two which had been engaged to spread superphosphate on a property in the Central Tablelands of New South Wales. The terrain consisted of gently undulating open country, with occasional patches of light timber. The weather was fine and calm, with unrestricted visibility.

The burnt out wreckage of the Beaver as it came to rest on the river bank nearest the rice paddy being treated.

After flying to the agricultural strip on the property, the pilot made an aerial inspection of the area to be treated in company with a property employee and then began spreading, lifting about 450 kg of superphosphate with each load. The first four flights were completed normally and, after being loaded for the fifth time, the aircraft took off, heading as before towards a line of widely-spaced gum trees, generally about 12 metres in height, which lay directly across the aircraft's flight path to the spreading area. Shortly afterwards and before the aircraft reached the spreading area, the engine, which had been running smoothly at high power, was heard to stop abruptly. Simultaneously there was a loud crack. The aircraft, in apparently normal flight and evidently without taking any evasive action, had flown directly into the top of a dead tree, in line with but nearly twice as high as the other widely-spaced live gum trees. Several stout branches of the dead tree were sliced off by the impact before the severely damaged aircraft dived almost vertically to the ground. The pilot was killed instantly.

* * * *

In neither of these cases does it seem that the pilot sighted the tree branches obstructing the flight path in time to take evading action. In both cases too, the tree branches struck by the aircraft extended above the general height of the other nearby trees. As well, in one case the tree was sparsely foliated, and in the other dead, rendering the branches much more difficult to see. Flights conducted during the investigations of these accidents to simulate the flight paths followed by the aircraft involved, showed that, from the line of flight, the trees struck tended to merge in each case into the background, and become almost invisible as an obstruction until the aircraft was almost upon it.

In the case of the Beaver accident, it was evident the operation was in any case a marginal one, with the trees on the river bank located so close to the boundary of the rice paddy. The fact that on the pilot's third run, the aircraft dropped no seed after turning over the trees, and then, during the next turn over the trees, suddenly climbed some 30 metres, suggests that the pilot was having difficulty sighting the marker at that end of the paddy. The gain in height possibly solved this problem, but it also meant that a considerably steeper descent was necessary to begin the seeding run. The greater height would probably also have accentuated the tendency for the branches of the higher, sparsely foliated tree, to merge into the background as seen from the aircraft. As well as this, the pilot, having sighted the marker as a result of the additional height gained, might have been concentrating on that position as he aligned the aircraft for the next run, in an effort not to lose sight of the marker again. In these circumstances, it seems that the pilot could quite easily have failed to notice the obstructing branches of the tree below his aircraft in time to take any avoiding action.

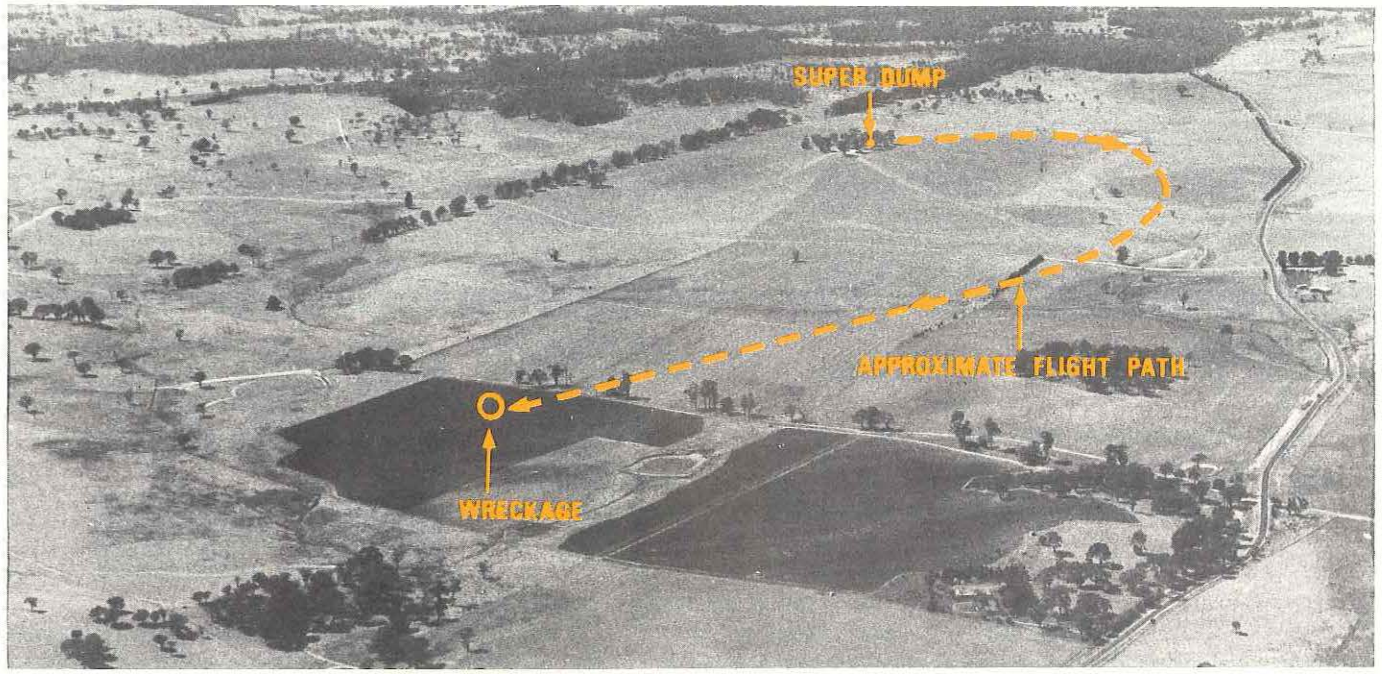
The mechanics of the accident to the Cessna 180 appear to be a little different. The pilot knew that the line of gum trees lay across his flight path to the treatment area and, having crossed them several times in the course of his earlier spreading runs, had no doubt established what he believed was a safe height at which to fly to and from the treatment area. In all probability however, this height was based on his assessment of the easy-to-see line of live gum trees with abundant foliage cover, and it seems likely that he might not have noticed the larger dead tree at any time. Once having reached the height that he believed was safe during the fatal run to the spreading area, the pilot might have transferred his attention to this area further ahead, perhaps concentrating on the point where he intended to begin that particular spreading run. But again, with the upper branches of the dead tree merging effectively into the non-contrasting background of the surrounding paddocks and hills, it seems that the pilot either did not see it at all, or at least was not aware of its proximity to his aircraft until too late to avoid it.

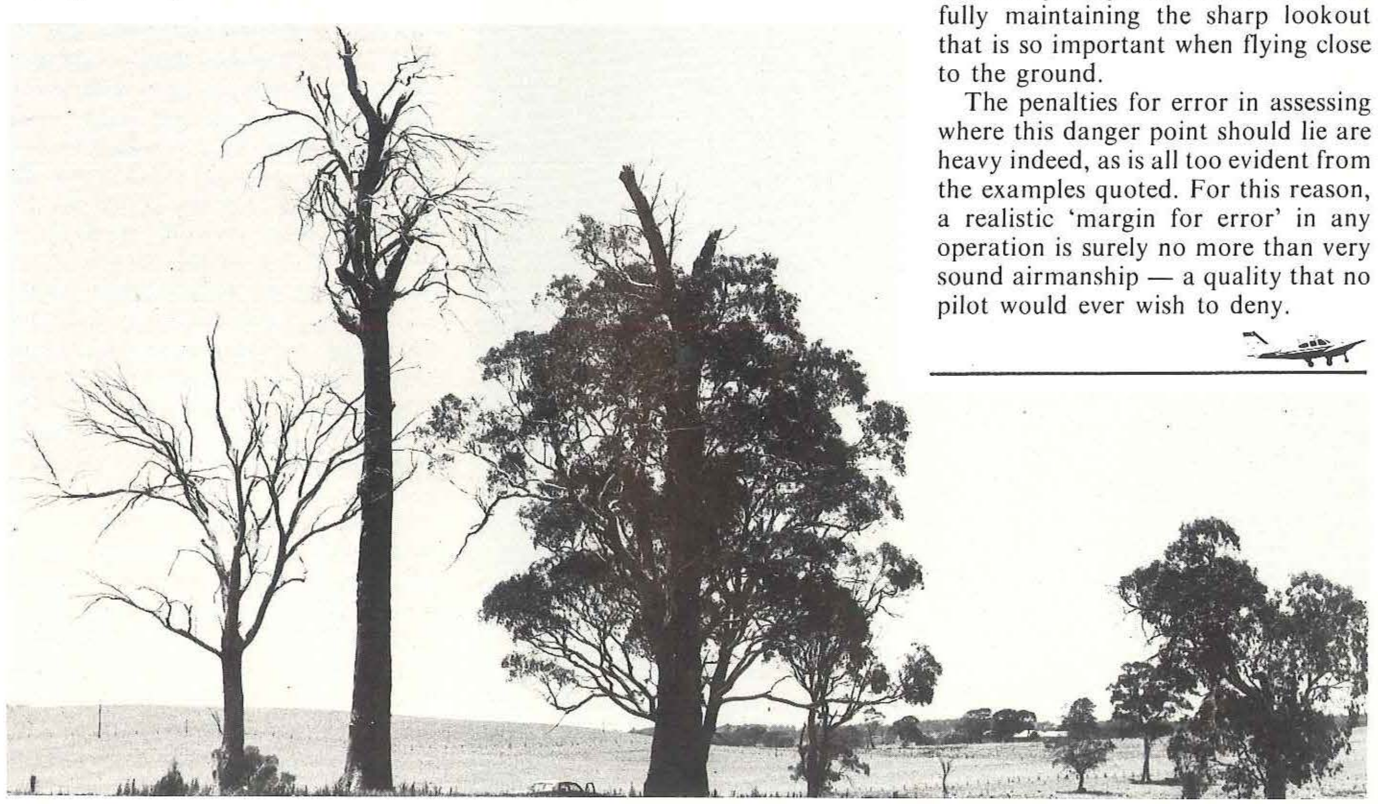
* * * *

The message of these two tragically unnecessary accidents speaks for itself. As in all other types of flying, there are surely no prizes for cutting things fine in agricultural operations. But perhaps by its very nature, flying constantly with almost an intimate relationship with the ground, an agricultural pilot tends to become a good deal more nonchalant than others both in his attitude to obstructions, as well as in his ability to see and avoid them. Yet while this is an entirely natural and even desirable characteristic in a capable and confident agricultural pilot, there surely must be a point beyond which it is unwise even for the most able to go. This is especially so when the pilot, as well as flying the aircraft safely, has to give some of his concentration to the task of accurately positioning his spreading pattern, or otherwise preparing his aircraft, perhaps to the detriment of fully maintaining the sharp lookout that is so important when flying close to the ground.

