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AVIATION SAFETY DIGEST

Special Reference Edition - Part 1

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FOREWORD...

With the Aviation Safety Digest now approaching its twenty-fifth year of publication, almost everyone who has anything to do with flying in Australia knows that it is not just another aviation magazine — one that seems to like dabbling in the more adventurous aspects of piloting aeroplanes! Rather, most readers recognise that it is intended as a serious education medium, the purpose of which is to make people more safety conscious and so reduce the frequency of accidents — accidents that are costly both in human lives and expensive machinery.

The Digest has always sought to fulfil this role by being the means through which the results of accident and incident investigations, and in particular the operational lessons derived from these investigations, may be passed on to people in the industry. In this way, pilots, maintenance engineers, aircraft owners and operators are given the opportunity to apply these lessons, learned in the hard school of practical experience, to their own operations.

This function — the application of the findings of air safety investigations to the improvement of aviation safety generally — is of course the ultimate purpose for which these investigations are carried out. And it is for this reason that the Department has always believed that the cost of issuing qualified licence holders with a personal copy of each issue of the Digest is fully justified.

Although for a variety of reasons it has not been practical to include individual student pilots in this arrangement, the Digest is distributed to flying schools and many of them have found its content effective instructional material for their students. Habits and thought patterns developed at this early stage of the pilot's career usually persist, and some experienced instructors believe that pilots are never more impressionable or receptive than when they are students. Thus, giving students a Digest article to read has often proved an effective form of preventative medicine.

Despite this encouragement and support from instructors, there is some evidence that the Digest's existing safety coverage still falls short in one important respect. With the various messages it offers from time to time on different themes of air safety, the Digest has frequently found itself preaching to the converted — to practising pilots already aware of the problems reviewed from issue to issue. Yet sometimes newer pilots, not having had the benefits of repeated exposure to this ready-made hindsight, have come into the industry and begun flying. And before they have had the opportunity to learn from someone else's unhappy experience, they themselves have fallen victim to the same sorts of errors, sometimes with tragic results. This perhaps is one of the reasons why there is such a repetitive pattern in the types of accidents that continue to afflict our general aviation industry.

For reasons such as these there have been a number of requests and suggestions that the distilled wisdom of the accident reviews and educational material, published in the Digest over the years, should be re-presented in a concise summarised form for pilots new to the industry. In this way they could have the immediate benefit of all that has been learned from past experience — without having to wait for the whole range of accidents to be again reviewed in the Digest.

The merit of these arguments is undeniable. As a result, this fund of accumulated experience, suitably revised and updated, is now being presented in two issues of the Digest — this one and the one to follow. It is hoped that these revisionary Digests will not only meet the needs of pilots new to the industry, but also serve to refresh the understanding of those practising pilots who have forgotten some of the classic, oft-repeated operational situations which can be accidents in the making.

As well as being distributed to regular recipients of the Digest, copies of these two issues are being distributed, through flying schools, to currently active student pilots. Copies are also to be provided in future to new pilots qualifying for their Private Pilot Licence.

By making this provision the Department hopes that new pilots will become more safety conscious, that the articles will reinforce the advice, instruction, and self-discipline which they receive from their flying schools, and that as a result, they will develop sound concepts of airmanship which will remain with them throughout their flying careers.

COCKPIT CHECKS HAVE A PURPOSE!

Strict adherence to a check list of vital actions has long been regarded as a major requisite for the safe operation of an aircraft. As a principle this is of course accepted by all responsible pilots.

There is nevertheless a danger that although the check list rituals may be religiously recited, the real meaning or effect of the various items may be lost simply as a result of this constant repetition. For example, a pilot can go through his cockpit check list, touching or pointing to each item in turn as he does so, but without consciously observing the actual position or indication of the particular control or instrument.

This very insidious form of complacency has been responsible for a number of accidents and incidents to Australian general aviation aircraft. For example:

- A Piper Comanche was being flown on circuits and landings to give a private pilot conversion training on the type. During the pre-flight inspection before the training period commenced, the instructor had remarked to the pupil that 'There was plenty of fuel on board'. The starboard tank was full and the port tank a third full. The port tank was selected for starting and after the engine had been warmed, the flying training began.

For the first three circuits the pupil was briefed on circuit patterns, cockpit checks, airspeeds and other procedures, but at this stage his progress was satisfactory and the instructor permitted him to continue without prompting. Flying a somewhat wider than usual pattern to allow time to complete the cockpit drills unhurriedly and to get the 'feel' of the aircraft, the pupil successfully completed several more 'touch and go' circuits. On each one, the pupil recited the downwind check 'fuel on and sufficient', pointing to the port fuel gauge.

During the tenth circuit, while flying the downwind leg at 1000 feet, the engine failed suddenly and the instructor immediately took over control. The aircraft was beyond gliding distance from the aerodrome and even the most favourable terrain within reach was lightly timbered. As the aircraft approached for a forced landing however, the surface looked satisfactory and because there seemed a good chance of avoiding the trees during the landing roll, the instructor lowered the undercarriage. A low telephone line was then sighted in the approach path and an attempt was made to force the aircraft beneath the wire, but the wire struck the upper part of the fin, shearing off the top ten cm. The aircraft landed heavily, bounced and became airborne again for about 150 metres, during which the instructor weaved to miss a tree, then touched down again. The instructor braked harshly, but before the aircraft could be brought to rest, the starboard wing struck another small tree and was badly damaged.

The engine failure had been caused by fuel starvation. The fuel selector was still positioned to the port tank which was empty. The pupil pilot had apparently been misled by the instructor's advice that the aircraft had sufficient fuel and did not press the point during the downwind checks, despite the fact that the fuel gauge must have been indicating almost zero for the last few circuits. Because 'touch and go' circuits were being flown, no pre-take off checks were made after the first take-off.

Likewise, the instructor did not physically check the pupil's cockpit drill on the downwind legs. The fuel tank selector in the PA24 is located between the pilots' seats and can be seen readily from either position. He also failed to carry out the emergency procedure for engine failure. Had the starboard fuel tank been selected when the engine failed, there is little doubt that the engine would have regained power almost immediately.

• Very shortly after take-off, the engine of a Victa Airtourer suddenly lost power at a height of about 200 feet. The pilot quickly completed a trouble check, but the engine did not respond and he was committed to a forced landing. The only suitable area within gliding distance was the over-run of an adjoining runway, so the pilot headed towards it, turning off the switches as the aircraft descended. The aircraft struck the ground heavily just to the right of the over-run, rolling the port main tyre off its rim, but sustained no other damage. Neither the pilot nor the passenger was injured.

During the investigation of the incident, it was found that the owner of the aircraft normally left the fuel cock in the 'on' position at all times. It is evident that the pilot flying the aircraft on this occasion, not being familiar with the owner's practice, had mistakenly turned the fuel cock to the 'off' position during his pre-start checks, believing that he was turning it 'on'. It was also found that the fuel cock itself was defective and that this had the effect of concealing the pilot's error until the aircraft was airborne.

Because of a deteriorated moulded rubber seat in the fuel cock, sufficient fuel was able to flow through the cock in the 'off' position to run the engine at low and medium power. It was only when full power was applied and sustained during the take-off that the engine lost power from fuel starvation.

• A Cessna 182 was departing from a controlled airport for a private flight and after taxiing to the holding point for the duty runway, was seen running up in the normal way. The pilot then reported ready and the tower controller cleared the aircraft for take-off. It entered the runway and began what appeared to be a normal take-off, but on lifting off, immediately assumed a steep nose-up attitude. The aircraft then turned sharply to the left and began a series of erratic climbs and descents. A few moments later, the pilot transmitted a Mayday call requesting a clearance to make an emergency landing on the duty runway.

The aircraft was immediately cleared to land, the crash alarm was sounded, and the fire crew turned out. Eventually, after making a wide circuit, during which the aircraft continued to manoeuvre in an alarming, erratic manner, it was more or less lined up with the runway but appeared barely under control. Then a third of the way down the runway, still airborne, control seemed to be regained and the aircraft touched down smoothly. A fire tender followed it as it rolled to a stop, and it then taxied to the parking area and shut down.

Shortly afterwards, the pilot telephoned the tower to explain his hair-raising experience. The report he wrote later speaks for itself:

> 'Receiving a taxi clearance, we proceeded to the holding point for runway 14, where I commenced the run-up and pre-take-off checks, but forgot the last and most basic of all — checking that the controls were functioning normally!
>
> We were cleared for take-off. With 20 degrees of flap selected, I lined up the aircraft and opened the throttle. The aircraft became airborne at about 65 knots and immediately entered a very steep climb. Corrective action taken was to apply forward pressure to the control column but then I discovered that the control were jamming. Fearing a full-power stall, I tried applying elevator trim, which relieved the situation temporarily. I was also worried that the starboard wing might drop, so I applied a little rudder to counteract this which consequently turned us to port. Then the nose dropped away, so the trim was used to correct it. I transmitted a "Mayday" call and requested an immediate landing on runway 14. With the aircraft pitching rather violently, I tried to keep it under control with the use of power and trim.
>
> Because only the rudder controls were left, the turn on to final was very wide, and as a result I used up a lot of runway before finally landing. At first, I thought all this had been caused by a mechanical fault, but on taxiing in realised what I had done, or in this case, had not done. The control column lock was still in place!'

Cessna pilots and operators, accustomed to the normal Cessna internal control lock, which incorporates a red metal 'flag' to cover the master or magneto switches when in place, may wonder how a pilot could fail to notice that the control column lock had not been removed. So did our investigator — until he found that the standard control lock was missing from this particular aircraft and that a small metal bolt was being used in its place! Even though a piece of red cloth had been attached to the bolt to make it more conspicuous, it still escaped the pilot's notice until, very relieved to be safely on the ground again, he was actually taxiing in!

Although this fact does not excuse the pilot's gross omission in not checking the controls for freedom of movement before taking off, it is abundantly clear that the operators of the aircraft, by allowing such an unlikely and obscure type of 'control lock' to be used at all, had set the stage for a very serious and possibly fatal accident. The fact that such an accident was finally averted in this case was due only to the pilot's presence of mind and his skilful handling of the aircraft, in combination with reasonably smooth flying conditions with, no doubt, a large measure of what we can only call luck!

Accidents in which pilots have been deprived of control after take-off by locks unintentionally left in place have occurred all too frequently throughout the history of heaver-than-air flight. Nearly always the results have been catastrophic. Spared the fate that has befallen so many others in a like predicament, the pilot of the Cessna has no doubt learnt a lesson he will remember for the rest of his life, but all of us who share his experience through the pages of the Digest — pilots, engineers, operators and owners — can also profit by it. We can resolve never to condone any makeshift operating practice, that could conceivably become a link in a chain of events leading to an accident.

Deficient operational or workshop practices by other persons responsible for the aircraft, can of course cause problems which are not of the pilot's making. But as yet another 'cockpit check incident' bears out, thorough pre-flight checks can do much to ensure that any such deficiencies do not reach the stage of becoming a danger to flight.

• While carrying out a cockpit check immediately before taking off from his station property, the owner of a Piper Cherokee found that the control wheel became obstructed at about the 11 o'clock position when he attempted to apply port aileron. He taxied the aircraft back to its hangar and removed the inspection cover beneath the port wing. Examining the aileron control linkage while the port aileron was moved carefully, the pilot discovered an engineer's file, complete with handle, jammed between the port aileron bell crank and the wing rib.

Efforts were made to determine how and when the file could have been left in the wing. The log books showed that the aircraft had last undergone an inspection for the renewal of its Certificate of Airworthiness, two years before. Subsequent to this, it had undergone a 100 hourly inspection one year previously, and shortly afterwards the starboard fuel tank had been repaired by a maintenance organisation. There was no record of any other work having been performed on the aircraft during the preceding two years.

Apart from illustrating the importance of accounting for all tools and equipment when completing work on an aircraft, this incident stresses the absolute importance of ensuring that the flying controls are capable of *full* movement in their correct sense before each and every flight. Clearly, the file had been in the wing of the aircraft for a considerable period without causing any difficulty, and it was not detected until this particular cockpit check. The pilot had made a brief flight shortly before the obstruction was discovered and if he had not carried out a further cockpit check for this next flight, the obstruction may not have been noticed until after the aircraft was airborne, again setting the stage for a serious or even fatal accident.

* * * *

All these cases demonstrate the importance of being properly 'tuned-in' when carrying out cockpit checks. Seldom these days do pilots actually forget their cockpit checks, but it is all too easy to complete a check in a purely mechanical way without actually thinking what one is doing. And even if one *is* thinking, it takes only a momentary lapse in concentration to miss a vital check.

It is not only the 'normal' cockpit checks that pay dividends in the safe operation of an aircraft of course. Emergency drills — those that we learn during our flying training but probably don't really expect to use — also have a purpose. Two similar, initially quite minor accidents show by the contrast in their outcome, the real value of these drills in an actual emergency:

• Approaching to land at a country airstrip, the pilot of a Cessna 182 selected full flap, and with the power right off, made a smooth touchdown on the grass covered surface.

After running straight for a short distance, the pilot heard a violent rattle from the front of the aircraft and felt the nose leg begin to collapse. Before he could take any action, the propeller tips began striking the ground, but he managed then to raise the nose with elevator and hold it off the ground. As the speed decreased however, the pilot was unable to prevent the nose lowering to the ground. He turned off the fuel, and the aircraft slid to a stop on its nose and main wheels. None of the four occupants was injured.

Although the lower portion of the engine compartment was extensively damaged as shown in the photograph above, including breaking the carburettor off the intake manifold, no fire broke out and the aircraft was later repaired and restored to service. The nose leg failure was attributed to damage sustained during a previous landing or take-off.

• In the course of a cross country flight, the pilot of a Cessna 182 attempted a landing on a small bush airstrip, in gusty cross-wind conditions.

The strip, which was nominally about 20 metres wide, proved to be still under construction and only a five metre wide section down the centre had been properly graded and was suitable for use. The remaining width consisted of soft soil.

After it had touched down initially on the narrow centre section of the strip, a gust of wind lifted the aircraft. The pilot held it off the ground and crabbed into wind in an attempt to remain over the graded section, but, still in the crabbing attitude, the aircraft dropped heavily to the ground and the nose wheel dug into soft earth to the right of the intended landing path. The nose leg was torn off, and the aircraft pitched down on to its nose and slid 30 metres on the underside of the nose cowling and main wheels. The pilot and his two passengers were unhurt and hastily left the aircraft.

The pilot then returned to the aircraft, turned off the magneto switches and began to examine the damage. As he was doing so, a sudden explosive puff of flame leapt out from in front of the engine compartment firewall on the lower starboard side. Fanned by the strong wind, which was blowing from the starboard side of the aircraft, the fire quickly spread. Soon afterwards, the starboard fuel tank exploded and the whole aircraft was engulfed in flame. It was completely burnt out within about 15 minutes.

It was found later that the pilot had not turned off the fuel. It was probable that when the nose leg failed, damage occurred to the fuel system in the vicinity of the carburettor or the fuel filter bowl, which is mounted near the lower starboard side of the firewall. Because the fuel was not turned off, it would have flowed freely into the engine compartment resting on the ground, thus making it possible for the fire, once started, to develop uncontrollably.

It is very likely that, had this pilot adopted the same procedure as the pilot in the first accident, no fire would have broken out and the aircraft would not have been destroyed. Although the occupants were out of the aircraft before the fire broke out, it is easy to see that in circumstances only a little different, occupants who might otherwise be uninjured, could be trapped and incinerated.

The pilot of this Cessna 182 didn't do his emergency drills!!

WIRES ... are where you find them!

Most pilots probably associate accidents involving power lines and other earth-bound obstacles only with agricultural flying, not realising how many of these occur to other general aviation aircraft. The actual reasons for these accidents vary greatly, but a large number (though not all) have at least one point in common — disregard for the very Regulations that have been framed for the purpose of preventing such accidents.

