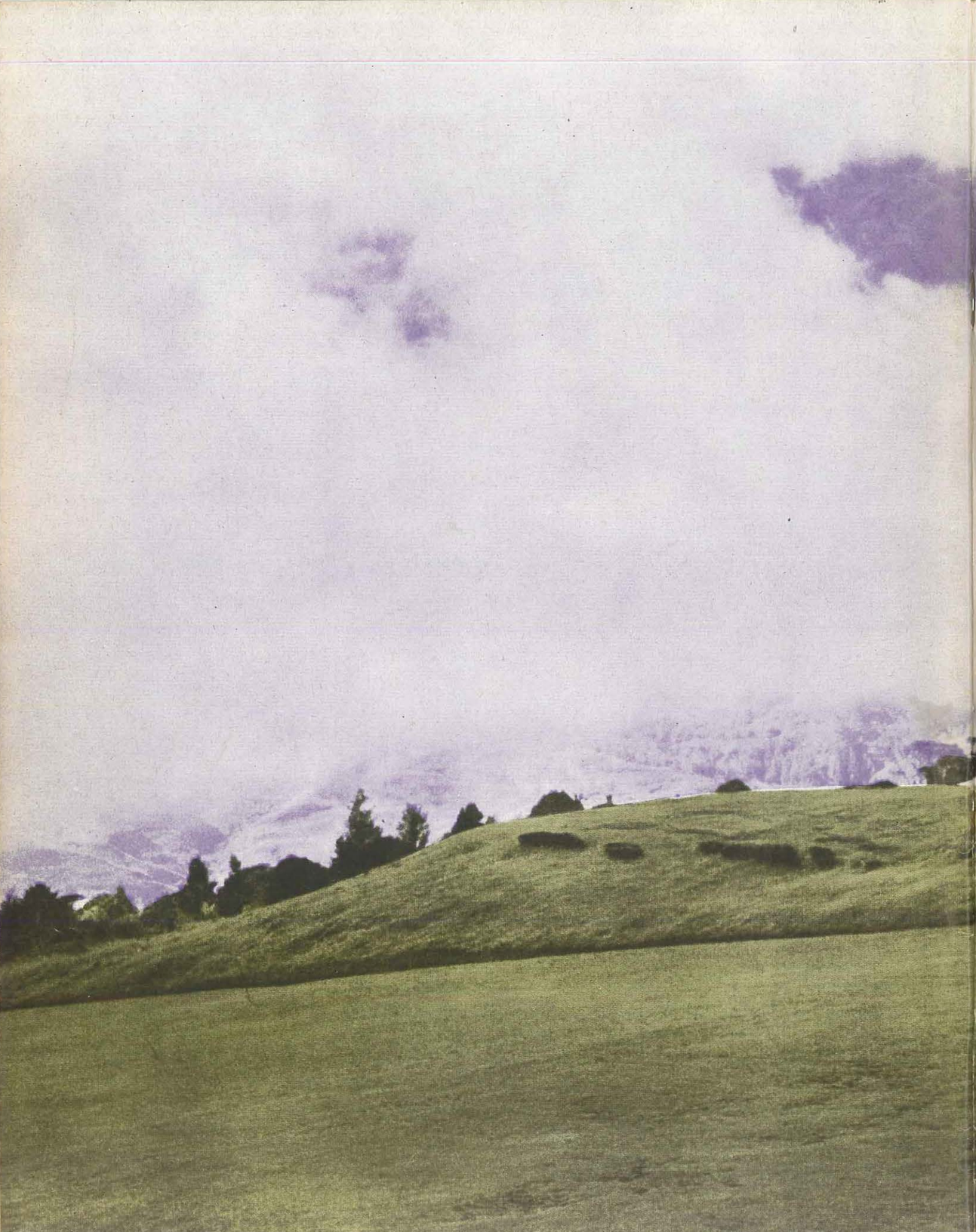
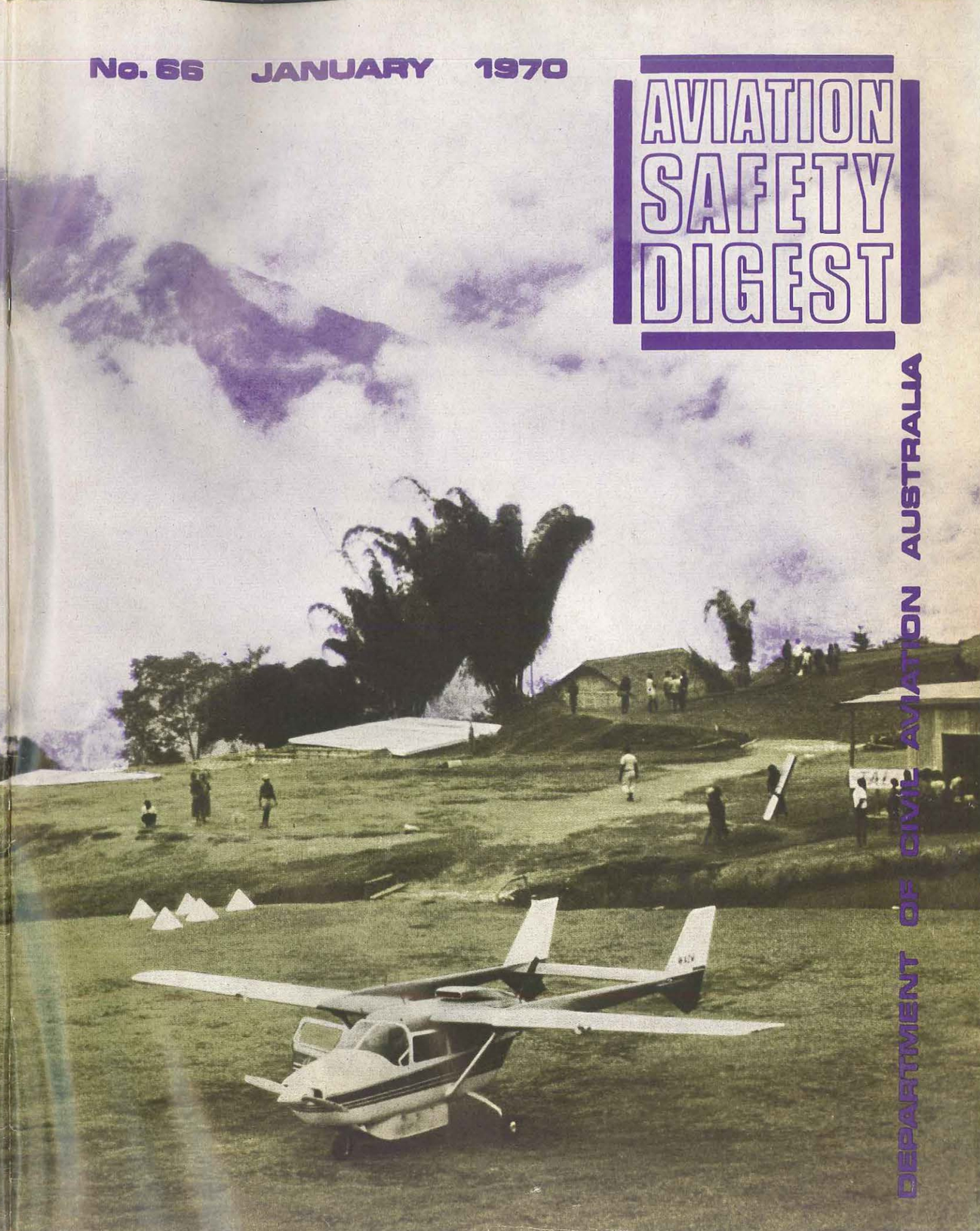
No. 66 JANUARY 1970

AVIATION SAFETY DIGEST

DEPARTMENT OF CIVIL AVIATION AUSTRALIA





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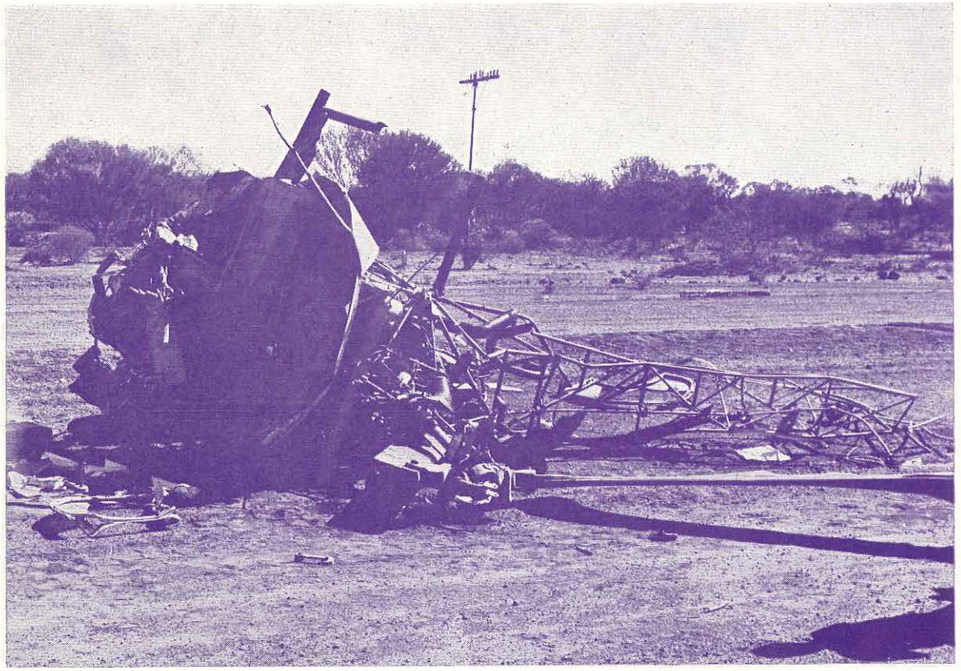
DEPARTMENT OF CIVIL AVIATION, AUSTRALIA

Contents

COVER: Surrounded by cloud-enshrouded peaks, the airstrip at Omkalai, 5,500 feet up on a valley side in the towering New Guinea Highlands, bears dramatic witness to the skill and judgement of Territory pilots for whom such difficult operating conditions are all in a day's work. This "one way" strip is among the most steeply sloping in the Territory of Papua and New Guinea and pilots using it are officially cautioned to "maintain momentum with power after landing in order to negotiate the steep slope."

