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AVIATION SAFETY DIGEST

No. 38, JUNE 1964

DEPARTMENT OF CIVIL AVIATION

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No. 38 **JUNE, 1964**

Prepared in the Air Safety Investigation Branch,
Department of Civil Aviation, Commonwealth of Australia

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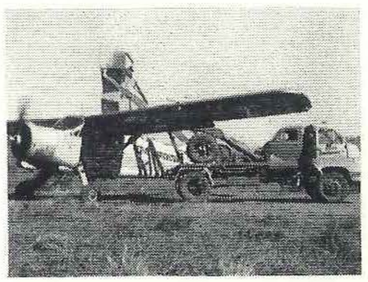


On a typical agricultural airstrip, a Beaver engaged in spreading operations is loaded with superphosphate.

—Picture by Douglas Baglin Pty. Ltd.

What are you doing to your Aircraft?

Some Vital Facts for Agricultural Pilots

Many Pilots appear to be unaware of the serious consequences which can result from their disregard of the various limitations placed on their aircraft. This problem is most acute in the case of those agricultural aircraft for which a substantial increase in take-off weight (T.O.W.) has been permitted under the provisions of A.N.O. Section 100.20. This article explains, in what we hope are simple terms, the reason for these limitations and should serve to illustrate the need for great care on the part of the pilot if structural safety is to be maintained.

Structural design loads

The fact that an aeroplane can be operated through a wide range of weights and speeds and be subjected to a variety of different flight conditions makes it impossible to specify a single criterion or even several criteria which would completely cover its entire structural strength requirements. The present practice is to consider the widest possible range of operating conditions that the particular aircraft type is likely to encounter and to specify strength — speed "envelopes" for a given design gross weight.

Loads imposed on the aircraft structure during symmetrical manoeuvres may be presented graphically in the form of a V-n diagram, often called a Manoeuvre Envelope. A typical Manoeuvre Envelope is shown in Fig. 1. The vertical axis of the graph is the load factor "n", which is simply the ratio of the total lift produced by the aircraft structure, to the actual weight of the aircraft. (To make this relationship clear, we can take the example of an aeroplane in a balanced steep turn maintaining a constant airspeed with a 60° angle of bank. As many of us will recall from our student days, this manoeuvre will subject the aircraft to a force of "2G", i.e., twice the force of gravity. Because the aircraft is in a state of equilibrium, the lift it is producing in the turn must equal twice the force of gravity. In other words the ratio of the lift to the weight of the aircraft is 2:1). The horizontal axis of the graph is the aircraft speed, "V", and as long as the aircraft is never operated at a combination of "V" and "n" outside the Manoeuvre Envelope, it remains structurally safe.

Aeroplanes also have to be designed to cope with vertical gust encounters in flight. Here the conditions are similar to the manoeuvre case, except

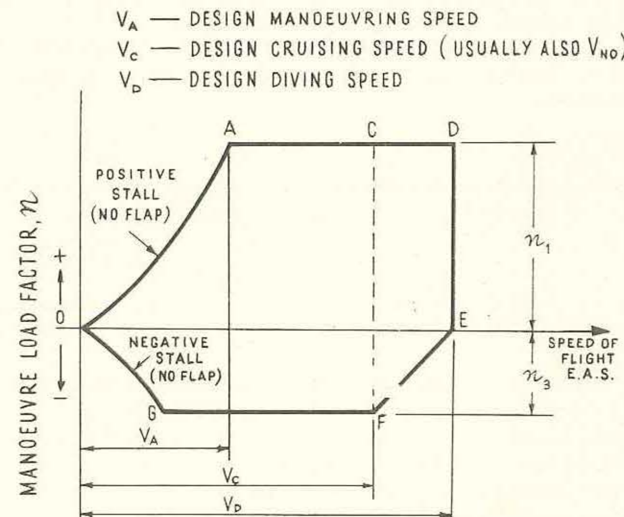


FIG. 1 TYPICAL MANOEUVRE ENVELOPE

that it is the gust itself which introduces the loads to the structure by effectively changing the angle of attack of the aeroplane. The effects of gust loading can also be presented in the form of a V-n diagram, which in this case, is called a Gust Envelope. A typical Gust Envelope is shown in Fig. 2.

On each of the two V-n diagrams, the points, A,B,C,D,E,F and G serve to define the basic flight design cases for the aeroplane and the results obtained by investigating the loads represented by these various points are usually sufficient to specify the speeds and limit load factors which must be used. Limit loads are defined as the greatest which

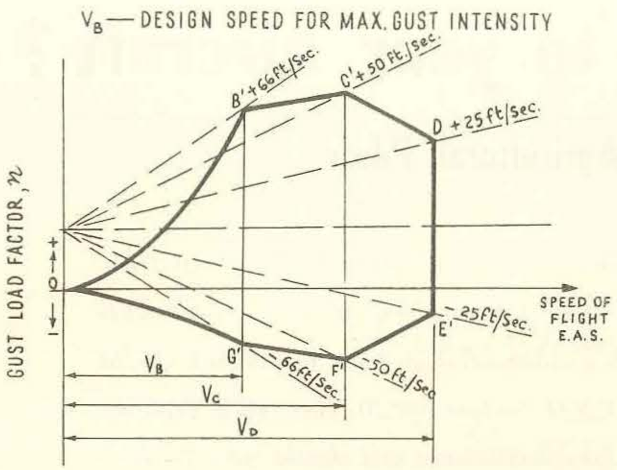


FIG. 2 TYPICAL GUST ENVELOPE

the aircraft is likely to meet in service, and in the United Kingdom and in Australia these are specified for Normal Category aircraft by the following tables:—

n1 (max. "Positive G") $= 2.1 + \left\{\frac{24000}{W + 10000}\right\}$

(W = Design Max. Weight)

but n1 need not be greater than 3.5 and shall not be less than 2.5

n3 (Max. "Negative G") $= -1$

A slightly different formula is used in America to determine limit loads but as the resulting Positive Load Factors obtained do not vary significantly from our own, the discussion in this article is valid for American as well as for British and Australian designed aircraft.

The strength of Agricultural Aircraft

The types of light aircraft which are used in aerial agriculture are nearly all designed to a Manoeuvre Envelope only, because they are not "gust critical" at their design gross weights. The discussion which follows will therefore mainly concern the Manoeuvre Envelope and we will examine a representative envelope for a non-agricultural aeroplane and show what is involved structurally when it is adapted to aerial agricultural work in accordance with Australian practice.

When an aircraft type is cleared for aerial agriculture, an increased maximum take-off weight may be allowed after an assessment of its performance, previous service experience, and any other relevant factors. The maximum Agricultural T.O.W. which will be permitted in the particular case is based on the aircraft's original design strength and its design gross weight. Virtually all agricultural aircraft in this country are authorised to operate at an increased T.O.W. and the nett effect is comparable to a reduction in strength. The extent to which this occurs is clearly set out in Figure 3 which shows flight strength envelopes drawn for a typical light aircraft. The outer one is for the aircraft as originally designed and the inner one is as converted to agricultural use with the greater T.O.W. Operation beyond the positive and negative load factor boundaries will result in structural damage and ultimately in structural failure, so that for the aircraft to retain the same structural safety margin at the higher T.O.W., it is necessary to impose more critical operational limitations.

Although the difference in load factor may not appear to be large, it represents for a typical aircraft of 3,000 lb. design weight, a reduction in limit load of approximately 15 per cent. This means that the limit load is becoming more easily attainable, particularly when it is remembered that the flight controls were designed to function under the more generous limitations of the original load factor. It will also be noted that not only are the load factors lower, but the stall boundaries have moved, giving higher stalling speeds.

It is also possible that the aircraft will have now become "gust critical". Although the higher weight aircraft may react less violently during turbulence, this effect is more than offset by the higher stresses present. As a result of this, the structure could be damaged or even fail in flight due to a gust encounter, quite irrespective of how carefully the aircraft is flown.

It will be realised from what we have said that operations at an increased weight involve a higher

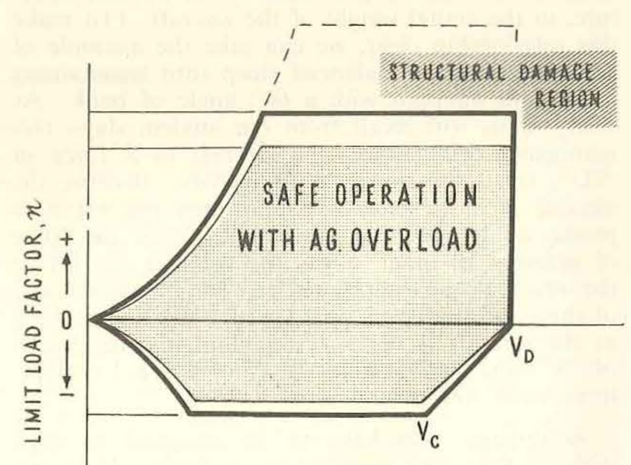


FIG.3 FLIGHT STRENGTH ENVELOPE

risk of structural failure than other forms of flying, but this has been justified in the past on the basis that agricultural aircraft will normally fly in reasonably good weather, that they will be **handled carefully by competent pilots with due regard to their heavier loaded condition** and that their payload is quickly disposable.

The pilot's handbooks published by the manufacturers of some of the different aircraft types used in aerial agriculture contain a statement that the aircraft is "150 per cent stronger than it need be". Such statements are merely commercial presentations of the very fundamental fact that all aeroplane design requirements call for a safety factor of at least 1.5 between the limit and ultimate loads. **These statements can be dangerously misconstrued in some ways.**

Pilots have, for instance, interpreted the 1.5 factor as meaning that they can overload the aeroplane by 50 per cent or fly up to 50 per cent above placard speeds without getting into trouble. This is an extremely perilous supposition, particularly in the case of speeds. Aerodynamic loads vary as the square of the speed, so that increasing a speed 1.5 times will increase the aerodynamic loads 2.25 times; double the speed and the loads increase by four times, and so on. Fig. 4 shows the effect of increase in speed above the design placard values. This is for **normal gross weight** and shows that even under these conditions, a 23 per cent increase in speed over the allowable value may result in structural failure.

Some Examples

Overloading

A recent check has shown that with very few exceptions, local agricultural aeroplanes are consistently operated at weights **in excess of the maximum** Agricultural T.O.W. permitted by A.N.O. Section 100.20. At the high stress levels associated with such practices, the risk of failure of some part of the aircraft structure is high. The risk of structural failure through fatigue is also dramatically increased. For example, 10 per cent additional weight can account for 30 to 40 per cent reduction in safe life of the principal structural elements.

Rough Handling

Flight tests in connection with the Department's fatigue studies have shown that some pilots operate their aircraft up to measured limit load factors of 3.0g. While this is safe at normal design weights, it is most hazardous at any higher weight and adversely affects fatigue life.

The effects of "bunting" to close hopper doors is another practice which can affect fatigue life, as

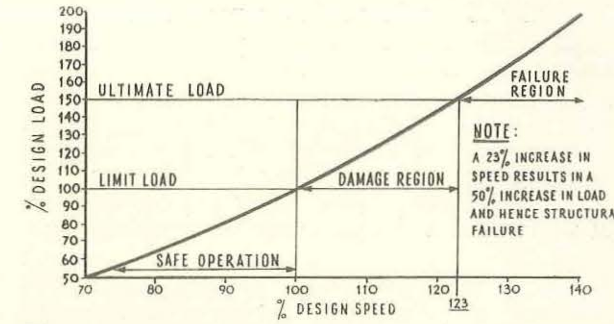


FIG. 4

VARIATION IN APPLIED LOADING WITH SPEED

one bunting operation does fatigue damage equivalent to an additional ground-air cycle. The practice of doing ground pivot turns under engine-take-off power also adds to the onset of early fatigue failure of both engine mounts and landing gear components. The possible effect on propellers was discussed in Aviation Safety Digest No. 31 of September, 1962.