It is not for nothing that 500 feet has been stipulated as the minimum height at which an aircraft may fly; for illegal, unplanned, spur-of-the-moment aircraft operations at low level have been responsible for innumerable fatal accidents almost from the earliest days of aviation. The dangers inherent in this form of exhibitionism have certainly not changed in character as the light aeroplane has developed over the years — it is just as easy to kill yourself this way today in a Cherokee, as it was in an Avro 504K, 50 years ago. If anything *has* changed, it is the likelihood of running into something — particularly power lines. Power lines today are literally everywhere there is habitation. They criss-cross the countryside in sizes and shapes ranging from multi-cable, high tension transmission lines carried on massive steel pylons, to the homely, pole supported, single-wire lines, now so widely used in rural electrification schemes. Power lines span rivers, often far above the water, and cross valleys from hilltop to hilltop. In such locations they can be found at heights up to 300 and 400 feet above the valley floor. Worst of all, with the possible exception of the main high voltage lines, which are more easily identified because of their rows of steel pylons, power lines are notoriously difficult to see. Experience shows in fact, that they nearly always remain unseen from a low flying aircraft unless the pilot is expecting them and is deliberately looking out for them. This is especially true of single-wire power lines which, though not usually far above ground level, have extremely long spans between inconspicuous poles and are deliberately routed away from roads and buildings to minimize electrical interference to telephone circuits.

Logically, with a history of low flying accidents extending back more than 50 years, and with the greatly increased hazard now posed by the proliferation of power lines in rural areas, one could be excused for imagining that pilots of today would be wise enough to withstand the temptation to go 'beating up' properties at tree-top height (usually for the benefit of lesser mortals watching from the ground). But human nature being what it is, some are unwilling to learn by the experience of others and think they know better — hence they remain unconvinced until it *has* happened to them. Unfortunately, as often as not, they don't get a second chance. Here are some examples to illustrate what we mean:—

• In a valley at the foot of the Great Dividing Range in Victoria, a young farmer was mowing a paddock on his father's property. Suddenly, the whine of a light aero engine drowned the noise of his tractor and a Victa Airtourer flew very low in front of the tractor's path. The aircraft's sudden arrival came as no real surprise — the pilot was engaged to his sister and a number of times in the past few weeks had flown low over the property, waggling his wings.

The aircraft seemed to be flying nearly straight and level as it flashed across in front of him. But as he turned his head to follow it, he was shocked to see it slice through a single-wire power line running parallel to the tractor's path. The power cable snapped and fell to the ground and at the same time the engine noise ceased abruptly. The nose of the aircraft rose, the port wing dropped and the aircraft rotated to the left until the starboard wing-tip struck the ground. The wing crumpled, the nose slammed into the ground and the wreckage skidded to a stop and caught fire. Jumping from his tractor, the farmer ran towards the burning aircraft. As he approached there was an explosion in the wreckage and the flames leapt up more fiercely. By the time the pilot was dragged from the blazing wreckage, it was too late.

The pilot was 20 years of age and held a restricted private licence. His total flying experience amounted to 130 hours, of which more than 50 had been flown in Victa aircraft. As the holder of a restricted licence, the pilot was authorised to fly 'in command' only within eight km of his departure aerodrome or within the confines of the flying training area assigned to that aerodrome, except when engaged in an approved solo cross-country navigational exercise. The point where the aircraft crashed was some 25 km beyond the boundary of the training area concerned, and the pilot had not been authorised to make a solo cross-country training flight.

• Towards the end of a training flight in Queensland, this Victa, with a young 'C' rated instructor and a pupil on board, was seen returning towards the aerodrome from the training area at low level. The weather was fine and the aircraft was functioning normally. After flying for some distance at an average height of about 15 feet, which varied only enough to avoid obstacles, the aircraft flew into a power line. Taking one wire with it, the aircraft then climbed steeply into a near vertical attitude, fell over on its back, and crashed to the ground inverted. Both occupants were killed and the aircraft was burnt out.

• In N.S.W. a private pilot and a friend had flown to a property in this Tiger Moth to visit some friends. When it was time to leave, the two men boarded the aircraft in the paddock where it was parked and took off.

The aircraft flew around the homestead then turned back towards the party of friends who had gathered in the paddock to farewell the men. The aircraft descended as it approached the group, passing in front of them about 20 feet above the ground. It then began to climb, but the undercarriage struck a single-wire power line. The aircraft then dived steeply into the ground and overturned. The passenger was killed and the pilot seriously injured.

• A Pawnee had just been flown to a property in western N.S.W. to begin its day's work. The pilot landed normally on the property's agricultural strip but, finding that his loader-driver had not arrived with the lorry, he decided to take-off again and look for him so that he could direct him to the airstrip. Very soon after he had climbed away from the strip, the pilot sighted the lorry entering the gate of the property. The pilot dived on the vehicle from behind, flying over it at comparatively high speed in the direction of the airstrip and at a very low level. Almost immediately the aircraft had overtaken the vehicle, it flew into a two-wire power line strung 30 feet above the road, which the pilot had not seen. The wires rapidly decelerated the aircraft and it hit the ground nose first, somersaulted on to its back and almost instantly caught fire. The pilot was able to escape unaided but suffered serious injuries and burns.

• Shortly after a Tiger Moth had taken off from a private airstrip, its two pilots saw that there was cloud close to the high ground on their proposed track, and decided it would be better to track via lower country in the nearby river valley. The aircraft was accordingly turned to cross a saddle in the hills that lay between their position and the river valley.

As the aircraft flew through the saddle, it struck a single-wire power line, suspended about 150 feet above the ground. The impact shattered the propeller, and the cable broke in two places some 300 metres on either side of the aircraft and railed rearwards from the engine cowling. Some control of the aircraft remained and the pilot-in-command force landed in a ploughed paddock directly ahead.

Shortly after touching down the aircraft nosed over on to its back, but neither occupant was injured. The crew said afterwards that there had been no deliberate intention to fly low as the ground in the river valley slopes quite steeply away from the hills and the aircraft would have been above 500 feet very soon after passing over the saddle. Both pilots admitted however, that though there was low cloud and rain in the area, there was no real necessity for the aircraft to be flown below 500 feet between the hills.

• A private pilot was making a local flight in a hired Cessna 172 with three friends as passengers, when he decided to inspect a dam on a nearby farm.

The aircraft flew around the property at a very low level, then climbed to about 150 feet over a power line. The engine was then throttled back abruptly and the aircraft descended again. At a height of 30 feet it collided with another power line on the boundary of a paddock, and dived into the ground in a near vertical attitude and somersaulted. The engine and rear fuselage broke off and the aircraft came to rest in an upright position. The pilot later died of the injuries he received and his three passengers suffered serious injuries.

• During a ferry flight in deteriorating weather, the pilot of a Grumman Ag-cat descended to a low altitude to try and remain below the lowering cloud base. But when only six km from his destination, he saw it would be impossible to continue the flight visually because of even lower cloud and reduced visibility on the hills ahead, and he began a turnback on to a reciprocal heading.

During the turn the pilot unintentionally entered a patch of cloud, and the aircraft collided with the upper section of a 220 foot high radio mast belonging to a local broadcasting station. The mast collapsed, taking the aircraft with it. The pilot, though seriously injured, survived the crash and was able to extricate himself from the wreckage.

• Ferrying a Musketeer, with a student pilot as a passenger, to a country centre, an instructor followed the course of a dry river at 500 feet to point out suitable forced landing areas to the student. In answer to a question by the student, the instructor set out to demonstrate a forced landing approach to a sand bar in the river bed, allowing the aircraft to descend below the level of the trees flanking either side. As he was about to climb out of the river course, the occupants heard a loud 'TWANG', and saw that the H/F aerial had been severed. The aircraft continued to fly normally however, and thinking the aircraft had struck a bird, the pilot continued to his destination where he made a straight in approach.

Unknown to the pilot until after he landed, the aircraft had struck and broken two telephone lines strung across the river and these were trailing for nearly 200 metres behind the aircraft. As the aircraft approached to land, the wires dragged across a power line, shorting it out and breaking several wires. Fortunately, no great damage was done and no-one was injured, but it is easy to imagine similar circumstances creating an extreme hazard for persons or property in the vicinity of the power line.

• When this accident occurred, a private pilot was taking a friend for a flight in a Victa from a country aerodrome. Sighting a farmhouse where a friend of the passenger lived, the pilot descended, as he said later, 'to allow the passenger to have a good look at his friend's property'. The aircraft approached the house at low level, converging at an acute angle with an unseen single-wire powerline running to the property. The aircraft's undercarriage caught on the power line and the aircraft skidded along the wire, lifting it clear of the supporting poles. The pilot attempted to land in a field beyond the house, but the aircraft, still restrained by the power line, struck the ground heavily, cartwheeled through a fence and came to rest. The aircraft was destroyed and both occupants were severely injured.

• At a country flying school a pilot holding a restricted private licence hired a Cessna 150 to make a local pleasure flight, with a friend as passenger.

After flying in the training area for some time, the passenger suggested they fly along the nearby coast. Although this would take the aircraft beyond the boundary of the training area, the pilot agreed and, at an altitude of about 500 feet, they flew along the coast just to seaward. At a point where thickly timbered hills rise steeply from the shore line, the pilot decided it was time to return to the aerodrome.

Instead of turning to port over the water, which could have been accomplished quite safely at the height at which the aircraft was flying, the pilot turned to starboard towards a valley running inland at approximately right angles to the coast. On either side of this valley, the terrain rises above the height at which the aircraft was flying, and the pilot applied power intending to climb and continue up the valley.

No sooner had he done so than there was a loud bang from the starboard side of the aircraft as the starboard wing struck and severed one cable of a high tension power line spanning the valley. The aircraft continued to fly normally however and the pilot was able to return to the aerodrome and land.

The pilot said afterwards that he did not see the power line at any time. This is hardly surprising as the line spans a distance of 600 metres and, at the point of impact, is about 250 feet above the valley floor. From the air,

The Grumman Ag-cat after tangling with the radio mast . . .

the only cues to its location are the steel pylons on which it is carried but, as the two that support the line on either side of the valley are on high terrain and surrounded by dense timber, they would not have been visible from an aircraft flying in the valley at or below 500 feet AMSL.

* * * * *

All that has been said so far, relates to deliberate and unnecessary low flying in contravention of those Air Navigation Regulations which exist for the express purpose of preventing low-flying accidents.

But as inferred in the opening paragraph, there is another side to the 'Wires Are Where You Find Them' coin. And this concerns one aspect of low level operations that is perfectly legitimate — approaches to land! The following further examples also speak for themselves:

• A private pilot was making a business trip to a country property in a Cessna 182 accompanied by one passenger. Arriving over the airstrip on the property, he inspected it from a height of 500 feet, noticing that because of a hill rising beyond its western end, it was a 'one way' strip and that at its eastern end there was a large tree right in the approach path. However, the pilot failed to see a three-wire power line which also crossed the approach path, because its supporting poles were hidden by trees some distance away on either side.

The pilot made an approach to land to the right of the tree, then aligned the aircraft with the strip. On short final approach, he suddenly saw the wires about six metres in front of the aircraft. The pilot applied full throttle, pushed the control wheel forward and flew directly at the wires, cutting them cleanly with the propeller. He then continued the approach to make a normal landing. Damage to the aircraft was confined to a broken VHF aerial.

. . . and the Cherokee which struck the power line on its approach to land in a paddock.

After they had landed, the passenger mentioned having had a 'close shave' with the same wires in another aircraft only a week previously but, being occupied with 'the scenery' during the approach on this occasion, he had 'not thought' to warn the pilot. Local residents also told the pilot that there had been a few 'near misses' during approaches to land on the strip and that they were 'expecting it to happen sooner or later'.

It was established during the subsequent investigation that the landing area was a 'one-way' agricultural strip and did not meet the minimum standards for an authorised landing area.

• A farmer was flying his Cherokee 235 to a property where his employees were harvesting wheat. The strip met the minimum requirements for an authorised landing area, and he was aware of a two-cable powerline which crossed the approach path at an oblique angle.

The day was very hot, and the wind, gusting to 15 knots was producing a fluctuating cross-wind component on the strip.

Closing the throttle, the pilot lowered full flap, intending to touch down just beyond the threshold. On short final approach, just before the aircraft reached the position of the power line, the aircraft entered a particularly turbulent area and seemed to lose height rapidly. Suddenly the pilot sighted the power line immediately in front of the aircraft, but it was too late to avoid it. The aircraft flew into the wires, and slid to port along the power line. One cable broke, but the other stretched, arresting the aircraft's forward motion as it did so, and it descended almost vertically to the ground. The aircraft sustained considerable damage but the pilot escaped injury.

The pilot had landed in this direction over the power line several times before. On these earlier approaches however, the harvesting machinery had been positioned directly beneath the power line to provide the pilot with excellent height reference and depth perception. By contrast on this approach, though the pilot knew the power line's general location, he had nothing from which he could accurately gauge its position. In this already difficult situation, complicated by the gusty, hot and turbulent flight conditions, the pilot tried to judge a steep power-off approach to land 'short' over where he estimated the obstruction to be. In the circumstances, the pilot was virtually attempting the impossible.

• At a country aero club in N.S.W., an instructor and student pilot were conducting a period of general revision in a Cessna 150. After completing a number of exercises, including a forced landing, the aircraft was climbed back to 3000 feet and the instructor again closed the throttle to simulate an engine failure. The student selected a field and established the aircraft in an approach pattern for a landing into wind.

The instructor saw that the field was of marginal length for a forced landing but, as the student's planning and judgement during the descent were good, he let him continue. On reaching a height of about 300 feet, where the exercise would normally have been discontinued, the instructor decided to allow the student to descend still further in order that he would realise for himself that the field was too small. This had the desired effect and drew an exclamation from the student, but neither instructor nor student noticed that there was a power line on the near boundary of the field, crossing the aircraft's path at an angle of about 60 degrees.

Just as the instructor was about to call 'go around', the aircraft flew into

the wires. The aircraft slid sideways along the power line and descended to the ground. The impact with the ground was not severe, most of the damage to the aircraft being sustained by the collision with the power line. Neither instructor nor student was hurt.

It was found afterwards that, although the area being used for the forced landing practice was within the flying school's authorised low flying area, the power line was not marked on the map displayed in the school's briefing room as required.

• At the conclusion of a charter flight to a station property, the pilot of a Cessna 172 commenced an approach to land, aiming to touch down right on the threshold of the property strip.

Just as the wheels made contact with the ground the pilot was aghast to see that the aircraft was passing beneath a single-wire power line stretched across the approach end of the strip. The power line was not marked in any way and had the pilot not been employing a short-field type of approach it is very likely that the aircraft would have collided with the wire.

The pilot said afterwards that the passenger he was carrying had worked on the property for two years and had assured him that the strip was satisfactory. He had however, forgotten to warn the pilot of the presence of the power line, which had been installed (apparently with little imagination) by an electricity supply authority after the airstrip was built.

* * * *

In forwarding a report of this latter incident, the pilot concerned was justifiably indignant that such a hazard should be allowed to exist in close proximity to an airstrip. What he apparently did not appreciate however, and perhaps what the pilots of aircraft involved in other, similar occurrences do not realise, is that pilots themselves are entirely responsible for establishing the suitability of proposed landing areas.

Where the proposed landing area is a Government or a Licensed Aerodrome, its physical dimensions and characteristics are published in the Aeronautical Information Publication and the Visual Flight Guide. As well as this, Notams on the condition of the aerodrome are issued whenever it does not conform to the published data, and the aerodrome itself is appropriately marked.