AUSTRALIA

Printed by The Ruskin Press Pty. Ltd., 39 Leveson Street, North Melbourne



HELICOPTER DESTROYED

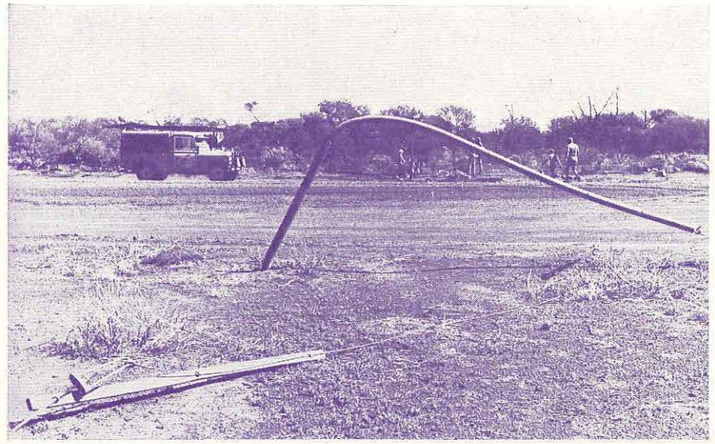
during low level cross-country flight

IN Western Australia, a Bell 47 helicopter was being ferried from Perth to Mt. Newman in stages extending over two days. The crew consisted of two commercial helicopter pilots who were taking it in turns to fly the aircraft on the long trip.

For the first day's flying, refuelling stops were planned at Wongan Hills, Payne's Find and Mt. Magnet, with the final stop for the day at Meekatharra. On the actual day of the flight, however, strong winds were encountered, making progress slower than the crew had hoped. To enable them to still reach their planned refuelling stops with adequate reserve fuel, the crew resorted to flying low, to minimize the effect of the head winds. Apart from this factor, the first day's flying proceeded according to plan and the crew spent the night at Meekatharra.

Departing from Meekatharra at 0855 hours the following morning, the flight again encountered unfavourable winds and for the first hour, a ground speed of only 46 knots was achieved. The pilot flying the aircraft then descended to a very low height and for the rest of the flight to the next refuelling stop at Kumarina, the ground speed rose to 55 knots.

In planning the next leg of the flight to Mt. Newman, it was apparent to the crew that they



The anchor point for the stay wire, pulled to the ground after the helicopter had struck the wire above the road. The telegraph pole which the stay wire was supporting was on the opposite side of the road where the group of men are standing.

would not be able to reach their destination with the fuel available unless they could maintain a ground speed of 55 knots throughout—the speed that was achieved on the previous leg only by flying at a very low level. After departing from Kumarina at 1220 hours, the flight was therefore resumed at very low level along the old section of the Great Northern Highway north from Kumarina. Twenty minutes later, while flying only a few feet above the ground but well to starboard of the telegraph line that runs along the road, the helicopter approached the point where the old section of the road rejoins the new. As it reached the intersection, in the words of the pilot who was flying at this stage, "the aircraft suddenly seemed to explode," somersaulted on to its back, and crashed to the ground by the edge of the road. The cockpit bubble disintegrated and the second pilot was flung out when his seat belt failed and was seriously injured. The pilot who was flying the helicopter was restrained in his seat by his safety harness and escaped serious injury.

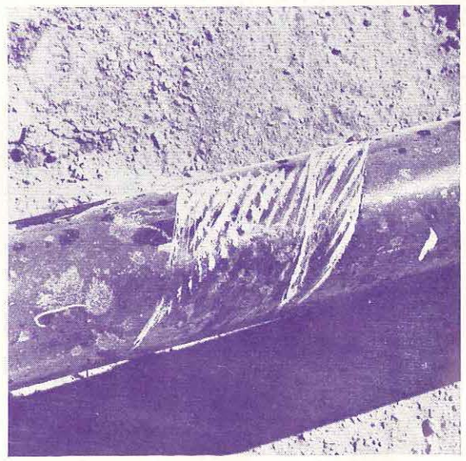
The two members of the crew were picked up by a passing motorist who arrived on the scene soon after the crash, and were driven back to Kumarina for first aid and subsequent transfer to hospital in Perth.

* * *

Examination of the accident site and the wreckage showed that the helicopter had collided with a stay wire supporting one of the telegraph poles, which passed from the pole horizontally above the road to an anchor point on the opposite side. The stay wire was a high tensile steel cable 7/16" in diameter and it was evident that the helicopter had snagged the cable with its skids. This sudden check, together with the aircraft's momentum had somersaulted the helicopter on to its back. The height of the stay wire above the road was only 18 feet.

The pilot said that he was wearing sun glasses at the time of the accident, and as the surface of the cockpit bubble was tinted green, it would have been difficult for him to see an obstruction such as the stay wire. It seems very unlikely however, that even without sun glasses and with a clear perspex cockpit bubble, that it would have been possible to see the cable in time to take avoiding action.

Cable strike marks found on the starboard skid of the helicopter. Similar marks were also evident on the port skid.



The company which operated the helicopter held an approval to conduct aerial work operations at a height lower than 500 feet when their work necessitated low flying. Ferry flights such as this one, however, are private operations, not aerial work flights, and the pilot was therefore required to plan and conduct the flight at heights above terrain which conform with those prescribed in ANR 133 (2) (b). But quite apart from the legality of the situation, it is debatable whether the pilot's action in flying at such an extremely low level served any real purpose. Rather, it seems that whatever relief from the head winds there was to be gained by flying low, would not have been greatly improved below 100 feet.

Although the cause of the accident has been attributed to operating the helicopter at an unsafe height, it is also apparent that the planning of the operation was a contributing factor. The refuelling stops were planned on the basis of making the flight in nil wind conditions and made no allowance for possible head winds, yet the pilots were aware, from this experience on the previous leg, that the winds were adverse.

The accident serves as a further reminder that to operate an aircraft at such low levels, even a versatile and highly manoeuvrable machine like a helicopter, is to invite disaster. Expensive as this object lesson was, it could very easily have been far worse. In the circumstances, the two occupants can consider themselves extremely fortunate to have survived.

General view of the wreckage with the position of the stay wire indicated by the heavy dotted line. The damaged anchor point shown on the opposite page can be seen at the extreme left. The picture was taken looking back in the direction of the helicopter's approach.

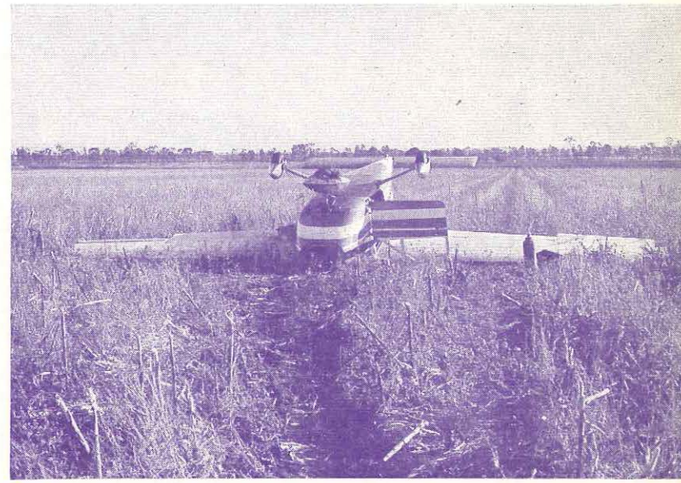
Briefing disregarded . . .

FROM Cambridge, Tasmania, an instructor and three trainee pilots set out in a Cessna 177 on an extended navigational exercise to Cairns, in north Queensland. The main purpose of the flight was to enable one of the pilots to gain the experience necessary to have the area restriction removed from his private licence. En route, this pilot successfully completed several exercises both dual and solo, and five days after leaving Cambridge, the aircraft and crew arrived at Dunk Island, off the Queensland coast, some 65 miles south of Cairns.

Late on the following day, the instructor briefed the trainee on the proposed route for his final solo exercise. He was to fly firstly to Innisfail, land and refuel, and then proceed inland over Mount Garnet and Port Douglas, to Cairns (see map). After refuelling once again, he was to return to Dunk Island by the direct route along the coast, planning to arrive no later than 1700 hours, thus ensuring adequate time to complete the flight before the end of daylight, which on this occasion was 1821 hours. The instructor also briefed the trainee to make an assessment of the local weather when he landed at Innisfail and, if conditions appeared to be unfavourable inland, to replan the flight direct to Cairns via the coast and return to Dunk Island the same way. The instructor made it clear that he did not wish the trainee to fly inland during the afternoon, because of the possibility of encountering adverse weather along the coastal ranges.

Next morning at about 1030 hours, the pilot took-off from Dunk Island and flew to Innisfail as planned. After refuelling at Innisfail the pilot decided to fly direct to Cairns because there was rain and low cloud in the area and he thought it inadvisable to fly inland over the ranges in these circumstances. The pilot arrived at Cairns in due course and, after a stay of several hours, prepared for the return journey to Dunk Island. After obtaining a weather briefing and satisfying himself that he would be able to conduct the flight in visual meteorological conditions, he planned to return to Dunk Island not via the coast as he had been instructed, but by flying in the reverse direction over the inland route that he was to have used for the outward portion of the exercise that morning. At 1541 hours, the aircraft departed from Cairns in fine and clear weather conditions with an estimated time of arrival at Dunk Island of 1730 hours, or 51 minutes before the end of daylight, and a SARTIME of 1800 hours. During the flight the pilot made several minor corrections to his heading and eventually arrived over Mount Garnet aerodrome some 10 minutes late. He then continued towards Innisfail but, 15 minutes later, noticed that the cloud base was beginning to lower. He turned northwards to intercept a road which led through the ranges to Innisfail and followed this road for a further five minutes until he saw that, ahead of the aircraft, the cloud base lowered almost to ground level. Realising that he would not be able to proceed any further towards his destination in visual meteorological conditions, the pilot then turned on to a reciprocal heading in order to retrace his route, but found that the cloud had also lowered in the area from which he had just come and was now blocking his return.