The penalties for error in assessing where this danger point should lie are heavy indeed, as is all too evident from the examples quoted. For this reason, a realistic 'margin for error' in any operation is surely no more than very sound airmanship — a quality that no pilot would ever wish to deny.

Above and Below: The remains of the Cessna 180 as it came to rest. The upper picture was taken looking in the direction of impact and portion of the wreckage trail can be seen in the foreground. Note the almost complete destruction of the forward section of the fuselage.





Opposite Page —
Top: Aerial view of area in which accident to Cessna occurred, showing final flight path.

Bottom: The dead tree struck by the aircraft. The uppermost branches were broken off by the impact.

FALSE ALARM

BOEING 707 OVER-RUNS

Condensed from report published by the National Transportation Safety Board, U.S.A.

At John F. Kennedy International Airport, New York, the crew of a Yugoslavian-registered Boeing 707 were preparing to depart on a direct flight to Rijeka Airport, Yugoslavia. The aircraft was loaded to its maximum structural weight of 141 520 kg and the reference speeds for take-off were calculated to be V1 150 knots, VR 160 knots, and V2 170 knots.

When the aircraft taxied for departure from the terminal, runway 22R, 3 460 metres long, was in use but as the length which the aircraft required for take-off was on the limit for this runway, the crew requested the use of the airport's 4 442 metre runway 13R. This was granted and after it had taxied into position, the aircraft was cleared for take-off.

As the aircraft accelerated, the co-pilot called '80 knots' then, 25 seconds later, V1. Three seconds afterwards there was a sudden loud noise in the cockpit similar to an explosion. The captain immediately abandoned the take-off, deployed the speed brakes, selected reverse thrust, applied 100 percent N1 on all four engines, and then applied the wheel brakes. As the aircraft began to decelerate, the co-pilot saw the starboard-side sliding window had blown open and he called 'window open'. Nearing the end of the runway, the aircraft began a gradual turn to starboard and, after using the entire length, it over-ran the right side of the paved surface, crashed through a steel blast fence, and finally came to rest with the upper section of the port wing engulfed in flames. The eleven members of the crew and all 175 passengers evacuated the aircraft without major injury. The fire was soon extinguished by the airport emergency equipment, but the aircraft sustained severe damage.

During the subsequent investigation, the co-pilot's sliding window, which had sprung open during the take-off, was examined. It was found that the roll pin, which secures the window handle to its shaft, was withdrawn about seven millimetres. The trigger lock bolt was worn, and the window adjusting rod shortened by one full turn. As well, there was excessive play in the window handle mechanism. The window was checked for operation and it was found that a force of 22 to 27 kg was required to lock the window, as against the normal force of about 20 kg. The spring-loaded trigger in the handle hung in a mid-travel position and the associated trigger lock bolt did not fully engage the lock plate hole. In this condition, though the window appeared to be in a closed and locked position, any pressure applied to the handle would disengage the trigger lock bolt, enabling the window to open.

Examination of the aircraft's braking system showed that the numbers two, three and four front and rear brakes had been subjected to extreme internal heat. The disc lugs for these brakes had been sheared, and pieces of the lugs were found in the wheel slots. A number of the brake return springs were also missing, several of which were found scattered over the last 300 metres of the runway. It was also found that, because of a defective V-3 relay in the port anti-skid system, the number one front and rear brakes were incapable of being energised above a speed of 20 knots. As a result, no matter how much pressure was applied to the brake pedals, the number one front and rear brakes remained in a released condition. Because of the intense heat generated by the brakes, the fusible plugs in the numbers two, three and four front and rear wheels had melted, allowing the tyres to deflate. However, there was evidence to indicate that when the aircraft came to rest, the tyres were intact and inflated.

* * * *

The opening of the co-pilot's sliding window was the initiating factor in the captain's decision to abandon the take-off. The condition of the locking mechanism of the window was such that, to all outward appearances, the window was closed and locked. In fact however, the locking mechanism was out of adjustment and as a result, the locking bolt was not fully in place.

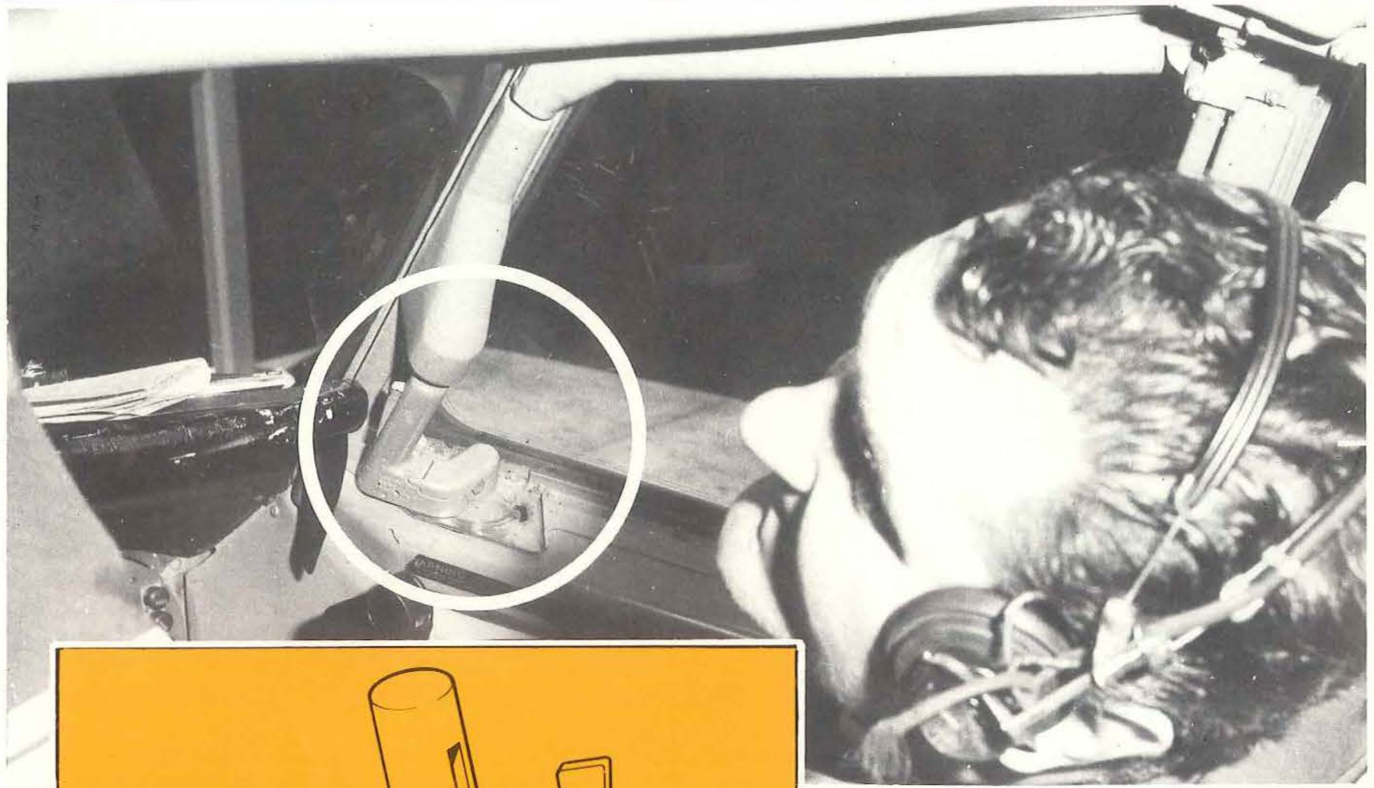
Roughness and undulations in the surface of runway 13R, which had actually been discussed by the crew while they were taxi-ing to the runway, were considered to have been a factor in the opening of the window during the take-off. The roughness of the runway would have been transmitted to the airframe while the aircraft was accelerating, causing the fuselage to flex. With the window locking pin only partially engaged, this could have been sufficient to disengage the lock completely and allow outside air pressure to force the window open. Had the aircraft been pressurised at the time, the positive pressure inside might have held the window in the closed position. Also, because the pressure differential increases as soon as the aircraft leaves the ground and the window is a plug-type installation, it is probable that the co-pilot could have closed the window in flight. However, even before the co-pilot had called that the window was open, the captain had initiated action to abandon take-off and the problem thus became one of stopping the aircraft within the confines of the runway.

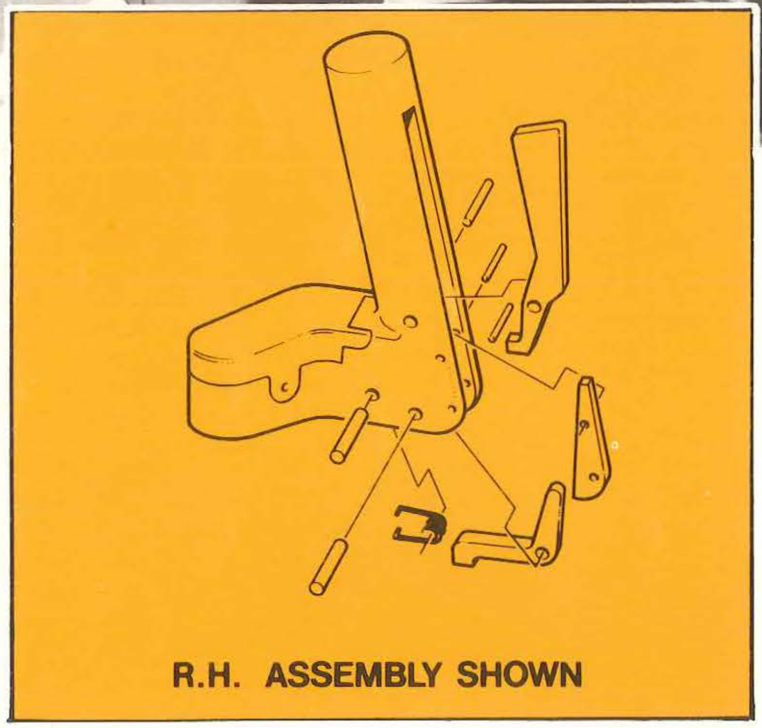
Pilots are keenly aware of the possibility of an explosive device being placed on board their aircraft. In addition, immediate action to abandon a take-off is a natural reaction to a sudden, unexpected, loud noise. A pilot in this situation normally has no way of immediately assessing what has happened to his aircraft, or whether or not control will be affected. For these reasons, the pilot's decision in this case to stop his aircraft on the ground, rather than to continue with the take-off, is understandable.