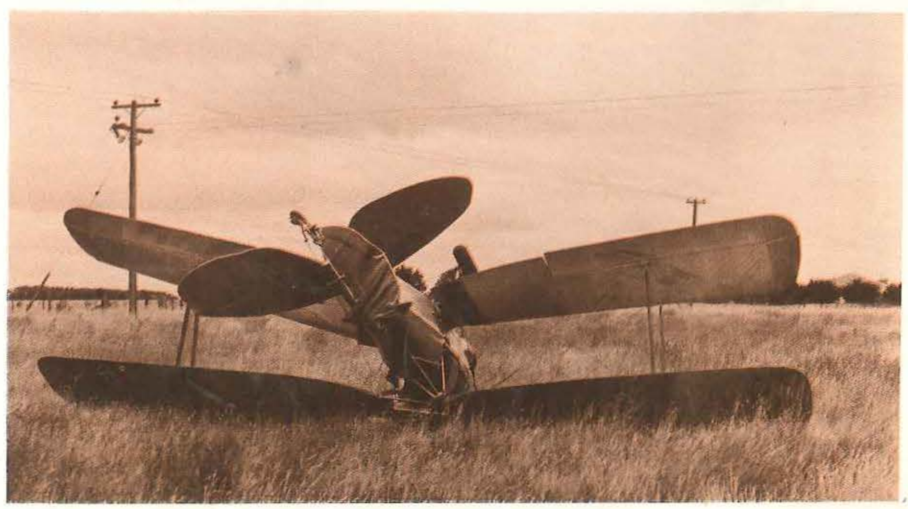
But the situation is entirely different when the proposed landing area is not a Government or Licensed Aerodrome. In this situation, the pilot must establish the physical dimensions and characteristics of the landing area for himself and must obtain the owner's approval for the landing. The pilot must then ensure that the proposed landing area conforms to the standards for authorised landing areas set out in the A.I.P. and the V.F.G., and that the surface is sufficiently smooth and firm for the aircraft type involved.

As the foregoing examples show so well, a pilot intending to use an authorised landing area cannot afford to assume there are no hidden obstructions in the approach path, just because no one has mentioned them or he has not noticed them. Instead, when making enquiries as to the suitability of the landing area, he should take the initiative in seeking out pertinent information on wires in the landing area's vicinity.

Even while these words were being written, yet another aircraft collided with a power line while approaching to land at another country airstrip. The two occupants were seriously injured and the aircraft was written off. The strip, on private property, was clearly marked and had previously been used as an authorised landing area. But unknown to the pilot, a power line had been erected across the approach path, which, in effect, meant that the threshold was displaced further into the strip to meet the obstruction-free gradient requirement prescribed in the AIP and the Visual Flight Guide. There were no markings to indicate this fact however, and although agricultural pilots using the strip were aware of the power line, the significance of its position was not apparent to the owner of the property who had no aeronautical training. The pilot had telephoned the owner before setting out on the flight to obtain his permission to use the strip and to check that it was serviceable. The owner had assured the pilot that it was, but no mention was made of the power line. If the pilot had thought to question the owner directly about wires in the vicinity of the strip, it is most likely that he would have been told about the power line.

All information of this sort should, of course, be obtained before the flight begins but, in addition, when a pilot is not familiar with a particular area, he would be well advised to thoroughly inspect it from the air before attempting a landing. It is obviously unwise for a pilot to simply accept a layman's word that a strip is suitable for his aircraft.

Another point to emerge from all these occurrences is that there is no particular type of approach which can be regarded as 'safe' from the danger of obstructing power lines at an unknown strip. In the case of the Cessna 172, the pilot's 'short field approach' happened to place the aircraft *beneath* the wire at the end of the strip. Yet in the last-mentioned case the pilot, not having landed on the strip before, presumably made a similar, long shallow final approach, 'dragging' the aircraft in with power, which placed it directly in the path of the unseen wire! And even where a power line is far enough from the threshold of a strip to conform to the standard 1:20 obstacle-free gradient requirement, an approach of this type could endanger an aircraft by placing it below this gradient.



These photographs of the Tiger Moth which struck power lines . . .

Is there anything more to be said on the necessity for extreme care when operating anywhere but on normal cross country flights from a Government or Licensed Aerodrome? For instance, could it perhaps be argued that the task of always seeing and avoiding the ever-proliferating power lines in country areas, is becoming more than can reasonably be expected of individual pilots?

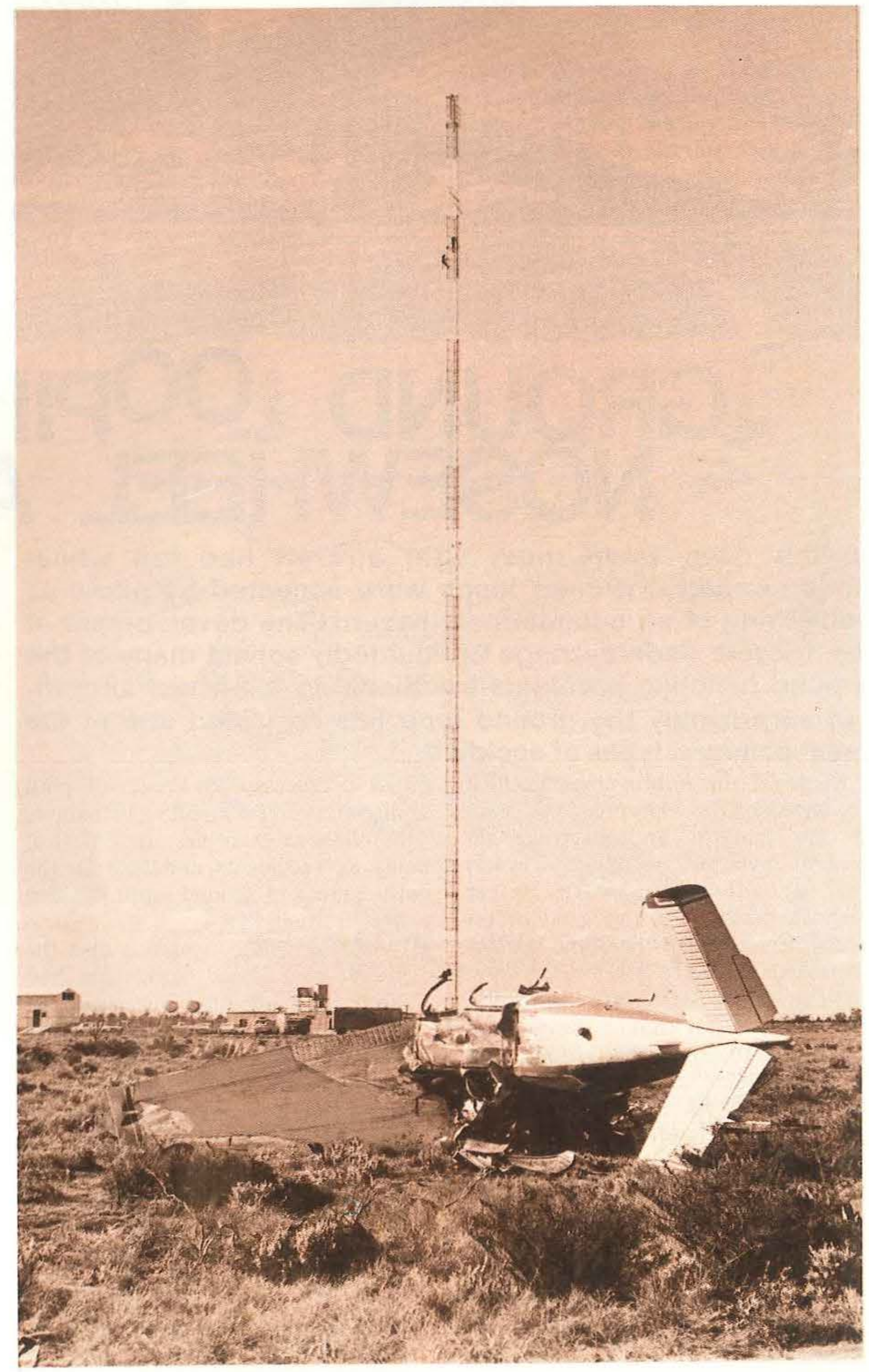
It is certainly not an easy task. Nevertheless the final responsibility for the safety of any given task has to rest with someone. And where that task happens to be the operation of an aircraft, that final responsibility can only be given to the pilot-in-command. This is a basic, inviolate and proven principle that aviation has inherited from hundreds of years of seafaring experience. So regardless of the particular operational situation in which an aircraft is placed, pilots must recognise this fact and accept it with all its implications. And so they must realise that the only *complete* answer to the problem of colliding with overhead wires at the present time is still greater vigilance — not only in keeping a sharp look-out while actually in flight but, equally important, in assimilating beforehand all relevant information on the positions of wires in the area of operation.

The same philosophy of vigilance can even be applied by the pilot who is unlucky enough to have to 'pick a paddock' for an emergency landing. The possibility of wires in the intended landing path is at least as important a consideration as the suitability of the field's surface. A well planned forced landing approach to an apparently suitable field is to little avail if one is going to be unpleasantly surprised by the presence of a hitherto unseen power line too late in the descent! The wiser course, in selecting a paddock in any reasonably developed rural area, is to assume that there will be wires somewhere in the vicinity, and to maintain a constant look-out for them throughout the descent, using whatever cues there are on the ground to assist in their detection. In this way there should be a much better chance of sighting any wires in time to plan a final approach which will avoid them.

* * * *

The accidents discussed in this review show beyond any doubt that unseen wires can be a very great hazard to aircraft that for any reason have to fly close to terrain. Because the likelihood of encountering wires is growing constantly greater as their distribution in rural areas increases, the only safe course is to assume that wires will be a hazard in *any* operation involving flight near the ground, and to take the precautions necessary to avoid them.

Better than any other words of advice, the accident histories cited show what some of these precautions must be, if similar disasters are to be avoided in the future.



. . . and the Bonanza which collided with the guy wire of a radio mast, tell their own story.

GROUND LOOPING IN NOSEWHEEL AIRCRAFT

In the days when most light aircraft had tail wheel undercarriages, ground loops were accepted by pilots as something of an occupational hazard. The development of the tricycle undercarriage undoubtedly solved many of the ground handling problems traditional to tail wheel aircraft, yet surprisingly the ground loop has remained one of the most common types of accident.

Some of the improvements which accompanied the widespread adoption of the tricycle undercarriage on general aviation aeroplanes nearly two decades ago, were better manoeuvrability on the ground, especially in strong winds, and greatly improved visibility over the nose. In the light of these welcome developments, it might have been reasonable to expect that ground loop accidents would soon become a thing of the past. As already indicated, however, this has proved far from the case, and ground loops have continued to afflict the operation of these supposedly easy-to-handle nose wheel light aeroplanes. It is clear from this experience that, in some conditions, especially during the critical stages of take-off and landing, the tricycle undercarriage can be just as demanding as its predecessor in terms of pilot ability and correct handling technique. The following examples are typical of many such accidents, and illustrate the development of ground loops in three common situations:—

- A student pilot, who was also the owner of a Beech Musketeer, had been receiving dual instruction in his own aircraft and, after successfully undergoing a flight check with an instructor, was authorised to carry out a period of solo circuit and landing practice. A number of touch-and-go landings were then conducted without incident, during which time the runway direction was changed twice owing to wind fluctuations. A further successful landing was carried out in gusty wind conditions, following which the pilot re-applied power for take-off and, at the same time, eased the control wheel forward. As the speed increased, the aircraft swung off the runway, crossed the flight strip and, after turning through almost 180 degrees, came to rest badly damaged in a storm water drain.

* * * *

- A Piper Cherokee was being flown by a student on solo circuit and landing practice. Following a normal take-off on one of these circuits, the duty runway was changed because of variable wind conditions and the aircraft then made an approach for a full-stop landing in the new direction. Although there was a significant cross-wind component on the new runway, the approach and touchdown appeared quite normal to the pilot and, after the aircraft had run forward a short distance, he started to raise the flaps. Simultaneously, the aircraft veered to port and the pilot was unable to correct the rapid swing which followed. As the aircraft commenced to slide sideways, the nose strut folded to the left, and the propeller and starboard wing tip struck the ground.

* * * *

- Another Cherokee pilot had planned to carry out a series of cross-wind take-offs and landings in conditions in which the cross-wind component on the runway to be used was fluctuating at about the maximum authorised for the type. Before opening the throttle on the first take-off, the pilot applied aileron into wind, and forward pressure on the control wheel at the same time. Shortly after the aircraft began to roll, a swing to port developed and, as speed increased, the port main wheel lifted clear of the ground. Despite attempts by the pilot to correct the aircraft's heading, the swing continued and the aircraft left the runway about a hundred metres from where the take-off run had commenced. By this time, the turn had progressed through approximately 110 degrees and, as the aircraft slid sideways, the nose-wheel strut collapsed, and the propeller struck the ground.

* * * *

Although in general, the chances of a ground loop in a nose-wheel aircraft are much less than in a tail-wheel type, experience shows that certain tricycle undercarriage aircraft have ground loop accident histories significantly worse than those of some tail-wheel aircraft! The precise reasons for this need not concern us here, but it is obviously desirable for pilots to understand the basic causes of the ground loop, together with its appropriate corrective action, as it applies particularly to nose-wheel aircraft. In looking at the mechanics of the ground loop itself however, and in order to gain a more complete appreciation of the overall problem, we will use as a starting point for our discussion the classic sequence of events as it affects aircraft with tail-wheel undercarriages.

GROUND LOOPS IN TAIL-WHEEL AIRCRAFT

Tail-wheel aircraft are generally more prone to ground-loop accidents than nose-wheel types primarily because the centre of gravity is located aft of the main wheels. Figure 1 depicts the forces which would exist if, for example, the aircraft began to swing during a take-off or landing ground roll. In this situation the tendency for the aircraft to move sideways is opposed by another sideways-acting force at the main wheels which is generated by friction between the tyres and the runway surface. In the tail-wheel aircraft, the fact that the centre of gravity is behind the main wheels gives rise to a yawing moment tending to pivot the aircraft about the main wheels. With the distribution of forces shown in the diagram, an unstable situation exists and the tighter the turn, the more powerful the yawing moment which causes the turn becomes. Similarly, as the distance between the main wheels and the centre of gravity increases, the effect of this adverse yawing moment will also increase, further adding to the severity of the swing in some aircraft. If the runway surface is slippery, the tyres will rapidly lose their grip and the aircraft may slide backwards; if it is dry, the spiral may continue to tighten until a situation is eventually reached where the inside main wheel lifts and the outer wing tip and propeller strike the ground.

THE NOSE WHEEL CASE

Turning now to the tricycle-undercarriage aircraft in Figure 2, we have a set of circumstances and distribution of forces virtually the opposite to those just described. In the tricycle-undercarriage case, the centre of gravity is ahead of the main wheels and if the aircraft is turning or begins to swing, the main wheel tyres will be subjected to an opposing side force which acts in this instance *behind* the centre of gravity. The yawing moment thus created tends to re-align the aircraft with the runway heading and it can be seen that in these circumstances, a basically stable situation exists. In addition, the further the centre of gravity is ahead of the main undercarriage, the greater the restoring force and, consequently, the more stable the ground roll becomes. Where then, does the problem lie?

EFFECT OF NOSE WHEEL CASTER

In actual practice, the situation depicted in Figure 2 is valid only where the aircraft's nose wheel is held clear of the ground with up elevator control, or where the nose wheel is of a type which is completely free to caster or swivel. If an aircraft with a fully castering nose-wheel touches down in a crabbed attitude, the nose-wheel will caster as it contacts the ground, allowing the aircraft to straighten up and continue travelling in the runway direction.