Excessive Airspeed

The use of flaps to wash off speed for turns invariably means that flap speeds are exceeded. In one classic example of this, the pilot was operating his aircraft overloaded with flaps down, at 30 knots above the normal placard flap speed. This aircraft subsequently suffered serious wing flutter which could easily have destroyed it. Other cases of exceeding placard flap speed have been noticed during take off operations.

THE FUTURE

The statistics of the U.S. Civil Aeronautics Board reveal that on the average there have been 25 in-flight failures per year over the last 10 years or so with light aircraft types, as a result of operations outside the design envelopes. These casualties have occurred to aircraft operating on a Normal Gross Weight basis only and as many of the same types are being used in Australia for aerial agriculture at higher weights, it is obvious that the seriousness of exceeding operational limitations cannot be over-emphasised. It may be argued by some, that 25 in-flight failures per year is a reasonable figure to expect from the operation of about 73,000 light aircraft. However, when some adjustment is made for the relative flight time utilisations of agricultural as compared to normal operations, the expected in-flight failure figure increases at least SIX-FOLD, even disregarding any considerations of the effect of overloads and structural fatigue.

Whilst it can be said that less than three per cent of all aircraft accidents are caused by structural failure, there occurrence has a far greater psychological effect than the 80 odd per cent caused by "human factors". The confidence that some pilots have in their ability to "get away" with a certain amount of abuse of their aircraft has undoubtedly stemmed from their accumulated experience with some of the very robust earlier types, but we now have to realise that modern aeroplanes do not possess the design conservatisms which were built into their predecessors. Today, through refined analysis techniques, structural margins of safety have been reduced to a few per cent and **because of this, operational excesses can easily damage or fail modern light aircraft types at their normal design weights. Hence operations at the maximum agricultural loadings require the highest standards of airmanship and the strictest adherence to all appropriate limitations.**

With the loading at present authorized in accordance with A.N.O. Section 100.20, the Department finds that there are fatigue critical elements having lives ranging from 1,000 to 5,100 hours in the structures of the various agricultural types used in Australia. The matter is so serious that a full-scale fatigue test of the wings of a representative agricultural aircraft type has now been commenced. Whilst it is possible to predict fatigue lives and structural strength limits for agricultural aircraft without undue conservatism if their operators observe weight and speed limitations, the Department's work in this field will be largely negated if the practices that have been noted in recent times are continued.

It should now be quite clear that flight safety is seriously jeopardised by deliberate or careless neglect of the structural limitations placed on agricultural aeroplanes. That such actions constitute violations of the Air Navigation Regulations and may lead to prosecutions, problems with insurances, etc., should alone be a deterrent. In this article however, we are more concerned with emphasizing the dire physical consequences which might result from these practices, so that all who are directly concerned with agricultural operations will appreciate the urgency of the problem.

NON-TECHNICAL REPAIR

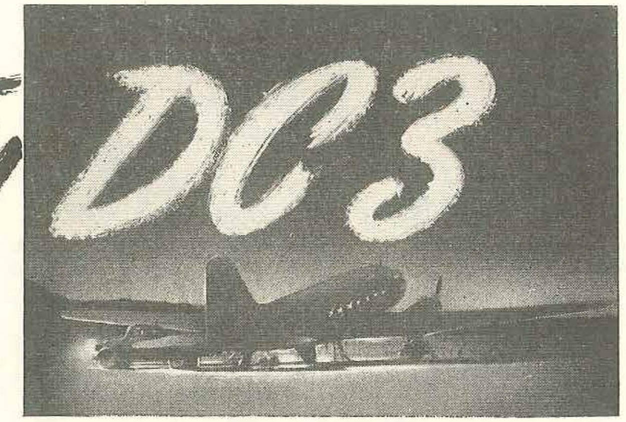
A light aircraft engaged on a charter flight was forced to return to its place of departure when a radio failure prevented the transmission of a position report about 30 minutes after take-off. The aircraft subsequently had to be ferried to a radio maintenance organisation where the fault in the HF equipment was rectified. The ferry flight involved a return trip of approximately one hour, bringing the total unproductive flight time to two hours.

The defect in the radio equipment was found to have been caused by a temporary repair made on some previous occasion, the aerial lead from the transceiver to the aerial loading coil having been fastened to the loading coil by means of a small aligator test clip. In service, the clip had vibrated around and shorted out approximately four turns of the loading coil.

It was not possible to establish when or where this non-technical "repair" was carried out. It is obvious however, that the person responsible had no appreciation of the value of serviceable radio equipment and even less knowledge of radio repair techniques, particularly in such a case as this where the adjustment of the loading coil is most critical for optimum HF performance.

VFR charter, aerial work and private operators are permitted to choose the workshops to which their removable items of aircraft radio equipment may be taken for repair, but this incident clearly illustrates the importance of choosing an organisation which has had adequate experience in the maintenance of airborne radio.

A Thirsty DC3



A DC-3 departed from a country aerodrome on a night flight to Sydney with adequate reserves of fuel. When the aircraft reached cruising level, both engines were selected to the port auxiliary tank which contained sufficient fuel for at least one hour's operation at the two engine consumption rate. Although it was then noticed that the two main tank fuel gauges were indicating a slightly assymetric fuel distribution, the readings appeared to be quite consistent with the fuel gauge inaccuracies experienced on this type of aircraft, and no abnormality was suspected.

After passing Bathurst only forty minutes later, the port auxiliary tank indicated empty and each engine was then selected to its respective main tank. Shortly afterwards, the main tank readings showed that the assymetric distribution of the fuel load was becoming more pronounced. At this stage, the captain reviewed the whole fuel situation, and although this confirmed that the remaining reserves were adequate to justify continuing the flight to Sydney, he decided there was reason enough for returning to Bathurst.

After a normal descent and landing at Bathurst, the tanks were dipped and the uneven distribution of fuel was confirmed, the port tank dipping at 15 gallons, while the starboard was found to contain 45. The crew then made a thorough inspection of the port engine and fuel tank area by torchlight, but no leakage was detected.

In view of this, together with the fact that the fuel pressure had remained normal throughout the flight, the captain concluded that either the port side fuel tanks had not been properly filled at the last refuelling point, or that the port engine carburettor had been metering fuel to the engine at a higher than normal rate throughout the whole day's flying. That both these factors had combined to produce the existing fuel conditions was also considered a possibility. The aircraft was therefore refuelled to well in excess of the normally required reserves for the flight on to Sydney.

After starting the engine, a further external examination was made, but as this still did not reveal any leakage, the captain continued the flight to Sydney where the matter was referred to the maintenance staff.

Investigation in Sydney revealed that the aircraft had used approximately 140 gallons during the 53 minute flight from Bathurst. This, when related to the normal fuel consumption of the aircraft for the same flying time, showed an excess fuel usage of 123 per cent. The high rate of consumption was traced to a leak in the supply line between the fuel pump and the carburettor. This leak had allowed fuel to be discharged under pressure into the nacelle area between the engine "dish pan" and the fire-wall and it thus constituted an extremely serious fire hazard.

The leak in the three-quarter diameter stainless steel fuel pipe line was found to have been caused by prolonged chafing of the line against the rear crankcase vent pipe. In view of the thickness of the fuel line the chafing had probably been taking place from the time the engine was installed in the aircraft 1025 flying hours before.

It is difficult to understand how a fuel leak of this magnitude could have escaped notice during the ground inspection at Bathurst, particularly as the inspection was specifically directed at the integrity of the fuel system. But it did escape notice on this occasion and thus the first lesson from this incident is the need for great patience, thoroughness and imagination in searching for defects of this type.

When no fuel leak was discovered, the crew conjured up operational explanations for the extremely high fuel consumption. They accepted the explanations which posed no danger to the aircraft and which thus permitted the flight to continue. Apart from the established fact of the high fuel consumption, there was no evidence to support their supposition, let alone to justify a gamble that nothing serious was wrong with the aircraft.

Fuel is a highly dangerous cargo and at all times we should be able to account for its consumption. The decision to land at Bathurst for an inspection was a wise one; the decision to continue from there to Sydney on a conjectural explanation of the situation is hardly in the same category.

Finally there is the lesson of the chafed pipe for the maintenance engineer. In an aircraft regularly engaged in public transport operations it seems astonishing that a defect of this nature could go undetected for so long. The fact that this is what happened only serves to emphasise yet again, that in aviation NOTHING can be taken for granted.

THE BIRD PROBLEM

—*Photograph by courtesy John Fairfax Feature Services.*

The menace to aircraft operation caused by the presence of bird life on and around airports, has been the subject of increased attention by aviation authorities throughout the world during the past year.

Here in Australia, where it has been found essential to have a fund of statistical information for any investigation programme, a special request was made to all pilots to report every instance of a bird strike, whether or not damage was caused to the aircraft. Partly no doubt as a result of this, the number of bird strikes reported during the eleven months to the end of May this year reached the record figure of 208. This was 123 more than in the preceding twelve months and included three cases of damage to turbine engines, three of broken windscreens, and 24 other cases of minor damage.

The bird strike problem is viewed so seriously that the Department has arranged for a detailed ecological study of the species concerned, and a five year research programme to cost £50,000 has been approved for this purpose. The study is being made on behalf of the Department by the Wildlife Research Division of the C.S.I.R.O. A leading Canadian ornithologist, Dr. Gerard Van Lets, has been engaged by the Division for this task and has already commenced a field investigation at Sydney Airport, but it is expected that two years' work will be required for any significant findings to emerge.

The problem at Sydney Airport is also being tackled in quite another way. It is evident that the very large number of birds congregating in the vicinity of Sydney Airport are being attracted there by a large rubbish dump nearby. While this potential source of danger is seen in its most serious form at Sydney, it is by no means confined to that airport and so legislation has been passed which gives the Director-General power to prohibit the dumping of waste foods near airports when he considers that it could create a hazard to aircraft by attracting birds to the area.

The subject of bird strikes with aircraft was discussed in Australia at an international level during the year when the Directors of Civil Aviation in Asia and the South Pacific held their third informal meeting in Melbourne last November. During the same month, an International Symposium on Bird Deterrents was held at Nice, France, at which Australia was represented by Dr. H. J. Trith, Chief of the C.S.I.R.O.'s Division of Wildlife Research.

One of the most important aspects of the whole problem, "Provisions to enable aircraft to withstand bird strikes," was set down on the agenda for the sixth meeting of the I.C.A.O. Airworthiness Committee to be held in Paris during June this year.

Despite the interest which the problem of bird strike has aroused amongst aeronautical authorities in many countries of the world, and the intensified investigation which is now going on to find a means by which it can be overcome, no effective solution is yet in sight. Meanwhile, in Australia, the Department is making every possible effort to reduce the risk of bird strikes to a minimum by attempting to keep birds away from aerodromes. The most effective way of achieving this, particularly during the hours of daylight, has proved to be by shooting to scare the birds from the vicinity of the aerodrome. The method nevertheless has its limitations as it is almost useless at night and at some aerodromes the birds return so persistently that an almost continuous patrol is required to keep them at bay.

Where necessary, environmental control measures are being adopted to discourage the presence of birds. As we have already mentioned, the dumping of food waste is no longer permitted near aerodromes. Around some aerodromes, existing ponds and water holes will be filled and drained and types of vegetation attractive to birds will be removed. Where the bird species is carnivorous, bird carcasses are being removed immediately they are found and aerodrome personnel will in future inspect the aerodrome with this intention whenever a bird strike is reported.

Pilots will be given every assistance by ATC and COM units to enable them to avoid bird strikes, and will be kept informed of any congregation of birds on or near the aerodrome at which they are operating.

Pilots for their part are being asked to assist the Department by continuing to report every bird strike they experience. They are also asked to advise an ATC or COM unit when there is a significant concentration of birds at any unattended aerodrome into which they may be operating.

Familiarity leads to Error

Take-off was abandoned at an early stage when the pilot of a DC-3 noticed that both airspeed indicators were reading full scale -350 knots. Replacement indicators had been fitted as part of a routine component change immediate beforehand and both sets of pitot and static pipe lines had been connected in the reverse sense, thus causing the indicator needles to rotate backwards and give the impression of a full scale reading.

