AVIATION SAFETY DIGEST

No. 34, JUNE, 1963

DEPARTMENT OF CIVIL AVIATION

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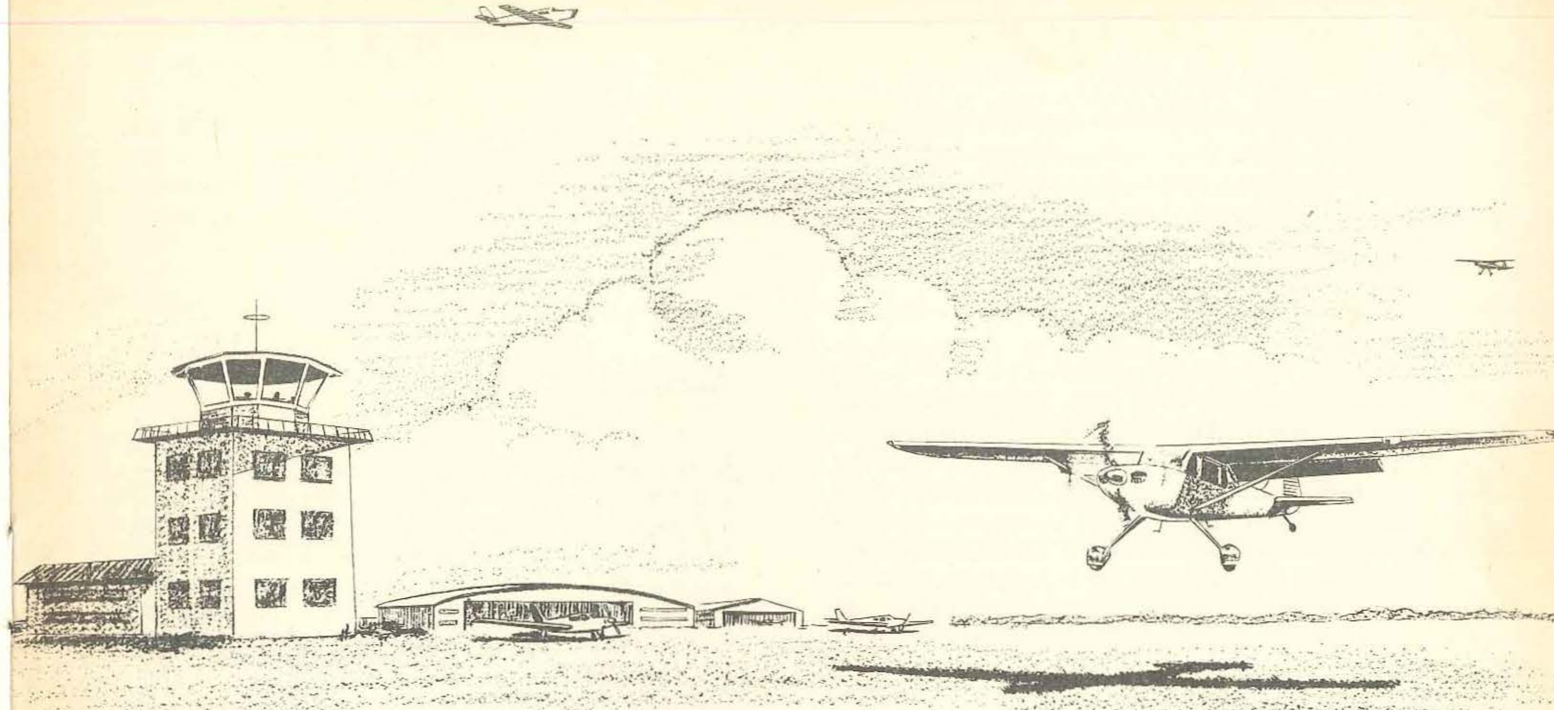
No. 34 **JUNE, 1963**

Prepared in the Division of Air Safety Investigation
Department of Civil Aviation

Contents

Commonwealth of Australia

The De Havilland 125 recently ordered by D.C.A. for high level checking of the radio-navigation network and for pilot training.