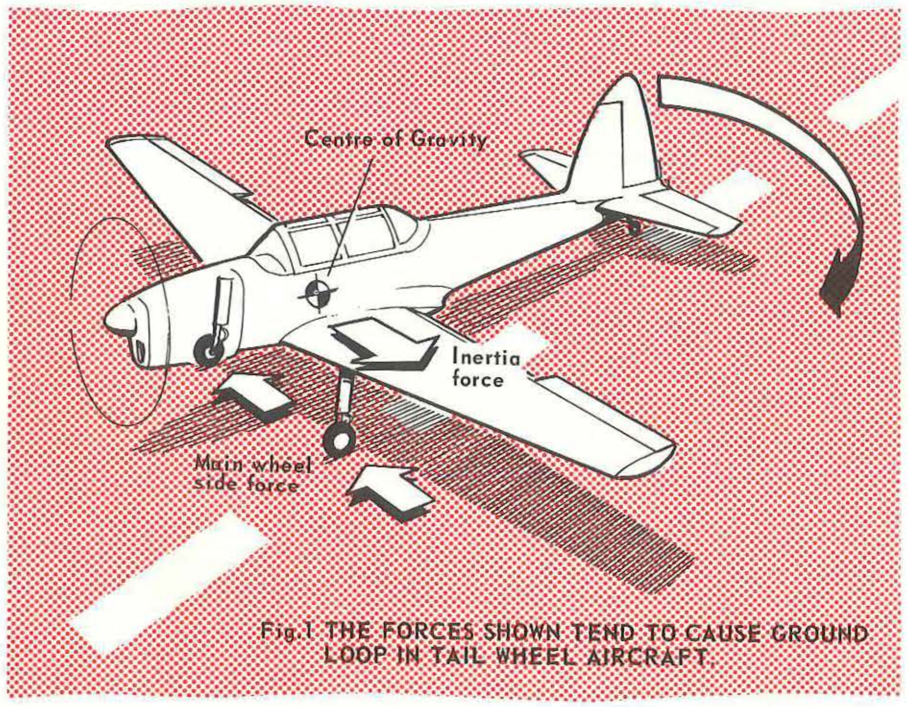


Fig.1 THE FORCES SHOWN TEND TO CAUSE GROUND LOOP IN TAIL WHEEL AIRCRAFT.

However, the nose wheels of most general aviation aircraft are not completely free to caster, but are limited by virtue of their steering characteristics, shimmy dampening and other design considerations. The extent of any swing developing either during the ground roll or as a result of an excessive crab angle at touchdown, may be sufficiently large to preclude any effective castering action and the nose wheel will be subjected to a side force arising from the reaction

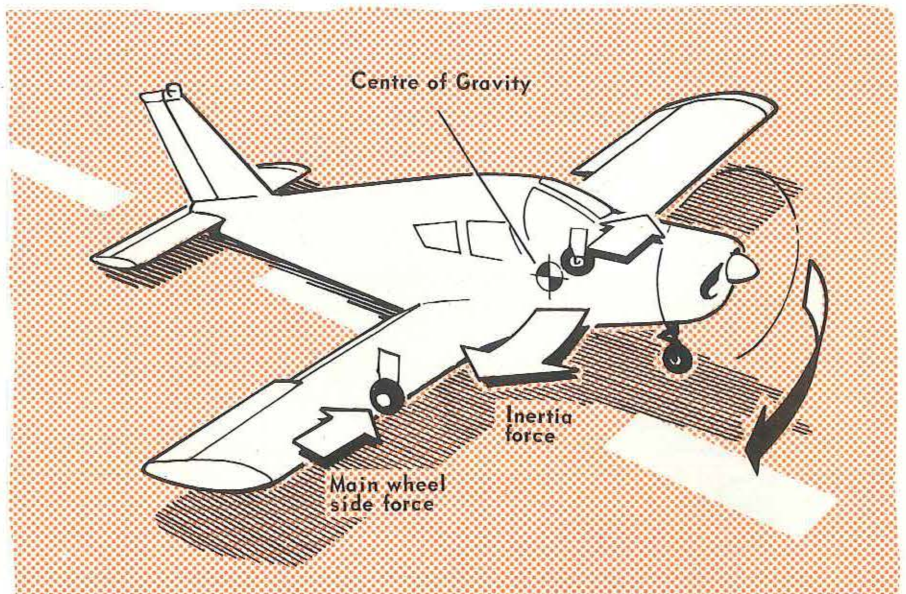


Fig.2 WITH NOSE WHEEL HELD CLEAR OF GROUND TRICYCLE UNDERCARRIAGE AIRCRAFT IS DIRECTIONALLY STABLE.

between the tyre and the runway surface. The yawing moment created by this force may be powerful enough to overcome the inherent ground stability of the tricycle undercarriage and cause the characteristic initial swing of the ground loop. This is the case illustrated in Figure 3.

FACTORS LEADING TO LOSS OF CONTROL

The extent and severity of the initial swing during the ground roll depends to a very large degree on the distribution of the aircraft's weight between the main and nose wheels, and in particular, the percentage of this weight supported by the nose wheel.

Control difficulties can develop during the take-off and landing ground roll if insufficient back pressure is maintained on the control wheel. Consider for example, a situation where a pilot is using a higher than normal airspeed on an approach to land and the aircraft touches down at this high speed with little or no flare. To prevent the aircraft becoming airborne again, the pilot then deliberately holds it on the runway with a firm forward pressure on the control wheel. With the aircraft still travelling at high speed, the wings will continue to produce considerable lift, especially with flap extended, even though the wheels may be in contact with the ground. This effect, combined with down-elevator or 'stabilator' control, will tend to lighten the load on the main wheels and, if the speed is high enough, may even raise them clear of the ground. In these circumstances most, if not all, of the aircraft's weight is thrust on to the nose wheel, placing the aircraft in a highly unstable situation often referred to as 'wheel-barrowing'. Though this phenomenon is more commonly encountered on landing, a similar effect can also arise during the take-off run through the use of excessive forward pressure on the control wheel to hold the aircraft on the ground after take-off speed has been reached.

Directional control of the aircraft on the ground is achieved through the use, either separately or in combination, of nose-wheel steering and differential braking. In the situation just described, it is obvious that both braking and steering capabilities of the aircraft will be severely diminished. Thus it requires only a slight deviation in heading, as the result of either a wind gust or steering effects, to cause the aircraft to pivot rapidly about the nose wheel in a ground-loop type manoeuvre. Provided the main wheels are in contact with the ground and able to contribute even a small opposing moment, the turn on this occasion will not tend to tighten of its own accord but damage to the aircraft, usually in the form of undercarriage failure, may occur because of excessive sideways loading.

AIRCRAFT HANDLING TECHNIQUES

As most ground loops are basically the result of loss of directional control on the ground, it is obvious that the primary means of avoiding such accidents must lie in the use of correct handling techniques during take-off and landing.

It has been explained that forward pressure on the control wheel, combined with excessive speed during the ground roll, may result in a considerable percentage of the aircraft's weight being transferred to the nose wheel with a correspondingly marked decrease in steering and braking capability. If the situation is then further aggravated by cross-wind conditions or lack of nose-wheel caster effect, the stage is set for a ground loop. On the other hand, if the main wheels are firmly in contact with the runway and the nose wheel is lightly loaded (or even held clear), any adverse yawing moment which may be created as the result of a side force at the nose wheel will be insufficient to overcome the relatively large restoring force at the main wheels. The ground roll stability of the tricycle undercarriage configuration will then tend to re-align the aircraft with the runway direction.

The majority of ground loops in nose-wheel aircraft occur during the ground roll just after touch-down or in the latter stages of take-off. It follows that, in order to obtain maximum benefit from the restoring forces provided by the main-wheel reaction, and also differential braking if this is available, the aircraft weight must be predominantly on the main wheels during these critical phases of take-off and landing. For this reason, the use of excessive forward control-wheel pressure to hold the aircraft on the ground at speeds above normal during take-off should be avoided. During landing, the aircraft should be flown so as to touch down on the main wheels first and the nose wheel allowed to contact the runway only after speed has diminished. In the case of a maximum effort landing, heavy braking will tend to throw a high proportion of the aircraft's weight on to the nose wheel. To avoid loss of control in these circumstances, as well as gain maximum braking effect, it may be necessary to hold full up elevator control while the brakes are being applied.

Operating in cross-wind conditions requires special care. Allowing the aircraft to contact the runway in a crabbed attitude during a landing out of wind is one of the most common causes of loss of directional control. As well, pilots must be especially careful with the use of rudder at the point of touchdown. Of the various methods of drift correction, all require some degree of rudder application to align the aircraft with the runway direction. On many general aviation aircraft, the nose wheel is steered through a direct acting linkage when rudder is applied and if the nose wheel is allowed to touch down while it is at an angle to the landing path, the aircraft will immediately swing in the direction the wheel is turned.

Much the same situation applies when taking-off in a cross-wind. In this case, directional control is maintained by a combination of rudder and nose-wheel steering, assisted by into-wind aileron. As speed increases and the flying controls become effective, the use of aileron may result in most of the aircraft's weight being supported by one of the main wheels. This is normal and has no adverse effect on directional stability so long as the aircraft is not pushed forward on to the nose wheel as well.

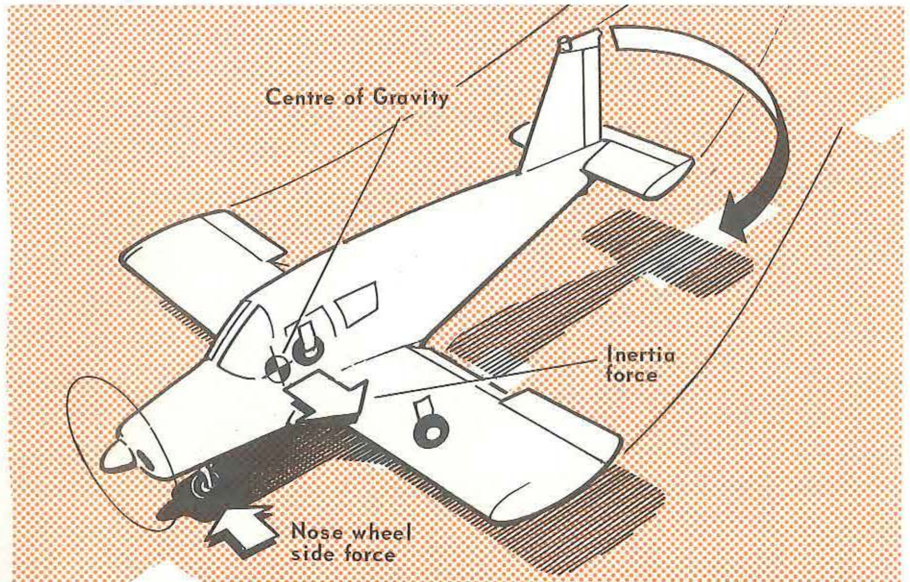


Fig.3 AIRCRAFT 'WHEELBARROWING' WITH MAIN WHEELS CLEAR OF GROUND. WITHOUT RESTORING FORCES AT MAIN WHEELS, AIRCRAFT PIVOTS ABOUT NOSE WHEEL

RECOVERING DIRECTIONAL CONTROL

A series of tests conducted in a popular type of training aircraft showed that, while a swing readily develops if the main wheels are allowed to leave the ground, it is just as easily controlled by prompt recovery action. The initial swing however, can be quite severe and there is little doubt that it is the abruptness of the heading change which catches pilots unawares. Naturally, the main wheels will leave the ground more readily if the control wheel moves forward as engine power is applied, particularly with the flaps fully, extended. This of course is a situation that can very easily arise in touch and go landings.

It should be appreciated that once an aircraft has begun to swing during the take-off or landing ground roll, the manoeuvre may progress very quickly to the point beyond which recovery is not possible. The pilot should therefore be constantly alert for signs of a swing starting or indications that the aircraft's weight is shifting to the nose-wheel. In either case, depending on the extent to which the situation has developed, he should immediately:

- Close the throttle and relax forward pressure on the control wheel to aft of the neutral position, to lighten the load on the nose wheel and return steering and braking to normal; or
- If the aircraft is not pivoting, and adequate performance and runway length are available, carry out a go-around.

The pilot should also be prepared to go around unless he is confident that, in strong or gusty cross-wind conditions, the aircraft can be landed with little or no drift resulting from the cross-wind effect.

A good landing, particularly in a cross-wind, depends to a large extent on a well planned and executed final approach. This in turn requires that the pilot make proper compensation for drift, and that he uses the correct approach speed and touchdown technique for the prevailing conditions. Careful monitoring of all these factors, as well as strict observance of recommended aircraft handling techniques, is essential if loss of directional control on the ground followed by the inevitable ground loop, are to be avoided.

1977 AIR FORCE SAFETY CALENDAR

Knowing that the Digest numbers many aviation enthusiasts amongst its readership, the Australian Government Publishing Service has asked us to announce that the Air Force Safety Calendar is now available for 1977.

Produced by the Directorate of Air Force Safety, this high quality calendar contains six full colour paintings of some Australian service aircraft of yesteryear, each with a brief safety message. The paintings, by D.A.F.S. staff artist Peter O'Connor, each measure 297 mm x 420 mm, and are all eminently suitable for framing.

The calendar, price $1.50, is available from the Australian Government Publishing Service, P.O. Box 84, Canberra A.C.T. 2600, or from AGPS retail outlets in capital cities. The AGPS catalogue number is 76–3356–1. Postage of 40 cents should be added if ordering by mail.

...the pilot, who was not qualified for instrument flight, proceeded into conditions in which visual flight could not be maintained....

The stark words on the previous page have been the epitaph of many a light aircraft pilot and their theme has been repeated time and again in the Aviation Safety Digest over the years. Despite this, tragedies of the same sort continue to occur.

They continue to happen in some cases because the pilots concerned seem unable to recognise weather which, if they persist with their flight, will sooner or later deprive them of visual reference; or they simply fail to recognise the point beyond which they are compromising the margin of safety built into the Visual Flight Rules.

The situation can be likened to the driver of a motor car who, though feeling drowsy, is quite sure he can keep awake at the wheel until he arrives at his destination. He learns the folly of this judgement only if he recovers consciousness in hospital.

So too with the pilot trying to maintain visual flight in deteriorating weather. When his aircraft has reached a point where he is **forced** to see that he cannot continue visually, it is too late. So very often the aircraft has already entered cloud, and the pilot is rapidly losing control. Unfortunately, pilots who make this mistake seldom have the opportunity to review their folly, either from the vantage point of a hospital bed, or anywhere else.

It is just here that the difficulty lies. Because it is beyond our experience, most of us will simply not accept the fact that we can quickly be deprived of control by loss of visual reference. In fact it seems that the 'it can't happen to me' philosophy is more prevalent in regard to marginal visual flying, than to any other form of chance-taking in light aircraft.

Let us look quickly at a hypothetical case of a pilot trying to press on visually in deteriorating weather:

Believe it or not, before the pilot lost control in cloud, this was a sleek Cessna 210. The tremendous force with which it dived into the ground is obvious.

Even though visibility is poor, this pilot can see the ground ahead and to either side reasonably well, and has every confidence that he can continue safely. Admittedly, the overcast is forcing him to fly lower than perhaps he would in better conditions, but he is not dangerously low. So on he goes.

The conditions worsen — now he has to dodge an occasional patch of cloud at his own level, which is already lower than he prefers. There isn't much forward visibility now, but he can still see the ground below the aircraft quite well, so there is nothing to worry about. Nevertheless, if the weather gets much worse, he feels, he might have to turn back. On the other hand, perhaps he might be through the worst of it soon, and then conditions should improve. Besides he knows it is important for his passenger to get there today.

Down to a few hundred feet now, the pilot follows a path between two big patches of stratus. Yes, there's another landmark on the ground that he can recognise, so all is well. But wait a moment, there's cloud straight ahead now too, and right down to the ground! And this time, there's no way round it. So he'll have to turn back after all.

Bad luck. Oh well, never mind, he knows exactly where he is and he can easily retreat the way he has come. He rolls the aircraft into a medium turn to port to bring it round on to a reciprocal heading. But that cloud on the left is closer than he thought — in fact there isn't going to be enough room to make the turn in the clear! Before the aircraft has turned much more than 90°, it plunges into the cloud at what is suddenly a frightening speed. Instantly the world beyond the cockpit windows is reduced to opaque wet greyness. Whew! He was quite sure he wouldn't be caught in cloud but here he is. Still, if he can just keep this medium turn going at the same rate, the aircraft should be out into the clear again in a moment or two.