From their performance charts, the crew knew that the aircraft should have been able to accelerate to a V1 speed of 150 knots and stop in 3 480 metres. The crew also knew that this stopping distance did not take into account the use of reverse thrust and that the runway on which they were taking off was more than 4 420 metres long. The aircraft should therefore have been able to come to a stop from V1, with at least 940 metres of runway remaining. In actual fact, the sudden noise of the opening window occurred three seconds after the V1 call, by which time the aircraft had accelerated to 154 knots. Even so, with all brakes operating, it theoretically should have stopped 760 metres before the end of the runway. The captain's action in abandoning the take-off was thus a reasonable one in the circumstances.

The malfunction present in the braking system would not have been evident in the course of a pre-flight inspection. Indeed from all outward indications, the maintenance representative as well as the crew, could only have assumed that the brakes were not worn below safe limits and were operating normally. There was no maintenance requirement or procedure by which the entire braking system was regularly checked, and only in the case of an entire undercarriage change, would there have been a functional check of the sort necessary to reveal the malfunction experienced in this accident. Normal landing procedures preclude the use of brakes at speeds above 80 knots and, when the brakes are applied in normal circumstances, they are used only to slow the aircraft to turn off the runway. Under these conditions, it seems doubtful that a pilot could detect the difference between six-wheel braking and eight-wheel braking. In actual fact this difference might only become evident when a maximum braking effort was made, such as during an abandoned take-off or a landing on a short runway without using reverse thrust. At the time the captain abandoned the take-off, the crew did not believe an emergency situation existed. Rather they knew that the runway was more than 940 metres longer than that required for an accelerate-stop in this particular take-off.

Altogether several factors combined





Top: View of starboard side of Boeing 707 cockpit showing co-pilot's sliding window and spring loaded trigger.

Inset Diagram: Exploded view of trigger mechanism.

in this case to prevent the crew from stopping the aircraft within the confines of the runway. The first was that the take-off was abandoned at a speed four knots above V1. This excess speed alone produced a 210 metre increase in the stopping distance over that required from V1 speed. Another factor was that the transition segment of the rejected take-off was more than 300 metres longer than allowed by the accelerate-stop criteria. This might have been the result of either longer transition times, or the use of less than maximum braking during the transition period. Both these possibilities could be attributed to the fact that the crew did not believe there would be any problem in stopping the aircraft in the length of runway remaining. The third significant factor was that only six of the eight brakes were operating and that during the rejected take-off, the effectiveness of the operative brakes deteriorated and they were subsequently destroyed. The deterioration occurred because the energy-absorption capacity of the six brakes was exceeded during the captain's attempt to stop the aircraft on the runway. The total energy required to stop the aircraft was 53.4 million newton metres for each of the six brakes, which was greater than the maximum energy level of 52.6 million newton metres the brakes had been demonstrated to be capable of absorbing.

* * * *

Probable cause

The National Transportation Safety Board determined that the probable cause of this accident was the unknown degraded capability of the heavily loaded aircraft's braking system, which precluded stopping the aircraft within the runway distance available. The reduced braking capability resulted from a malfunctioning V-3 relay in the left anti-skid control shield of the aircraft's braking system, which rendered two of the eight wheel brakes ineffective. A sound like that of an explosion in the cockpit during the take-off roll caused the captain to reject the take-off.

IS AIR SICKNESS YOUR PROBLEM?

Almost everyone, pilots as well as earth-bound mortals, have at one time or another experienced some form of motion sickness. Whether it be during travel by ship, train, aeroplane or motor car, or merely as a result of outrageous physical treatment at the hands of some mechanical monstrosity in an amusement park, the symptoms are typical. There is first of all a gradual onset of headache, a general feeling of being unwell, a cold sweat, and nausea which culminates ultimately in vomiting if the motion causing the sickness continues. Once vomiting occurs however, or the motion ceases, there is usually an immediate improvement in the sufferer.

Motion sickness in flight, generally described as air sickness, results from disturbances to the inner ear, brought about by the accelerations of flight, especially in turbulent air. For this reason, passengers travelling in smaller aircraft are generally likely to feel the effects of air sickness more than those in large aircraft with a more stable flight regime.

Experience shows that pilots handling the controls of an aircraft are not often affected by air sickness but, unless they belong to that happy minority who are seemingly endowed with a 'cast iron constitution', they can be just as vulnerable as anyone else if they are flying as a passenger.

Is there anything a person can do when he feels all is not well in flight and that he might be air sick? Keeping the head steady on one plane and directing cold air from a cabin vent on to the forehead can often help avert the worst. But it is wise to keep an air sick container handy — just in case!

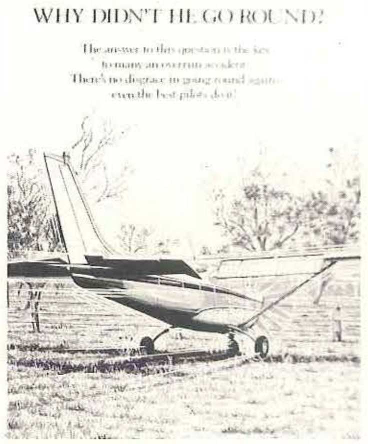
There are many remedies for air sickness on the market which are entirely acceptable for passengers. Many however, have decided contra-indications for pilots, because of their side effects. And unfortunately none sound quite so interesting as one prescribed for sea sickness many years ago. This was a soup made from horseradish sauce and rice, and seasoned with red herrings and sardines, which the sufferer was to take with champagne! Other recommendations of yesteryear which might or might not appeal to air-minded travellers today were 'tight clothing around the abdomen', 'the prone position', and 'iced champagne'. But lest these should prove unsatisfactory, a few of today's proprietary motion sickness remedies are set out in the following table. Most of them do not require a prescription:

Trade name	*Active ingredient*
Ancolan	Antihistamine
Andramin	Antihistamine
Avomine	Antihistamine and hyoscine
Calms	Hyoscine
Decadol	Antihistamine
Dramamine	Antihistamine
Kwells	Hyoscine
Marzine	Antihistamine
Perazil	Antihistamine
Plassids	Hyoscine
Prosamine	Antihistamine
Sea-legs	Antihistamine
Travacalm	Antihistamine and hyoscine
Travamine	Antihistamine
Travel Tabs	Antihistamine
Travs	Antihistamine and hyoscine

As can be seen from this list, all these preparations are either antihistamines or hyoscine compounds. In some cases they are a mixture of both. Hyoscine may result in drying of the mouth, but if taken in the correct dose, rarely causes side effects. It is probably the best air sickness remedy available. Antihistamine products, on the other hand, can produce side effects such as drowsiness, slowness of reaction, and disorientation, but these are not usually of serious consequence for persons flying as passengers.

Pilots who are inclined to suffer from air sickness should drink an adequate amount of fluid before they fly, at the same time avoid eating fried or greasy food. And it is a useful exercise, when not intending to fly, to test one's reaction to one of the proprietary air sickness remedies. If it produces side effects, another should be tried in an effort to find one that is compatible with flying. The doseage instructions should of course be followed carefully. If necessary the pilot's doctor, or aviation medical examiner should be consulted.

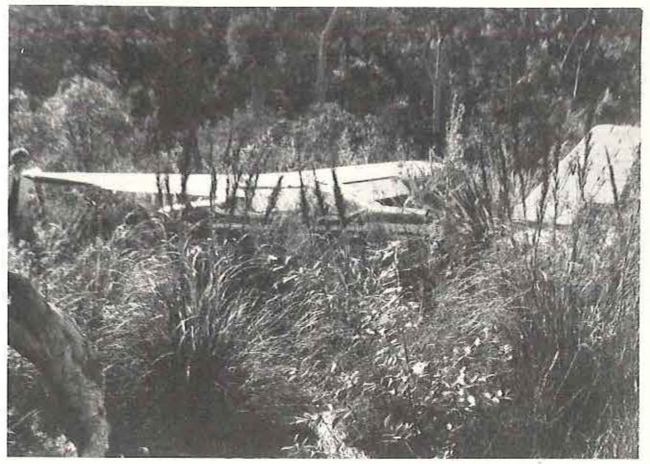
But even if the problem seems to be defeated, keeping an air sickness bag (preferably with a good seal!) near at hand when flying, is good insurance. Charts, or a passenger's new hat can be an expensive substitute!



GOING AROUND

Something the Digest reminds its readers about from time to time — to wit these two safety posters published six years apart.

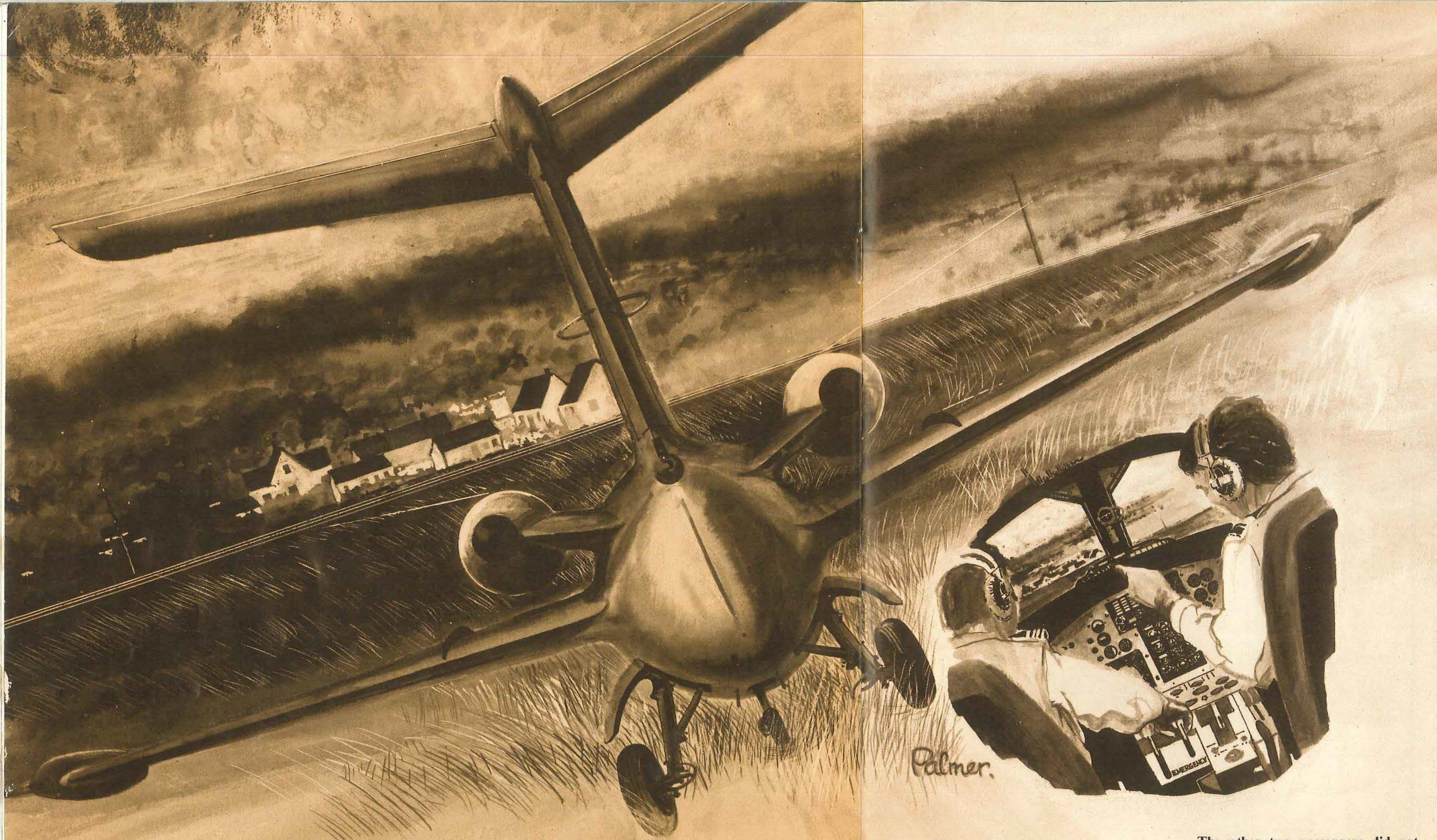
But a lot of pilots don't seem to get the message and the results usually speak for themselves —