A.T.C. Clearances for Light Aircraft

Controlled airspace is established around the busier routes and aerodromes in Australia and no doubt you are aware of the need to operate in accordance with air traffic control clearances whilst you are operating within controlled airspace. If you are one of those pilots who do not regularly operate in controlled airspace you probably approach such a flight with some misgivings arising mainly from your lack of familiarity with the procedures in use. Perhaps we can show you that the requirements are not as mysterious or as difficult as you may have imagined.

In this explanation it is assumed that you and your aircraft are restricted to operating in accordance with the visual flight rules (VFR).

The three categories of controlled airspace are:

Control Areas (CTA) embrace the busier airline routes;

Control Zones (CTR) surround the busier aerodromes at which instrument approaches and instrument departures are carried out;

Aerodrome Traffic Zones (ATZ) surround the aerodromes at which a large number of VFR circuit operations occur.

Normally these categories of controlled airspace are established permanently and their dimensions are set down in the aeronautical information publications, but any one of the three categories may be established temporarily to cover an abnormal local activity such as an air pageant or abnormal activity along a route such as occurred at the time of the recent British Commonwealth Games in Perth. The dimensions are then published in NOTAMs.

In addition to these controlled airspaces we sometimes refer to *controlled aerodromes*. These are the aerodromes for which a control zone or aerodrome traffic zone is established. Usually only one controlled aerodrome is situated within a control zone or an aerodrome traffic zone, although this one-for-one relationship is not essential and probably we will have two controlled aerodromes within the Melbourne Control Zone at some time in the future when Tullamarine is developed.

The Air Traffic Control service is responsible for issuing clearances, instructions and information for the purpose of preventing collisions between aircraft operating in any of these three categories of controlled airspace. However, the responsibility for avoiding collisions in controlled airspace does not entirely rest with the air traffic controller. It is important that you, as a pilot in command, should know what part you are expected to play in this vital matter of avoiding collisions, and an explanation of your responsibilities is included below. At this point, however, three fundamental concepts must be appreciated.

- You may operate in controlled airspace only in accordance with an ATC authority or clearance which regulates the time and path of entry to controlled airspace and in most cases, specifies the route and level to be flown whilst you remain within controlled airspace.
- You must comply with any ATC instructions issued to you amending clearances or, if you cannot comply for safety reasons, you must immediately advise ATC and request an alternative clearance.
- Irrespective of ATC clearances and instructions you must always in visual flight conditions maintain an adequate watch for collision hazards.

With these concepts firmly fixed in your mind you must prepare for your flight in controlled airspace in three distinct steps. First you must know when you will require a clearance and in order to determine this you must know where controlled airspace lies in relation to your intended flight path. This requires pre-flight investigation and planning. Secondly you must let ATC know your intentions by lodging a flight plan. Lodging this on air-ground radio frequencies is not a fair thing to other people requiring use of the frequency and this method should not be used unless it is completely unavoidable. Finally you must receive a clearance from ATC before entering controlled airspace. In some circumstances, you will have to make a specific request for "ATC clearance".

The type of clearance you need and must obtain will vary a little, depending on the category of airspace involved and other circumstances. Whilst you are operating on the aerodrome surface or in the circuit area at a control aerodrome the rules are fundamentally the same whether it lies within a control zone (CTR) or within an aerodrome traffic zone (ATZ), and we shall look first of all at the important factors affecting operations at these points.

Controlled Aerodromes

The basic requirement at a controlled aerodrome is that you receive authority to use the landing area, and for this purpose obtain a clearance to land or a clearance for take-off. You must also obtain a taxi clearance, primarily to ensure that you do not in any way create a hazard to other aircraft taking off or landing. If you are landing in the direction in general use at Bankstown, Archerfield, Parafield, Camden or Moorabbin you do not have to obtain a landing clearance, although at the last mentioned aerodrome this exemption may be withdrawn for periods when operations are restricted to a single landing strip as can occur during the winter months. At these same aerodromes clearances also will not be given for taxying in certain areas but if you intend operating at any of these five aerodromes you would be well advised to study the special aerodrome procedures for them described in the Light Aircraft Handbook.