But what's wrong? There seems to be no end to the cloud. Perhaps the aircraft is no longer in the turn. It certainly doesn't feel as though it is turning. No, that can't be right, the needle on the turn and bank indicator is still well over to the left. But look, that ball isn't in the centre now — the aircraft must be slipping in. Or is it skidding out? Quickly, use rudder to correct. Must try to keep calm though — now let's see, which way is that ball indicating? Hey, look at the airspeed — must have let the nose drop a bit! Ease the stick back a little — ah, that's better. Or is it now? Why is the 'G' increasing like that? And what's happening to the turn needle now — it's hard over against the stop! That turn must be tightening — push the stick forward again before the aircraft stalls. No, not that much, now it's diving again — hear the engine screaming. Look out, the altimeter is unwinding like mad! Try not to panic — must do something quick . . .

* * * *

In other instances, accidents continue to occur because the pilots concerned have a completely false confidence in their ability to fly by reference to instruments should the weather conditions in which they are flying deteriorate to the point where this becomes necessary. They believe that, because they have never had the slightest difficulty in interpreting the instruments when flying visually, there is no reason why they should not be able to continue to do so, just because the view through the windscreen happens to be obscured by cloud!

Taken to its logical conclusion, this type of thinking implies that the long, expensive, and arduous training undergone and maintained by professional instrument-rated pilots is quite unnecessary; that any pilot can fly in marginal weather, in cloud, or at night, provided his basic manipulative ability is sound and of a high enough standard. There is an old saying that 'a little learning is a dangerous thing' and any such premise is obviously very much in this category, because it takes no account of that most important occupational hazard of flying without visual reference — physiological illusions.

These illusions are false sensations or perceptions, derived from the various sensory mechanisms of the body, especially the organ of balance. They are a natural physiological phenomena in instrument flight and are common to all pilots. The difference with instrument rated pilots is that they are trained to disregard them, and to accept only the indications of the aircraft's instruments! It is the difficulty of learning to disregard these illusions, just as much as the actual task of learning to control an aeroplane on instrument indications alone, that makes instrument training so absolutely vital to any sort of flying without full visual reference.

Flight is an unnatural environment for man and not one for which the human sensory mechanisms are well suited. But because the most powerful stimuli received by the brain are those of vision, a pilot learns to use his eyes to counteract the false sensations received from the other sensory organs. For example all pilots remember the confused feelings experienced on their first flight; but with further air experience these strange sensations very soon ceased. The aeroplane no longer seemed to be 'standing still' in the air; the horizon no longer 'tipped up' when the aeroplane banked; and so on. In other words the student pilot learns to overcome the false sensations conveyed to the brain by the movements of the aircraft in flight, and learns to see these movements as they really are.

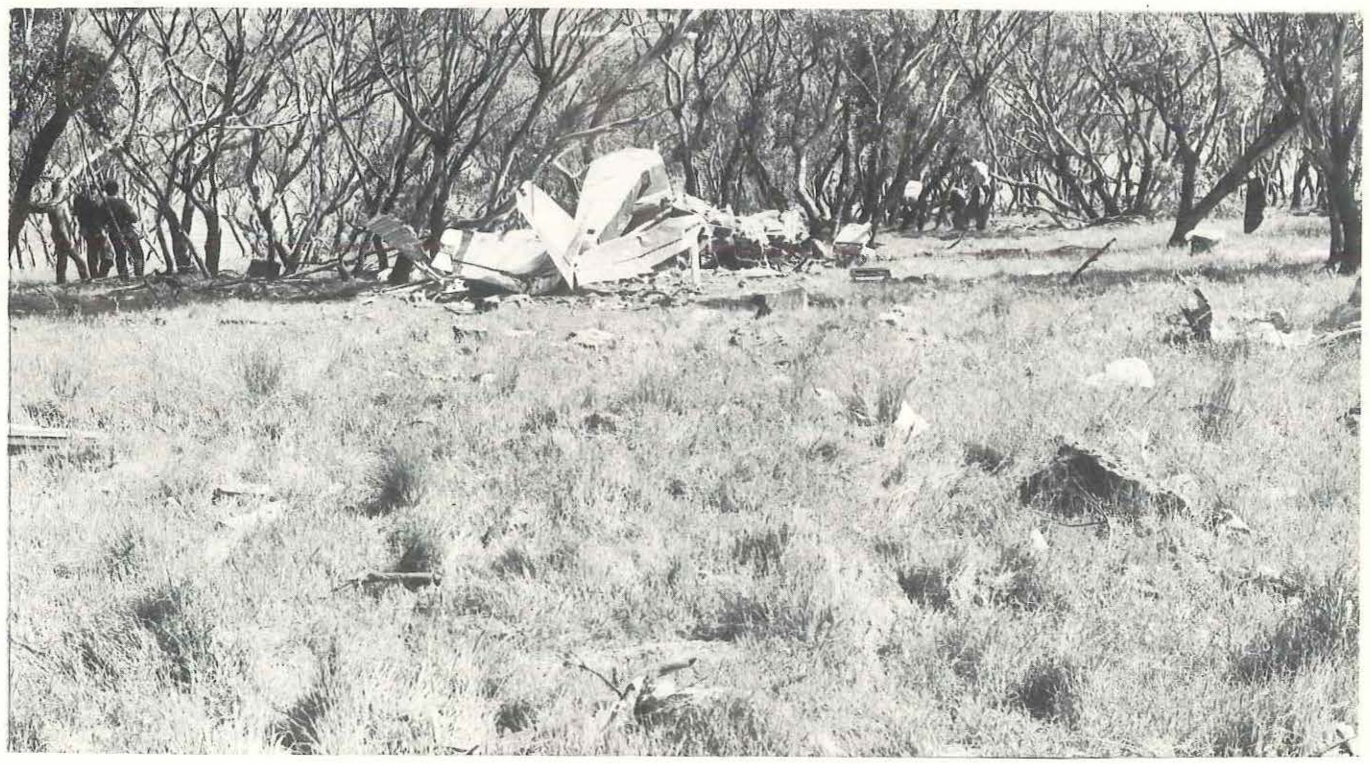
All remains well while a pilot continues to receive this visual information from outside the aircraft — while he continues to 'maintain visual reference'. It is important to note here that there is no such thing as 'partial visual reference'. Either the pilot has visual stimuli outside the aircraft or he has not. It follows, as most pilots will know from their own experience, that very little outside stimuli, for example the sight of just a small patch of ground through a hole in the cloud, can be sufficient to maintain the visual 'input' that the pilot's brain continually needs to overcome the false sensations inherent in flight.

But once this outside visual reference disappears altogether, as can happen very quickly indeed when the remaining view of the ground is already small, and the counteracting influence of vision on the brain is removed, the false sensations from the other sensory organs suddenly become paramount. Illusions of movement or attitude are then inevitable and, unless a pilot has learned by experience, in the form of instrument training, to ignore these illusions by concentrating his whole attention on instrument indications in a systematic way and reacting accordingly, their effect is over-powering. As a result a pilot can become absolutely convinced that his aircraft is turning, or that its attitude has changed, when in fact it has not. Conversely, he can be led to believe that the aircraft is flying straight and level, when in fact it is 'winding up' into a spiral dive. This, of course, is the natural aerodynamic result of any uncorrected banking or turning movement applied to an aircraft, as is demonstrated to all student pilots at a very early stage of their training.

Powerful illusions of this sort are the most common form of disorientation in flight and the loss of control that almost inevitably follows has been responsible for many fatal accidents in 'below VMC' weather. They are also the explanation for the phenomenon experienced by nearly all who become disorientated in cloud — the belief that the aircraft's instruments have suddenly gone 'wild'. But very rarely is it the instruments that suddenly lose their sense of order in these circumstances!

As with the pilot who becomes caught in cloud unintentionally, accidents involving 'do-it-yourself' instrument flying follow a distinct pattern of development.

In this case of course, the aircraft, usually in a quite normal attitude — straight and level or perhaps climbing — enters cloud deliberately — very likely only the sort of cloud that is 'not



thick enough to worry about' or that the aircraft 'will soon be through'.

As it does so, just as with the pilot unintentionally entering cloud while trying to turn back, the world outside the aircraft changes almost instantaneously from one of familiar normality, to one alien and threatening. One where there is no 'up' or 'down' as we usually understand it, nothing but a bewildering wet grey void where time and distance seem to have lost their meaning. Inside the aircraft nothing seems to have changed and perhaps all is well so far; but the pilot cannot help being awed by this strange and unreal environment into which he has suddenly plunged. He is unable to resist frequent glances outside, as he sub-consciously seeks some glimpse of the familiar world which can so quickly restore normality and confidence.

But there is none: it is up to him now to fly the aeroplane on instruments alone; those same instruments which in the past have been so helpful in making nicely balanced turns in the training area, and accurate rates of descent at the end of a cross-country flight, but which have suddenly become such utterly inadequate substitutes for the sight of real earth and sky.

The pilot tenses a little and takes a firmer grip of the control wheel. For a few moments more all remains calm. Perhaps the aircraft feels as though it is descending a little, but the altimeter shows that it is not, so there is no need for concern — undoubtedly this is one of the 'believe your instruments' sensations he has read about! Perhaps this instrument flying isn't so hard after all — there, the bat and ball is still well and truly in the middle!

But soon the aircraft encounters some slight turbulence, perhaps no more than that found in the most innocuous patch of cloud. The aircraft bumps a little, the 'bat and ball' oscillates gently and settles down again. But now the aircraft feels as though it is flying one wing low — why doesn't it settle down again too? Without thinking the pilot applies a little opposite bank. He watches the wing tips to try and see when they are level again. Ah! that's better — or is it? No, the aircraft still feels a bit one wing low. He adds a little more opposite bank. If only he could **see** where the wings really were in relation to the horizon! But that certainly feels right now.

He glances back at the instrument panel to confirm that the wings are really level. But now the artificial horizon shows a steep bank the other way! That can't be right — the aircraft still feels straight and level. But wait — which way is the artificial horizon showing? It's always a bit hard to interpret, especially when you can't see outside. He glances at the turn and bank indicator again. The

FIG.1

ball isn't in the middle any more. And the turn needle is well over to one side too! But before he can think which way he should correct, his glance falls on the airspeed indicator — it is registering well above normal! Very tense now, the pilot tries to correct in the most obvious way he knows — by easing back the control wheel. The speed begins to drop a little, but at the same time the vertical speed indicator, already showing more than a 500 feet per minute descent, dips frighteningly towards the 1000 mark and beyond. And now the airspeed is increasing again, this time alarmingly. And with it the engine begins to overspeed, its note rising increasingly into an ear-splitting scream. As the spiral dive tightens, the artificial horizon gives up the struggle and topples, the directional gyro spins furiously and the needle of the vertical speed indicator plummets to full deflection down. Panic stricken, the pilot realises too late that the situation is utterly beyond his ability. His training and experience have stopped far short of such demands.

If the base of the cloud is not too low when this sort of situation develops, it is possible that the pilot may have room to recover from the resulting 'graveyard spiral' before the aircraft plunges into the ground. But there is also an excellent chance of structural failure occurring during the recovery, as a result of the excessive aerodynamic forces that this inevitably applies to the airframe. Even the few pilots who have been lucky enough to succeed in recovering control after emerging from the base of a cloud, have in most cases caused severe structural damage to their aircraft. Usually, however, when a non-instrument pilot loses control in such a situation, the cloud base is already low, if not actually lying on the higher terrain, and a catastrophic ending to the flight can be the only result.

Some pilots with no first hand experience of flight in instrument conditions may feel that our little dramas are exaggerated. We assure you that they are not and refer sceptics to an article published as far back as Aviation Safety Digest No. 20 in December, 1959. This described a study undertaken by the University of Illinois in the United States to determine the extent to which non-instrument pilots could retain control of their aircraft in instrument conditions. The study showed that, of a representative group of twenty non-instrument pilots, not one was able to retain control when deprived of visual

reference. Unfortunately for a number of people, the warning which this series of tests sounded to all non-instrument pilots, has too often gone unheeded.

The warning applies also to those of us who have done a little instrument flying for private or commercial licences, as well as to those who perhaps had a lot of instrument experience a long time ago. Although our reaction might be 'that doesn't apply to me — I **know** how to fly on instruments', the unpleasant fact is that we are little safer than the pilot with no instrument experience. Indeed, we may be the more dangerous in marginal conditions because we are reluctant to recognise

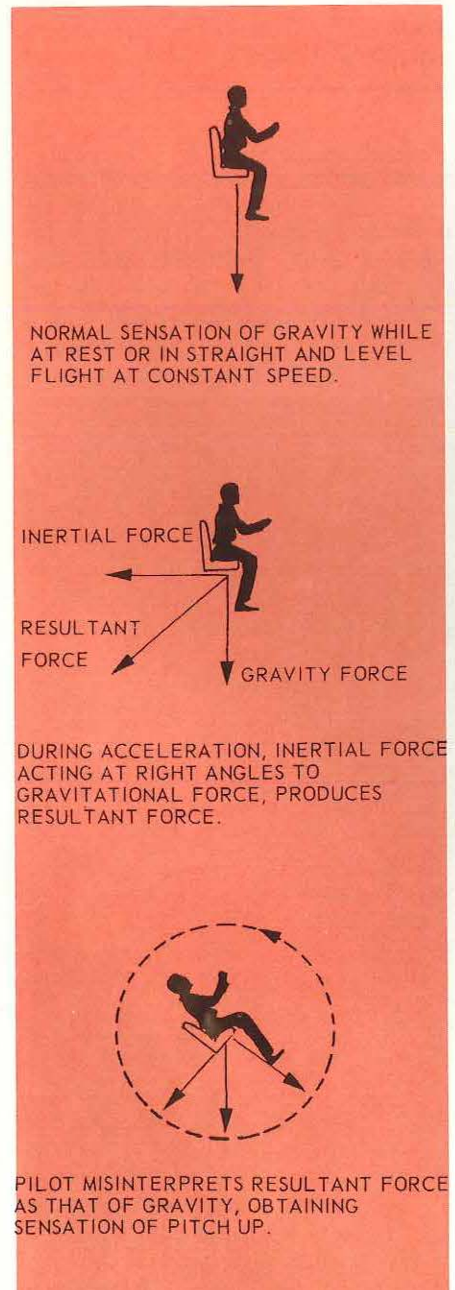


FIG.2

our limitations.

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The illusions which bring about disorientation and loss of control in cloud, though very real to the person experiencing them, are simple in character and can be traced to the vestibular apparatus of the inner ear which maintains the sense of balance. This organ achieves its purpose by conveying sensations of orientation to the brain. The vestibular apparatus consists of a sac and three semi-circular canals at right angles to each other. The sac contains a membrane which senses the direction of gravitational force, so controlling the balance of the body when it is stationary. The canals contain a fluid and small sensory hairs connected to the nervous system. The fluid reacts to rotational movements of the head, stimulating the hairs so that a nerve impulse conveying an appropriate impression of movement is transmitted to the brain, thus controlling the sense of balance while the body is in motion.

The balance mechanism of this inner ear apparatus works well enough while we remain on our natural habitat — the ground. Here, even with our eyes closed, we can maintain our balance. But maintaining our equilibrium in the air is a very different matter. In the first place, in the three dimensional motion of flight, centrifugal reaction often distorts the effects of gravity, giving our balance and orientating mechanism a misleading stimulus. In a properly co-ordinated turn for instance, 'down' is always felt to be the floor of the aeroplane, regardless of the angle of bank. Secondly, while our balance mechanism is well able to sense the comparatively small angular accelerations involved in normal body movements in relation to the ground, it can be completely deceived by the large scale angular accelerations imposed upon the body by an aircraft in flight. In very gentle turns, the rate of change of direction may be insufficient to cause any movement of the fluid in the semi-circular canals of the inner ear, so there will be no feeling of turning. In prolonged turns, even though a turn may have been sensed when it began, the fluid in the canal 'catches up' with the motion of the aircraft. The turn is then no longer sensed and we feel that the turn has stopped. Similarly, if a recovery from a turn is made suddenly, the inertia of the fluid in our inner ear canals causes it to flow for a brief period, which can give us the completely false impression that we are turning in the opposite direction.