The engineer who installed the indicators freely admitted that he failed to functionally check the instruments after installation, because he was working against time to complete the work. He was quite aware that in so doing he failed to comply with a specific requirement detailed in the company's maintenance manual.

The functional check was omitted because the engineer believed that his knowledge of the particular aircraft was so adequate that he would not make a mistake. A belief such as this is akin to "famous last words" and has no place in aviation. Constant repetition and familiar routine can easily become the enemies of air safety unless engineers impose upon themselves a rule of strict obedience to company instructions and accepted aeronautical practices.

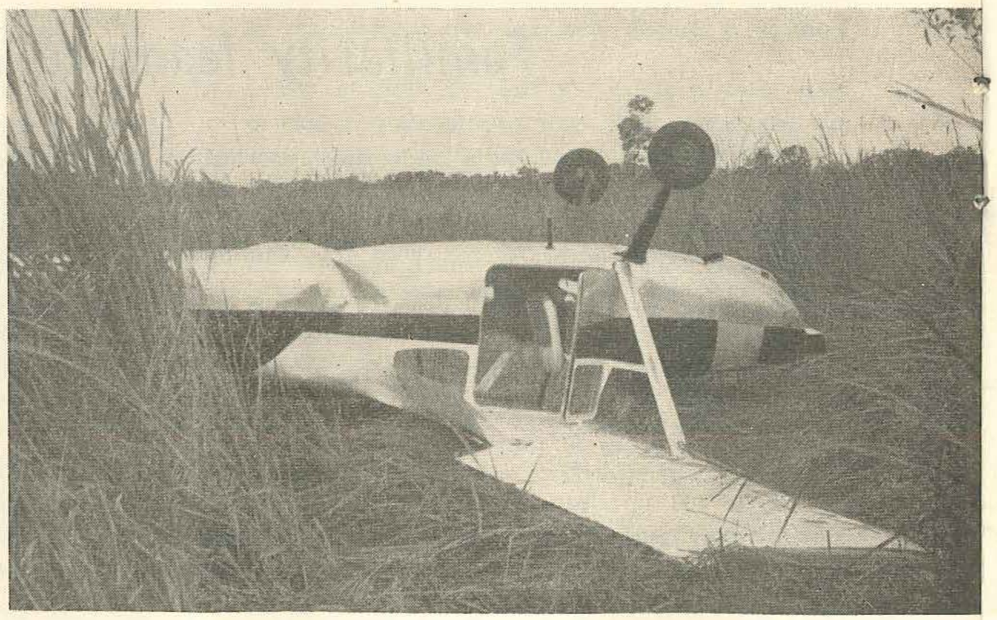
Forced Landing in Kunai Grass

Whilst on a private flight to a New Guinea mission station, with the pilot, three adult Papuans and an infant on board, the engine of a Cessna 170 failed at about 1,500 feet above a heavily timbered rain forest area some eight miles from its destination. All attempts to restore power proved fruitless, so the pilot had no option but to attempt an emergency landing in a kunai grass patch about one mile in length and one-quarter of a mile in width. The patch contained some scattered trees and was covered with a dense growth of kunai grass eight feet high.

The pilot transmitted a 'May-day" call, turned towards the selected kunai patch and warned his passengers that a crash landing was imminent. He checked that their belts were fastened and that the infant was securely held, then instructed the passengers to lean forward until their heads were resting on their knees, with their arms positioned to protect their heads from injury.

Flaps were lowered in rapid stages after lining up on the final approach path and the aircraft was trimmed for landing. Late in the approach, the ignition and master switches were turned off and the fuel selector was closed. The aircraft settled into the kunai grass at about 40 knots and slowed down considerably before the wheels contacted the ground. The wheels rolled through the grass but the tail could not be brought down even with full aft elevator control, due to the drag from the dense grass. About 70 feet after the wheels had touched down, the port wheel dropped into a hole and the aircraft overturned, sliding for a further ten feet before coming to rest on its back. The pilot quickly released the passengers from their inverted positions and ushered them clear of the aircraft. Fortunately, fire did not occur, but to further safeguard the aircraft from this possibility, the pilot discharged the contents of a fire extinguisher in and around the engine compartment.

Conscious of the fact that he had not heard an acknowledgment of his "May-day" call, the pilot waited some twenty minutes for the engine to cool down and then prepared to attempt radio contact. After ensuring that there were no fuel leaks which could present a fire hazard, he turned the master switch on and checked the electrical system for evidence of short circuits. The radio equipment appeared to be serviceable, so the broken radio aerial was disentangled from the wreckage and a passenger was instructed to hold it up by the insulator in an extended position. In this way, radio contact was re-established with a communications centre and the details of the accident, and the position in which it had occurred, were passed. As a result it was possible for the Search and Rescue Organisation to arrange for emergency rations and a medical kit to be dropped nearby. In the course of further radio contact with the communications unit, the pilot advised that as all passengers were fit and well, they would walk to meet a search party which was proceeding to the scene of the accident from the home mission station. Advice of their intended track and estimated time of arrival at the mission were also passed by radio prior to their departure from the accident site. The pilot then removed all useful items of equipment from the aircraft, including the compass, and subsequently used this instrument to assist him to navigate his party through the dense forest. Some two hours later they met the rescue party.



The total loss of engine power had been brought about by what appears to have been simultaneous mechanical failure in both magnetos; subsequent examination showing that the tungsten contact points had become detached from the fixed arm of the contact breaker assemblies.

COMMENT:

The measures adopted by the pilot to lessen the chances of injury to the passengers, and to assist the rescue party, are worthy of note. To have achieved such attention to detail in a difficult forced landing situation and in the short time available, suggests that the pilot had frequently reviewed the procedures to be followed in the event of engine failure. Thus prepared he was able to act calmly and decisively when the emergency occurred.

One point is perhaps worthy of further comment. In our instructions concerning the Search and Rescue actions to be taken by the pilot in the event of a forced landing, it is emphasised that the occupants should remain with the aircraft.

In this instance we accept the pilot's decision to walk to meet the rescue party as he had first established radio communication with the Search and Rescue organization giving them full details of his proposed movements. As well, the crash site had been pinpointed and survival equipment delivered. Indeed, the pilot met this whole emergency in an airman-like manner and we do not doubt that if this radio contact had not been successful, he and his passengers would have stayed by the aircraft until rescued.

SEAT SECURITY

Several years and many "Digests" ago we drew attention to two accidents which occurred because, in each case, the pilot's seat slipped backward during take-off and control of the aircraft was lost. Recently, we received a report of an incident of a similar nature, which could quite easily have become an accident. Here is the pilot's own description of the event:—

"Fortunately neither myself nor the aircraft were in any way damaged, but I must admit that it was, to say the least, a rather unnerving experience. I had spent the night at Shepparton and was departing for Mangalore, conditions were ideal and the wind southerly at 2-3 knots. After a routine, but in retrospect insufficient daily inspection, the aircraft was started and taxied out to the end of the 18 runway.

Again a routine pre-take-off check and the take-off commenced, the throttle was opened smoothly and fully and as the aircraft accelerated I was suddenly and efficiently carried backwards with the seat, completely out of the reach of the controls. The seat had not only travelled backwards but had on reaching the rearmost limit of its travel tilted back so that my head was against the back of the rear seat. The continuing acceleration and my safety harness tended to maintain the status quo. After a few moments of disorganized panic I managed to pull off the power with my feet and as the aircraft decelerated and I regained a more normal position, I found that the aircraft was some eighty yards to the left of the runway centre-line and during its erratic course had passed between two large gable markers.

Investigation of the cause revealed that neither of the seat rails were fitted with limiting pins, with the result that when the seat had been adjusted fully forward the seat runners had become disengaged from the rails and were sitting on the rails in such a manner that the seat locking device appeared to function so long as there was a positive weight over the anterior part of the seat.

Perhaps a more thorough daily inspection would have averted this incident".

We are grateful to this pilot for his frank report and for subsequent advice in which he informed us that a short time prior to the incident he had removed the seats from the aircraft to facilitate cleaning the cabin. He could not recall fitting the limiting pins when the seats were re-installed. One of the pins was subsequently found in the aircraft baggage rack, where he had placed it for safe keeping during the cleaning operation.

No doubt other owners and pilots have forgotten to replace limiting pins when they have removed the pilot seats. It is a wise precaution to fit or tie the pins in an obvious position when they are removed, so that they will not be forgotten when the seats are replaced.

In our earlier article in Digest No. 17 of March, 1959, we commented that strapping yourself into an insecure seat is only asking for trouble. We say again, MAKE SEAT SECURITY CHECKING A HABIT.

CAUTION!

WEATHER BELOW VMC

Within a short period prior to this issue going to press, three light aircraft were destroyed and their occupants killed. It is coincidental that all three of these accidents occurred under conditions of poor visibility because of low cloud or fog. While we have not yet concluded nor would we wish to impute, that this circumstance was necessarily the only significant factor in any or all of these three particular accidents, we believe that the coincidence in itself is sufficient justification to again sound a warning on the dangers of loss of visual reference to all pilots who are not currently qualified for instrument flight.

Readers will recall that the last issue of the Digest contained a report of another fatal light aircraft accident which occurred in "below VMC" conditions and elsewhere in this issue there is an account of an accident which befell a very experienced light aircraft pilot in similarly adverse weather in New Zealand.

The lesson is painfully clear — many valuable lives are being lost and aircraft are being destroyed because their pilots are failing to recognize weather conditions which, if they persist with their flight, will sooner or later deprive them of visual reference. Such pilots can be likened to the driver of a motor car, who although feeling drowsy, is quite sure of his ability to keep himself awake at the wheel until he arrives at his destination. He learns the folly of this judgment only when he recovers consciousness in hospital! In other words, when he finally realises his mistake, it is too late!

Similarly with the pilot who is 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, albeit unintentionally, 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 of educating pilots to this hazard lies. Because it is beyond our experience, most of us will simply not accept the fact that we can quickly be deprived of control of an aircraft by a loss of visual reference. 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 pressing on in deteriorating weather:—

Even though visibility is poor, this pilot can see the ground ahead and to either side reasonably well, and he has every confidence that he can continue the flight 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. Although there isn't much forward visibility now, he can still see the ground below the aircraft quite well so there is nothing to worry about. Nevertheless, he thinks, if the weather gets much worse, he might have to turn back. But on the other hand, he might easily be through the worst of it soon and then conditions should improve. Besides, the passenger he is carrying has already told him how important it is that he gets to his destination today. Down to a few hundred feet now, he follows a path between two big patches of stratus. Yes, there is 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. This time, there is no clear 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 fly back along the clear track that he has been following. 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 and the world beyond the cockpit windows is instantly reduced to nothing more than an 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 in 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 now. 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? 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 — put 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 unwiding like mad! Try not to panic, must do something quickly —

Some pilots with no first hand experience of flight in instrument conditions may feel that our little drama is exaggerated. We assure you that it is not and suggest the sceptics refer to an article which we published in Aviation Safety Digest No. 20 in December, 1959. This article described a study which had been undertaken by the University of Illinois to determine the extent to which non-instrument pilots could retain control of their aircraft in instrument conditions. The study showed that, of the representative group of twenty non-instrument pilots selected for testing, not one was able to retain control when deprived of visual flight references. Unfortunately for a number of people, the warning which was sounded to all non-instrument pilots by this series of tests, has too often gone unheeded.

The lesson also applies to those of us who have had a little instrument flying, as well as to those who perhaps had a lot of instrument experience a long time ago. Although our reaction to a warning like this is often "that doesn't apply to me — I know how to fly on instruments," the unpleasant fact is that we are no safer than the pilot with no instrument experience. Indeed, we are probably the more dangerous in marginal visual conditions because we are reluctant to recognize our limitations and we might be tempted to deliberately enter a patch of cloud that is "obviously too small to worry about".