At controlled aerodromes controllers issue instructions and clearances to aircraft operating visually in the traffic circuit for the purpose of regulating the amount of traffic and the general direction of flow of aircraft in the circuit and will provide you with traffic information which is considered essential to your particular operation. The actual spacing of your aircraft from others is largely in your hands, however, and you are required to bear in mind the rules of the air and the fact that, if you are using the same landing path as preceding aircraft, there are certain minimum spacings prescribed with which you must comply. At an aerodrome at which ATC issues a clearance to land the controller will step in and direct you to go around if these minimum spacings appear likely to be infringed — a decision which ought to coincide with your own.

When flying in visual conditions in the traffic circuit of a controlled aerodrome, prevention of collision is therefore very much a co-operative affair. At aerodromes at which simultaneous landings cannot be accommodated, because operations are confined to runways, the controller will take a greater part in ensuring that you maintain safe separation from other aircraft because the wider spacing of aircraft allows him to make a judgment with more confidence. On the other hand at aerodromes at which simultaneous landings can be accommodated the pilot inevitably must assume a greater responsibility because the controller is unable to adequately judge that a safe lateral separation exists between aircraft making simultaneous approaches. The reason for the elimination of the landing clearance at Bankstown, Moorabbin, Parafield, Archerfield and Camden is to emphasize the increased responsibility of the pilot at these aerodromes.

The division of responsibilities between you as a pilot and the controller whilst you are taxying follow the same principles as those described for circuit operations. ATC will decide who has priority in cases of confliction and will, by instruction, direct the general flow of traffic but the responsibility for adopting a safe spacing when passing or taxying behind another aircraft belongs entirely to you. Some points which do not appear to be widely known and frequently cause trouble at controlled aerodromes are:

- ATC has no responsibility for the safety of your aircraft whilst you are manoeuvring on the apron.
- You must not taxi onto or across any runway without obtaining a clearance to do so.
- A taxying clearance to a particular runway for take-off does not permit you to proceed beyond the holding position marked on the taxiway near the entrance to the runway until you have been specifically cleared to line up or cleared to take-off.

An *aerodrome traffic zone* (ATZ) is set up primarily to provide ATC services to VFR circuit traffic and the dimensions of the zone therefore are usually a circle of two miles radius centred on the aerodrome extending vertically from ground level to 2,000 feet. The relative responsibilities of ATC and pilots within the whole area of the zone are therefore as have been already described for a controlled aerodrome circuit area. If your intention is merely to join the circuit on arrival and land, report your position to the control tower when approximately five miles from the ATZ boundary and indicate "inbound". An acknowledgment and advice of the runway or landing direction by ATC is the normal indication that you are cleared to proceed and join the circuit.

If you are awaiting take-off from this aerodrome a report "Ready" should be transmitted and the clearance for take-off which you will then receive also gives you permission to fly the normal circuit pattern.

If you intend to carry out some manoeuvre which does not conform with the normal circuit, such as cross-wind practice or aircraft demonstration exercises, a clearance for the specific manoeuvre must be obtained before entry to the ATZ (i.e., before take-off or if inbound to the aerodrome whilst you are approaching the ATZ boundary). The prudent pilot will always discuss any plans he has for unusual manoeuvres with ATC before going to his aircraft and then, when taxying out, his first call to the tower will include in a few words an indication of the special nature of his flight. This enables the controller to quickly identify the unusual operation with a particular aircraft and he is able to provide an efficient service without delaying the flight, whilst things are sorted out and without cluttering the radio communication frequency.