at least the few examples depicted here do so eloquently enough!

So don't mind when you have to go around. As we said, even the best pilots do it!

Which category are you in?



HANSA FAILS TO BECOME AIRBORNE

Condensed from report issued by Department of Trade and Industry, United Kingdom

After accelerating normally for take-off from Blackpool, England, a German-registered HFB 320 Hansa jet failed to rotate and continued at high speed down the runway. The take-off was abandoned, but the aircraft failed to stop, over-ran the aerodrome boundary and the railway line that bordered it, and crashed into the buildings of an adjoining holiday camp. The two pilots and five of the six passengers were killed; the aircraft was destroyed by impact forces and the fire that followed. The surviving passenger, who was thrown out of the wreckage, was seriously injured.

The accident

The aircraft was one of a number of the same type operating a twice-weekly charter service between the Federal Republic of Germany and the United Kingdom. On the day of the accident, the aircraft arrived at Blackpool from Munich just after 0900 hours. It was on the ground at Blackpool throughout the day and, for most of the time, the crew remained with it.

At 1520 hours, six of the eight passengers to be carried on the return flight to Germany arrived at Blackpool airport and, as it was raining, sat in the aircraft, the auxiliary power unit of which was running. A flight plan was prepared for Munich via Rotterdam and filed at 1530 hours.

The other two passengers did not arrive at the appointed time and the APU was shut down while the passengers and crew waited in the aircraft. About 1630 hours, word was received that the two extra passengers were not coming. This meant that extra fuel could be accommodated, and a new flight plan direct to Munich was prepared and filed by the first officer, while the captain carried out the pre-flight check. Subsequently, the captain started the APU and, according to the passenger who survived the accident, indicated that the first officer should fly the aircraft in command under supervision from the right hand seat.

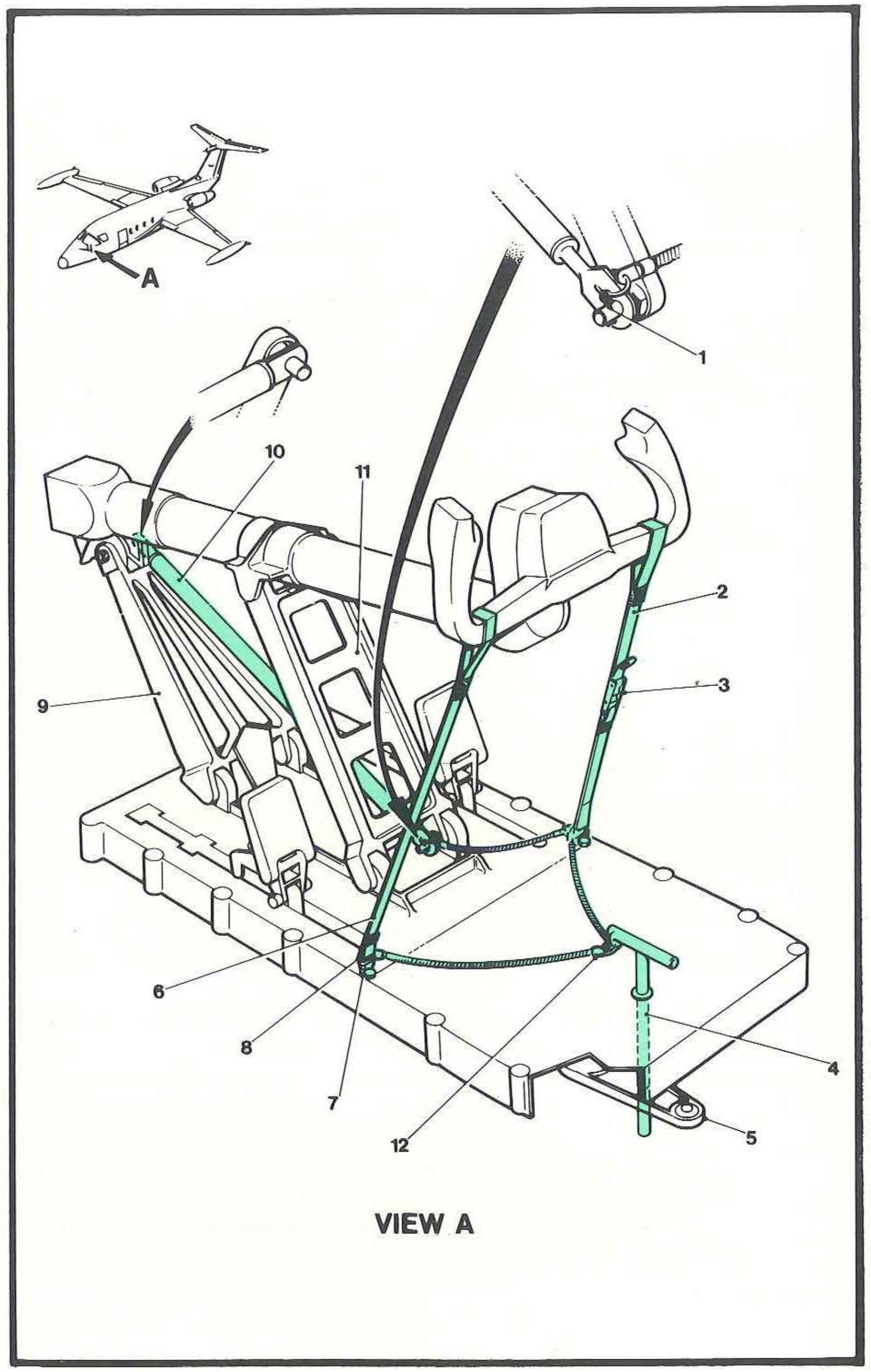
The aircraft taxied out, lined up and began its take-off run, reaching its normal rotation speed in the usual distance. Rotation did not take place however, and the aircraft did not become airborne. The surviving passenger saw the first officer's hand holding the thrust levers fully open and wondered why the aircraft did not take-off. Then he saw a gesture from the captain indicating that the take-off should be abandoned and the first officer immediately closed the levers. Observers on the aérodrome heard the engine noise die down approximately 300 metres from the end of the runway and subsequently, brake marks were found commencing in the same area. The aircraft left the end of the runway at high speed, in a level attitude, with its nosewheel and main wheels still in contact with the ground.

The first collision occurred when the starboard wing tip struck and severed a post supporting one of the runway approach lights. The aircraft continued, colliding with and badly distorting the double-track railway line bordering the airfield. The nosewheel was broken off and structural damage was done to the underside of the fuselage. Almost immediately beyond the railway line, the aircraft broke through a wall and collided with a row of single storey masonry chalets in the adjacent holiday camp, demolishing six of them and setting them on fire. Both wings were broken off, spilling fuel over the area, but the main part of the aircraft continued on, sustaining further damage as it did so. The wreckage finally came to rest against a second row of chalets, where it caught fire and was destroyed.

Investigation

Examination of the wreckage showed that the aircraft had been intact when it struck the railway line, and the flying controls had been in the neutral position. The cockpit, which had been twisted to the right and almost inverted, had been badly affected by fire, but it was established that the control yoke on the captain's side had been broken off in an upwards and forward direction. The gust lock attachment spigot on the forward yoke of the captain's control assembly was found to be bent in a manner consistent with the elevator gust lock strut having been in position at the time the aircraft collided with the railway line. There was no impact mark or other damage to account for the bend in this spigot. The control assembly on the first officer's side had broken up whilst in the neutral position, and the absence of impact marks on either set of control assembly stops indicated that they had not been 'hammered' at any time during the break up.

The aircraft's elevator controls are manually operated and of conventional pattern. Locking either set of cockpit controls locks the entire system. The gust lock system provides for locking the controls in the cockpit and consists of a pair of webbing straps, a 'T' shaped metal fitting, and a light alloy tubular rod which are normally connected together by cord. There is no interconnection between the gust locks and the thrust levers, and it is possible to obtain take-off power with the locks in place. When in use, the webbing straps are fastened over the control wheel horns to provide aileron protection, the rudder is held by inserting the 'T' shaped metal fitting through a hole in the cockpit floor, into a matching hole in the rudder mechanism, and the elevators are locked by a light alloy rod located on two spigots on opposite corners of the pantographic elevator control assembly. The manufacturer specified that the gust locks should always be fastened together. Notwithstanding these instructions they were sometimes separated for ease of installation, and they were reported to have been separated on the aircraft involved in the accident. When installed as the manufacturer intended, the complete gust lock system hinders access to the pilot's seat sufficiently to provide a safeguard. However this hindrance is provided by the aileron straps and it is lost when the elevator gust lock, disconnected from the rest of the apparatus, is installed on its own. It was noted that if the elevator gust lock is dislodged from its bottom spigot only, the control column can be moved fully forward, but fouling of the aircraft structure by the lock strut prevents any degree of rearward movement.