The pilot saw that conditions were a little better to the north and, as he understood that there was an airstrip near Atherton, he turned next in this direction. Soon afterwards however, he became uncertain of his position and at approximately 1750 hours, after an unsuccessful attempt to locate an airstrip, he decided to make a precautionary landing before darkness overtook him. After a brief search he chose a large cultivated field and inspected it from the air before making an approach to land. The aircraft touched down with a small tail-wind component and, following a curved path, headed slightly across the rows of shallow furrows which ran the length of the field. Towards the end of the landing run, with the speed still between 20 and 30 knots, the nose wheel struck the raised side of a higher ridge of earth. The nose wheel was deflected fully to the left, and remained in this position as it was forced through the soft soil. Losing speed quickly, the aircraft tipped forward on to its propeller and starboard wing, somersaulted, and came to rest on its back, badly damaged. The pilot escaped injury and extricated himself from the aircraft unaided.

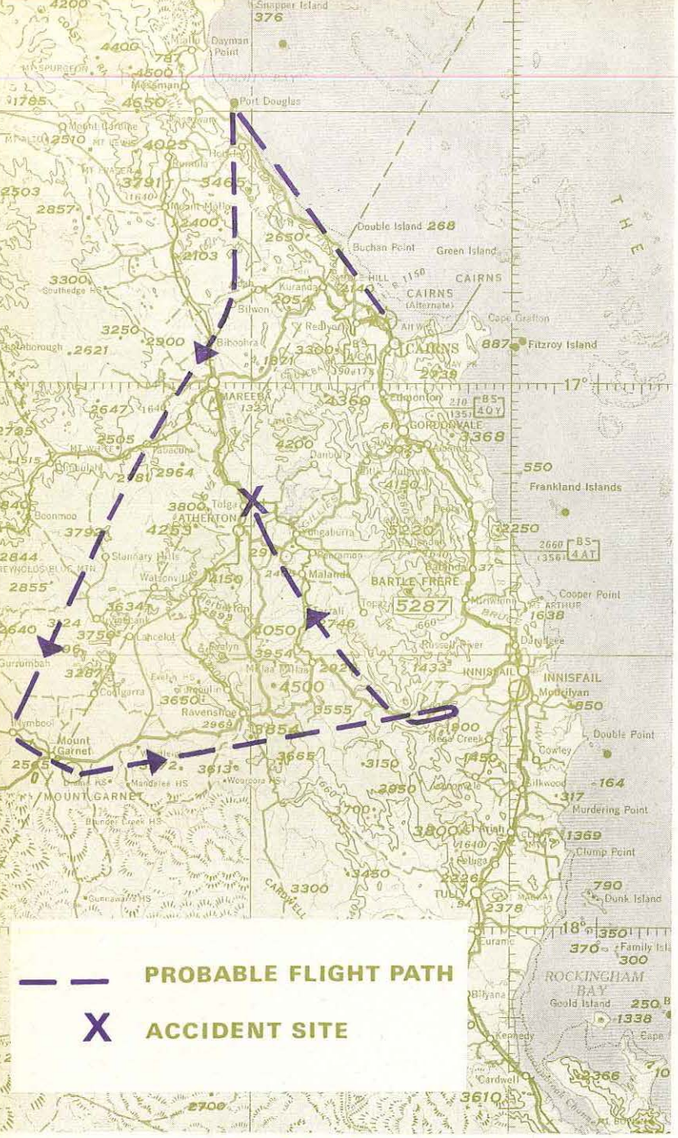


The ridge of earth which forced the nose wheel off-centre. The path of the deflected nose wheel through the soft soil is clearly evident.

* * *

When the pilot was questioned during the investigation of the accident to establish the reasons for his departure from the nominated route, the Departmental investigator gained the impression that, having flown from Dunk Island to Cairns the "easy way" (i.e. along the coast), the pilot did not wish his final navigation exercise to develop into a simple "there and back" flight requiring no excep-

The accident site looking in the direction of landing. The man in the foreground is standing at the aircraft's touch-down point.

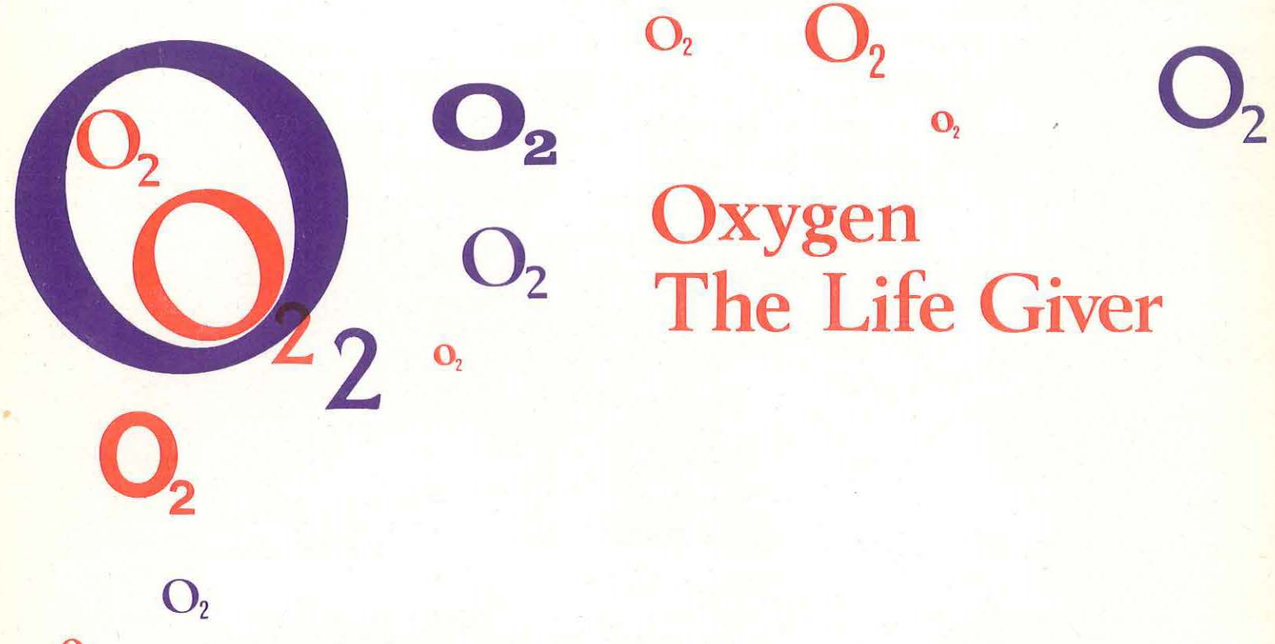


tional navigating ability and that he wanted to cover the route originally proposed one way or another, if this were at all possible. The route chosen however was over country which, in addition to being amongst the most rugged and uninviting in Queensland, is notorious for its rapidly changing weather conditions. The forecast, which the pilot saw before leaving Cairns, showed that the area was under the influence of a south-easterly airstream and the conditions which he encountered were typical of what could be expected in such a situation. Had the pilot properly comprehended the information contained in the forecast, he would have realised that the expected cloud and cover, which included stratus with a base of 1,500 feet and cumulus with tops reaching to 9,000 feet, would still be barring his way, as it had that morning, on the coastal side of the ranges to the west of Innisfail.

Although he had been briefed to arrive back at Dunk Island not later than 1700 hours, the pilot departed from Cairns with an estimated time of arrival at his destination of 1730 hours. At first he was not unduly worried about this extended time interval, as he considered that the time remaining still provided a comfortable buffer before the end of daylight. Once he encountered deteriorating weather conditions however, which led in turn to diversions and navigational difficulties, this buffer was gradually reduced, eventually leaving him uncertain of his position in conditions of rapidly failing light. The pilot said later that he had no intention of remaining airborne in the approaching darkness and so made the decision to land while sufficient daylight remained. The pressures under which the pilot found himself at this stage possibly contributed to his choosing a field which proved unsuitable for the purpose. The pilot, when he encountered deteriorating weather en route, acted wisely in turning back while still in VMC, rather than "pressing on", and then, having become unsure of his position in conditions of failing light, in deciding to attempt a precautionary landing, but it is probable that he would not have found himself in such an unfavourable position at all if he had followed his instructor's directions.

It is noteworthy that the pilot did not use his radio to seek assistance when he became unsure of his position or to advise his intentions prior to attempting a precautionary landing. Quite apart from alerting the Department's Search and Rescue organisation to his predicament, it is possible that on this occasion the pilot could have been advised of the position of Mareeba aerodrome, which is only 12 miles from the accident site.

In making the decision to depart from the route details specified by his instructor, the pilot apparently let his judgement be swayed by his strong desire to cover the proposed route one way or the other. In so doing, he chose to disregard the very sound advice given by his instructor and to rely instead on his own limited flying experience and knowledge of the local terrain and weather. Initiative and the ability for making the right decision at the right time are qualities to be encouraged in a pilot; in this instance however, the pilot's decision, with its lack of appreciation of the reasons behind the instructor's directions to remain east of the ranges during the afternoon, set in motion the chain of events which culminated in his unsuccessful attempt to carry out a precautionary landing in deteriorating weather conditions.