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 situation we have been discussing, the regulations alone cannot prevent accidents. Rather must the responsibility lie with the individual pilot. It is not good enough merely to be willing to turn back if conditions become impossible for flight under V.M.C. As we have seen, it may then be too late. Instead, when it becomes apparent that the weather conditions are deteriorating we must discipline ourselves to turn back whilst there is still room to manoeuvre safely and before the weather closes in behind us.

There is little doubt that some lives will be saved during the remaining months of winter weather, if all light aircraft pilots steadfastly resolve not to place themselves in a situation where they could be confronted with a weather situation below Visual Meteorological Conditions.

The Turbulent Wake

When preparing for a landing on an 8,000 feet runway in perfectly calm conditions, the pilot of a Viscount was forced to abandon the approach when his aircraft encountered the turbulent wake of a very large four-engined aircraft which had just carried out a touch-and-go procedure on the runway. The leading aircraft was at a height of approximately 300 feet upwind from the runway at the time that the Viscount encountered the turbulence.

Describing the experience, the Viscount pilot stated that his aircraft was approaching the runway at about 100 feet, at the threshold speed at 121 knots when the aircraft swung to the right about 20 degrees, the right wing dropped 45 degrees and the indicated airspeed fell off to 112 knots, which was the V2 reference speed for the landing weight. Despite the fact that by this time the engines had been opened up to full power, the airspeed remained at this critical figure for some seconds.

This incident bears out the warnings previously given in the Digest on the dangers of vortex turbulence, particularly in the article "Wingtip Vortices" in our issue No. 31 for September, 1962 which dealt with a study of the phenomenon made by American aircraft manufacturers. Especially pertinent to this incident was the statement that "since a slow flying aircraft leaves the most violent wake, the area around a runway is the most likely place to encounter this turbulence at its greatest severity. The hazard is increased by the necessity for staying within rather narrow confines when departing or arriving at an airport and a particular runway.

The study showed that the greatest portion of the turbulent wake is generated by the passage of the air over and around the wing tips, resulting in twin vortices of fast spinning air masses stretching back from each wing tip. These compact horizontal tornados remain close together and parallel, particularly under conditions of no wind, and reach their peak velocity about 33 seconds after the passage of the aircraft. A following aircraft which encounters these vortices is subjected to the double hazard of either loss of control in a critical situation, or the imposition of flight loads beyond those for which it was designed.

Under favourable meteorological conditions, dangerous turbulence can exist for at least 8,000 feet behind a large aircraft climbing away from an airport and a relatively large circulatory velocity can persist for at least three miles astern. In the case of a cruising jet transport aircraft, the peak vortex velocity is found three to four miles behind and a relatively high degree of turbulence exists for some seven miles. Naturally, horizontal and vertical air movements will tend to break up the circulatory movement, and turbulent wakes will therefore dissipate more rapidly on rough, windy days.

The vortex turbulence hazard is one of several factors that have been taken into consideration in determining the separation standards to be applied at controlled aerodromes, and in most conditions these standards provide adequate protection. When there is no wind to disperse the wake of a preceding aircraft however, the normal standards of separation may be insufficient, and pilots should allow themselves even more clearance behind a preceding aircraft. If necessary they should delay their take-off for a few minutes to allow the vortex turbulence to dissipate.

In the past, pilots of light aircraft wishing to land immediately behind large transport types have usually been warned of the turbulence hazard by air traffic controllers. Where possible, this warning is now being given to pilots of all types of aircraft when landing or taking-off in calm conditions. Pilots themselves must determine the extent of the additional separation required and realize that a warning cannot be given when they are operating away from controlled aerodromes.

It should be remembered that this phenomenon cannot be seen, nor will there be any warning prior to a savage encounter. There is, in effect, only one solution: KEEP YOUR DISTANCE.

AVGAS — Or is It?

Extract from Aviation Mechanics Bulletin:—

"The flight landed for normal refuelling. After refuelling, the sumps were drained, the flight departed the ramp and proceeded to the assigned run-up spot prior to take-off. Run-up was conducted without incident and the flight was cleared for take-off. Immediately after full throttle was applied, the engines started to splutter and misfire. The pilot chopped down the throttles and aborted the take-off. No emergency procedures were necessary as the take-off roll had just started and the runway was over 10,000 feet long.

After return to the ramp, inspection revealed that the tanks had been serviced with JP4 (turbine fuel) instead of 115/145 octane gasoline".

It Can Happen Here Too!

A recent occurrence in New Guinea shows that the incident we have quoted above is by no means an isolated one and should be of interest to all who refuel from drum stocks, especially where several drums are required.

On landing at an airstrip, the crew of a DC-3 found that the refuelling agent had three drums of aviation gasoline positioned ready for the aircraft. The crew informed the agent that they would probably require a fourth drum on this occasion, so an assistant was instructed to bring out the additional drum while the agent commenced refuelling. Towards the end of the operation, when about 15 gallons of the fourth drum had been pumped into one tank, the agent discovered that this drum contained turbine fuel. The affected aircraft tank was then drained completely and refilled with fresh aviation gasoline.

The agent had checked the first three drums to ensure that they contained the correct type and grade of fuel when they were placed in position, but, being then occupied with the refuelling, he overlooked checking the markings on the extra one brought by his assistant. The error also escaped detection when the contents of the fourth drum were checked for water contamination, because the sample drawn from this drum was emptied into the glass container holding samples from other drums before it was inspected.

This incident shows that even the most experienced people can occasionally get caught out by overlooking the obvious. That the agent was thoroughly alert is amply illustrated by the way in which he realised his mistake.

After dipping the quantity of fuel remaining in the drum when the delivery had been nearly completed, he noticed that the dipstick did not dry immediately. His suspicions were confirmed as soon as he looked at the drum markings.

Inadequate Cockpit Check Proves Costly

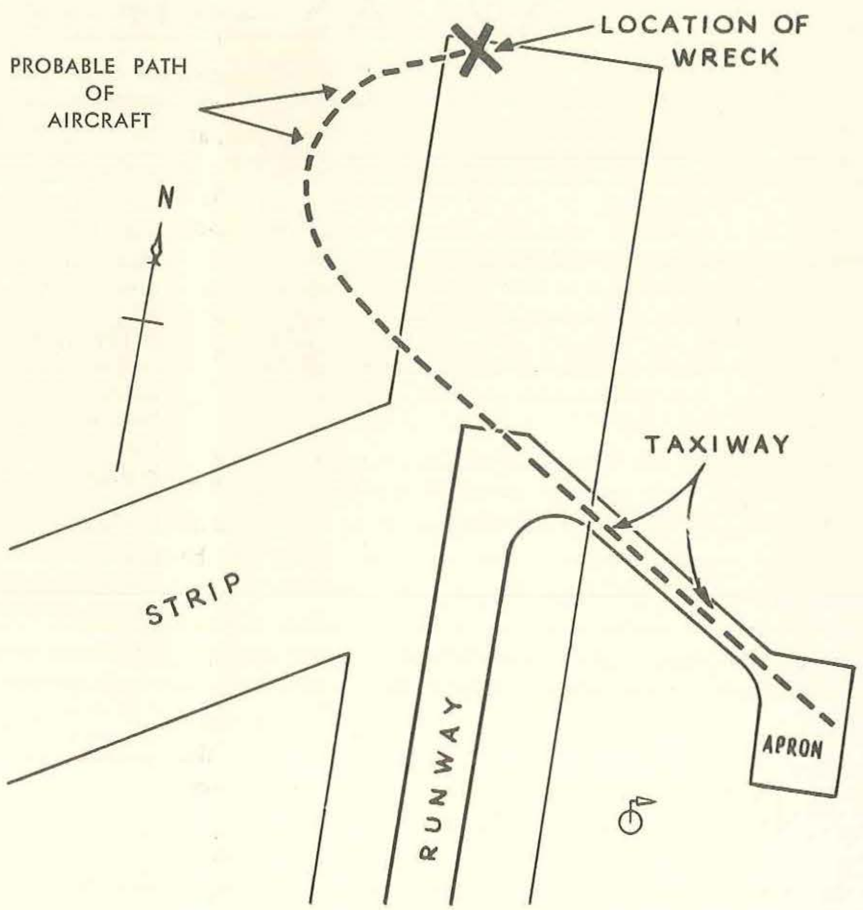
At approximately 1300 hours on an October afternoon a Chipmunk aircraft engaged in flying training operations at a country airport in South Australia crashed when the engine failed shortly after take-off. The aircraft was almost totally destroyed but the student pilot and his unauthorised passenger received only minor injuries.

Earlier in the day of the accident, the student pilot had been undergoing dual instruction in crosswind take-off and landing technique. At the completion of the period of dual flying, the student's instructor had authorised him to carry out one hour's solo practice on this training sequence. The instructor also mentioned that he would be going into town for lunch but that he would be back at the airport by the time the student had completed the hour of solo flying.

After his instructor's departure, the student completed several solo circuits and landings, then taxied the aircaft back to the apron in front of the terminal building, where he turned off the fuel and switched off the engine. He then offered to take his younger brother, who was waiting near the apron, for a flight in the aircraft.

After installing his brother in the rear seat and fastening the safety harness, the student pilot started the engine and commenced a take-off in a north-westerly direction along the taxiway which connects the apron with the northern end of the main north-south runway. The take-off and climb were normal until the aircraft attained a height of approximately 150 feet, when without warning, the engine failed completely. The pilot at once realised he had omitted to turn on the fuel before take-off and he immediately lent down and selected the fuel to the starboard tank.

The area towards which the aircraft was descending consisted of thick scrub interspersed with trees so the pilot began a turn to the right in an attempt to make a landing back on to the main runway. The aircraft lost height rapidly and the starboard wing struck the ground. The aircraft then cartwheeled, bouncing first on to its nose, then on to the port wing, finally striking the ground in a level attitude 350 feet from the point of first contact. The force of this last impact was severe enough to dislodge the engine from its mountings and to fracture the fuselage just aft of the rear cockpit. No fire broke out and both occupants were able to extricate themselves from the wreckage. The pilot suffered a broken nose and mild concussion, while his passenger sustained only bruises.



A thorough examination of the wreckage was carried out, including a strip inspection of the engine. This investigation could not produce evidence of any defect or malfunction which could have been a contributory cause of the accident. Indeed, the inspection of the engine and propeller showed that the engine was delivering power at the moment of impact, and it was concluded that as a result of the fuel having been turned on, the engine had commenced to fire again an instant before the aircraft crashed.

The pilot, who was eighteen years old, held a valid Student Pilot Licence and had accumulated just over 17 hours flying experience, all of which had been gained locally on Chipmunk aircraft. The pilot's younger brother, who was a passenger in the aircraft, was carried in contravention of ANR 52(9), and although it was established that the control column for the rear cockpit was not fitted and there was no evidence that he interfered with the flying of the aircraft in any way, it is possible that his presence in the aircraft had a psychological effect on the pilot to the extent of either distracting him or tempting him to disregard the pre-flight precautions which he would normally be expected to take.

Weather conditions at the time of the accident were ideal for flying training, with a light north-westerly wind and good visibility.

The pilot's action in turning off the fuel at the time he stopped the engine is in accordance with normal practice for this type of aircraft. However, the starting and pre-take-off cockpit procedures laid down in the operator's Operations Manual, require that the position of the fuel cock be checked "ON" to the appropriate tank, and the pilot later admitted that he had not checked the position of the fuel cock before commencing take-off from the taxiway.

During his earlier flying training, the pilot had been shown the correct procedure to be followed in the event of engine failure, but in this case a landing straight ahead would have been into trees and thick scrub. Because of this, he was prompted to try to regain the main runway by making a turn to the right. In the circumstances, it is believed that a turn to the left to land on the 238° strip which intersects the northern end of the main runway, would have had a greater chance of success. Nevertheless, the lack of judgment displayed by the pilot is not surprising when his very limited flying experience is taken into account.