It should not be hard now to see why the effect of these reactions is to produce illusions and disorientation when an untrained pilot attempts to fly in Instrument Meteorological Conditions. For example, a gradual entry into a turn or spiral can go undetected until a dangerous degree of rotation has been reached. Another common illusion, sometimes experienced even by qualified instrument pilots, is 'the leans'. Should the aircraft recover slowly from a movement in the rolling plane, the pilot may feel that it is still banked. Conversely, if the aircraft makes a sudden recovery from a banked attitude, he might feel that it has banked in the opposite direction. Sensations of turning during straight and level flight and sensations of climbing whilst banking are particularly convincing in Instrument Meteorological Conditions. Again, a rotary movement suddenly discontinued, can give a strong sensation of rotation in the opposite direction. This situation can occur during recovery from a spin when there is no satisfactory ground reference, and the sensation produced may be so strong that the pilot

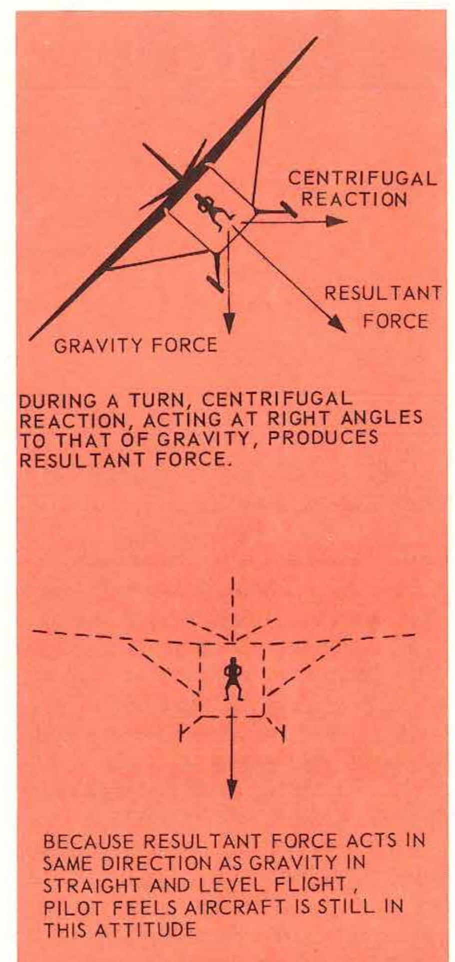


FIG.3

attempts to correct it and goes into a spin in the opposite direction. Another very powerful illusion, which has been responsible over the years for a large number of accidents, is the sensation of climbing during a rapid forward acceleration. During takeoffs on dark nights with no visual reference once the flare path is left behind, this illusion has deceived even highly experienced instrument-rated pilots. As a result their aircraft have been unwittingly flown into the ground.

As already explained, the only way these illusions can be overcome is by using the sense of vision to counteract them. If there is no visual reference outside the aircraft, the pilot's vision must be transferred immediately to the indications of the aircraft's instruments. But, as pointed out, for a pilot to gain sufficient visual stimulus from these instruments to enable him to overcome the illusions from his other senses, his responses must be conditioned by long and thorough instrument flying training.

There is simply no short cut to this stage — either a pilot has been properly trained to fly on instruments, or he must face the inescapable fact that he will not be able to do so. If this is the case he must, at all costs, avoid placing himself in situations where he is likely to be deprived of visual reference.

Deliberate flight into instrument conditions is of course forbidden, unless the aircraft is properly equipped for such operations and the pilot holds an instrument rating, but in the situations we have been discussing, Regulations alone cannot prevent accidents. Rather must the responsibility lie with the individual pilot. As we have seen, it is not good enough just to be willing to turn back if conditions become impossible for flight in VMC. By that time it might already be too late. Instead, when it becomes apparent that the weather is deteriorating, we must discipline ourselves to turn back while there is still room to manoeuvre safely and before the weather closes in behind us.

The numerous fatal accidents in this category that have been reviewed in past issues of the Digest convincingly testify to the fact that the pilot who has not been instrument trained, is not sufficiently equipped, mentally, physically or physiologically, to fly safely by reference to instruments. The pictures on the centre pages of this issue have been taken from these to demonstrate again the inadequacy of man's faculties to cope with 'seat of the pants' flying in non-visual conditions. They expose the utter folly of the type of thinking exemplified by one private pilot who, at a certain well-known pilot's rendezvous was heard to claim that he could fly in any cloud and stay level — 'provided he could still see his wingtips'!

Dress Optional?

Not altogether when flying aircraft! Look at these results:—

- For a short flight to a children's Christmas party, a passenger dressed as Father Christmas boarded a Tiger Moth which had landed at a country aerodrome to pick him up.

The pilot, seated in the rear cockpit, left the engine running while the passenger climbed into the front seat, but as he was doing so, part of his Father Christmas robes caught on the front cockpit throttle lever.

Almost before the pilot had time to realise what was happening, a sudden burst of power lifted the tail of the aircraft and the whirling propeller chopped into the ground.

- While landing in gusty, crosswind conditions, a Piper Comanche blew out both main wheel tyres and came to rest to one side of the runway.

The pilot said that, in correcting crosswind drift just before touchdown, he had made fairly heavy applications of rudder and believed that the toes of his fashion shoes had touched the toe pedals of the rudder controls, causing the brakes to be applied just before the aircraft touched down. The starboard tyre blew out first and then his sudden corrective action on the port rudder pedal caused the port tyre to blow.

- A student pilot flying a Cessna 172 over-ran the runway and bogged the aircraft after landing because he couldn't apply the brakes properly.

The reason? He was wearing thongs!

- At an agricultural airstrip, a commercial pilot ground-looped and damaged a Cessna 180 when his left foot slipped off the brake pedal.

And the reason in this case? The rubber soles of the boots he was wearing were slippery.

* * * *

In citing these examples we don't mean to infer that pilots should never wear rubber-soled shoes for flying, nor do we wish to lay down hard and fast rules for what passengers should wear in an aircraft.

Nevertheless we do suggest that some thought should be given to the sort of clothing that one should wear in a light aircraft, having in mind the aircraft type and the nature of the operation. A little common sense applied in this way may help prevent another incident!

Incidentally, problems with toe-actuated wheel brakes usually occur only if the pilot has his feet high enough up on the pedals to unintentionally apply braking during the stress of making a landing in difficult conditions. Pilots of aircraft that employ this type of braking system can normally guard against braking too early, by making a conscious effort to keep their heels on the floor until after the aircraft has touched down. In this position, the pressure of each foot is against the lower portion of the pedals and the toe brakes cannot be depressed without a deliberate ankle movement.

HAVE RESPECT FOR YOUR AIRCRAFT . . .

. . . and for yourself

Suppose you were out driving in the country and someone suggested that you could save time and take a short-cut by turning off the road and driving across the paddocks at high speed — would you do it? Of course you wouldn't, even if the country was open and looked safe enough! You'd have more respect for your motor car; moreover, you'd have serious doubts as to the sanity of your adviser!

However ridiculous such an idea might seem, it is not really far removed from what some general aviation pilots are doing to their aircraft almost every day — machines worth in most cases many times the value of a motor car! It is paradoxical that trained, competent and otherwise careful pilots are time and again causing serious damage to aircraft by attempting to land on terrain that 'looks all right' from the air. Overall flying experience seems to have little bearing on a pilot's propensity for this type of accident; the list of culprits ranges from newly licensed private pilots to the most experienced professionals. The following account of a few of the accidents that have occurred from this cause will show what we mean:

- The pilot of a Bonanza engaged on a charter flight to a cattle station was unable to locate his destination after being forced to divert around several storms. Finding a homestead and what appeared to be a cultivated paddock, he decided to land and determine exactly where he was.

As the aircraft touched down, what the pilot had taken for cultivated black soil covered with stubble, proved in fact to be clumps of basalt rock up to 23 cm in diameter. The nose strut was wrenched off completely, both main landing wheels were smashed, and the aircraft itself was substantially damaged as it lurched on to its nose and skidded to a halt on the rock-strewn ground.

Although the pilot was unsure of his exact position, he knew the aircraft's whereabouts approximately and there was no operational necessity for an immediate landing. The aircraft was fitted with radio navigational aids and its remaining endurance was 2 hours 20 minutes — more than ample to have enabled the pilot to safely fly to any one of three alternative aerodromes.

- A Cessna 210 landed on a station airstrip where recent heavy rains had softened the ground. Towards the end of the landing roll, the nose wheel of the aircraft sank 45 cm into a mud patch and stopped the aircraft suddenly. The rapid deceleration lifted the main wheels completely off the ground and the whole aircraft pivoted through 35 degrees on the nose strut, then struck the ground again with the port wing tip and the port main undercarriage. The fibre-glass wing tip was shattered and the port wing was buckled in several places.

- A PA-24 had been chartered to carry an urgently required machinery part to a farming property. There was no recognized airstrip in the near vicinity but from the air the pilot selected what he considered was a suitable landing area in a paddock. Just after touching down, the underside of the port wing rode over a tree stump a metre high. The stump broke through the lower skin of the wing and the force of impact fractured the main spar. The stump had been burnt and its blackened appearance merged into the surrounding black soil.
- Another PA-24 was making a charter flight with four passengers to a station property. The pilot had been informed that the intended landing ground at his destination was a clay pan, where other aircraft had landed previously. He was assured that it was suitable and, as well, arrangements were made for the surface to be checked before the aircraft landed.

On arrival over the site, the pilot saw a vehicle on the clay pan and a landing strip marked out with sheets of paper. A road crossed the up-wind end of the marked strip 60 metres from a clump of trees at the edge of the clay pan. Although the strip appeared to be short, the pilot considered that the aircraft could safely cross the road during the landing run and so utilise more than the marked strip length.

The aircraft touched down 10 metres inside the marked threshold, bounced twice and was then braked heavily. Still rolling fast, it crossed the road with a severe bump and bounced again. The pilot was forced to deliberately ground-loop the aircraft through 90 degrees, and it finally skidded sideways to a stop only 6 metres from the trees.

The starboard undercarriage leg had been pushed eight cm rearwards, extensively damaging the wing structure. The pilot then found that the road had 30 cm shoulders where it crossed the clay pan and the total landing run was only 350 metres. The performance chart for the aircraft indicated a required length of 820 metres.

- A newly employed commercial pilot had been assigned to fly his company's Cessna 172 aircraft on parachute dropping operations at an airstrip which, orientated north-east, south-west, had been constructed during the war. The north-eastern half of the strip, originally 2000 metres long, had since been abandoned and a fence had been erected across it to separate the abandoned section from the south-western half of the strip which remained serviceable. The abandoned half of the strip had been strewn with logs and had also become heavily overgrown with grass.

Because it was the pilot's first flight to the strip and he was unfamiliar with the area, he was briefed by another company pilot before departing. The briefing pilot sketched the area on a blackboard, indicating the serviceable south-western portion and pointed out the unusable section to the north-east. He also indicated the position of the fence across the strip and explained that the unusable portion of the strip was dotted with obstructions. The briefing pilot also suggested carrying out a low run to assess the state of the surface of the serviceable section before landing and that, if the pilot had any doubts about it, he should return without landing.

Despite this comprehensive briefing, the pilot was content to inspect the strip from a height of about 800 feet as he flew over it from north-east to south-west. He then planned to land into the south-west from a left hand circuit and flew a downwind leg at a height of about 600 feet, turning on to final approach at 500 feet. The point at which the pilot was aiming to touch down, however, was on the abandoned portion of the strip and some 120 metres short of the threshold of the serviceable strip. Not realising this, he continued the approach on to an area strewn with logs partly concealed by the long grass. Only after actually touching down did the pilot realise his mistake and he attempted to take off again, but the aircraft struck several logs in succession. The nose wheel and port main wheel were torn off, and the aircraft skidded to a stop on its nose. The impact was severe enough to fracture the fuel tank in the port wing, but there was no fire and the pilot was uninjured.

Subsequent inspection of the strip from the air showed that the usable portion of the airstrip was quite easy to define when viewed from a height of 800 feet, both dividing fence and the logs on the abandoned section being clearly visible. Despite the sound advice of his colleague, it was clear that the pilot had taken little care to identify the boundaries of the usable area before committing himself to a landing.

- In the course of a cross-country flight, the pilot of a Mooney planned to land at a strip serving a small country town. Arriving over the airstrip, the pilot made a circuit to inspect its condition and carried out a normal approach to land, turning on to final at about 500 feet. The pilot made a normal touchdown on a mown area, but during the landing run the undercarriage struck some scattered rocks. The nose wheel strut collapsed and the propeller was damaged.

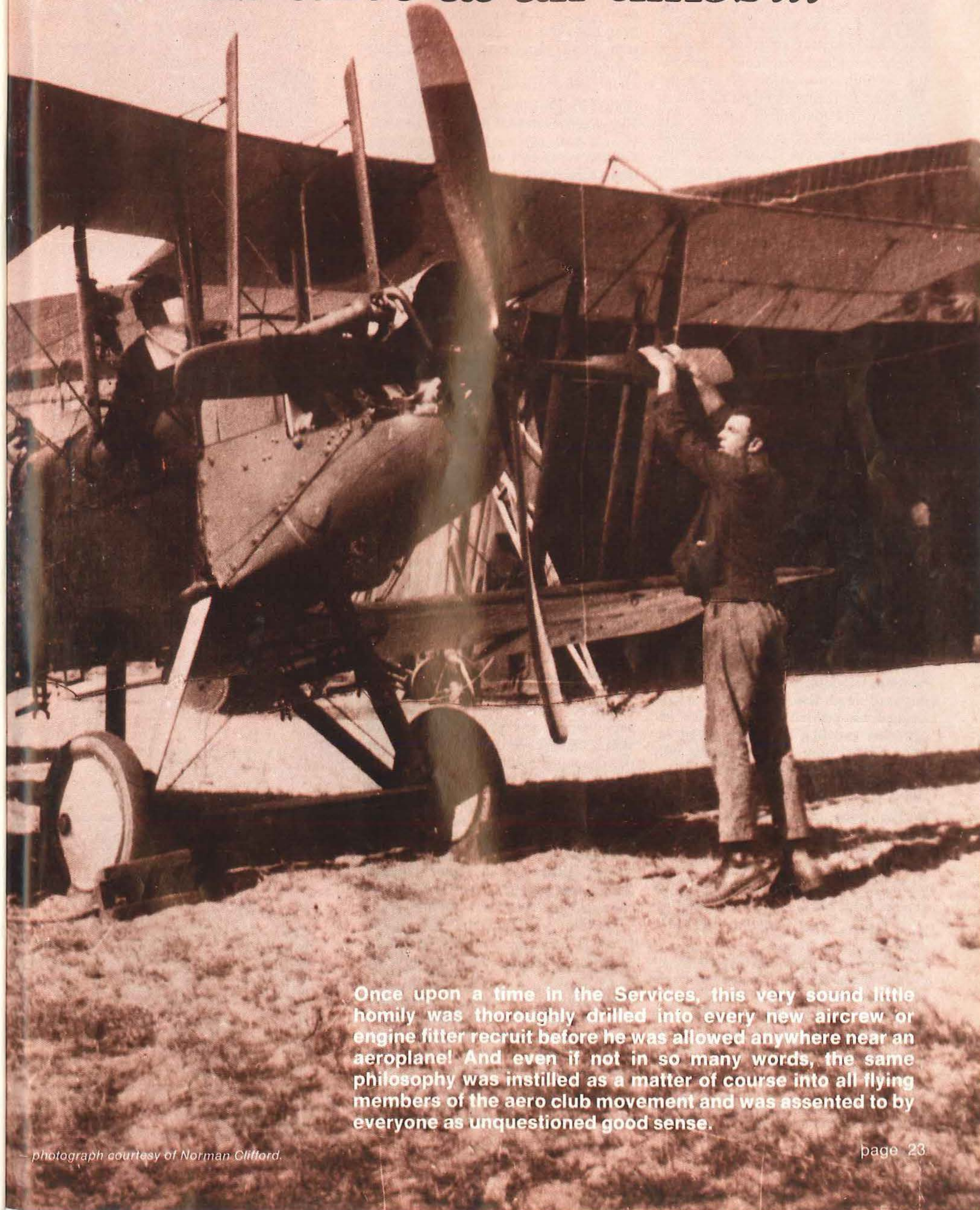
The pilot then found that he had landed on an area alongside the airstrip and not on the strip itself. The area on which the aircraft landed had been mown more recently than the strip itself and this misled the pilot into believing the mown section was the airstrip. The airstrip itself was marked with white painted motor tyres, and, though it was heavily grassed, these markers were clearly visible from the air. It was obvious that the pilot had not taken sufficient care during his inspection of the area before landing. Had he taken the trouble to properly identify the boundaries of the airstrip before beginning his approach the accident would not have occurred.