Oxygen
The Life Giver

Air Navigation Order 20.4—"Provision and Use of Oxygen", has recently been amended and will be distributed to flight crew licence holders shortly. Unlike the previous issue, the amended A.N.O. will apply to all Australian registered aircraft—including those in the private category—and to gliders. Many general aviation aircraft now on the Australian Register are capable of operation at high altitude, but comparatively few of the pilots who fly them have had the effects of hypoxia (or lack of oxygen) demonstrated to them in a decompression chamber. The introduction of the Department's new requirements therefore provides a timely opportunity to discuss the effects of high altitudes on pilot performance.

* * *

Oxygen is essential to life. It is absorbed by the blood from the air in the lungs and taken to every living cell in the body. Air consists of 21 per cent oxygen and 78 per cent nitrogen, and these percentages remain constant to altitudes as high as 14 miles. The rate of oxygen uptake by the lungs however, depends not on the percentage of oxygen in the air, but on the pressure. The amount of oxygen taken up by the blood (i.e. the percentage saturation of the blood) will thus decrease with altitude. The pressure of oxygen in the air is sufficient to maintain this process of absorption at a reasonably normal level at cabin altitudes up to 10,000 feet. Above this altitude however, the amount of oxygen absorbed falls rapidly as the atmospheric pressure decreases. At 20,000 feet, for example, the blood is only half saturated with oxygen.

Onset of Hypoxia

The altitude at which the onset of the effects of hypoxia occur varies with the individual to some degree and with the period of exposure to lack of oxygen. Poor physical condition, for instance, lowers the body's tolerance to altitude. But no matter how fit a person may consider himself to be, the onset of hypoxia is insidious, producing symptoms not likely to be recognised by the sub-

ject himself. The lack of oxygen has its effects first on the most highly developed cells of the body — those of the brain. Night vision — the ability to see in "the dark", is actually affected as low as 4,000 ft. Fatigue, the consumption of alcohol, sleep inducing drugs and carbon monoxide, all increase the likelihood and effects of hypoxia. The blood of heavy smokers contains 5 to 10 per cent carboxy haemoglobin and, as this percentage is unusable for carrying oxygen, heavy smokers, as far as physical effects are concerned, have to be regarded as several thousand feet "above" the cabin altitude.

At 10,000 feet, the upper limit to which flight crews may operate in non-pressurised aircraft without supplemental oxygen, a definite degree of hypoxia can take place during prolonged flight; there is a gradual impairment of the pilot's judgement, co-ordination and ability to assess a flight situation. At 14,000 feet the effects become more pronounced — thought processes and memory are impaired and headache, dizziness, fatigue and slurred speech occur. The nails and lips may become blue.

At 16,000 feet disorientation, belligerence and an over-confident feeling of well being are common symptoms — effects much like those of alcoholic intoxication — a "not caring a damn" feeling. Between 18,000 and 20,000 feet, unconsciousness, akin to a fainting attack, may occur. The time taken for hypoxia to cause unconsciousness shortens rapidly as the altitude increases.

Useful Consciousness

The "time of useful consciousness" is the time interval from the moment a flight crew member is deprived of oxygen at a given altitude (e.g. a sudden decompression), to the start of mental or physical impairments which prevent his taking rational action. In other words, it is the time available to the flight crew to recognise the problem, re-establish an oxygen supply and initiate emergency procedures. It is most important for crews of pressurised aircraft to understand that the time available to them in the event of a sudden decompression can be very brief indeed and the figures quoted in the following table will provide some guidance. As the table shows, the time of useful consciousness varies with physical activity. Above 30,000 feet, the difference between the time of useful consciousness and the time to complete unconsciousness is very small.

Fogging of the aircraft and other distractions associated with a sudden decompression may shorten the period available for donning oxygen masks so it is essential that crews be entirely familiar with their equipment and how to use it. A suddent complete decompression is a rare event, but the consequences of hypoxia at high altitude in these circumstances could be catastrophic.

TIMES OF USEFUL CONSCIOUSNESS *

Altitude	Sudden loss of oxygen (Moderate physical activity)	Sudden loss of oxygen (Sitting quietly)
22,000	5 mins.	10 mins.
25,000	2 mins.	3 mins.
28,000	60 secs.	90 secs.
30,000	45 secs.	75 secs.
35,000	30 secs.	45 secs.
40,000	18 secs.	30 secs.

* (Quoted from U.S.Flight Surgeon's Manual)

Only Safeguard

The only safeguard against hypoxia is the use of oxygen and A.N.O. 20.4 now requires pilots to use oxygen for all flights above a cabin altitude of 10,000 feet. The specifications for oxygen systems required in aircraft are detailed in A.N.O. 108.4.4. The choice of the type of equipment should be determined by the flight altitude capabilities of the aircraft, the conditions of operation and the duties to be performed by the wearer, but as a general rule a "continuous flow" system which dispenses oxygen constantly to a face mask will suffice for flights up to 25,000 feet. It is important however that a good fitting mask, appropriate to the oxygen system installed in the aircraft, always be used.

Hypoxia has been a problem and a cause of accidents since the earliest days of aviation. Yet some pilots still believe it is possible to learn to recognise the early symptoms and take corrective measures when these symptoms occur. This theory is false and dangerous—as already mentioned, the early effects of hypoxia include impairment of judgement sufficient for a pilot to disregard the symptoms. There are other "knowledgeable" pilots who claim immunity to oxygen lack and who think wearing an oxygen mask is a sign of advancing age. Such a presumption, however, suggests a serious impairment of judgement, not at altitude, but at mean sea level!

PRE-FLIGHT INSPECTIONS ARE IMPORTANT TOO . . .

Shortly after taking-off from Moorabbin Airport for a flight in the training area, the pilot of a Cessna 172 saw that the airspeed and altitude indications were very obviously in error. After advising the tower, who obtained the services of a flying instructor to provide assistance to the pilot by radio, the pilot returned for a landing.

Assisted by the instructor's advice during his approach, the pilot landed safely and taxied in. The aircraft was inspected and it was found that the static ports were still covered by masking tape that had been applied earlier while the aircraft was being washed.

The incident says little for the standard of the pre-flight inspection given the aircraft before it departed!

CHARTER FLIGHTS — AND DANGEROUS CARGO

IT is some time now since the Digest has had cause to discuss the hazards that are sometimes created by unthinking people who consign potentially dangerous cargo by air without declaring the nature of the goods. On past occasions, it has been airline aircraft whose safety was compromised in this way, but a recent incident in South Australia shows that charter operators, as well as airline staff, need to be on their guard when accepting freight for transport by air.

In this incident, a light aircraft had been chartered to fly a quantity of freight from Parafield Airport to a mining camp in the north of the State. The freight arrived in two vehicles and consisted of a number of cartons of various sizes containing equipment for the mining camp. One carton was marked "This side up" but the pilot had previously carried packages of drilling equipment marked this way only because the equipment contained a small amount of oil, and he assumed this package to be in the same category.

After an uneventful two hour flight, the aircraft landed at its destination. While the freight was being unloaded, it was noticed that a large amount of liquid had spilt from the carton marked "This side up", and a moment's examination proved the liquid to be acid. The carton was hastily removed from the aircraft and was found to contain a six volt wet plate battery, the electrolyte of which had leaked while the aircraft was in flight.

As no maintenance personnel were available at the mining camp, the pilot himself immediately poured water over the affected area from a two gallon container carried in the aircraft, then obtained more water and bi-carbonate of soda from a nearby homestead which he applied to the interior of the aircraft to try and neutralize the effect of the acid. After he satisfied himself that corrosion would not affect the safety of the aircraft in the two hours of flight necessary to reach Parafield, the pilot then decided his best course of action was to depart as soon as possible and arrange for maintenance personnel to inspect the aircraft on arrival.

After the aircraft arrived back at Parafield, all areas of the cabin that had been affected by the spillage were stripped of upholstery panels and carpets and the fuselage was thoroughly flushed out with water. It was then found necessary to un-rivet the fuselage fittings and skin joints where the acid had penetrated, to eliminate all traces of corrosion. To do this, the whole fuselage had first to be supported on trestles and the wings had to be removed. All the affected areas of the fuselage were treated with anti-corrosion compound and sprayed with primer before being re-riveted, and the aircraft was then assembled again. Finally, new carpets and upholstery panels were fitted to replace those that had been damaged by the acid.

* * *

The work and expense that were necessary to restore this aircraft to an airworthy condition conveys, better than any words, the extent to which potentially hazardous cargo can so easily damage an aircraft structure.

The use of light aircraft in charter operations in Australia is growing steadily and, often now, an aircraft is chartered at short notice to transport small, urgently needed, items of freight from place to place. A lot of this work is associated with the expanding mineral development of the country, but is by no means confined to this activity. With the sense of urgency associated with such flights, there is a natural tendency for operators to concern themselves only with the weight and physical dimensions of the items they are carrying, and to neglect to ascertain the contents and characteristics of these articles.

Although Air Navigation Regulation 120 and Air Navigation Order Part 33 places the responsibility for the consignment and carriage of dangerous goods equally on both consignor and operator, operators and pilots need to remember that some consignors and their agents are ignorant of the Department's requirements, particularly regarding those goods which do not appear at first sight to be a source of danger. Articles such as explosives are obviously dangerous, but few people would expect wet paper stock, for example, to be unacceptable for carriage by air. In addition to those goods which are prohibited from being carried in aircraft, there is a considerable range of other goods which, if they are to be transported by air, must be packed in an approved manner. Information on these will be found in the I.A.T.A. Regulations referred to in Air Navigation Order Part 33, "Carriage of Dangerous Goods".

Charter operators and pilots clearly need to exercise a good deal of vigilance if similar, and possibly more serious, "dangerous cargo" incidents than the one described above are to be avoided in the future.

It could have been helped!

ARRIVING in the circuit area at Port Hedland, Western Australia, at the conclusion of a local charter flight, the pilot of this Cessna 210 selected the undercarriage down and continued with what he expected to be a normal landing. But as he rounded out and the aircraft sank towards the runway, there was a sudden vibration as the propeller tips clipped the runway and the aircraft slid to a grinding halt, wheels up. Only then did the pilot realise he had not checked the undercarriage position indicators, or visually checked the position of the undercarriage itself, after moving the selector to the down position.