1. *Pin.*
2. *Aileron gust strap.*
3. *Length adjustment device.*
4. *Rudder gust lock pin.*
5. *Bellcrank.*
6. *Aileron gust lock strap.*
7. *Angular bracket.*
8. *Hook.*
9. *Forward yoke.*
10. *Elevator gust lock strut*
11. *Aft yoke.*
12. *Steel split ring.*

The only remnant of the gust lock equipment found in the wreckage was the steel, T-handled, rudder locking pin. It was noted that the steel split ring, by which the aileron straps and elevator gust lock are normally attached to the rudder locking pin, was missing.

Other evidence which came to light during the wreckage examination showed that the flaps were at the take-off setting and the speed brakes were out. The landing gear was selected up and the braking parachute was unlatched with only its drogue chute extended. The crash switch had been operated.

Analysis

The evidence indicated that the pilots were not incapacitated in any way during the attempted take-off, and no evidence of defect or malfunction was found during the investigation that could account for the failure to rotate. However, the mode of break-up of the cockpit elevator controls indicated that they were in a neutral position when the first impact occurred. The results of calculations, and the observed performance of the aircraft, also indicated that the elevator control surfaces were in the neutral position throughout the take-off run. The lack of impact marks or damage to any of the control stops on either the captain's or co-pilot's controls, indicated that they were not forcibly struck at any time in the accident sequence. Damage to these stops would certainly have resulted had the cockpit controls been free to move.

The gust lock attachment spigot on the forward yoke of the captain's control column was found to be distorted in a way indicating that it had been in position when the accident occurred. There was no other related impact damage or apparent reason to account for the bending of this spigot. Although the gust locks should have been attached to one another and should therefore have been stowed together after removal prior to take-off, only the rudder locking part of the gust lock assembly was found during the search of the wreckage. The absence of a split ring on the part found indicated that the components had not been fastened together, despite the maker's recommendation that they should be.

The captain was known to make frequent use of the gust locks and, since the aircraft had been standing all day, it is most probable that they were in position on this occasion. According to the evidence of the survivor, the pre-flight check was carried out by the captain. The only item on the check list carried in the aircraft that referred specifically to proving the freedom of the flying controls was in the 'Before Starting Engines' check. This could easily have been overlooked, had the captain's check been interrupted. In this context, it might be pertinent that the departure was delayed, and a new flight plan made out, when two of the prospective passengers did not arrive. It is considered unlikely that the first officer, on his return from filing the flight plan, would have duplicated the 'Before Starting Engines' check already carried out by the captain.

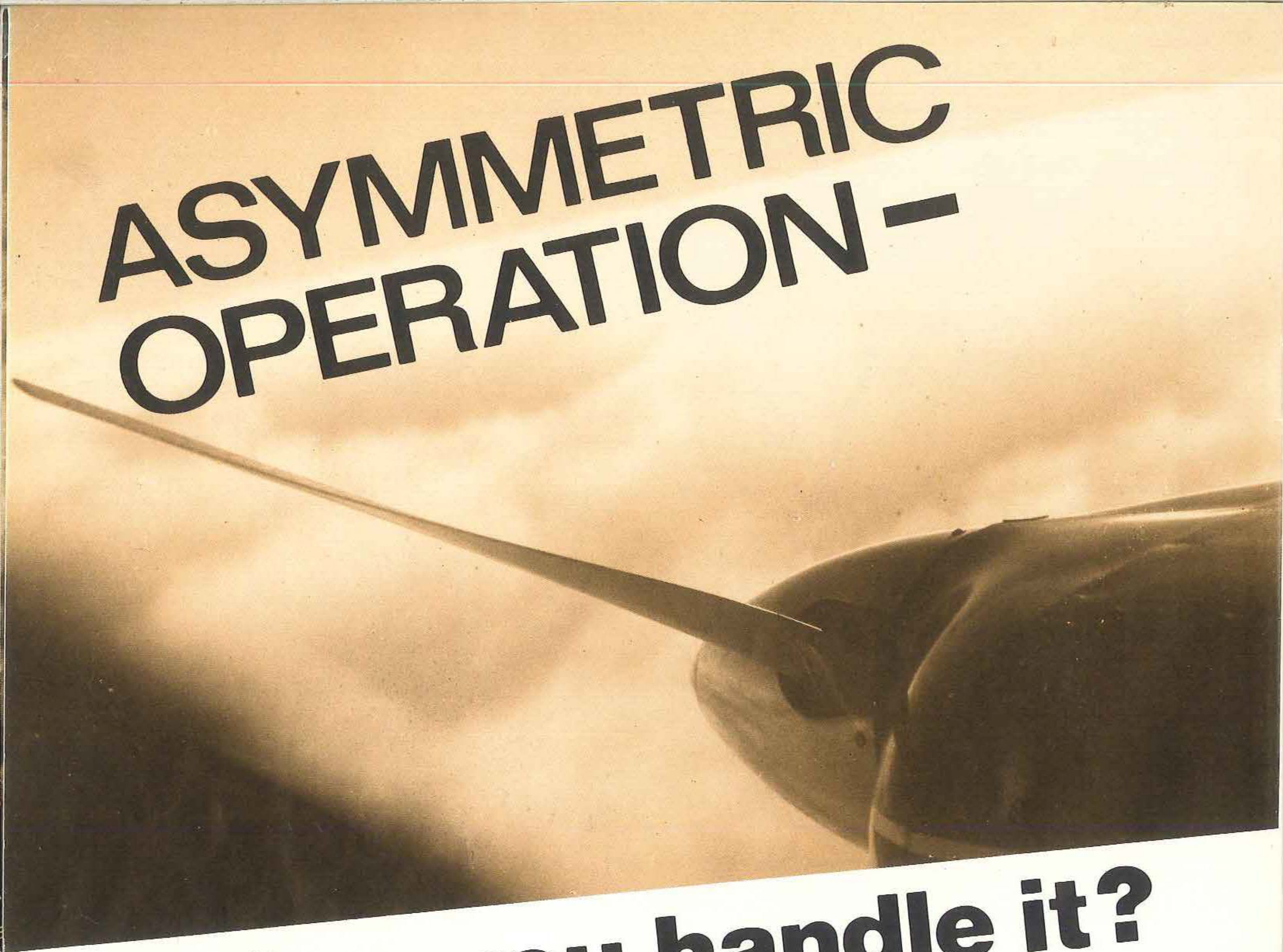
The elevator portion of the gust lock was inconspicuous when installed and did not interfere with access to the seats or the operation of the aircraft in any way other than the locking of the elevators. There was no requirement, in the 'Before Take-off Check', to exercise the flight controls and, as the pilots would probably have been occupied with copying their clearance and preparing the aircraft for take-off while taxi-ing out, it is probable that the flight controls were not checked before the start of the take-off run. On public transport aircraft it is common practice for the freedom of the flying controls to be checked *after* the engines have been started, during the 'Before Take-off Check'. This is specifically to guard against the possibility that one of the control locks might still be engaged or that movement of the controls is inhibited in some other way.

In the absence of any interconnection between the gust locks and the thrust levers in HFB 320 aircraft at the time of the accident, it was possible to obtain full power from the engines with the lock in place, and the design and performance of the aircraft is such that, with the elevator gust lock in position, the aircraft is incapable of unsticking. Later HFB 320 aircraft have been modified so that is is no longer possible to obtain take-off power from the engines with any of the gust locks engaged.

The considerable period between the aircraft attaining rotation speed and the subsequent decision to abandon the take-off is of some significance. Once a malfunction had become apparent to the pilot it is reasonable to assume that he would have abandoned the take-off promptly. However the effect of the elevator gust lock in the control system would not necessarily have been apparent until rotation speed was reached and it is likely that some confusion as to why the controls were not operating might have delayed corrective action by the pilot. The take-off was abandoned while the aircraft was still on the runway and the deceleration initially achieved on the concrete surface might have given the pilots the impression that the action thus far taken was enough to stop the aircraft within the confines of the aerodrome. Perhaps when the aircraft continued on to the grass overrun it was not immediately apparent that the deceleration was now considerably reduced and the brakes alone would not suffice. But whatever the reason for the delay, the braking parachute was not unlatched and the undercarriage not selected up, until it was too late for them to effectively reduce the speed of impact.

Cause

The accident was the result of a failure to unstick at the appropriate speed, most probably because the elevator gust lock was still in position. The take-off was abandoned at too high a speed for the aircraft to be brought to rest before colliding with obstructions.



ASYMMETRIC OPERATION – Can you handle it?

At Jandakot in Western Australia, the pilot of a Cessna 411 had planned to conduct some asymmetric circuit training as refresher flying in preparation for an instrument rating renewal test. Intending to do an hour's circuits and landings, he had arranged with air traffic control to do his practice during lunch time, when it was expected that other aerodrome traffic would be light.

About midday the pilot took off on his first circuit. At about 100 feet, after retracting the undercarriage, he throttled back the starboard engine to zero thrust and completed the circuit and landing with the starboard engine at this setting. After taking off again, with both engines operating, the pilot made a normal circuit and, when he had descended to about 100 feet late on final approach, carried out a practice overshoot. As the aircraft began to climb away, he reduced power to zero thrust on the port engine, retracted the undercarriage and stabilised the speed at 104 knots, the aircraft's best single-engine rate of climb speed. At a later stage in the circuit, he re-introduced power on the port engine and made a normal two-engine circuit and approach which he continued down to a height of 100 feet. He then again carried out an overshoot, this time reducing power on the starboard engine to the zero thrust setting. As the aircraft climbed away on each of these missed approaches, it passed over rising terrain beyond the far boundary of the aerodrome and the pilot saw that the aircraft seemed to be clearing this higher ground by only about 50 feet.

During the next circuit, the pilot feathered the starboard propeller and, after advising the tower he would be making an approach with one engine shut down, he completed a landing to a full stop. Planning to do only one more circuit to finish the exercise, he then re-started the starboard engine and took off again. On the downwind leg with the undercarriage still lowered, he feathered the port propeller and, after raising the undercarriage, he set climb power on the starboard engine, reducing this a short time later to about 65 per cent to maintain circuit height and airspeed.

A Cherokee 140 was ahead of the 411 in the circuit and the pilot, hearing the Cherokee report on turning base that it would be making a touch and go landing, waited until the Cherokee was on final appoach before turning on to base leg himself. He then experienced difficulty in keeping the Cherokee in view while on base, and gave his whole concentration to his efforts to maintain separation behind this aircraft which, as the Cessna 411

neared the extension of the runway centreline, was still high on final approach. Continuing his single-engine approach at about 104 knots with the flaps lowered 25 degrees, the pilot of the 411 became increasingly concerned, after the Cherokee had touched down, that it seemed to be taking an unusually long time to leave the ground again. He transmitted a call for the Cherokee to vacate the runway and, when the 411 was only a short distance from the runway threshold and at a height of about 50 feet, the other aircraft began to go around. Seeing that he now had sufficient clearance behind the Cherokee to continue with the landing, the pilot of the 411 closed the throttle on the starboard engine.