Control Zones

A control zone (CTR) is an airspace encompassing a controlled aerodrome at which instrument approaches and departures occur in addition to visual operations. Because of the airspace which must be allowed for the instrument approach systems, a CTR is much larger than an ATZ and extends well beyond the limits of the visual circuit area. In the case of a military CTR even larger airspaces are involved because of the higher speeds and different patterns of military descent procedures and the whole of this military airspace is normally out of bounds to civil aircraft. Special arrangements can be made through ATC if there is a good reason why a civil aircraft should operate in or through a military CTR but don't expect to make these arrangements in flight. In the vertical dimension control zones around civil airports are generally only of sufficient height to be contiguous with an over-lying control area. They usually extend from ground level to about 2,000 feet above aerodrome elevation although the upper limit is defined with reference to mean sea level rather than aerodrome elevation. Exceptions to this general rule for vertical dimensions of control zones are found at Port Moresby (29,000), Madang (12,500) and Wewak (6,000) feet above mean sea level. In these cases there is no over-lying control area. Military control zones in most cases extend to all usable heights.

Beyond the traffic circuit but still within the control zone, the responsibility of ATC in relation to the separation of aircraft operating VFR is merely to advise you as the pilot of one of these aircraft of the position and intentions of other VFR aircraft which may be in your vicinity. It is then your responsibility to determine any hazard which may arise from this traffic and to take appropriate action. On the other hand ATC has a very clear responsibility to provide a positive collision avoidance service to IFR aircraft, irrespective of the flight conditions in which they may be operating at the moment. In order to achieve this object ATC will issue a clearance to you as a VFR flight operating in a control zone giving very definite instructions as to your route or area of operation, the level at which you are to fly, and if necessary a point at which you are to hold or orbit. It is most important, therefore, that you obtain a clearance from ATC on all occasions before entering a control zone. Fifteen minutes before reaching the zone boundary and on the radio frequency which you are currently using you should say "Request air traffic clearance" and this message will elicit from ATC a clearance specifying the conditions of entry and the instructions for further flight within the control zone. If you have not obtained this clearance before reaching the boundary of the CTR, you must hold or orbit outside the boundary until it is received. If you are departing from a controlled aerodrome within a control zone you will have lodged a flight plan covering your intended operation and when taxying out, you should indicate the nature of your flight in your first contact with the control tower. At a convenient time in your cockpit routine, you should say "Request air traffic clearance". The clearance then given will specify the route to be flown and the provisions covering climbing and cruising whilst in the control zone. In this case it should be particularly noted that the air traffic clearance given as a result of this request is not a clearance to either line up on the runway or to take-off. In respect of either or both of these movements additional clearances must be obtained.

Control Areas

Now let us look at the remaining form of controlled airspace set up for the protection of aircraft. These are control areas (CTA) and they are set up along the air routes where traffic density is high. The horizontal extent of airspace within these control areas allows for the inadvertent deviations from track which occur in the normal course of navigation and, because there is a need to accommodate instrument navigation by reference only to non-directional beacons, the horizontal dimensions of control areas can be quite considerable. The vertical dimensions of control areas are designed to accommodate most of the airline traffic flying the particular route but at the same time allowing as much airspace as possible beneath the control area to permit operations by aircraft not desiring the services available within the control area. At each end of a particular CTA descending steps in the lower boundary must be provided so that airline aircraft may continue to be protected whilst they are descending into or climbing out of control zones.

In control areas the responsibility of ATC is to ensure that clearances are provided for the operation of all aircraft, including VFR flights, in accordance with safe separation standards. You will have noticed a difference here in respect of VFR aircraft operating in control zones where you, as pilot in command of a VFR aircraft must devise your own separation from other VFR aircraft on the basis of traffic information supplied by ATC. In control areas the primary responsibility for collision avoidance rests with ATC in respect of all aircraft but, nevertheless, in visual meterological conditions you as a pilot are responsible for maintaining an adequate visual watch for other aircraft even whilst you are operating under the terms of an ATC clearance.