* * * * *

In some of these cases, the pilots concerned had made what might have seemed adequate enquiries about the suitability and serviceability of their intended landing ground. In the light of subsequent events however, it is clear that the pilots' specification of minimum requirements, their informants' assessment of the area, or even the process of communication between the two, must have been totally inadequate.

Over the years many, many capable pilots have learned to their cost that merely accepting a layman's assessment of a 'safe' landing ground can often lead to a very hazardous operation. Your light aeroplane is an expensive and complicated piece of machinery. Treated with respect it can provide you with a great deal of pleasure and profitable utilization. Except in a dire emergency don't endanger it by attempting to land on doubtful surfaces — the risk far more than outweighs what you could possibly stand to gain. Make it a rule not to land on an unrecognised landing area without first inspecting it from the ground yourself or obtaining reliable advice from a knowledgeable person familiar with aircraft operations!

'This airscrew is to be treated as alive at all times...'



Once upon a time in the Services, this very sound little homily was thoroughly drilled into every new aircrew or engine fitter recruit before he was allowed anywhere near an aeroplane! And even if not in so many words, the same philosophy was instilled as a matter of course into all flying members of the aero club movement and was assented to by everyone as unquestioned good sense.

photograph courtesy of Norman Clifford.

At that time of course, many types of aircraft, and certainly all *ab initio* training aeroplanes, had to be started by hand. Thus, in the minds of the pilots of the day, flying and propeller handling were inseparable, and the seemingly dangerous task of swinging the propeller was taken for granted as a normal, everyday aspect of operating a light aeroplane. Far from engendering a high proportion of propeller handling accidents as might have been expected, the number of injuries were surprisingly few — no doubt because the operation was treated seriously. Learning the technique of propeller swinging was part of every pilot's training and, as a result, it was accorded the respect it deserved.

By contrast today, with the luxury of electric starting almost universal, engine starting by hand is only rarely attempted on most types of aircraft, and this very sound attitude seems to have been forgotten. Although the great majority of pilots now start their engines simply by 'pressing the button', propeller handling accidents are occurring with surprising frequency. Had we the space to do so, we could list a large number of such instances, all of which have a useful safety message. However, the following few examples should be sufficient to show that propeller hazards haven't changed, even if pilot attitudes have!

• While carrying out a daily inspection, the pilot of an agricultural Pawnee checked that the switches were off and took hold of the propeller to pull the engine through its compressions. As he swung the blade, the engine proved 'tighter' than he expected. The pilot lost his balance, fell forward, and the still-moving blade gashed his head badly. A major inspection had just been completed on the engine, making it hard to 'pull through', as well as causing it to 'kick' vigorously over compression.

• The pilot of a Cessna 180 had started the engine and taxied his aircraft from where it had been parked overnight, to a position nearer the terminal building. Here he shut down the engine and left the aircraft while he went to the tower to submit his flight plan.

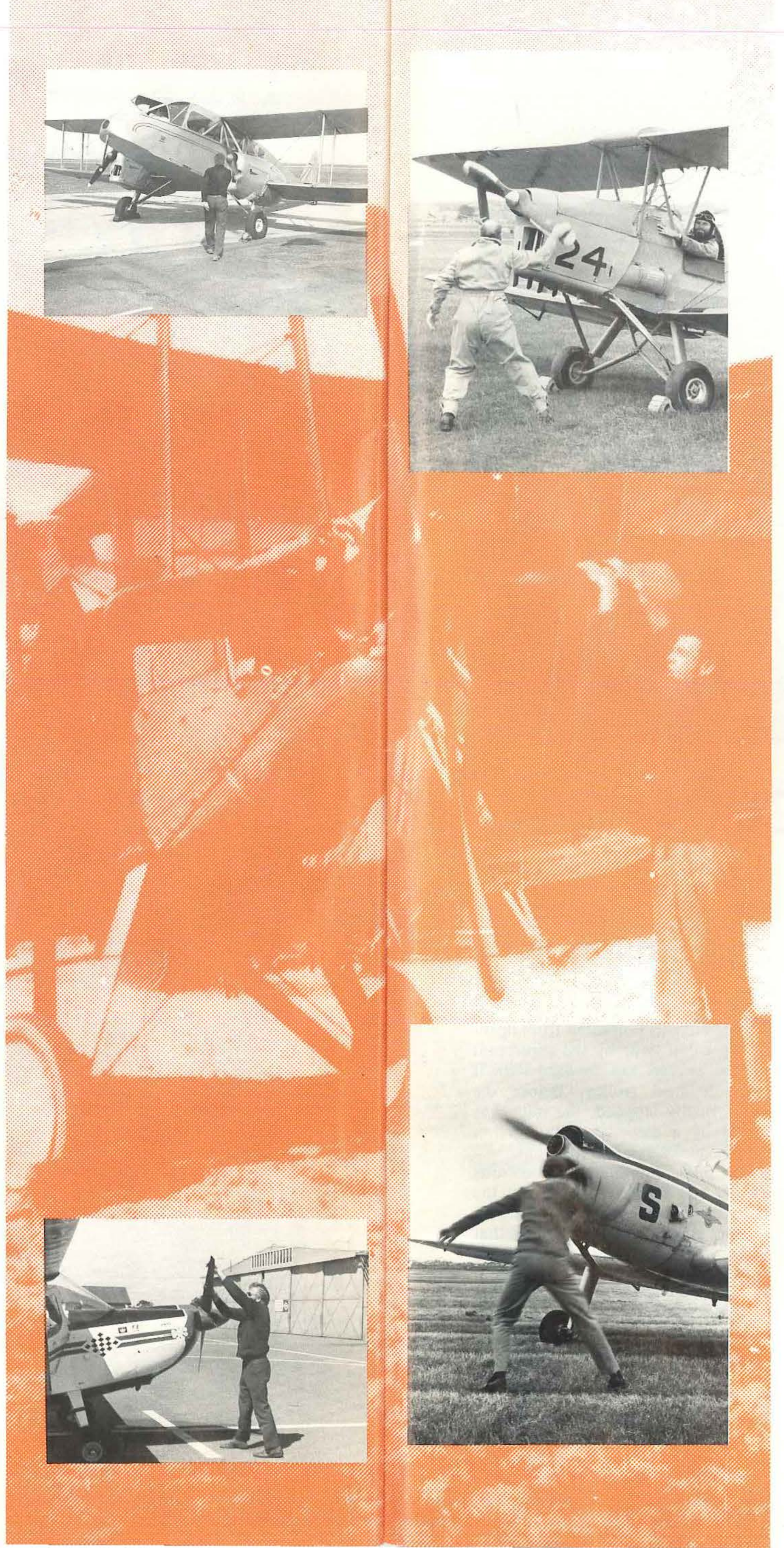
Returning to the aircraft about 10 minutes later, the pilot began a preflight inspection, including a cylinder compression check. The pilot pulled the propeller through once, and expecting that the blades would stop in a near-vertical postion, he stepped forward to take hold of the upper blade. But instead of them stopping, the engine fired once and the propeller spun several times, gashing the pilot twice on the upper left leg and almost severing it. The propeller also grazed his right hand and thigh, causing minor injuries.

Investigation indicated that the aircraft's ignition was switched off at the time and with the switch in this position, both magnetos were earthing correctly. The engine had run for about three minutes before the pilot shut it down, which would probably have been sufficient for the cylinders to reach normal operating temperature. During the 10 minutes that elapsed after the engine was shut down, there was no cooling airflow through the engine cowlings and there would have been little decrease in engine temperature. In this situation, all that was required for the engine to fire momentarily, was a piece of hot carbon in one cylinder, plus a sufficient amount of fuel-air mixture. The pilot had shut down the engine in the normal way, by placing the mixture control in the idle cut-off position, but as the engine was fitted with a float type carburettor, there was every possibility of some mixture remaining in the cylinders.

• At the completion of a 100 hourly inspection, the engine of a DH.82 was started, warmed up, then run to full throttle to check its performance. The test run was satisfactory and the engine was shut down and the fuel and ignition switches were turned off. With the throttle closed, the cylinder compressions were then checked by pulling the engine through one complete firing cycle. To finally check that the impulse coupling on the starboard magneto was not sticking, the engineer wound the propeller backwards a few pulls, then forward again. On the second compression, as the propeller passed through the vertical position, the engine fired and the engineer was struck heavily on the arm. The ulna of his right forearm was broken and the arm badly bruised.

Because the engine had just been run at full throttle, it is probable that carbon deposits in one or more of the combustion chambers were still incandescent and that this ignited the fuel-air mixture drawn into the cylinders while the compressions were being tested. 'I didn't treat the 'hot prop' with the respect it deserved', was the engineer's comment later. His remarks at the time of the accident, though not recorded, were no doubt rather less philosophical!

It is not only the Department that is concerned with the trend illustrated by these accidents. There are a number of



pilots too, who mindful of the dangers of propellers, are conscious that not everyone's attitude to propeller handling generally is satisfactory. Three who have written to the Digest, make no claim to be immune from error themselves, but have taken the trouble to describe their own salutary experiences to try and inculcate a healthier respect for propellers generally. Their accounts speak for themselves:

• 'I had prepared my Chipmunk for starting but it failed to start. I reprimed the engine, pulled the propeller through and went to place the propeller in the impulse position. To my amazement the engine sprang into life. But for the thorough training I had received in the past, the propeller would have struck my hand, arm, head or torso, and it was only the habit of handling a propeller correctly that saved my life. Of course, the magneto switches should have been turned off when I re-prepared the engine.'

* * * *

• 'After completing a local flight in my Citabria, I noticed before shutdown that the left magneto was "live" with the switch "OFF". As I had previously experienced this problem with the right magneto, I knew the reason for the trouble — the magneto earth terminal wire had broken. Having a spare terminal I made up my mind to replace it on my next visit to the airport.

A week later I decided to complete a daily inspection before replacing the broken terminal, and began by checking the cockpit. I noted the throttle was closed, mixture in idle cut-off and that the magneto switches were "OFF". As the aircraft is fitted with a fuel injected engine, I switched on the emergency fuel pump for about three seconds to check the fuel pressure. I then went to the engine and checked oil contents, plug leads, pipes and wiring, and I again noted and even handled the broken earth wires to the left magneto. Without thinking, I then walked to the front of the aircraft and pulled the propeller through one compression. Immediately the engine fired and ran for several revolutions.

I was mentally stunned. In the past I had spent considerable time trying to develop a hand-starting technique for this aircraft without success. Fortunately, thanks to R.A.A.F. training and over 20 years experience, I had developed a healthy respect for propellers, and through force of habit I was well clear when the engine fired.

On checking the mixture control in the cockpit, I found that it was not quite in the full idle cut-off position, but still had about a quarter of an inch of movement before it reached the stop. This was obviously sufficient for all cylinders to receive a charge of fuel when I checked the emergency fuel pump pressure. I had not been particularly concerned about accidental firing of fuel injection engines because of the exacting procedure required to start them under normal circumstances. Needless to say, I do not intend to take such chances in the future.

Regardless of circumstances, it must always be assumed that a propeller is "live" and lethal at all times, and it should be treated accordingly. I am thinking particularly of pilots I have occasionally seen turning propellers by standing directly in front and using a twisting action with a hand on each blade. Should the engine fire or kick back, there would be no way to avoid being struck a severe and possibly lethal blow.'

* * * *

• 'With nearly 1 000 hours logged in earlier years flying a DH.84 in the outback, I had, I suppose, become fairly casual in my attitude to propeller swinging. However, I can now assure you that my attitude to this potential game of Russian Roulette will not be quite so cavalier in the future!

Lately I have been operating a little Continental powered Champion 7EC which, despite its mere 95 hp, I have found a surprisingly pleasant little aeroplane. A few days prior to the incident in question, the starter cable had become disconnected. Being busy with other matters and with not long to run before the machine went back to the workshop for a 100 hourly inspection, I had been content to revert temporarily to my handstarting procedures of former years — a deceptively simple matter in the case of the Champion, particularly with a start from cold when the engine would consistently fire after a couple of strokes on the primer and a pull through.

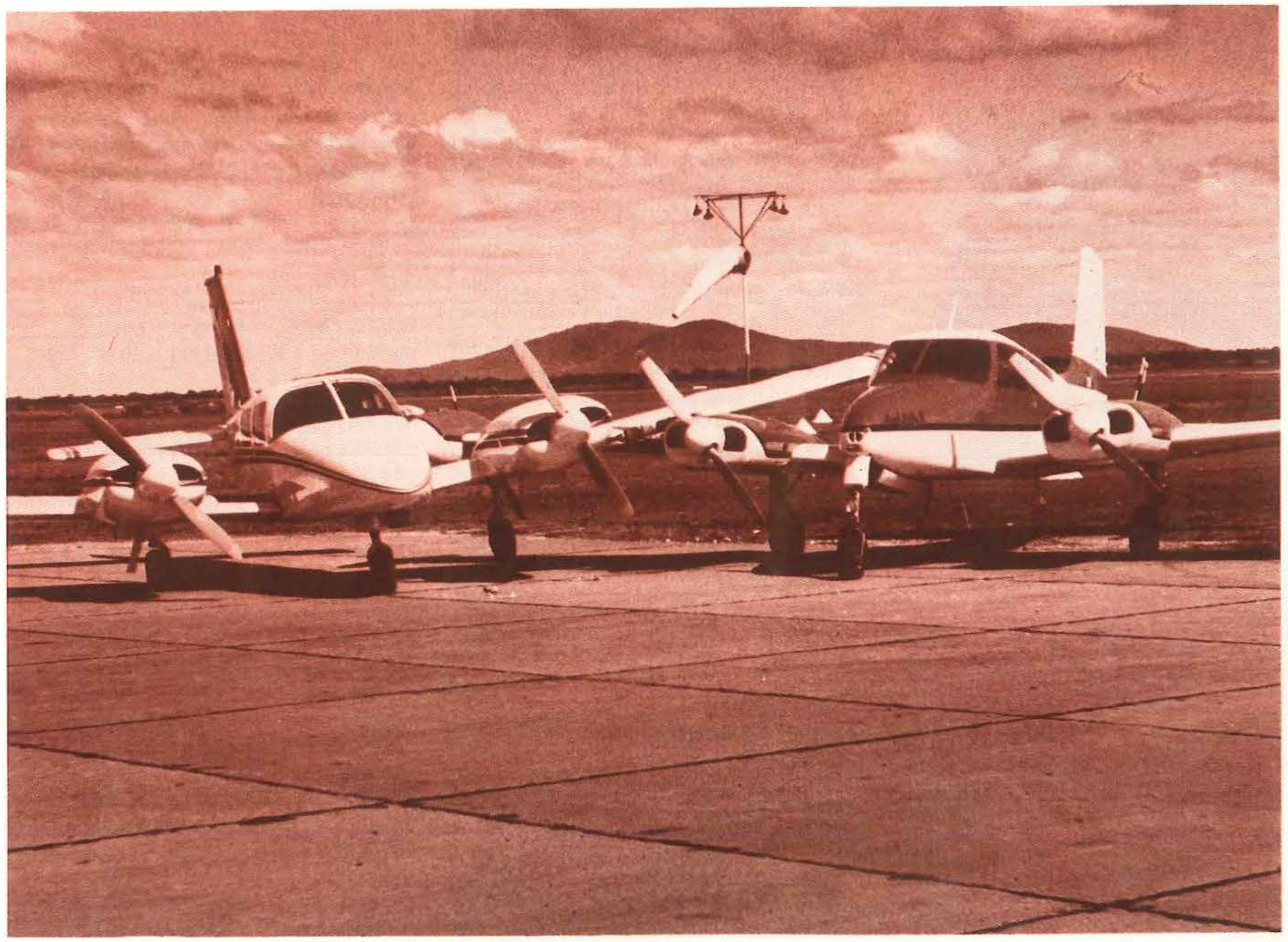
But on this occasion I was starting after refuelling and the engine was still warm. I did not prime it of course, but straightaway set the throttle, put the magneto switch to "Both" and swung the propeller. The engine coughed once then refused to do anything else. Obviously it was too rich. I switched off, opened the throttle wide and set about pulling it through several compressions to blow out the rich mixture.