* * * *

Meanwhile, the pilot of a Cessna 150 at the holding point had called ready and had been instructed to hold position until the 411 had passed. As the twin crossed the threshold, he noticed that one engine was feathered, but then realised the undercarriage was still retracted. Picking up the microphone he transmitted a call that the landing aircraft 'doesn't have any wheels down'.

As soon as the pilot of the 411 had closed the throttle, the undercarriage warning horn had sounded. Almost simultaneously, he heard the radio transmission that the undercarriage was not extended. Applying full power on the starboard engine to go around, the pilot quickly glanced at the undercarriage selector and saw it was still in the UP position. He selected the flaps up from 25 degrees, let the aircraft swing slightly to port to avoid the Cherokee climbing out ahead, and attempted to carry out a missed approach.

By this time, the speed had dropped to 98-100 knots, and looking out, the pilot saw that he was now lower than the top of the nearby windsock. Although the Cessna 411's best single-engine angle of climb speed is 100 knots, the pilot attempted to achieve the best rate of climb speed of 104 knots and, as the aircraft did not seem to be accelerating, he went to re-start the port engine. But though the propeller turned over on the starter, the engine would not fire. During his starting attempts, the speed still had not increased above 100 knots and realising that, unless the port engine was operating, he would be unable to clear the rising ground beyond the end of the runway, the pilot decided his only course of action was to land on the grass. Closing both throttles, he

The condition of the Cessna 411's propellers tell their own story better than any words.

The Cessna 411 aircraft as it came to rest looking in the direction of flight. Impact and slide marks are clearly discernible in the foreground.

selected the undercarriage and flaps down, turned off the ignition and battery master switches, and manoeuvred the aircraft to a clear area beside the runway. The aircraft touched down with the undercarriage only partly extended and was extensively damaged as it slid to a stop. The pilot was not injured, and left the aircraft immediately it came to rest.

* * * *

It was learned during the subsequent investigation that the pilot had never undergone formal twin-engine endorsement training. He was experienced on single-engine types and had taken the opportunity from time to time to receive dual training on twin-engine aircraft, but this had been spasmodic and conducted over an extended period.

Although the basic cause of the accident was attributed to the pilot's omission in neglecting to lower the undercarriage, the circumstances and events leading up to it contained a number of other object lessons in airmanship. In approaching too close behind the Cherokee 140, the pilot allowed his attention to be diverted to the extent that he omitted to carry out his pre-landing cockpit checks. As well, he persisted with the approach to a very low height and well beyond the stage where he could be certain that the situation could be recovered if the preceding aircraft failed to clear the runway in time. And, perhaps most important of all, in continuing his single-engine approach to a height as low as 50 feet, at a slow speed with flaps extended and with rising terrain ahead, he placed the aircraft in a position where he had virtually no chance of carrying out a successful asymmetric missed approach. His action in attempting to unfeather the port propeller only served to increase the drag of the aircraft even further at a critical stage, and his decision to put the aircraft on the ground was wise in the circumstances.

During their initial twin or multi-engine conversion training, pilots normally receive instruction in the basic theory of flight with asymmetric power. They learn the meaning of such terms as minimum control speed, take-off safety speed, and accelerate-stop performance, as well as the techniques and important reference speeds applicable to their particular aircraft. They also learn, and have demonstrated to them, that when a light, twin-engine aircraft is flown on one engine, *the climb performance remaining* is not simply equal to half that available with both engines operating, but *is commonly as low as 20 percent or less.* Under conditions of high temperature and aerodrome elevation, this figure may be even lower. If an engine is lost at a critical stage during take-off, not only may the aircraft be incapable of maintaining height in the take-off configuration, but it may be unable to accelerate from the lift-off speed to a safe climbing speed without descending.

While most pilots are aware of the magnitude of this performance loss and realise it is not unusual for this class of aircraft, many do not appreciate the reasons for adopting a particular handling technique for one aircraft type and a different technique for another. In fact, in order to achieve even the minimum level of performance available with one engine inoperative, it is imperative that the pilot adopt the correct technique for the particular type. Conversely, the use of the wrong technique can mean an even greater loss of performance and, in extreme cases, loss of control. The following discussion briefly reviews some of the less well understood theoretical aspects of asymmetric flight and distinguishes those areas where significant handling differences between aircraft types may be encountered.

* * * *

The first requirement is to clearly understand the normally accepted difference between yaw and sideslip.

Yaw

Yaw is the angular change of aircraft heading from a specified datum heading. An aircraft which has completed a 360 degree turn has yawed through 360 degrees.

Sideslip

Sideslip is the relationship between the aircraft heading and the direction of the airflow approaching the aircraft. It may be expressed as an angle (β) or a lateral velocity (v) — see Figure 1.

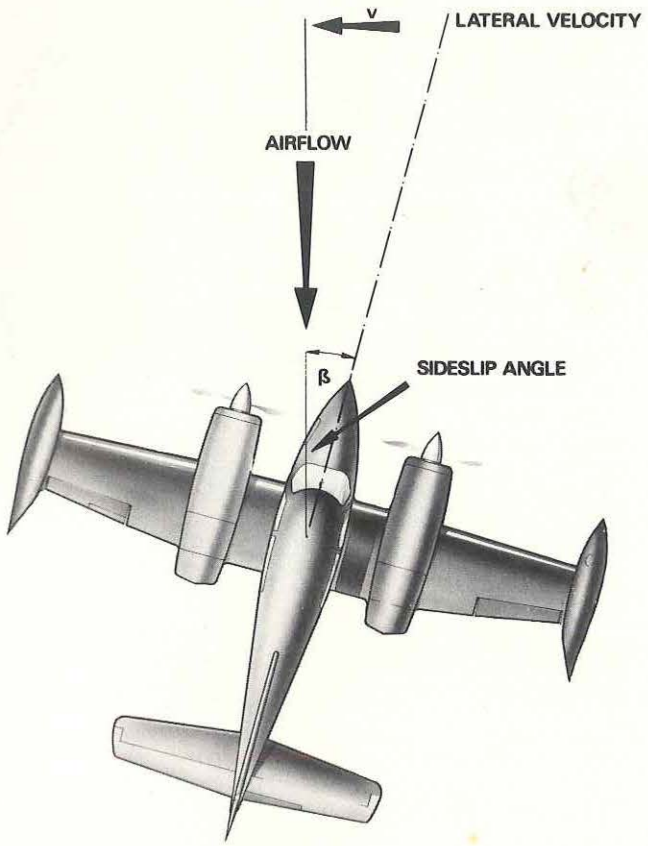


fig.1. SIDESLIP

Thus it follows that, during a flat turn using rudder alone, the aircraft will yaw in one direction and sideslip in the opposite direction.

Steady asymmetric flight

To show the differences between the techniques that may be used to maintain steady asymmetric flight, we will consider two cases:

- wings level; and
- small bank angles.

Although a third procedure, using zero rudder deflection could be described, this method is impractical as it requires both large bank angles and large sideslip angles to achieve steady flight.

Wings-level asymmetric flight

In wings-level asymmetric flight, the yawing moment caused by the asymmetric thrust is balanced by a moment generated by the fin-rudder combination (see Figure 2). Although the moments are balanced, the rudder side force is not. This unbalanced force accelerates the aircraft laterally until the drag caused by the lateral velocity — sideslip — is equal to the rudder side force. The aircraft is now in steady-heading flight with a sideslip velocity away from the live engine. But because the wings are level and the aircraft is in straight flight, the slip ball — an acceleration detector — will remain in the centre. An airflow direction indicator however, would show the sideslip angle present.

In this situation, the aircraft's directional stability would normally cause it to yaw into the airflow and reduce the sideslip to zero. This must be prevented by the pilot in order to maintain the balance of forces and moments, and he does this by holding a greater rudder deflection and applying greater rudder pedal forces than would be necessary if the aircraft was flown without sideslip.

Asymmetric flight with small bank angles

If the rudder side force is balanced by some force other than a drag force caused by the aircraft's lateral velocity, the aircraft can be flown without sideslip. This condition may be achieved by using a small bank angle — usually less than 10 degrees — towards the live engine (see Figure 3).

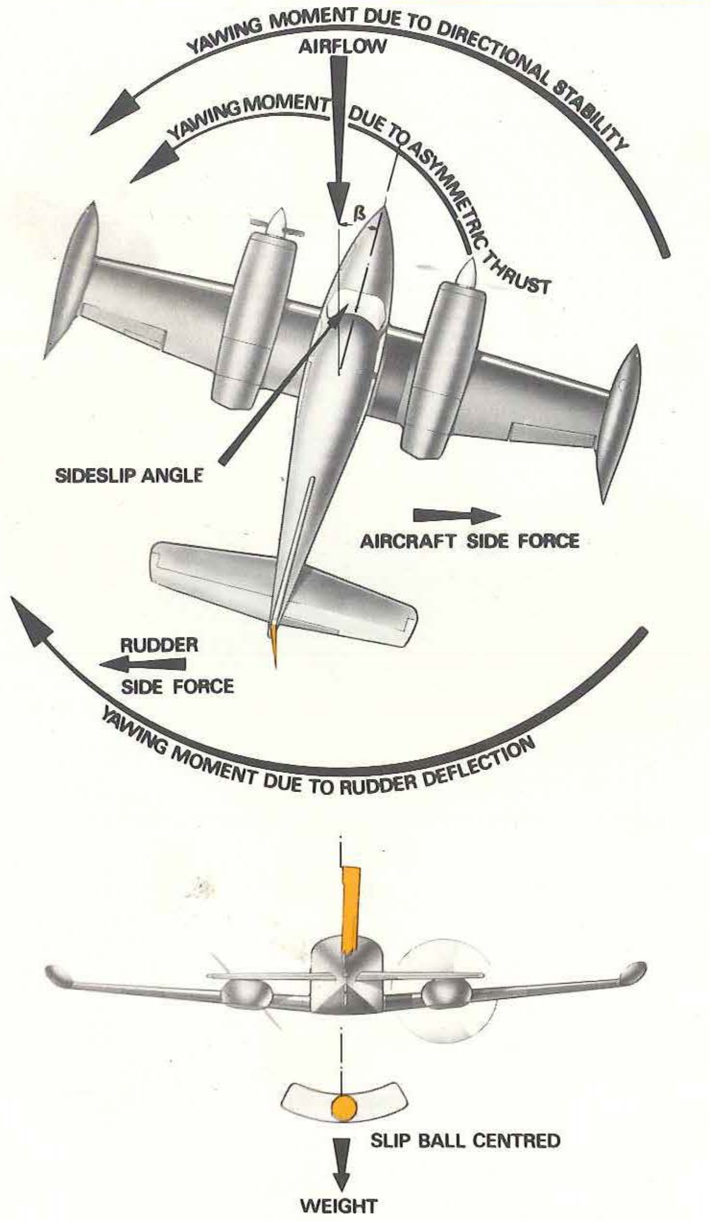


fig.2. WINGS - LEVEL ASYMMETRIC FLIGHT

In this case the slip ball will not be in the centre, for though the aircraft is not sideslipping, it is flying in a straight path with a small bank angle.