The primary cause of the accident was the pilot's failure to follow the proper flight check procedure before start-up and prior to commencing take-off. His lack of flying experience, together with his decision to take-off from the taxiway also contributed to it, and there is little doubt that if this student pilot had not acted in contravention of his authorization, flying discipline, and the Air Navigation Regulations the accident would not have occurred.

LOOSE ENDS

When attempting to raise the flaps after take-off in a Cessna 150, a solo student pilot found that the flap lever between the two seats could not be moved in either direction. He subsequently noticed that the loose end of the adjustable strap of his seat belt was caught between the two seats. When he pulled this end clear the flaps operated normally.

Although others have since tried to duplicate this particular form of jamming intentionally without success, there is little doubt that the strap end was the cause and it presumably could happen again. It might be worth checking your own aircraft to see whether the loose ends of belts in use could foul any of the operating mechanism of the aircraft, particularly when being worn by a slim person. It would be even better to make some provision for securing the loose ends so that they cannot "dangle in the works".

Finally, although in this instance the offending belt was one being worn by a pilot, the incident provides further support for the mandatory requirement for correctly securing seat belts or harness when they are not in use.

PETROL AND PLASTICS DON'T MIX

Plastic containers do yeoman service in the storage and carriage of a wide variety of different fluids. Light, convenient and relatively unbreakable, **it is a pity that they are unsuitable for use with petrol, including aviation gasoline of all grades, but such is the case.** Various well-informed bodies, including fuel companies, have felt obliged to issue strong warnings on this subject during recent months.

The reasons given for such advice may be of interest:—

1. Plastic does not conduct electricity and under dry conditions can carry a heavy static charge which cannot be adequately earthed by the use of earth wires and clips. A plastic container, so charged, could easily cause a dangerous spark when brought close to a metal fuel tank inlet during a fuelling operation.

2. Gasoline should always be stored in the dark. Modern fuels contain tetra-ethyl lead and dyes which will readily decompose and come out of solution, in the form of a whitish powder, when the fuel is exposed to sunlight for any appreciable time. Not only will this seriously reduce the knock rating of a leaded fuel, but the powder itself could easily cause fuel starvation through blockage of filters. Cases of deterioration of aviation fuel stored in translucent plastic containers have already been reported in this country.

3. Gasoline will leach out certain types of plasticisers and adhesives commonly used in the manufacture of plastic fluid containers. This can have two very dangerous effects. Firstly, deterioration of the container as a result of brittleness or loss of adhesion at the seams is likely to cause leakage of liquid fuel; secondly, there is a risk of the fuel itself becoming seriously contaminated by excessive gum formation.

4. Hazardous leakage of fuel vapour can occur under high ambient temperature conditions unless the tops are sealed with more than usual care.

Car, motor boat and especially aircraft owners and pilots, would do well to heed this advice which is solidly based on practical experience. As far as aircraft are concerned, the aerial transportation of gasoline in plastic containers would constitute an infringement of Air Navigation Order Part 33—Carriage of Dangerous Goods.

The following quotation from Bulletin No. 213 issued by the Petroleum Information Bureau (Australia) provides an appropriate conclusion:—

"DO NOT USE PLASTIC CONTAINERS FOR CARRYING PETROL. We strongly recommend that you pass this warning on to your family and friends."

Those Finishing Runs Again!

As long ago as September, 1958, an article in this Digest emphasized the particular dangers to which agricultural pilots are evidently exposed while carrying out their finishing runs—particularly on those runs that are made at right angles to the primary spraying pattern for the purpose of treating the end strips of the area being worked. The article ("The Finishing Run"—Aviation Safety Digest No. 15) pointed out that there was a tendency to overlook the proper planning of these runs and that, of nine instances of collisions with power lines by spraying aircraft, no less than six had occurred when the operation was almost completed.

It is abundantly clear from the number of agricultural flying accidents which have occurred during the intervening years, that there are still many pilots engaged in this class of work who have not yet appreciated the lessons which are to be learned from the unhappy experiences of pilots other than themselves. The following extracts from two different reports of separate but strikingly similar incidents are published in the hope that they may help to overcome the complacent "it can't happen to me" attitude which undoubtedly tends to afflict us all from time to time.

Pilot No. 1 writes of his collision with a power line:—

"The paddock is approximately 180 acres with the rows of cotton running east-west. The transmission lines are located on the southern boundary.

The aircraft, a Super Pawnee, was loaded with a chemical defoliant at 1600 hours, local time. I elected to commence spraying on the northern perimeter making east-west runs. All proceeded reasonably well until the ninth load when, after completing a run into the east and finding that there was only about five gallons of chemicals left, I made an unconsidered, spur of the moment decision to run it out on the south-east headland. Carrying out the run along the headland in a southerly direction, after running out the tank I applied the chemical pump brake, increased power and placed the aircraft in a climbing turn left, immediately looking back over my left shoulder to observe if the chemical drift had covered the crop right to the edge adjacent to the timber line. At this moment I remembered the transmission lines and looked forward again to find them just ahead and above me. I cannot vouch for my exact actions from that point onwards. However, my impressions were that I pulled the nose up. There was a loud noise, almost explosive and a sudden deceleration.

This is the first time I have sprayed this particular field. I discussed the job with the owner and briefed the flagmen, prior to commencing work, and gave it a good aerial inspection.

In summing up, I feel the reason for my remiss was a mixture of preoccupation, poor visibility with reference to the power lines because of light and timber background, and the nearest pole possibly concealed by timber.

The main work I had contracted for here was, with one exception, free of power lines, and I feel this situation over the last five months was a contributing factor where I was personally concerned. However, as from the 21/0610 GMT, the false sense of security, in this respect, has been suitably rectified!"

Pilot No. 2 writes of his similar experience:—

"I was engaged as pilot of Pawnee aircraft VH . . . on aerial spraying of wheat.

The area being treated was half of an area of approximately 120 acres. The direction of the longest run was approximately east and west. On the southern boundary of the overall area and parallel to the boundary fence was a single strand power line. The treated area was the northern half of this paddock.

I had completed treatment of the area with a final run from east to west and had climbed to the left, when I considered that with the amount of spray still remaining in the hopper, I could quite well strip the entire width of the paddock.

I then fixed my attention to the position of the marker, who was at this time standing about midway along the western boundary fence and dropped the aircraft to a height where spraying would have commenced midway between the southern boundary and the marker.

On crossing the boundary, no impact was felt, but I was conscious of a slight deceleration and noise coming from some part of the aircraft consistent with a wire or cable being pulled across the front struts of the undercarriage.

In conclusion, I was aware that the power line existed along the northern boundary of the field as prior to the first spraying run I had thoroughly inspected the field and satisfied myself of the position of all branch lines, etc."

There is a remarkable accord in the circumstances leading up to these two incidents, and it is worth considering their real cause a little more closely.

In both these cases the significant factors are:—

(1) The collision took place after the aircraft had turned from the primary spraying pattern and while manoeuvering in the course of making a finishing run at right angles to the earlier runs for the purpose of spraying the end strips of the area.

(2) The decision to carry out the run was made "on the spur of the moment," apparently on the basis that just enough spray was left in the tank for this final run.

It is clear that the operations up to the completion of the primary spraying runs were conducted in a satisfactory manner as a result of adequate planning and it was only when the pilot made his "on the spur of the moment" decision, that the train of circumstances leading to the collision was set in motion. Fortunately on both occasions the pilots were able to execute safe landings but there can be little doubt that, if the finishing runs in each of these operations had been carried out with the same forethought that was given to the primary runs, these extremely dangerous situations would not have arisen. It would be well, at this stage, to ponder afresh the advice offered in the earlier Digest:—

"Plan the whole operation, including the finishing runs, in relation to all obstructions which are observed at this time. Further, if you decide to change your plan of operation it is essential that you consider if your new plan takes into account previously insignificant obstructions".

Crosswind Landing ends in Disaster

When attempting to go around after a missed approach in gusting crosswind conditions, a Piper Tripacer stalled and crashed. The pilot was seriously injured and two passengers died in the ensuing fire. One passenger escaped with minor injuries.

On the morning of the accident, the pilot was making some private sightseeing flights over a nearby New South Wales town, carrying friends who had been staying with him. Shortly before the accident, he made a flight carrying two adults and two children as passengers and during the take-off he had noticed a crosswind of about 10 knots from the port side with some turbulence. The flight lasted about twenty minutes and a normal landing was made back on to the same runway in similar conditions of wind and turbulence. The pilot then embarked one adult and two children and again took off from the same runway.

After a flight of similar duration, an approach to land was made once more towards the same runway. By then the crosswind had strengthened considerably and was varying between 45° and 90° to the flight path. A "crabbing" approach was made with the nose of the aircraft yawed into wind to offset drift, and the wings level. The aircraft was aligned with the runway as it neared the ground but it then developed a pronounced drift with a simultaneous tendency to roll, to the right.

The pilot applied full power to carry out a missed approach and attempted to maintain directional control with port aileron but the aircraft continued to veer to the right until it was flying down wind in a pronounced nose-up attitude. The flaps were slowly retracted, but with very little gain in height, the aircraft maintained a nose-up attitude until it neared the eastern boundary of the aerodrome. By this time the aircraft had reached a height of only approximately 50 feet, and to observers on the ground it was becoming noticeably unstable. Shortly afterwards, it suddenly lost height and struck the ground close to the boundary fence. It then bounced through the fence and came to rest in an upright position. Fire broke out immediately. The pilot was able to escape through the port side cabin window and release the passenger in the port side rear seat but the intensity of the fire prevented rescue of the passengers seated on the starboard side. The pilot sustained serious injuries and burns and the surviving passenger suffered minor burns.

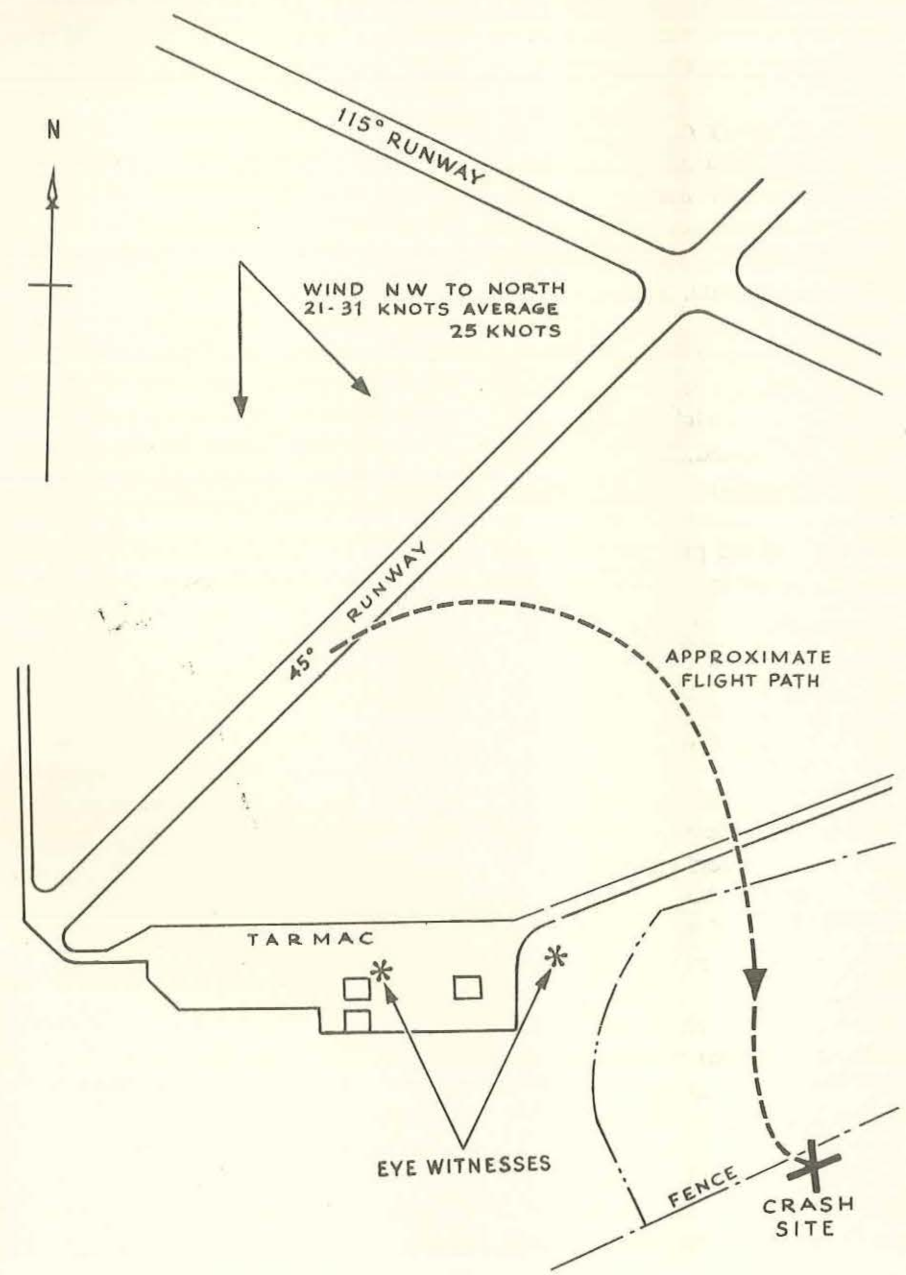
The weather at the time of the accident was clear with unlimited visibility and negligible cloud. It was ascertained that the wind at the time of the accident was oscillating between north-west and north at 20 knots with gusts to 30 knots. It was also evident that the wind direction had changed from the north-east to the north-west quarter sometime between 0600 and 0900 hours.