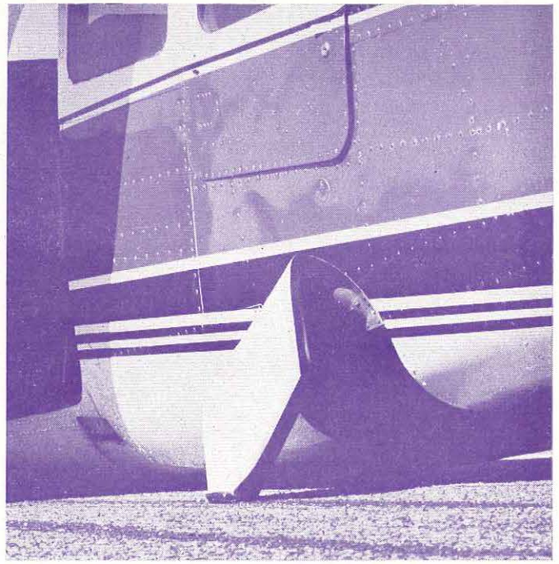
Examination of the aircraft after the accident showed that the oil level in the hydraulic system reservoir was low and that, although the undercarriage doors had begun to open when the undercarriage was selected down, there was insufficient fluid in the system to complete the extension cycle. The reason for the low oil level was a slow leak from a gland in the nose leg uplock ram. The emergency extension system was nevertheless fully operational and there would have been nothing to prevent the pilot pumping the undercarriage down manually.

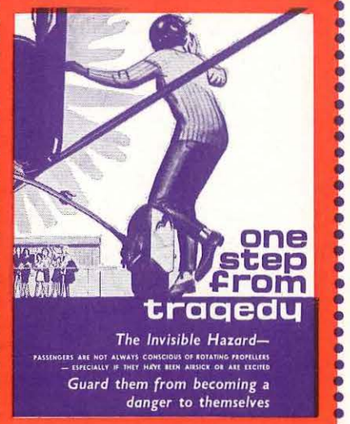
The pilot had a sound flying background but

These pictures show clearly that the undercarriage extension cycle had begun before the aircraft landed. The nose wheel doors are half open and the port main undercarriage door is fully open. Insufficient fluid in the hydraulic system prevented completion of the cycle.

was inexperienced on the aircraft type. He was obviously unfamiliar with the operation of the undercarriage selector system, for it should have been evident that some malfunction had developed when the selector lever did not return automatically to the neutral position after the undercarriage was selected down. Even so, the pilot had considerable experience with other types of retractable undercarriage aircraft and it is difficult to understand how, if he was accustomed to the normal "undercarriage down" checks in these other aircraft, he could have completely overlooked them in this case.

We have no doubt that the pilot involved in this story mentally kicked himself afterwards for not acting while he had the chance and that he is determined not to be so complacent in the future. But there is no reason why all who read these words can't do the same without waiting for an expensive object lesson. The accident is a classic demonstration of a fact that has been proclaimed many times in the past—both in the Digest and elsewhere. **Rigid adherence to established cockpit checks is the only sure way to prevent accidents of this sort!**





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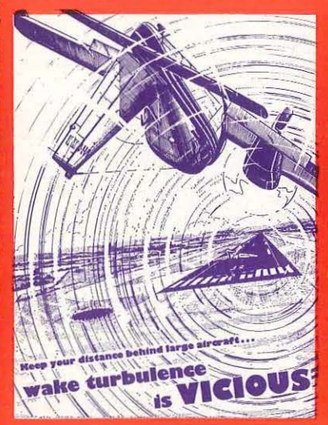

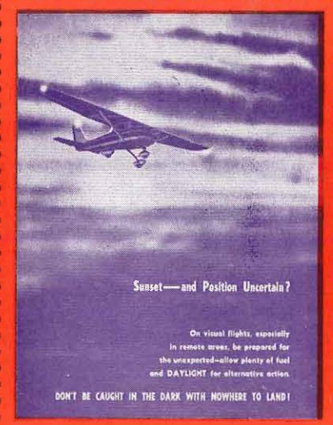

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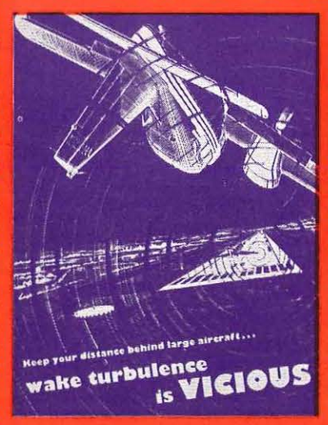


The Stamp of Authenticity!

The situations depicted issue by issue on the inside back cover of the Digest are not fiction– they are all based on fact.

Make sure your flying doesn't provide the inspiration for one during 1970!

ON SAFARI

— Papua-New Guinea Style

A FLYING visit to Australia's "Red Centre" has long been an attraction for city dwelling private pilots wanting to "get away from it all" for a week or so. But in recent months, some of the more adventurous, apparently having seen what the mainland has to offer, have been setting their sights on the Territory of Papua-New Guinea. The transition to New Guinea-type operations is not one to be taken lightly however, and it abounds in pitfalls for the uninitiated. Level, open terrain, of which there is no shortage in Central Australia, is a rare commodity in many parts of the Territory. The settled areas which most visitors wish to see are either situated amid dense tropical jungle, or can be reached only by flying through gaps in rugged steep-sided mountain ranges. A large proportion of the Territory's airstrips are high up on mountain slopes and are extremely short with steep overall gradients. In the ranges that form the "spine" running the length of the island, there are peaks rising to 15,000 feet, while many of the passes and gaps in the ranges are at 8,000 feet or higher. En route radio navigational aids are often affected by atmospheric interference and the perennial problem of pilot visual navigation, which has been the subject of numerous articles in the Digest over the years, is just as critical away from the coastline in New Guinea as it is in outback Australia. In many parts of the Territory aviation is, of necessity, still conducted in the "bush pilot" tradition, combining a very high standard of manipulative skill and a detailed knowledge of an aircraft's handling characteristics with a thorough knowledge of the country and its weather. In such circumstances it will be obvious that something more than a hearty desire to "see the sights" is required of pilots who wish to make a tour of the Territory. Two recent episodes in the Territory, both of them involving Cessna 182s hired in Victoria by pilots holding Private Licences, attest to this truth all too well. It would not be exaggerating to say that it was more a matter of good luck than good management that the occupants of these aircraft eventually returned to the mainland still in good health!

In the first of these episodes, a major accident was in all probability averted only because of the initiative and intervention of three professional pilots who happened to be operating in the same area as the 182, soon after it had entered the Territory from Daru Island.

One of these pilots was making a charter flight to Nipa in the New Guinea highlands, when he first overheard the 182 reporting that he was having difficulties with weather en route to Koroba, also in the highlands, 40 miles north-west of Nipa. The 182 had encountered heavy cloud which it could not outclimb and had turned back. Flying south towards clearer weather, the 182's pilot then happened to sight the strip at Nipa and decided to land to get his bearings. While on the ground at Nipa he decided to try and continue to Tari, some 15 miles short of his destination, but hearing that the charter aircraft would be landing in a few minutes, he decided to wait and ask its pilot the best route to Tari.

On landing at Nipa, the charter pilot was amazed to learn that the 182 was being flown by a very inexperienced private pilot from Melbourne who had almost no knowledge of operating conditions in New Guinea. After spending some time pointing out to him the accepted standards of operation in New Guinea, the charter pilot contacted another aircraft by radio to obtain a further report on weather conditions towards Tari. This was most unfavourable, with cloud build-ups to 13,000 feet, so he invited the visiting pilot to follow his aircraft back to Mendi and spend the night there. The charter pilot explained that the 182 could then follow another Mendi-based aircraft to Koroba the next morning. To this suggestion the 182 pilot finally agreed.

As they were boarding their respective aircraft, the charter pilot had some second thoughts about

Widespread areas of low-lying cloud and the often violent weather of the tropics are among the greatest hazards to safe operation in the Territory. Typical of conditions frequently encountered is this severe tropical storm over Slate Creek, a short distance from the abandoned Slate Creek airstrip.

the load being carried by the 182. "With the quartering tail wind blowing at the time," he later wrote, "I knew from experience that I would not be able to lift more than 500 pounds from Nipa in my Cessna 206, a more powerful aircraft than the model 182. On checking the load, there was 700 pounds on board the 182 and I am quite sure that this aircraft would have crashed on take-off if it had tried to depart with this load. Nipa is 2,900 feet long and relatively flat but at the same time rather deceptive, for it is surrounded by rising ground. While it would be possible to lift a full load from the strip, it would be impossible to outclimb the rising terrain, although this is not entirely evident from the ground. I therefore took one passenger and all the cargo from the 182, and led it back to Mendi."

On arrival at Mendi both aircraft were met by another commercial pilot, who had overhead part of the earlier radio discourse while approaching Mendi in a Cessna 402. Taking the opportunity to speak to the visiting pilot, he " . . . quickly gained the impression that his general aviation knowledge and experience were slight, to say the least. He also had no knowledge of leaning out the fuel mixture for altitude operations, so I personally instructed the pilot how to achieve this and how to arrive at mixture settings for altitude take-offs."

After the overnight stop at Mendi, arrangements were made for another charter aircraft to accompany the visiting Cessna to Koroba and the events of the next day are related by the third pilot in our story: "Before take-off, I explained to the pilot of the Cessna the length, slope and nature of the surface at Koroba and pointed out to him the necessity for approaching and landing at such strips with the utmost caution and in the short-landing configuration.* I requested him to take-

Situated on the edge of a ravine amid towering mountain peaks is the airstrip at Tapini, 3,000 feet above sea level. This picture dramatically illustrates the rugged nature of the surrounding terrain with its characteristic cloud cover, and exemplifies the difficulties facing pilots who operate into this and many other such strips in the Territory.