Any attempt to centre the slip ball with rudder will result in an unwanted sideslip accompanied by an increase in drag and a possible reduction in climb performance. The rudder deflection and forces will be less than the wings-level case as the pilot does not have to overcome the aircraft's directional stability with additional rudder deflection. As well, there is only a small yawing moment because of the bank angle, which means that slower speeds may be reached before loss of control occurs. In the determination of the minimum single-engine control speed at the time of an aircraft's initial certification, it is of interest to note that the relevant airworthiness requirements permit the use of bank angles of up to five degrees towards the live engine.

The effect of sideslip

The best asymmetric performance for a particular aircraft type will be a compromise between the performance lost because of the extra drag whilst sideslipping and that lost because of the higher wing incidence, or angles of attack, required for the increased lift force necessary for banked flight.

A 'further effect' of sideslip is that rolling moments are produced because the aircraft has lateral stability. This is commonly referred to as dihedral effect. If the aircraft has strong lateral stability it may require correspondingly large aileron deflections to prevent the aircraft rolling. In extreme cases, such as with degraded lateral control that may result from a system failure, the rolling moments caused by sideslipping may be greater than those which can be produced by the controls. This would cause an uncontrollable rate of roll until the pilot reduced the sideslip angle.

Control position during asymmetric flight

Obviously, the amount of aileron and rudder deflection required for steady asymmetric flight will vary from aircraft to aircraft. The position of the ailerons will be dictated by:

- dihedral effect and magnitude of sideslip;
- aileron power;
- rolling moments caused by rudder deflection (particularly with a large fin and rudder mounted high above the aircraft's centre of gravity);
- rolling moments caused by differences in airflow over the wings behind the live and failed engines (mainly on propeller driven aircraft); and
- airspeed.

On the other hand, the rudder position required for asymmetric flight, in addition to being affected by speed, nose attitude and engine power settings, is also dependent upon:

- the aircraft's directional stability (if the sideslipping technique is being used);
- rudder power;
- aileron drag, if the ailerons are deflected; and
- the combination of rudder and bank angle used to control yaw.

* * * *

Compared with a single engine aircraft, a twin offers many obvious safety advantages, not only in the en route phase of flight, but during take-off and approach as well. But the safety margins can be small indeed and any advantages that may be realised by having a second engine can rapidly become disadvantages unless the pilot fully understands the real level of performance available with one engine inoperative and the precise techniques which must be used in order to achieve even these minimum levels.

Of all the techniques and procedures peculiar to asymmetric flight, probably the least understood aspect is that the slip ball is no longer an indication of sideslip. As we have seen in this brief discussion, the slip ball can be in the centre when there are significant sideslip angles present, just as it can be out to one side when the aircraft is flying with zero sideslip. Attempts to centre the slip ball with rudder when flying with bank can result in unnecessarily large rudder deflections with high forces and crossed controls. These effects can only cause a further degradation of performance, as will the simultaneous use of bank, sideslip and possibly large aileron deflections to achieve a steady flight condition. Unless the pilot appreciates these facts, he may be unable to obtain maximum performance from the aircraft he is flying.

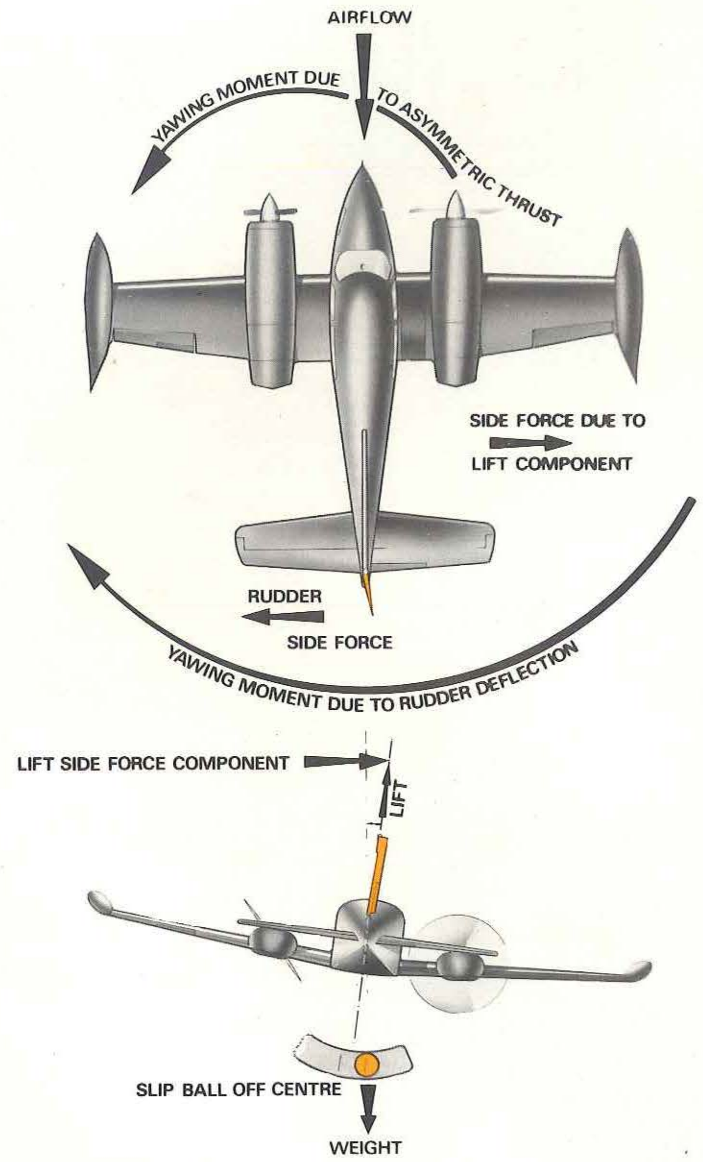
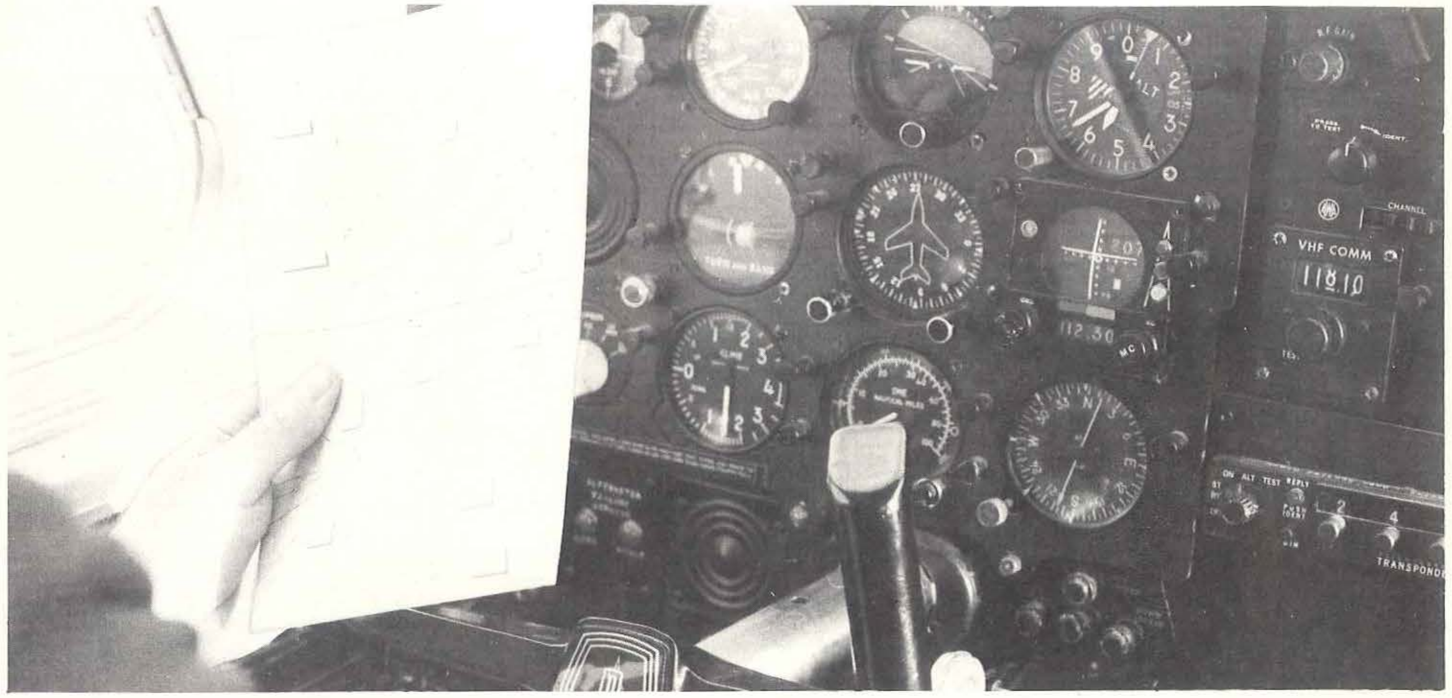


fig.3. ASYMMETRIC FLIGHT WITH SMALL BANK ANGLE



AUTO·PILOT DISENGAGEMENT

The following account is part of a report received from the pilot of a PA-34 aerial ambulance, which was making a night flight from Whyalla to Leigh Creek, South Australia, and return.

'The weather forecast had included two oktas of cumulonimbus cloud and, approaching Leigh Creek at 40 DME, we encountered an area of thunderstorm activity which extended to within ten miles of our destination. We finally established visual contact only five miles out, and carried out an NDB approach to the aerodrome.

When preparing to depart again, knowing there was this thunderstorm activity over the hills, I planned to climb in the circuit area to pass through 4000 feet before setting heading from Leigh Creek. After taking off from runway 16, I turned left on to 070 degrees M at 1400 feet, and left again on to 340 degrees at 1700 feet. At 2500 feet I engaged the auto-pilot master switch, the heading hold and auto-trim, and set up a climb at 700 feet per minute and 110 knots, and then, on the auto-pilot, I positioned the aircraft to overfly the NDB on a track of 189 degrees M.