The all up weight of the aircraft and the position of the centre of gravity were determined to be within the specified limits, and it was established that the starboard fuel tank was full and the port tank a little less than half full at the time of the accident.

Impact marks showed that the aircraft had struck the ground at a low forward speed but at a high rate of descent. The marks also indicated that the aircraft was in a shallow nose down attitude with the starboard wing low. From the point of first impact, the aircraft had bounced eighteen feet through the post and wire boundary fence and had finally come to rest on its main wheels another eighteen feet further on. The fire had ignited as the aircraft passed through the fence and was probably caused by friction of the wire strands against the airframe structure, combined with a spillage of fuel from the starboard wing tank. Study of the wreckage indicated that the fire had commenced near the starboard door and had rapidly spread to the cabin.

Although the aircraft structure had been virtually destroyed by the fire, it was possible to determine that the flying controls had been properly installed and that they were functioning correctly up to the time of the accident. The condition of the engine and the propeller, which had been sheared from its shaft after striking the ground, showed clearly that substantial power was being developed at the moment of impact. A detailed examination of the wreckage did not reveal the existence of any component failure or defect prior to the crash and it was concluded that the aircraft had been capable of normal operation up to the time of the accident.

The aircraft was watched by several observers on the ground from the time it commenced the missed approach procedure until it came to rest after the final impact. These witnesses were unanimous that after the missed approach the aircraft had seemed to be laterally unstable and a nose-high attitude had been maintained throughout the flight until the final loss of height.



The pilot, who was also the owner of the aircraft, held a valid private pilot licence endorsed for the PA 22. He had logged a total of 113 hours flying experience, of which 46 hours had been gained in Tripacers. The investigation found no evidence which suggested that the pilot was suffering from any physical disability at the time of the accident.

In the PA 22, the aileron and rudder control systems are interconnected by springs and short cables in such a way that the movement of these control surfaces is co-ordinated to simplify the execution of normal turns. The interconnecting springs are arranged so that by over-riding the spring tension, the controls can be crossed for slipping or skidding manoeuvres. The spring tension is light and thus opposite rudder may be easily applied during either a yawed or slipping approach to a crosswind landing.

The pilot had chosen to approach for the landing on to the sealed runway, despite the fact that the wind conditions then prevailing were producing a very strong crosswind component from the port side of the landing path. The crosswind component was well in excess of the maximum permissible figure of 15 knots specified for the PA 22 in the Light Aircraft Handbook and in these conditions a successful landing would have demanded a very high degree of pilot skill.

Although both the aerodrome's sealed runways would have been subjected to strong crosswind components in the conditions existing at the time, it would have been possible to land the aircraft into wind by selecting an approach path on to the smooth grassed area of the aerodrome. The pilot was unable to provide a definite reason for attempting a crosswind landing on the runway instead of adopting the easier course of landing into wind on the grass, but it is possible that he was influenced by his customary preference for sealed runways for reasons of passenger comfort and reduced wear to the undercarriage. He had successfully completed a similar flight immediately before the one which terminated in the accident and it is reasonable to assume that he would not have committed himself to the second crosswind landing on the runway had conditions been troublesome on the first occasion. There is some evidence however, that the surface wind changed substantially in strength and in direction whilst the last flight was in progress.

The pilot stated that he had carried out a yawed crosswind approach in accordance with the technique demonstrated to him during his training. At the stage where he had applied starboard rudder to align the aircraft with the runway, it had begun to drift to the right and at the same time, had exhibited a strong tendency to roll to the right. At this point, the pilot had opened the throttle to execute a missed approach.

The drift to the right suggests that the pilot failed to synchronize the change in aircraft heading with a firm touch down, while the tendency for the aircraft to roll to the right indicates that at the same time he did not apply sufficient corrective port aileron. The use of starboard rudder, through the interconnected control system, would normally produce a corresponding application of starboard aileron and, in order to keep the aircraft laterally level, it would be necessary for the pilot to resist the tendency by holding on port aileron pressure. There would be a further tendency for the aircraft to roll to the right as a result of the yawing movement which would increase the airflow over the port wing and cause a corresponding increase in its lift. Conversely, the same action would reduce the lift being developed by the starboard wing. Thus, at the moment of yawing the aircraft to the right, even more port aileron pressure would be required to maintain a level attitude.

With the strong and gusty crosswind which existed, the sudden tendency for the aircraft to roll to the right would no doubt be most disconcerting to a relatively inexperienced pilot. Corrective measures would demand an immediate application of heavy port aileron with a simultaneous release of starboard rudder, but in the circumstances it is hardly surprising that the pilot was unable to take such positive remedial action. The pilot afterwards stated that he had applied port aileron to correct the rolling tendency, but it appears probable that he did not at the same time release starboard rudder. As a result of the starboard pressure thus transmitted to the aileron controls, the pilot could easily obtain the impression that he was applying much more port aileron than was actually the case and that he was unable to prevent the aircraft from veering to the right. Thus it seems likely that a combination of starboard rudder and some port aileron produced a flat turn to the right.

Once having turned downwind in the prevailing conditions, the aircraft was in a most difficult situation. It had almost no altitude and a very low airspeed and it was rapidly approaching the aerodrome boundary where there were trees 50 and 60 feet in height. The pilot stated that as the aircraft flew downwind it was slowly gaining height, but he had not noticed the airspeed. It is probable that his attention was distracted from the airspeed indicator by his preoccupation with the aileron controls, combined with the impression of speed over the ground which he no doubt gained as a result of the strong tail wind component. This factor, together with the obvious urgency of gaining sufficient height to clear the trees, probably accounts for the abnormal nose-up attitude of the aircraft from the commencement of climb until the final rapid descent. It is apparent that, in attempting to gain the height required, the airspeed was progressively lost until the aircraft stalled just before reaching the aerodrome boundary.

There is little doubt therefore, that a loss of control occurred when the pilot operated in surface wind conditions beyond his capability and experience, and that during his attempt to recover from an unsafe approach configuration, the aircraft stalled and crashed.

In aviation, it is not only a mark of wisdom for a man to confine his actions strictly within the bounds of competence, it is also conducive to longevity.

OVERSEAS ACCIDENTS IN BRIEF

Many official reports of overseas accidents come to our notice which we are unable to publish in detail because of space limitations in our Digest. Nevertheless, because we believe that some of these provide us with grim reminders of what could happen in Australia, we have included condensed versions of several such accident reports in this one article.

Viscount Propellers Contact Runway after Gear Retracted

After a normal lift-off and landing gear retraction, the captain's attention was momentarily distracted when rainwater from the window channel fell on to his left shirt sleeve, and he inadvertently allowed the aircraft to settle until No's. 2 and 3 propellers struck the runway. No. 4 engine and propeller were damaged by pieces of metal thrown from No. 3 propeller. Increasingly severe vibration, a rapidly developing right wing heaviness and a sudden excessive rise in the exhaust gas temperatures of No's 2 and 3 engines necessitated an immediate emergency landing. This was effected, wheels up, in a wheatfield about 7,000 feet beyond the end of the runway, to the right of its extended centreline.

The thirteen passengers and three crew members escaped injury and evacuated the aircraft in approximately 90 seconds.

The aircraft was destroyed in an intense and uncontrollable fire which broke out in the right wing area soon after the propellers contacted the runway. Fragments of No. 3 propeller had ruptured the No. 4 engine casing, dislodged combustion cans and decoupled the engine. High temperature gases from No. 4 engine apparently ignited fuel escaping from the lines and tanks which had also been ruptured by propeller fragments.

Weather conditions were not a factor in the accident, the runway was unusually long, the take-off was made nearly into a 12 knot headwind, the aircraft load was well below the maximum and the load distribution was within permissible limits. The investigating authorities concluded that the accident was probably due to diversion of the captain's attention during take-off.

Comet Leaves Runway During Landing

At its destination after the completion of a night flight, the aircraft was cleared for an ILS localiser approach to runway 12, on which the glide-path was inoperative. Low stratus cloud on the approach to this runway and patches of fog on the runway itself had been reported by the pilots of preceding aircraft.

The first approach was abandoned at a low altitude when the runway was found to be obscured. A second approach, flying V.M.C., was made on to runway 29, which is equipped with high intensity lighting, but this was abandoned at 400 feet. Another approach was then made on to runway 12, using the I.L.S. localiser and low intensity lighting. The whole of the runway was visible when the aircraft was approximately four nautical miles out and remained visible until the aircraft reached the threshold. **Just before touchdown however, the aircraft entered a patch of fog and the crew lost all visual reference for completing the landing.** The aircraft left the runway, damaging the airframe and engines. None of the 33 passengers and eight crew were injured.

Douglas DC-3 Leaves Runway During Landing

The aircraft arrived over its destination on completion of a night flight carried out in good weather conditions. Having been advised that the aerodrome visibility was reduced to approximately 80 yards, the captain made a circuit and noted that the airport lighting and the lights of towns at distances up to 20 miles were clearly visible from a height of 4,000 feet. He then queried the visibility advice passed by air traffic control. He was informed that the airport was enshrouded in shallow fog which had formed about three feet from the ground and which had gradually increased in depth. At the time this later information was passed to the captain the depth of fog then existing was not known, but advice from a vehicle posted at the runway threshold was that the visibility along the runway was one hundred yards or less.

A second circuit was made at 1,200 feet, followed by a third at 1,000 feet, after which the captain decided that the visibility on the first half of the runway and the references available to him were sufficient to make an approach and landing. The approach was made with half flap and at a speed five knots above that recommended, to facilitate a go-round in case the approach had to be abandoned. The landing lights were left off. Two miles from the threshold, at a height of 700 feet, all runway lights were visible. At 400 feet the lights on the first half of the runway were clearly visible but some of those at the far end were obscured. As the aircraft crossed the threshold it entered a layer of fog and the number of lights visible was substantially reduced. The captain flared the aircraft for landing but it "floated" further than he had anticipated. At this stage the landing lights were switched on as the captain considered that there was no longer a risk of mistaking the illuminated top surface of the fog for the runway surface. Unfortunately, both pilots were dazzled by the reflection of the landing lights on the fog and lost visual reference. The aircraft bounced slightly at touchdown and then ran off the runway. In the ensuing landing run it contacted a brick building 575 feet to the left of the runway. The six passengers and three crew members were not injured but the aircraft was substantially damaged.

COMMENT:

Both this and the preceding report demonstrate that, despite the case histories of accidents which have occurred in shallow fog, unwary pilots can still be trapped by the false impression of adequate visibility obtained from vertical or slant vision through fog.