The variable slope of the strip at Tapini is clearly shown in this picture looking back along the approach and landing path. Maximum gradient over the 1,100 feet nearest the camera is 11.6% and, as is the case with a number of other strips in the Territory, full take-off power must be applied immediately after touch-down in order to reach the parking area at the top of the slope.

off from Mendi before me and to wait at the Hum Gap, which is approximately four miles north of Mendi, while I caught up. After I departed, the Cessna was nowhere to be seen and on making contact on VHF, it was painfully obvious that this pilot had become lost in five minutes of flying. I orbited at 9,000 feet for approximately 15 minutes while talking to him on VHF, trying to ascertain his position from his description of the surrounding country. He finally caught up with me, approaching from the north-east, and we set course for Koroba . . . En route I went to great pains to explain to this pilot, on VHF, the salient land features and airfields, to make sure he was correlating my information with his map, as I realised that he would have to make his way back unaided.

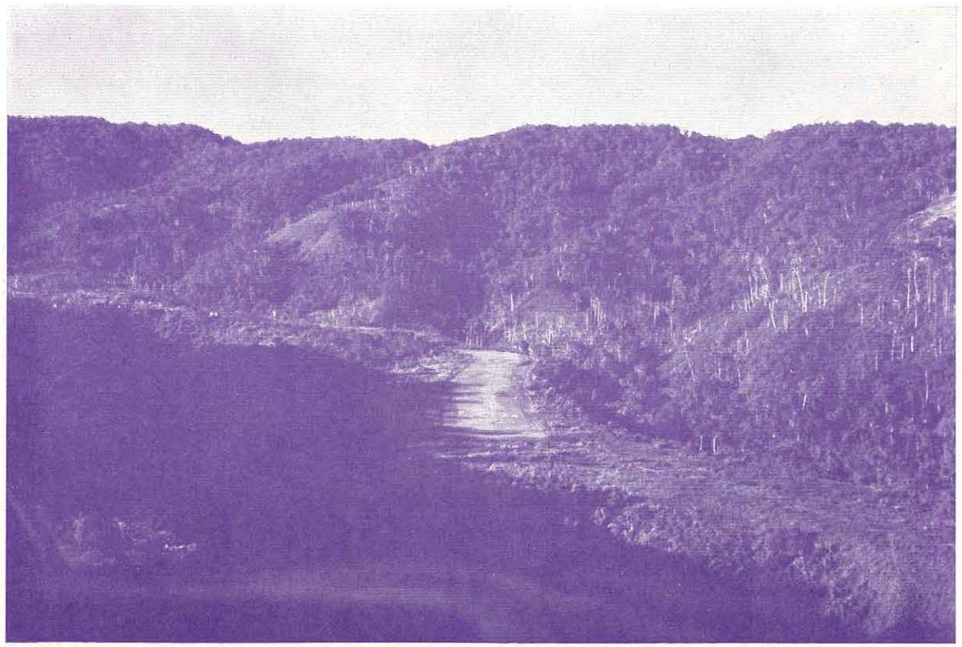
"Weather conditions at Koroba were marginal with some low cloud over the strip, so I landed first and gave him a detailed report of conditions on the strip and described to him the type of circuit he should make. I also reiterated the importance of deciding early whether the approach was satisfactory and making a decision then and there, whether or not to 'go around'. Despite my recommendations, the Cessna was very high on final approach, and the pilot only made a safe landing by reducing power completely and violently pointing the nose down." The charter pilot concluded his description of events with the statement that in his opinion the visiting pilot " . . . was in grave danger of doing injury to himself and to his passengers by not gaining an adequate briefing before coming to the Territory. His flying techniques were 'rusty' and his knowledge of the aircraft's performance was inadequate. His map-reading and navigation were poor, and his coming to the Territory placed a burden on all associated with aviation in the Territory, from Departmental Flight Service Officers trying to relate his position to his flight plan, to pilots who had to go out of their way to seek out and help this pilot, and thus avoid a disaster."

Notwithstanding these events, and further "adventures" of a similar nature which befell the 182 during the next few days, the pilot "made it". It was with some sense of relief however, that the three commercial pilots later heard the 182 reporting en route for Daru and the mainland on its way home!

* * *

The pilot of the second visiting Cessna 182 was not so lucky. During his tour of the Territory with three passengers, he stayed overnight as planned at Wewak, on the north-west coast of New Guinea. Before leaving Australia, the pilot had prepared a detailed itinerary of his proposed tour, but at Wewak he elected to divert from this itinerary and visit Maprik, 37 nautical miles to the west. In planning this additional flight, the pilot

(*Koroba airstrip is 1,850 feet long with a 3% up-slope in the landing direction and only one-way operations are permitted.)



Operation into the airstrip at Efogi, 3,800 feet above sea level on the Kokoda Trail, makes heavy demands on a pilot's judgement and ability. Th is "one way" strip is only 1,100 feet long and has a 9.5% up-slope in the landing direction.

did not refer to the aircraft landing weight charts or, for that matter, to any other information on Maprik, other than to ascertain that the strip was 2,130 feet long.

After an uneventful flight, the aircraft arrived over Maprik, where the pilot flew over the strip while he checked the wind velocity and landing direction. He then commenced a wide, right-hand turn which he continued until the aircraft was positioned on a left base leg. After turning on to final approach with full flap selected and the throttle closed, the pilot noticed that the aircraft was high and thought the airspeed was a little low, so he lowered the nose.

The pilot flared the aircraft over the threshold, but it floated and did not touch down until 1,200 feet down the strip. Bouncing back into the air, the aircraft settled again a further 400 feet along the strip. The pilot applied heavy braking but was unable to stop in the distance remaining and the aircraft over-ran the end of the strip and came to rest in a dry creek bed. The pilot and front passenger sustained minor injuries, and the aircraft was badly damaged.

During the investigation of the accident it was found that the approach procedures the pilot had used while landing at Wewak the previous day also left much to be desired. On this occasion, the aircraft had been cleared to join the circuit on a right base leg. The pilot acknowledged this clearance and reported when he was established on right base and again on final approach. The tower controller looked for the aircraft but as he was unable to see it, he asked the pilot to confirm his position. The pilot replied that he was " . . . on final, but a bit high". The controller left his seat and went to the window, where he finally saw the aircraft at about 500 feet and still descending but by this time a good half-way down the strip, which is 5,020 feet in length. Before the controller could return to his desk, the pilot applied power and climbed away for another circuit. On his second attempt, although the landing was completed without mishap, the aircraft crossed the threshold at more than 500 feet at a very high speed, and used almost the entire length of the strip to complete the landing.

It was found that before leaving Australia, the pilot had obtained an Operations Manual and take-off and landing weight charts for operation of the aircraft in Papua-New Guinea. Although the pilot studied the performance charts before leaving on

his tour, it was evident that he did not refer to them again and it is by no means certain that he really understood them or, for that matter, that the operator from whom he hired the aircraft had taken the trouble to ensure that the pilot was fully conversant with them before departing. It is ironical that in the conditions existing at the time of the accident, the strip at Maprik was suitable in all respects for the operation of a Cessna 182, and its length would have been ample if a proper circuit and approach had been conducted.

* * *

The experiences of these ill-prepared pilots should make it clear that operating a light aircraft in Papua-New Guinea is a vastly different proposition to a comparable operation on the Australian mainland and requires correspondingly higher standards of aeronautical knowledge, airmanship and manipulative skill. There are a number of airstrips in the Territory over 7,000 feet above sea level, an even larger number less than 1,400 feet long, and several with average slopes of up to 13%. Portions of some of these strips are even steeper. Because of their characteristics, operations into such strips could be considered difficult even for reasonably experienced pilots. But to attempt to operate into them almost totally unprepared, with no appreciation of the procedures and aircraft handling techniques involved, is simply courting trouble. In the Highlands too, the majority of strips are more than 5,000 feet above sea level and density heights approaching 10,000 feet are not uncommon. A pilot accustomed to the near sea-level conditions encountered at a large number of aerodromes on the Australian mainland can thus find his aircraft's performance reduced to an extent he has never before experienced. In these situations, to ensure that maximum engine power and aircraft performance are achieved, the pilot must be familiar not only with the normal procedure for adjusting the mixture as height increases, but also the technique for leaning the mixture for high altitude take-offs, as recommended by the engine manufacturer.

Many flights between aerodromes in the Territory are made through gaps in the mountain ranges and local knowledge, or at least a thorough briefing on the particular route to be flown, is usually

Cloud rests on the hills surrounding the airstrip and settlement at Boana. The close proximity of rising ground to the strip leaves little margin for error in manoeuvring an aircraft in the circuit and during the approach to land.