As the aircraft crossed the NDB at 3500 feet, it appeared to me that the active thunderstorm area was moving to the east, and I decided to deviate to the west of track if the turbulence became too severe for the patient we had on board. I accordingly unfolded my Radio Navigation Chart to copy the Woomera NDB frequency and DME channel on to my knee-board, then swung around in my seat to brief the ambulance attendant on what I intended doing.

Having done so I turned my attention to the controls again and checked the instrument panel. Immediately I saw that the aircraft was in a 20 degree bank to the left, about 45 degrees off heading, and was now climbing at only a little over 100 feet per minute!

After re-establishing the climb on a heading of 220 degrees to intercept the track of 189 degrees, I checked the auto-pilot and found the master switch off. I therefore disengaged the auto-trim and heading hold, turned on the auto-pilot master switch again, and re-engaged these two modes. Throughout the rest of flight the auto-pilot performed faultlessly in whatever modes were selected.

On reflection, I realised that, while checking the Woomera frequencies from my RNC, I had accidently switched off the auto-pilot by allowing the chart to come in contact with the electric trim switch on the left hand side of the control wheel.

Although the aircraft was at no time in any danger during this episode, it occurred to me that it could easily be otherwise in different circumstances. If it happened for instance when the pilot workload is high enough to adversely affect one's monitoring of the auto-pilot, such as during a climb in IMC after departing from a primary airport on a complex instrument departures clearance, when there is a high communications workload as well, the situation could be potentially very hazardous indeed.'

Comment

We very much appreciate our contributor's concern for safety in bringing this incident to our attention. The sharing of potentially dangerous experiences like this one can only result in an increased safety consciousness by other pilots in similar situations.

The possibility of an occurrence of this sort was in fact considered during the investigation of the fatal accident to a PA-31 at Golden Grove, South Australia, on 13 July 1972, but there was insufficient evidence either to support or refute this hypothesis. Tests conducted during this investigation established however, that the auto-pilot disconnect button on the control wheel of the aircraft type involved, was extremely sensitive, and that disconnection could occur if the button were gently tapped with a sheet of paper, or even brushed with a shirt sleeve.

Although auto-pilot controls for reasons of operational safety, need to have the capacity to be readily and quickly disconnected when the need arises, it is possible that control column switches of this type may be too prone to inadvertent operation and they are currently being examined by the Department.

THE REAL THING

Most readers will remember this safety poster, which was published on the inside back cover of Digest No. 86.

A conscientious pilot has just written to point out, against himself, that despite the warning and the fact that he was aware of this particular danger, he found himself in exactly the circumstances depicted in the poster — and a potential tradgedy was avoided by the narrowest of margins.

This pilot writes:

I had begun to daily my aircraft at Kempsey one morning recently, for a flight to Tuncurry, when a yell from a friend caused me to swing around just in time to see him knocking a bottle out of his little boy's mouth.

The bottle was about a third full of green soft drink — in reality 100-130 octane aviation fuel! After carrying out a water check on one of the aircraft tanks, I had placed the soft drink bottle used for the purpose on the ground, still with the "green stuff" in it, while I continued with the inspection.

Obviously the little chap had felt like a drink and was about to begin sampling the interesting looking liquid in the bottle. He hadn't quite got the bottle into a horizontal position when his father knocked it away.

This probably saved his life, for he is one of those kids who puts the neck of the bottle right into his mouth. So if he had tipped the bottle any further, the fuel would have flowed straight down his throat!

It is bad enough that this incident occurred at all, but it is rendered all the worse by the fact that, even as I was taking the bottle out of the aircraft to do the water check, I remembered some time before reading a warning in the Digest about:

- The danger of using soft drink bottles for doing water checks; and
- Leaving fuel samples lying around in a container, rather than emptying it straight away, so preventing it becoming a temptation to thirsty or curious little people.

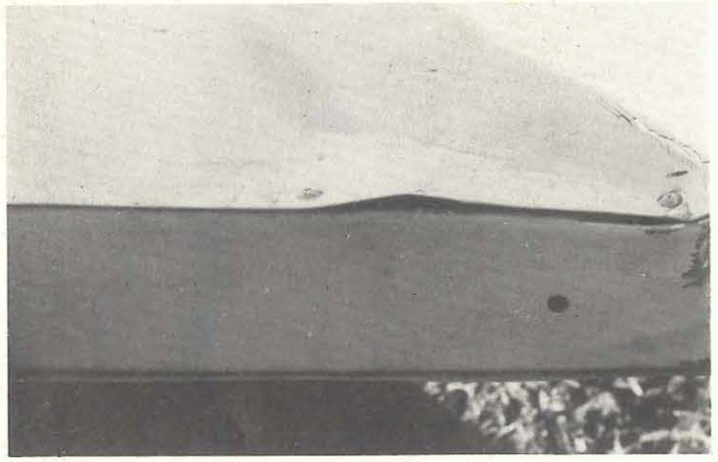
I hope this experience might assist in some way to emphasise the necessity for extreme caution whenever children are in the vicinity of aeroplanes.

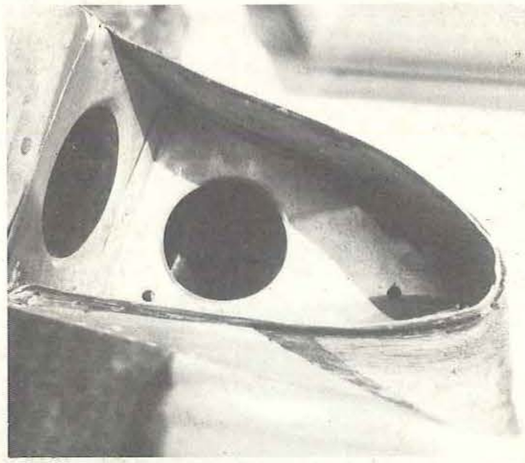
A Moo-t Point!

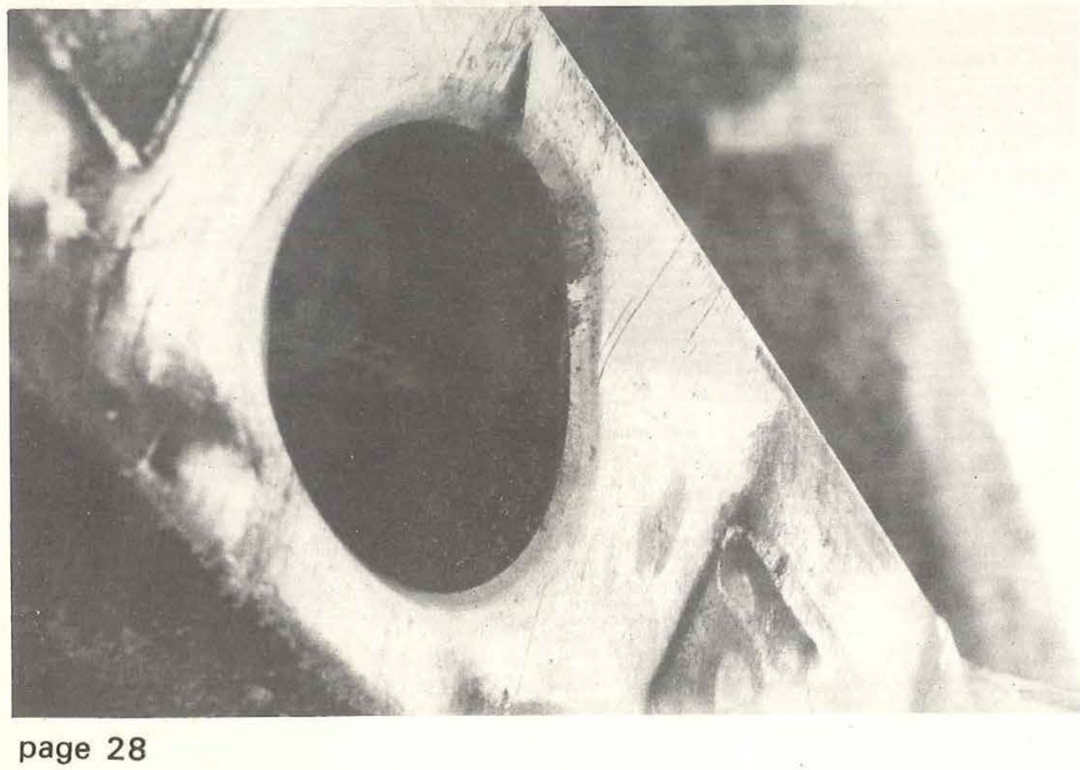
Not long ago, the owner-pilot of a Cessna 172, telephoned a Maintenance Organisation at Parafield, from Kingston, South Australia advising that his aircraft's tailplane had been damaged and that he wished to bring the aircraft in for repair.

Apparently, while the aircraft was left parked in a paddock, a cow had taken a fancy to the shade it offered and had settled herself comfortably under the tail section. Evidently then, when the owner-pilot had returned to resume his journey, the cow, possibly upset at having her rest disturbed in this way, had stood up somewhat too suddenly, giving the underside of the tailplane a heavy blow. As the damage seemed to be confined to some minor denting and buckling, plus a few scratches as shown in the first two pictures, the pilot thought it would be all right to fly the intervening 220 kilometres to Parafield to have the damage repaired.

Fortunately, the chief engineer of the maintenance workshop, prevailed upon the pilot to remain where he was, and despatched an engineer in another aircraft with a replacement tailplane. It was as well he did. When the damaged tailplane was examined, it was found that it had been seriously weakened internally, with a torn and buckled main spar, as well as separation of a leading edge rib from the buckled spar bulkhead.







Top
Outboard edge of starboard tailplane showing buckling of skin. The tailplane is upside-down in the picture.

Centre
Hidden damage revealed after tailplane was removed from aircraft, the leading edge rib is buckled and has separated from spar.

Bottom
The torn and buckled main spar.

Would the tailplane have failed if the pilot had attempted to fly the aircraft to Parafield? Who can tell — it would probably have depended on the intensity of the turbulence encountered during the trip. What is certain is that the structural strength of the tailplane was greatly reduced by the unseen internal damage, and to have flown the aircraft in that condition would have been a risky venture indeed.

Thanks to the vigilance of the chief engineer however, there was no possibility of this developing into another fatal object lesson in air safety. Thus, happily for the pilot concerned, it is one that he, as well as other readers of the *Digest*, have the opportunity to learn from.

AND STILL IT HAPPENS!

Hand starting today is the exception rather than the rule – yet the number of aircraft that get away is quite astonishing. The results are inevitably expensive.

Simple common sense precautions can prevent this happening to you!