I wound the propeller affectionately, as one might a ship's helm, standing much too close in front. After all — I'd done this hundreds, perhaps thousands of times before and had long since ceased to regard the old Air Force admonition on propellers as anything more than advice to "erks" who didn't know any better!

Three more pulls and the nonchalance built of years was shattered in an instant. The engine suddenly fired, caught as the fully opened throttle took effect, then as suddenly died. I stood transfixed in front of the aircraft — the propeller had actually brushed my tie as it spun, I had felt the breath of its passage on my face and its tip had lightly flicked the fingernails of my right hand!

A subsequent check showed that, although the magneto switch was functioning correctly in the "L" and "R" and "Both" positions, it was no longer earthing properly in the "OFF" position and the engine was fully capable of running with the switch in this position.

So I can assure you that in future, not only will I be affording propellers the respect due to them, but as well there will be much more diligence shown in the checking of magneto switches during daily inspections!'



...and don't forget the CHOCKS!

The point has already been made that, to judge from the accidents that have occurred in recent years, starting aeroplanes by hand must be an operation absolutely fraught with hazards — not only to the person swinging the propeller, as discussed on the previous pages, but also to the aeroplane itself, and anything else that gets in the way! For there have been many instances where aircraft have run away out of control when either the brakes failed to hold or the aircraft was inadequately chocked. In fact, on one never-to-be forgotten occasion at Bankstown some years ago, an Auster actually took off unoccupied and created chaos in Sydney's controlled airspace for more than two hours before Navy Fireflies shot it down into the sea off the Heads! It is the unwariness that can lead to this particular (and often spectacular) variation of the hand-starting theme, that we now propose to examine.

As we have already seen from the previous discussion, in years gone by when nearly all light aeroplanes had to be started by hand every time they flew, accidents of this sort were comparatively rare. And they were avoided because the hazards of hand starting were fully recognised, accepted as normal, and the proper precautions taken. It is paradoxical that today's aircraft, with all their refinements designed to make handling easier and safer, can promote practices which lead to an accident when, for one reason or another, the pilot is temporarily denied some of these advantages.

For example on one occasion after refuelling his aircraft at a country airport, the pilot of a Cessna 182 had attempted for several minutes to start the engine without success. Eventually, when the battery was exhausted, the pilot concluded the engine was flooded, so he turned off the switches, applied the hand brake, and chocked the port main wheel with the single chock he was carrying in the aircraft. He then opened the throttle fully and wound the propeller several times to blow out the rich mixture. Setting the throttle for starting, the pilot then turned on the magneto switches, swung the propeller, and the engine fired. It roared into life and in a moment the aircraft had ridden over the single chock and was gathering momentum. The pilot tried to climb aboard, but was prevented from opening the cabin door by the slipstream and the aircraft ran forward until it struck a steel trolley. Before the engine finally stopped, the pilot was injured by a piece of metal thrown from the badly damaged propeller.

The pilot commented afterwards that he had forgotten to tighten the friction nut when he set the throttle for starting. It is worth remembering that the throttles on modern aircraft tend to open when the engine is running if not restrained by the friction nut. This of course is a safety feature designed to ensure that engine power is not lost in flight if the throttle linkage should fail.

* * * *

The owner-pilot of the Cessna 150 pictured had an even more disastrous experience while preparing for a flight from his country property. When he found there was hardly enough charge in the battery to start the engine, he set the throttle, pulled on the hand-brake and chocked the wheels with three pieces of timber. After turning on the switches, the pilot swung the propeller. As the engine came to life, he realised the aircraft was going to jump the makeshift chocks, and ran around to switch off the engine. He grabbed the strut to restrain the aircraft while he climbed aboard but he missed his footing on the cabin step and was thrown to the ground. As he watched helplessly, the aircraft gathered speed, ran beyond the confines of the landing area, crossed a road, tore its way successively through three fences, and finally plunged through a creek-bed, before coming to rest on the other side of the creek, damaged beyond repair.

The Cessna 150 as it came to rest after running through the creek bed .....

On still another occasion, a Cessna 182 engaged in a charter flight with only the pilot on board, was about to depart from a station property after delivering some supplies. Describing the shattering events that followed, the pilot later wrote:

'... the battery refused to spin the motor more than two or three compressions. Leaving the throttle set, ignition and handbrake on, I proceeded to hand-start. The motor caught at once and appeared to be turning at approximately 1500 rpm.

The cabin window was closed and I was unable to gain entry to the controls and prevent the aircraft's progress.

The aircraft continued along the ground for about 150 metres, on a slightly semi-circular path to the left and was extensively damaged on impact with cattle yards.'

As readers will see from the accompanying photograph, the pilot's description of the damage is something of an understatement. He went on to explain that before swinging the propeller, he had opened the throttle to the usual setting for a battery start. The handbrake seemed to operate normally and he did not consider it necessary to chock the wheels. In any case he had no chocks with him in the aircraft as this was the first time he had had to resort to hand-starting.

Air Navigation Regulation 223B allows a pilot in some circumstances to handstart an unoccupied single pilot aircraft on the condition that 'adequate provision is made to prevent the aircraft moving forward'. This can obviously be achieved by either chocking the aircraft properly or, if they are up to the task, by applying the parking brakes. To satisfy this requirement however, a hand brake system must obviously have design characteristics capable of providing restraint over the range of powers likely to be developed immediately following a hand-start. It must also be maintained to a standard which will ensure that the designed degree of restraint will continue to be achieved.

Only a small particle of foreign matter in the system's hydraulic fluid could be sufficient to cause a slight leakage past a master or wheel cylinder valve, and while this would have a negligible effect on the brakes while taxi-ing, brake pressure could gradually be lost while the aircraft is parked.

Does YOUR handbrake make 'adequate provision'? Because this one obviously didn't!

..... and the 182 that corralled itself in the stockyard !

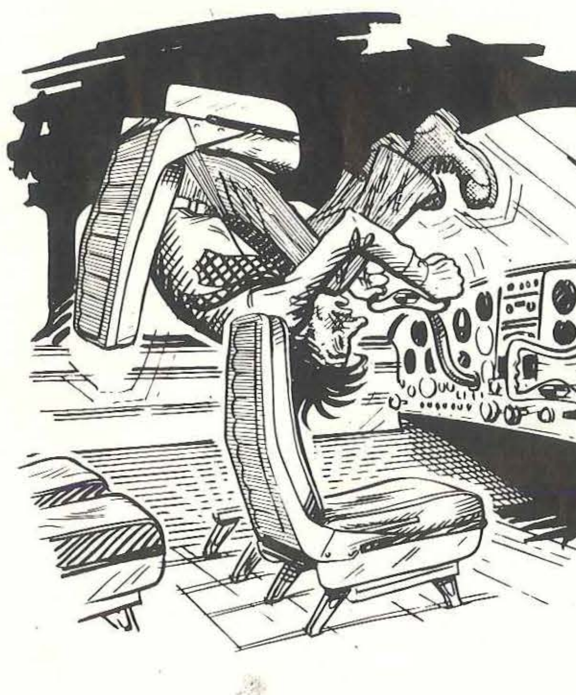
It is perhaps understandable that the pilots of these modern-type aircraft did not place much store on the need to adequately chock their aircraft before attempting to start their engines by hand. For to them, a handstart was an experience only rarely encountered. What *is* difficult to understand is that this 'no chocks required' thinking could be applied to surviving representatives of aircraft built in the era when chocks were standard equipment for starting — aircraft of the type exemplified chiefly today by the Tiger Moth. Consider for instance the pilot making a cross-country flight in a Tiger, who landed at an unattended country aerodrome to refuel.

After taxi-ing to the refuelling point, the pilot turned the aircraft into wind and switched off, but didn't chock the wheels. After he had refuelled the aircraft, he checked that the throttle was closed, turned on the ignition switches, and walked around to swing the propeller. The engine fired after a couple of pulls and the aircraft started to move forward. The pilot caught hold of the port wing, but only succeeded in swinging the aircraft broadside to the wind, which was now gusting between 10 and 20 knots. The aircraft continued to gain speed and the pilot rushed for the front cockpit switches. But as he flicked them off a gust lifted the starboard wing, the aircraft swung downwind and was blown over on its back.

Only a few weeks after this, another Tiger ran away in similar circumstances at a station property airstrip in another State. The aircraft, which was parked unchocked on the tarmac in front of the strip's two hangars, was to make a local flight. This time, the pilot was not on his own, having a passenger who was to accompany him on the flight. So the passenger was duly installed in the front cockpit, the throttle set for starting and the pilot swung the propeller. When the engine started, the aircraft began to roll forward and turned towards the hangars where the tarmac sloped slightly downhill. The passenger had the presence of mind to close the throttle and the pilot jumped up and cut the switches, but the aircraft gathered momentum down the slope, ran between the hangars and collided with two posts. Happily the passenger was not injured but this aspect of the accident nevertheless points up the wisdom of the third condition laid down in ANR 223B.

The title of this article is, of course, sound advice for pilots who still fly Tigers or perhaps ultra-lights not fitted with brakes. But it also has something to say to the pilots of modern light aeroplanes, not so much as a literal instruction, but as an adage to develop a right attitude of mind in all aspects of our flying.

Let us be careful that the improvements and comforts built into today's light aircraft do not make us complacent in our attitude to their safe operation.



ARE YOUR SEATS SECURE?

A flying instructor was being given a periodic flight check in a Cessna 172. Returning to the circuit area, the chief flying instructor, occupying the right hand seat, indicated he would take over, and slid his seat into the fully forward position to do so.

Taking hold of the controls, the chief flying instructor relaxed back in his seat, but immediately it unexpectedly fell backwards, and he was half-somersaulted into the rear seat compartment. The effect of the sudden backward pressure which he involuntarily applied to the control wheel, combined with the rapid change in centre of gravity position, caused the aircraft to nose-up violently. To make things more difficult, the chief flying instructor's feet became hooked beneath the lower rim of the control wheel. Although the pilot in the left-hand seat recovered control very quickly in the circumstances, considerable height was lost.

It was subsequently learned that a week beforehand, another pilot had removed the seat while the aircraft was used for parachute jumping. When he replaced it, he omitted to reposition the forward seat rail stops. Thus, when the chief flying instructor moved the seat forward in flight, the front leg runners slid off the front end of the seat rails. Restrained then only by the rear leg runners, the seat slid back on the rails and tipped over backwards until it came to rest against the cushion of the aircraft's back seat.

This incident is similar to one reported in the Digest a few years ago, when an examiner, preparing to conduct an instrument rating check, suffered a similar experience in the right-hand seat of a Cessna 411. In this case also, the seat had been removed previously and not properly replaced.

Fortunately in both instances, experienced pilots were occupying the left-hand seat, and in one case the aircraft was still safely on the ground. But what might the consequences have been if the pilot in the left-hand seat was an inexperienced student and the instructor's seat had failed at a critical stage of flight — for example (as would be quite likely) immediately after take-off? It is well to remember too, that even a seat that is not properly latched after adjustment could produce a very similar outcome.

REMINDERS FOR SAFE FLYING

(N.B. This is not a substitute for Departmental and other documents specifying operational requirements for safe flight. Rather it is an *aide-memoire* for all the so-easily overlooked 'little things', which, experience has shown, can become the ingredients for an accident or incident.)

Aircraft Operation

- *Am I in current practice on the type?*
- *Am I completely familiar with its operation? Have I an adequate knowledge of:*
- *The fuel system, fuel pump and mixture control operation?*
- *Power settings?*
- *Operation of the cowl flaps?*
- *Operating ranges of oil temperature and pressure, fuel pressure, and cylinder head temperature?*
- *How to use the carburettor heat control to best advantage?*
- *The undercarriage emergency extension system?*
- *Airspeeds for take-off, climb, approach and asymmetric operation if applicable?*

Aircraft Serviceability

- *Does the aircraft have a valid maintenance release and will it remain current for the duration of the flight?*
- *Is the aircraft fully serviceable in every respect?*
- *Is the oil level correct?*
- *Are the oil cap and dipstick secure?*
- *Have I ensured that there are no rags, birds' or wasps' nests, or other foreign matter on or in the engine compartment, air intakes, static and fuel tank vents, or pitot heads?*
- *Are the cowlings and inspection hatches secure?*
- *Have the external control locks and pitot covers been removed?*
- *Is there a need to carry tie-down equipment on the trip?*
- *Is the windscreen clean?*

Radio

- *Have I the correct frequencies for the proposed route?*
- *Have I a serviceable HF radio or a VSB if flying in a remote area?*

Emergency Equipment

- *Is there an adequate quantity of water on board?*
- *Are emergency rations warranted for the flight?*
- *Is the aircraft's first-aid kit well-stocked and in good condition?*
- *What about other survival gear? (See the pink pages of the VFG.)*
- *If portion of the flight is to be over water, is there an approved-type life-jacket for each person on board?*

Load

- *Is the load properly secured?*
- *Is it within the maximum permissible weight?*
- *Is the centre of gravity within allowable limits?*
- *Have any ferrous metal or magnetic articles been stowed where they could affect the compass reading?*

Fuel

- *Have I personally checked the fuel contents?*
- *Is it really sufficient for the flight including possible diversions and reserves?*
- *Are the tank caps properly secured?*
- *Have I allowed sufficiently for variations in fuel consumption with altitude flown and power used?*
- *Have the tanks and filter bowls been checked for water?*

Weather

- *Does the forecast I have obtained cover the period in which the flight will take place?*
- *Will there be adequate cloud clearance above the enroute terrain to maintain flight in VMC?*
- *Will I be able to remain clear of cloud or sub-standard visibility at all times?*
- *What is the likelihood of carburettor icing?*
- *Is an 'escape route' available if I should encounter conditions worse than forecast?*

Navigation

- *Have I an adequate knowledge of the route to be flown and the airways procedures to be followed — Enroute? In controlled airspace? At primary airports? Secondary airports? Aerodromes with a Flight Service Unit? Other non-controlled aerodromes?*
- *Have I the latest VECs, VTCs and FISCOM applicable to the route?*
- *What Restricted and Danger Areas are there on or close to the proposed track?*
- *Are my WAC charts current editions?*
- *Have I checked the NOTAMS relevant to the route?*
- *Is my flight plan accurate and sufficiently detailed for me to know my position at all times?*
- *Have I a safe alternative plan in case things don't 'work out'?*
- *Have I sufficient daylight for the whole operation — including the alternative plan?*
- *Is my SARTIME realistic?*

Destination

- *Have I checked the current aerodrome NOTAMS?*
- *Am I familiar with the local procedures?*
- *Do I know the location of the landing area in relation to a town or some other prominent landmark?*
- *Is the landing area adequate for the aircraft type?*
- *Are there hard-to-see obstructions on the approach — such as power lines?*
- *Is the likely cross-wind component within the limit specified for the aircraft?*
- *What is the surface like — is it likely to be affected by rain?*
- *Is the correct grade of fuel available there?*
- *What about a telephone, transport and accommodation?*