Helicopter Upset by Passenger

A Bell 47G was engaged in a flight to pick up two passengers from a cliff 4,700 feet above sea level. At the point where the passengers were to be embarked there was space sufficient to allow the helicopter to hover with the right float resting on the top of the cliff, while the main rotors cleared trees by approximately six feet and there was about ten feet between the tail rotor and trees. The pilot had not had an opportunity to brief the passengers on boarding precautions before picking them up.

The pilot set the aircraft down with the right float resting on the cliff top and the first passenger was safely embarked. The pilot then allowed the aircraft to hover clear of the cliff whilst the first passenger was secured in his seat. He was then asked to warn the second passenger not to attempt to board the aircraft until it was firmly on the ground but apparently his shouted warnings were not heard. As the helicopter moved back to the cliff top the second passenger climbed on to the float before it was resting on the ground and despite full left cyclic control the aircraft rolled to the right until the main rotor blades struck a tree. The helicopter then rolled down the cliff and was destroyed by fire. The occupants escaped with minor injuries.

Mid-Air Collisions:

Beagle and Chipmunk

About 15 and 20 minutes after their respective airborne times the Beagle and Chipmunk aircraft were observed to approach one another on reciprocal headings at an estimated height of 1,500 feet. Both aircraft appeared to be in level flight and neither was seen to attempt avoiding action as they collided head-on. All five occupants of the two aircraft were killed.

The collision occurred in clear weather conditions, with visibility in excess of ten miles. All five occupants were licensed pilots and three had had wide experience as flying instructors. Nevertheless, it was apparent that the accident was caused by the failure of both pilots to maintain an adequate look-out.

Cessna 140 and Aero Commander

The accident occurred in clear weather conditions about 1,000 feet above a lake, which is a little over seven miles long in a north-south direction, one and one-half miles wide and 1,108 feet above sea level. Mountains rise steeply to about 3,500 feet from the east and west shores of the lake, then rise more gradually to 6,500 feet. An airport is situated to the north of the lake, with a runway which is aligned on 340 degrees commencing at the northern shore. Aircraft flying in the circuit area of this airport can be difficult to see against the mountain background, particularly when operating on to runway 34.

The Cessna pilot was practising circuits and landings and was observed on the downwind leg of a right hand circuit on to runway 34. The Aero Commander was observed to be a little to the east of the airport about one mile behind the Cessna, flying on an almost parallel heading but at a considerably higher speed, thus overtaking the Cessna from the right. The collision occurred as the Cessna was turning on to base leg. The left propeller of the Commander cut into the upper surface of the right wing of the Cessna, then into the cabin and along the left wing.

Both aircraft crashed and all the occupants were killed. The investigating authorities considered that the accident was probably due to the pilot of the Aero Commander failing to observe the Cessna, which he was overtaking in the circuit area of an uncontrolled airport.

DC-4—Fire Damage in Hanger

Prior to the commencement of a major maintenance service the aircraft was defuelled outside the hangar. This was done by transferring all fuel to No's 2 and 3 main tanks by means of the boost pumps and then pumping the fuel from these two tanks out through the tanks' filler necks. As all the fuel could not be pumped out, that which remained in No. 3 main tank was transferred to No. 2 main and then as much as possible was removed by further pumping. Later in the sequence of events, the residual fuel was drained from all tanks except No. 2 main, which for some reason, was missed during this operation.

Subsequently, whilst maintenance work was in progress in the hangar, the residual fuel remaining in No. 2 tank was accidently spilled on to the hangar floor when the fairings were being removed from around No. 2 dump chute. A charge-hand attempted to remove an electrical junction box from the floor area where the fuel was flowing, by pulling on an electrical lead. The electrical plug came out of its socket and fire broke out immediately. As electrical power was being drawn from the junction box to operate fans and interior lighting in the aircraft, arcing obviously occurred as the plug was pulled out and the petrol vapour was ignited.

Eleven people were injured in the fire, three of whom were admitted to hospital and the aircraft was substantially damaged. Lack of proper supervision was considered to be one of the several causes that led to this accident.

GET RID OF ALL THAT WATER

One January morning an aero club DH-82 was substantially damaged when a forced landing was made on a country aerodrome in Queensland following a complete loss of engine power shortly after take-off. Fortunately neither of the occupants was injured.

Examination of the fuel system in the aircraft after the accident revealed that, although the fuel tank and fuel filter were clear of water, the main and power jets in the carburettor were fouled with aluminium hydroxide, indicating that some previous water contamination had occurred in the float chamber. The corrosion, which was still moist with water, was found all around the shafts of the jets to the level of the jet orifices. The inside of the carburettor float chamber was also found to be coated with aluminium hydroxide, again showing that there had been previous water contamination. Although the jet orifices themselves were found to be clear when they were removed from the carburettor, the build up of corrosion around them was such that a major blockage could have easily occurred and then been dislodged by the impact of the forced landing. No evidence was found of any other defect which might have contributed to the accident.

It was ascertained from the pilot, that during a take-off on a training flight the previous day, the engine spluttered when the throttle was being opened. The take-off was discontinued, but as the instructor then believed that it was probably caused by opening the throttle too quickly, flying was resumed. Subsequent flights were completed without further incident.

A further investigation revealed that some five weeks prior to the accident, water had been detected in the aircraft's fuel tank and fuel filter, and the instructor-in-charge had grounded the aircraft until he could carry out an inspection of the fuel system. He was unable to attend to this until two or three weeks later when he checked the fuel tank and fuel filter, then, after flooding the carburettor, examined the overflow of fuel from it without finding any trace of water. The engine then performed satisfactorily and he cleared the aircraft for further flying. He did not consider that an internal examination of the carburettor was called for as he believed that any water in the fuel would not have passed the filter. Subsequent events all too clearly demonstrated that this belief was ill-founded.

Whenever water is detected in a fuel system, all traces of it must be drained off immediately to prevent the formation of corrosion deposits. If it is suspected that water may have been in the system for some length of time, e.g., overnight, an internal inspection of the carburettor by a Licenced Aircraft Maintenance Engineer is essential to ensure that every trace of corrosion is removed. It must be remembered that while small amounts of water will collect at the bottom of a filter bowl and be thus prevented from reaching the carburettor, large quantities will fill the filter bowl and so allow the water to pass the filter into the carburettor line.

TEMPTING FATE

A light twin-engined aircraft took off from Sydney Airport for the purpose of measuring engine-out performance.

Before take-off the *port* generator would not cut-in but a decision was made to continue with the flight on the basis that it was local and because previous experience of the same fault suggested that it would rectify itself in flight. Full rectification was intended during a periodic maintenance service which was scheduled for the following day.

On reaching 2,000 feet on the climb the *starboard* engine was feathered for the purpose of the performance tests. Shortly afterwards it was noticed that the *port* generator had not cut-in after take-off.

On the first attempt to restart the starboard engine an incorrect starting technique was followed and the propeller did not unfeather. When a further attempt was made it was found that the battery energy was insufficient to turn the engine over. All electrical services other than VHF communication were switched off and the aircraft made a successful single engine landing.

We include this brief story without further comment and suggest that you make your own analysis. As a matter of interest the operation of aircraft, with a take-off weight of 4,500 pounds or above, with unserviceable equipment such as generators is prohibited unless the unserviceability is permitted under the provisions of an approved unserviceable schedule or, alternatively the flight has been specifically approved. ANO Section 20.18 refers.

We are glad to note that the performance of the aircraft was adequate to meet the situation.

Look Before You Leap Aboard

In Digest No. 34 of June, 1963, under the title of "The Importance of Pre-Flight Checks," we drew attention to three incidents in which light aircraft had taken-off with the tow-bar attached to the nose wheel. We cling hopefully to the thought that our article may have been instrumental in saving some pilots from the embarrassment of such a situation (in which case we would not learn of it) but note with some misgivings that at least two other pilots have since attempted to do the very same thing.

One case, resulting in severe propeller damage, is best told in the pilot's own words:—

"On the morning of the accident I had been to the hangar before breakfast to fuel and carry out a B.F.I. on the aircraft. Returning at 9.15 a.m. with two passengers and some luggage, I elected to pull the aircraft a short distance from the hangar to make for easy loading of luggage from the car. I left the tow-bar on so that, after loading, the aircraft could be pulled further out from the hangar before starting up. While I did a final water test and removed pitot cover, the passengers started a discussion as to who would sit in the front and actually got seated. This distracted me from my original intention of pulling the aircraft further out, and rather than unseat them at this stage, I elected to start up to taxi clear of the hangar for checks and engine run-up. This I did, forgetting to remove the tow bar.

I heard a couple of rattles on taxing but put it down to the open cowl flaps which tend to rattle on this type of aircraft in the "open" position. The tow-bar evidently slipped free on the ground till the take-off but when the nose-wheel started to rise the tow-bar caught and threw up, hitting the prop once. I immediately pulled power off and, as the aircraft was still on the ground, took measures to stop the run. The aircraft pulled up safely on the strip, where I left it until an engineer inspected it and removed the propeller for attention."

The other incident occurred late last year. As a Cessna 182 taxied out past a DC-3, the pilot of the larger aircraft noticed the tow-bar attached to the nose wheel of the Cessna and informed the aerodrome controller who, in turn, advised the Cessna pilot before the take-off was commenced. In this particular case the pilot had used the tow-bar to move the aircraft from the hangar to the tarmac, where he completed a pre-flight inspection. The tow-bar was removed and returned to the hangar, after which the pilot proceeded to organise food required for the flight. A maintenance engineer who was accompanying the pilot on the flight obtained the tow-bar again, and, after moving the aircraft to a position where loading could be more conveniently carried out, he left it attached to the aircraft. When the pilot returned he boarded the aircraft, started up and taxied out, not knowing that the tow-bar had been refitted.

We still find it hard to credit that anything as obvious as a tow-bar can escape detection during a last look around, but acknowledge that it is difficult for a pilot to keep one jump ahead of all the circumstances that can combine to create a situation where such things may be missed. Cautious pilots appreciate this difficulty and carry out an external check of their aircraft immediately before going aboard.

Cessna Crashes in Sea

During a flight in deteriorating weather from Haast Aerodrome to Hokitika, New Zealand, a Cessna 180 crashed in shallow water below cliffs, 25 nautical miles south of Hokitika. The pilot who was the only occupant, was killed and the aircraft destroyed.

The aircraft departed Haast Aerodrome on the western coast of the South Island, for Hokitika, approximately 110 nautical miles north along the coast at 1510 hours Local Time, on Friday, 7th February. The pilot had elected not to file a flight plan and in consequence no record of the flight was maintained by Air Traffic Control. Immediately after take-off at 1511 hours, the pilot made his only contact with Haast aerodrome when he requested Hokitika weather, and was advised that visibility was 15 miles with 8/8ths of stratus above 500 feet. A few minutes later, the pilot's company office at Hokitika requested Haast aeradio to advise the aircraft to remain there overnight, because of fog conditions on route and Haast aeradio then called the aircraft three times without success.

At approximately 1515 hours the aircraft was seen by a witness flying northwards past the mouth of the Whakapohai River which lies to the north of Haast, and was estimated to be at a height of 150 feet, flying up the coast 200 yards to seawards from the beach. Immediately afterwards, a bank of fog had rolled in from the sea and within a few minutes the visibility there was reduced to 25 yards.

Sometime after 1500 hours another witness 72 miles north along the coast from Haast, heard an aircraft which sounded to be about ½ a mile out to sea and heading north, but because of fog it could not be seen.

The failure of the aircraft to arrive at Hokitika was not regarded as serious at first, because it was assumed that the pilot had landed on a beach or at one of the strips en route and that he would remain there overnight, and it was not until about 1030 hours on Saturday, 8th February, that the Search and Rescue organization was alerted. The wreckage was finally located from the air at approximately 0630 hours on Sunday, 9th February.