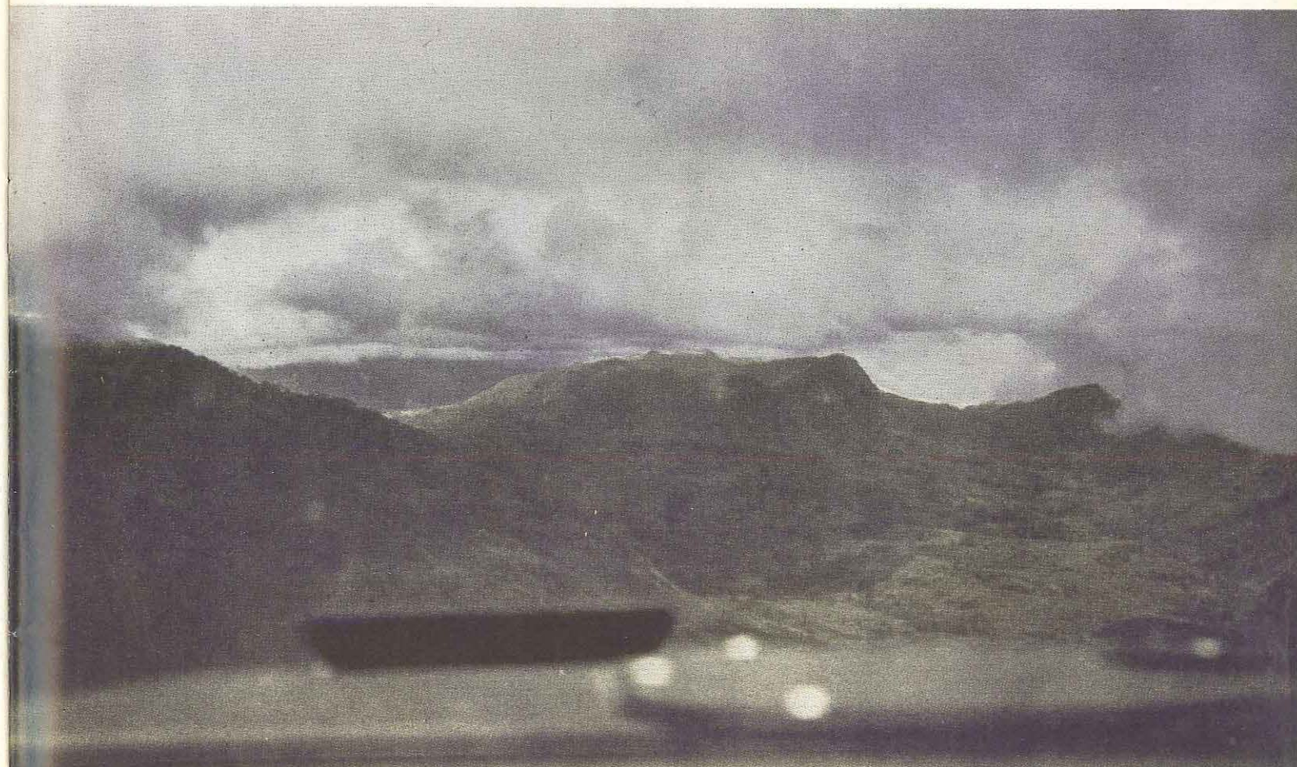
Marginal VFR operation — heavy cloud lying over the steep-sided Erave River Valley in the Southern Highlands. This photograph was taken from an aircraft flying along the river in the direction of the Erave airstrip.

essential to ensure the safety of the operation. The "pink pages" at the back of the Visual Flight Guide contain general information on weather conditions, radio frequency requirements, flight planning, etc., for flights in Papua-New Guinea, but the Department strongly recommends that pilots visiting the Territory, especially for the first time, plan to stop at Port Moresby as soon as possible after entering the Territory to obtain a personal briefing at the Department's Regional Office, before proceeding any further. In some instances a considerable diversion from a planned itinerary could be involved, but only by making such a stop can a pilot be assured of being adequately briefed on matters that could make the difference between a safe and enjoyable visit to the Territory and one terminating in disaster.

As a further indication of the level of competency necessary in Papua-New Guinea, Air Navigation Order 28.1 requires that a pilot, before being permitted to act as pilot-in-command of an aerial work, charter or regular public transport flight on the route to be flown, must complete five return trips over the route, two of them as observer or co-pilot and the remainder as pilot-in-command under supervision. Where a pilot converts to a new aircraft type and at the same time transfers to a new route, a combined total of up to 20 hours conversion and route familiarisation is often involved. Although there is no corresponding requirement for private pilots, aero clubs and training organisations in the Territory nevertheless adopt similar measures on a smaller scale, before authorising pilots to undertake cross country flights on their own.

Quite obviously, preparation of this order would be impracticable for private pilots visiting Papua-New Guinea. But, as should now be clear from this article, there are certain things that pilots planning a visit to the Territory of Papua-New Guinea must do in their own interest. At the very least, they must make certain that they are completely familiar with the performance capabilities of their aircraft, they must obtain a comprehensive briefing on special procedures and conditions at the strips they will be visiting, and finally, they must ensure that their short-field handling of the aeroplane is both sound and consistent. ——➥

More "heavy weather". Above: Low cloud in the rugged Snake River Valley as seen from an aircraft flying along the valley between Bulolo and Lae. Below: Cloud-covered peaks bordering the Oksapmin Valley, Western Highlands, between Oksapmin and Telefomin.



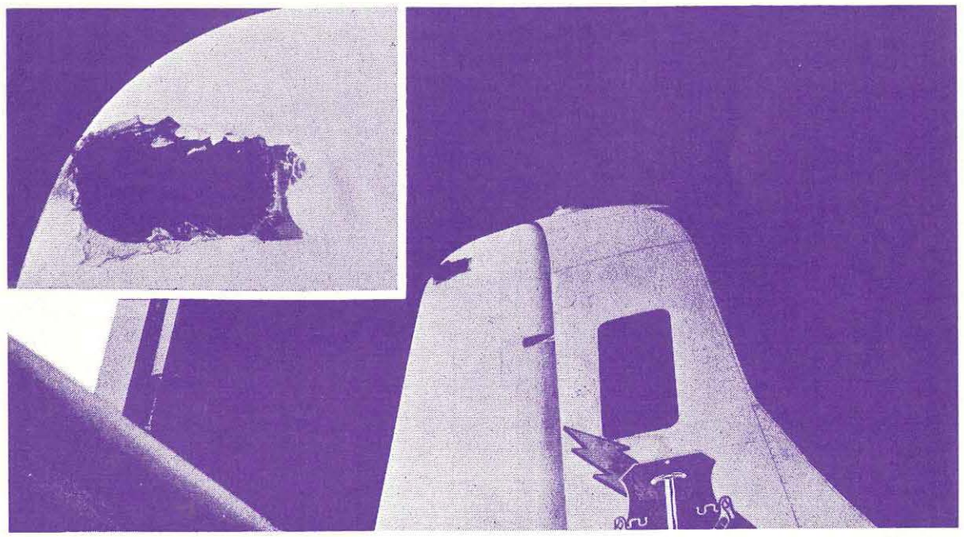
VOLTS From the BLUE

THE hole in the fibreglass-fabric covered rudder of the C-118 was the size of a volley ball. The pilot, who was unaware of the damage until he stepped down from the aircraft at the completion of what had appeared to be a routine flight, could hardly believe his eyes. There had been no blinding flash, booming jolt, tingling limbs, spinning compasses or other time-honoured indications of a lightning strike. Nevertheless, there was the hole in the rudder, and the only explanation for it was "a bolt from the blue."

The flight had been conducted at 16,000 feet, in an area of few-to-scattered thunderstorms. Airborne radar had been used to pick a path between precipitation returns. The weather had worsened en route, the thunderstorms had increased in number and size, and the pilot had carefully cross-checked his radar returns with air traffic control radar as the C-118 entered a stratus layer between drifting cloud buildups.

While driving between two sizeable bright spots on the airborne radar, winking about ten miles apart, the aircraft had encountered a flurry of light snow flakes, light turbulence, and precipitation static on VHF. The snow changed to light ice crystals and lightning had flashed several times, seemingly well clear of the aircraft, as the flight continued without incident. Sheer luck determined that the lightning bolt which passed through the rudder did not damage the operating mechanism.

(Reprinted with acknowledgement to "F.A.A. Aviation News".)



Since even the best radar will not paint an area of potential lightning strikes, how is a pilot to know when he is likely to become a target? Perhaps the best forewarning he can have is an intelligent understanding of the general theory of lightning discharges from clouds.

Rapid Transport of Electrons

Most lightning theories cluster around the idea that cloud-to-ground strikes are a rapid transport of surplus electrons from thunderstorm charge centres back to earth, thus maintaining the normal negative charge of the clouds. The number of thunderstorms in action all over the earth at any given time varies greatly: anywhere from 300 during a day to 1,800 at a single moment.

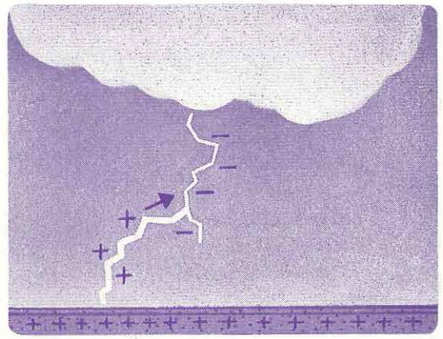
For some reason not fully understood, a daily peak of thunderstorm activity throughout the world occurs around 1900 GMT. Potential differences calculated at 20 to 100 million volts can exist between strongly charged areas in the thunderstorm itself, or between the cloud and the earth below. Currents in a lightning stroke are estimated at 10,000 to 200,000 amperes at its peak.

All clouds carry a positive charge at their top and a negative charge at their base, although a small pocket of positive charge also is located at the base.

The cumulo-nimbus, with its familiar anvil shape, is the demon among clouds responsible for electrical violence aloft. (Other less distinctive cumulus forms can develop into a thunderhead in a matter of minutes.) When fully developed, the base of the "anvil" can extend over from 20 to 200 square miles of earth and range upward from 3,000 to 60,000 feet, and above. A thunderstorm appears to achieve its full electrical force when building cloud tops reach an altitude where the air temperature is about —20° C. and when downdraughts and rain emerge from the cloud's base.

Speed Varies, Movement Erratic

While the exact nature of lightning remains something of a mystery to scientists, they are able, nevertheless, to describe fairly accurately how it travels between charge centres. A lightning flash does not travel with the speed of light and it does not move in a straight line. Its pattern is a stop-and-go, zigzag movement, at speeds estimated to be as slow as 130 miles a second, up to one-sixth the speed of light. The first impulse, called a "stepped leader," is a barely visible column of negative electrons. When the stepped leader nears the oppositely charged centre, (another cloud or section of cloud or land mass) a "welcoming" discharge of positive ions reaches out to meet the leader. Following contact, a brilliant flashback, called the "return stroke", occurs. The process is repeated, with much greater brilliance, several times, usually three—but as many as 42 repeat strokes have been observed on one contact.