The main wreckage of the aircraft was found about 40 feet seaward of the high water mark and many small pieces of wreckage were found along the shore line northwards for a distance of at least half-a-mile, their location being consistent with their having been carried along the beach by the sweep of the tides. One blade of the propeller, found close to the engine, displayed damage clearly indicating that it had been rotating under power at the moment of strike. The most noticeable feature of the wreckage was the almost complete absence of the fuselage forward of station 172. The mode of fracture and the presence of the instrument panel wedged against the rear bulkhead indicated that an extremely severe longitudinal compression of the entire fuselage had occurred. Despite the severity of the damage, it was possible to establish that there had been no pre-impact failure of any kind and the evidence obtained from the wreckage indicated the aircraft had struck with great force whilst in a steep diving turn to starboard. This conclusion was confirmed independently by an aeromedical investigator's examination of the pilot's injuries.

The pilot had held a valid commercial pilot licence and had accumulated well over two thousand hours aeronautical experience. The possibility that he had been suddenly incapacitated was considered, but an investigation of his activities throughout the day of the accident and a post mortem examination of the body failed to produce evidence that he was other than fit and well.

It was apparent, that weather conditions had deteriorated throughout the day of the accident, reaching a climax at the time when the pilot was on his flight back to Hokitika. It was learned that the pilot was particularly anxious to return to Hokitika that evening and it is probable that he decided to fly northwards at a height which would allow him to keep the ground in view all the time, believing that his extensive knowledge of the coastline would enable him to follow the line of breakers comparatively easily. However, at this time the sea was a glassy calm, and it is likely that the pilot would have been obliged to follow the shore itself, a procedure which would have required his flying a little to seaward to keep a continuous look out to starboard.

It seems most significant that the conditions existing in the area at the time of the accident were very unusual and of a character not experienced for a great many years, and it appears probable that the pilot unintentionally entered cloud while flying at a low altitude. He then became disoriented, with the result that the aircraft entered a steep diving turn to starboard from which a recovery could not be made before it struck the sea.

Although the pilot was under no compulsion to file a flight plan for this V.F.R. operation, had he done so the full resources of the Search and Rescue organization would have been ordered into action one hour after the aircraft's E.T.A. A flight plan would have made no difference to the ultimate result in this case, but it is easy to visualise an accident in which the pilot is injured or trapped in the wreckage of his aircraft and where delay in rescue could result in an avoidable fatality.

More Haste—Less Speed

Hurried Maintenance fouls Aileron Cable

When the pilot of a Fokker F27 disengaged the auto pilot and commenced a descent, he found that the aileron controls had become unusually stiff and jerky. The feel of the controls was so abnormal that the pilot doubted whether full aileron would be available, should it be required, for the landing. The stiffness remained constant throughout the descent, despite reductions in airspeed but no difficulty was experienced during the landing. Examination of the control system then revealed that a support rod on the flap drive motor had been incorrectly positioned relative to one of the port aileron cables, causing the cable to foul the flap motor support and the aircraft structure. The aircraft was delayed for several hours while the fault was rectified.

In the F27, the flaps are actuated by an electric motor which is attached to a gear box mounted immediately aft of the rear spar in the port engine nacelle. The outboard end of the flap motor is supported by a clamp ring, which is attached to the adjacent aircraft structure by three support rods. The "lock-clad" aileron cable passes through the area between the flap actuator assembly and the aft face of the spar. The accompanying photograph, which was taken looking forward and upward at this face of the spar, shows the motor and gear box assembly, the support clamp, two of the three support rods and the aileron cable, all in their correct relative positions. It will be noted that the clamp is positioned so that the lower support rod is aft and under the aileron cable. In the case concerned in this incident, the support rod had been installed so that it was forward and above the aileron cable, thus deflecting the cable and causing it to ride across the support rod. This also caused the cable to foul the aft side of the hole where it passes through the landing gear support bracket. While the clamp ring can be rotated slightly about the flap motor, the amount of rotation that can be obtained is insufficient to permit the cable to operate freely if it is positioned aft of the support rod.

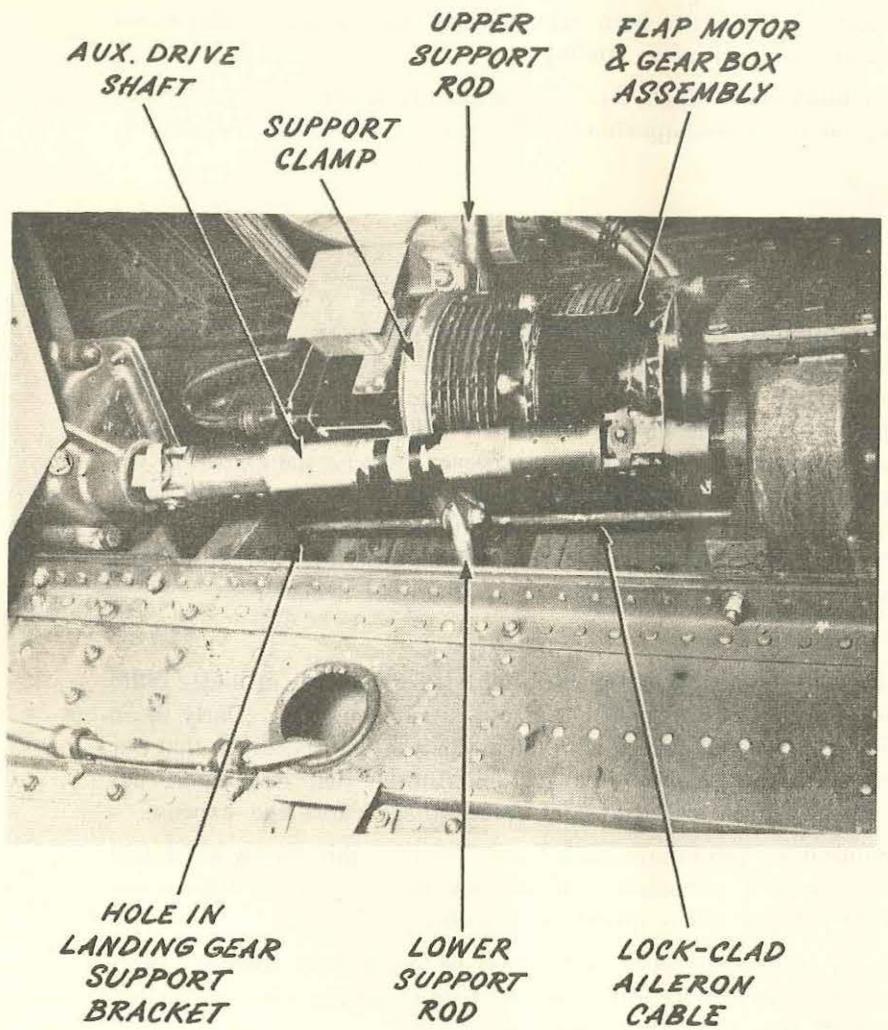
On the previous day, a pilot had reported a defect in the aircraft's gyrosyn compass system, and it was necessary to carry out a compass swing before the aircraft could be released for further operation. As well as this, the flap motor was time-expired and had to be changed in the course of a regular maintenance service. All this work had to be completed within a specified time because the aircraft was required for a scheduled flight.

Two maintenance engineers, neither of whom were licenced for F27, were detailed to change the flap motor. Neither of them had any previous experience in this particular duty, and they were given general instructions by the certifying engineer, but no reference was made to the aileron cable. This certifying engineer was also responsible for maintenance work on several other aircraft and so was not present when the replacement motor was being installed. The two engineers concerned with the flap motor change were under some pressure to finish their work and the incorrect positioning of the support rod was not detected at the time. On its completion, the installation was hastily inspected by the certifying engineer, but again the error remained unnoticed. The flap operation was then checked and found satisfactory and so the component change was certified. At this stage there seemed no reason for checking the movement of the aileron controls as this had been done earlier in the inspection and the gust lock had been engaged.

The flight controls seemed normal when the aircraft departed and during climb to cruising level. The auto-pilot was engaged at 5,000 feet and remained so until descent was commenced. It is apparent that the "lock-clad" aileron cable moved freely over the support rod during the early stages of the flight, possibly because of oil on the cable, but that the successive small movements about the neutral position gradually produced a worn area on the cable sheathing and caused the stiffness which was felt only when the auto-pilot was disengaged.

In disconnecting the flap motor support rods during the component change, the engineers had followed a procedure which had been superseded. The introduction of a modified flap motor support clamp incorporating a hinged section had made provision for the lower part of the clamp to be swung clear, thus enabling the motor to be removed without unbolting the support rods. As can be seen from the photograph however, this method cannot be employed unless the auxiliary drive shaft is first removed. The instructions contained in the F27 maintenance manual did not mention disconnecting the auxiliary drive shaft and so the later method of removal was not followed. Had it been used, the incident would have been avoided.

The circumstances of this incident follow a general pattern that is evident in many accidents and serious incidents which have stemmed from maintenance error. The description of events leading up to accidents or incidents of this type, usually contain reference to "shortage of appropriately licensed staff", "avoiding delay", or "pressure of work", and no doubt these factors have in some cases contributed to the error. Where this is so, some share of responsibility must be borne by supervisory engineers. In other cases however, it is apparent that certifying engineers have used these expressions as an excuse for inadequate inspection, simply because they did not take a few additional minutes to satisfy themselves that the particular work was correctly carried out. Certifying engineers must recognise that they, and they alone, carry the final responsibility for work done and that the quality of their workmanship must never be sacrificed in the interests of speed.



Accidents which stem from maintenance errors are not really accidents at all. They happen because someone, somewhere, has failed to do his job. All licensed aircraft maintenance engineers whatever their position may be in the aviation industry, must constantly be on the alert to guard against the unwitting acceptance of unsafe maintenance practices. In the light of the incident we have described, it would be appropriate for all of us who are licensed engineers, from supervisors through to certifying engineers, to ask ourselves how many times we have tried to gain minutes by using short-cuts, only to find later that it has to be paid for with hours of lost time. We venture to say that few could honsetly answer "No" to the first part of the question and that there are many of us for whom the second part is embarrassingly true!

How Good are

YOUR R/T PROCEDURES?

Good

A light aircraft arriving at a remote destination was heard to call "Circuit area . . .?" but the air-ground operator was unable to decipher the place name. No reply was received to further calls which he directed to the aircraft so the Search and Rescue system went into action immediately and telephone communication checks were commenced. Soon afterwards, advice of the aircraft's safe arrival at its flight planned destination was received from another ATC/COM centre.

Realizing that his circuit area call had not been acknowledged the pilot had telephoned the nearest ATC/COM Centre immediately after landing.

We acknowledged the promptitude with which this pilot acted. If all light aircraft pilots did likewise the work loading on the communications/SAR system would be considerably reduced.

Not so Good

A circuit area report was transmitted by a pilot but was not copied by the communications station to which it was addressed. Immediately afterwards however, another more remote ground station acknowledged a transmission from a second aircraft. The pilot reporting "circuit area," hearing this acknowledgment, incorrectly believed that it was for him and that his arrival report had been copied. Subsequently however, because the arrival of the aircraft concerned had apparently not been reported, Search and Rescue action was initiated and in due course this progressed to the stage where an aircraft was requisitioned to undertake a search. A lot of effort and expense thus was incurred, all unnecessarily and all because the pilot **assumed** that an acknowledgment he had heard was addressed to him.

As we all know, there is no room for assumption anywhere in aviation and this includes radio procedures! The moral of course is that, if we do not hear our aircraft call sign clearly in an acknowledgment of our transmission, we should check with the ground station to confirm that our message has been received. The extra few seconds involved in ensuring that our report has been correctly copied may save a great deal in terms of safety precautions, effort and expense.

Today, efficient radio communication procedures are a "must" and for this reason we should frequently review the standard of our R/T procedures. If they are not as good as they might be, then the rough edges should be polished off as quickly as possible!

Communications officers and air traffic controllers are always willing to help with any communication problems which may arise, and pilots should not hesitate to discuss their difficulties with ATC or COM officers whenever they have the opportunity.