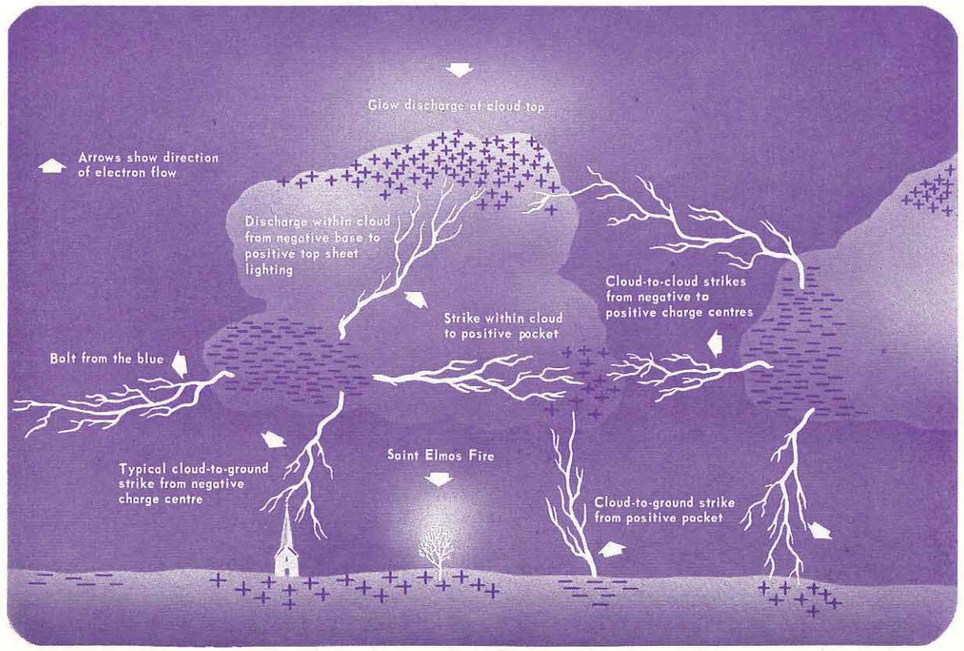
A lightning bolt starts with a "stepped leader", a column of negative electrons descending from the cloud to meet the "welcoming" discharge of positive electricity from the ground.

Cloud-to-ground strikes are only a small part of the total electrical display staged by thunderstorms, especially in hot, arid country where the distance from the cloud base to the ground is greatest. Most lightning discharges occur between and within clouds. The least frequent discharge is the "bolt from the blue"—with no apparent target.

Most weather scientists are of the opinion that aircraft do not attract lightning, but are struck accidentally when they happen to stray into the path of a discharge. Most lightning strikes on aircraft leave a visible entry and exit point. The centre of the aircraft is rarely struck; usually the nose or the wings are hit.

Knowing that he is not the intended target of Thor's thunderbolts is of small comfort to the pilot who does not wish to become an innocent victim. What can he do to keep his wings from being singed?

The simplest advice is to keep well clear of areas of reported thunderstorm activity. When it is not practical for him to do so, he should become alert for indications of precipitation static. Its growing intensity on low-frequency or VHF receivers



The intensity of static picked up on aircraft radio receivers is one way to identify highly charged air. Another warning signal is the phenomenon known as St. Elmo's fire—illuminated displays of static electricity on the wing or propeller tips. Aircraft do not attract lightning, but occasionally intercept it when flying through highly charged airspace.

identifies a highly charged airspace, conducive to lightning discharges. Another danger sign is the spectacle of St. Elmo's fire (illuminated displays of static electricity sometimes seen at wing or propeller tips), especially when occasional lightning is also seen in the area.

Outside air temperature appears to be a precipitating factor. Most recorded lightning strikes on aircraft have occurred when the outside air temperature was in the minus-to-plus 10° Centigrade range, with the heaviest concentration right around the freezing range, which corresponds to the charge separation level in thunderstorms.

Most Damage at Low Altitude

Lightning damage is a relatively low-altitude phenomenon. The majority of aircraft strikes have taken place below 10,000 feet; very few have been reported over 20,000 feet. Lightning activity is generally confined to an area no further than 20 miles from the generating storm. Distance is also a limiting factor. So far, no lightning strike beyond 20 miles of a thunderstorm has been recorded.

An understanding of Weather Bureau terminology concerning thunderstorm activity is vitally important. For example, if during a flight a forecast of "scattered thunderstorms" (up to 45 per cent of the area) is upgraded to a "numerous thunderstorms" category (up to 99 per cent of the area), the weather picture has changed radically.

Pilots who fly frequently in bad weather are subject to a variety of superstitions and misinformation on the subject of what invites a lightning attack. A recent study of the occurrence of lightning strikes showed that a majority involved aircraft without radar or with their radar turned off.

Neither airborne radar nor Air Traffic Control's ground based radar can guarantee a pilot immunity from lightning, but their intelligent use, plus a general understanding of thunderstorm behaviour and a healthy respect for the immense stores of energy hidden in the clouds, will go a long way toward reducing the hazard.

PERILS OF PAPUA

WE always knew that flying in Papua-New Guinea is a somewhat more adventurous way of earning one's living than flying sedately around the mainland — as witness the article on page 16. But perhaps we didn't appreciate the **full** extent of the hazards involved—at least not until this incident report from the pilot of a Short Skyvan, arrived on the Editorial Desk:

> "Shortly after departing from Kerema for Mendi, a movement under the instrument panel caught my eye. Bending down, I looked into the space forward of the rudder pedals and discovered a live crocodile approximately three feet long. I decided to return to Kerema and off-load as it was not on the manifest. This was done and the flight proceeded without further incident."

This intriguing piece of intelligence, which must surely rank as one of the understatements of the year, prompted a few further enquiries and finally the full story came out.

Apparently a museum and zoological gardens are being developed in Papua and one of the requirements is a crocodile farm. A number of crocodiles had been caught for this purpose and were being air-freighted on behalf of the Department of Agriculture. Large crocodiles were being crated for transport in the aircraft, while smaller ones were carried in sacks. (It has not been possible to determine what is a large crocodile requiring a crate or what crocodiles are small enough to be carried in bags. Such technical decisions are apparently left to the discretion of the operator's staff). The operator had been carrying the crocodiles during the two days preceding the pilot's unnerving discovery. Whether the offending reptile had escaped from a crate or from a sack has not been established—no one could "remember" finding either a damaged crate or an empty sack.

The events that followed the aircraft's return to Kerema after the pilot discovered the crocodile on board, though not referred to in his report, are also worthy of note as an exercise in off-loading "dangerous cargo". It appears that on landing at Kerema, the pilot made a somewhat quicker than usual exit from the aircraft, to find that the only other person present on the strip was a native policeman. The pilot therefore approached the policeman explaining that there was a "small young" crocodile in the aeroplane and would he please remove it. The policeman agreed willingly, but after entering the aeroplane apparently decided that the reptile was not small and young enough, and also made a rapid exit.

About this time a native labourer was unfortunate enough to arrive on the scene. Exhibiting a commendable willingness to delegate authority, the policeman thrust him into the aircraft with instructions to remove the reptile, together with any others he found present. After viewing the culprit the labourer also decided it would best be left alone and made to vacate the aircraft. By this time however, the pilot had positioned himself at one door and the policeman at the other, and indicated to the labourer that he would not be allowed to leave unaccompanied. Eventually the reluctant hero grabbed the crocodile by the tail and was then permitted to leap out the door. But

in doing so he lost his grip, and the crocodile fell to the ground where it commenced to show its displeasure at the treatment it was receiving by hissing and snapping at anything within reach. After a battle of wits the reptile was finally recaptured when the pilot managed to drop a cone marker over its head, and then had his unwilling assistant sit upon the marker to prevent the victim escaping. This did nothing to improve the crocodile's temper but by this time help was at hand, and soon afterwards the escapee was safely in custody once more.

A short time later the aircraft returned to Port Moresby for a 100 hourly inspection. During this work, a Departmental Airworthiness Surveyor was greatly impressed by the meticulous care with which the engineers went about inspecting the under-floor area of the aircraft. ➥

A BIT OF HISTORY

brought up-to-date

ONE of the earliest accounts of jet propulsion in industry was reported more than 50 years ago.

It concerned the experience of a drayman who was hauling three or four cylinders of compressed carbon dioxide gas in a one-horse dray when the cobblestone street caused one of the cylinders to bounce from the wagon. As it struck the pavement the neck of the cylinder was broken off and the heavy steel cylinder took off like a rocket. It passed back under the wagon, deflected from a cobblestone, and swerved across the sidewalk where it narrowly missed a woman carrying a loaded market basket.

It whizzed through the front of a feed and grain store, as a circus clown would jump through a paper-covered hoop, plowed through the displays, and finally was snubbed by the soft, stubborn resistance of several hundred bags of feed in a rear storeroom.

The only casualty was the horse, whose leg was broken as the projectile took off. They had to shoot it. Other damage amounted to a few hundred dollars.

Ever since that early jet flight the cylinder gas people have warned us that the fittings on the upper end of a compressed gas cylinder must be protected and that cylinders always should be stored on end and chained in place.

One would hope that more than 50 years of continuous consumer education would teach people how to handle these deadly devices. But here is the latest reported flight of one of these unguided missiles — in an aeroplane hangar, of all places.

Employees were moving a CO_2 gas cylinder, with the protective cap removed, across the hangar floor when it fell. The valve broke and the cylinder took off. It went through several aeroplane wings, broke off sprinkler heads, and started a flood, destroyed expensive instruments, went through a concrete wall, and finally came to rest outside. The damage was estimated at nearly half a million dollars.

When gas is compressed a power of great magnitude is confined under high pressure. Therefore, utmost caution must be observed in handling these cylinders.

Release that power by a sudden rupture and it means destruction. It can happen with any compressed gas—CO_2, oxygen, air, acetylene, or nitrogen. So, the only sensible solution is to keep gas cylinders chained, like a wild animal. You don't want a jet propelled bull in your china shop. ➥

—Aviation Mechanics Bulletin, United States.

WHAT IS THIS GOING TO COST?