If you are awaiting take-off at a controlled aerodrome and you intend to fly in a control area you should follow the same procedure as you would for a flight in a control zone. Similarly if you are approaching the lateral boundary of a control area the same procedure applies as if you were approaching the boundary of a control zone. The case may arise, however, in which your departure point is within 15 minutes flying time of the control area boundary. Your clearance to enter the control area should then be obtained before departure. If radio communication conditions are difficult it may be obtained after take-off but until you have received the clearance you must hold outside the boundary of the CTA. The clearance may specify a time of entry or a particular level at entry and will prescribe the route and the level to be flown in the control area. If obtained through a communication unit rather than directly from ATC the clearance will be preceded by the words "ATC clears" or "from ATC".

If you are taking off from a non-controlled aerodrome situated beneath a control area and intend to enter the CTA the same provisions apply as if you were approaching the lateral boundary of the CTA, but remember that where your departure point is within 15 minutes flight time of the lower boundary the request for a clearance to enter must be made either before departure or shortly after departure and whilst you are holding below the lower boundary of the CTA.

WORTH REMEMBERING

Finally it may be useful to you if we briefly look at some "do's and don'ts" culled from recent incident reports in which light aircraft pilots have gone astray:

- Approval of a flight plan (which is required for some classes of flights) does not constitute an air traffic clearance to proceed into controlled airspace. This clearance must be separately obtained before you take-off or before you enter controlled airspace.

- There are important requirements for the carriage and operation of suitable radio equipment when operating in controlled airspace. The details of these requirements are contained in Air Navigation Order 20.8.

- If you are unable to make contact on the communication frequency serving the area in which you are operating for the purpose of obtaining a clearance you should try to contact the nearest air traffic control unit on the appropriate frequency.

- Clearances are required for operation in all control zones and the ability to conduct radio communication with the appropriate control tower is a normal requirement. In special circumstances pre-flight arrangements can be made with ATC for clearance to enter or leave a control zone without radio.

- The term "clearance limit" is used in some clearances. This indicates the point beyond which your flight is not currently authorised to proceed. You must orbit this point if a further clearance is not received prior to reaching it.

- There are procedures for entering control zones without a clearance when your radio equipment has failed. For this you should study the pink pages in the Light Aircraft Handbook. These procedures do not permit you to enter the control zone serving the primary airport of a capital city. You should use the less busy secondary airport in these cases and the same principle should be followed wherever there is an alternative to entering any control zone without a serviceable radio.

- If your intentions, as expressed in your flight plan, are changed in flight and the change involves a new requirement to enter controlled airspace some delay in obtaining your clearance will normally be encountered whilst your flight plan details are transferred to the responsible control unit and an assessment of the situation is made. If the change is the result of an urgent safety requirement you should indicate the nature of the emergency in making your request.

He got the Picture, but . . . .

The following was taken from a report of an investigation into a recent fatal accident.

"Evidence indicates the pilot fell from the aircraft whilst attempting to take aerial photographs. A camera was found near the wreckage area, on the film of which were two exposures. A subsequent print made of the one good negative showed an aerial view of the countryside. The safety belt was unfastened and unbroken."

(Flight Safety Foundation)

The Importance of PRE-FLIGHT CHECKS

Early last year an aerodrome controller observed that a Cessna 210 had taken off with a tow bar attached to the nosewheel. He alerted the pilot who was able to carry out a landing back on the aerodrome without damage to the aircraft. Perhaps you are a little incredulous that such a thing could happen and yet two further reports of a similar nature have recently been received.

The front section of a two-piece tow bar dropped from a SAAB Safir during the take-off run and, an hour later during the final approach, the pilot observed what proved to be this section of the tow bar on the runway. Inspection of the aircraft immediately after the landing revealed that, although the rear section of the tow bar was still attached to the nosewheel, there was no damage to the aircraft. Before take-off the pilot had noticed that the tow bar was in position but in the pre-flight inspection his attention was diverted by a passenger and the forward area of the aircraft was not properly examined.

During January of this year a take-off was commenced in a Cessna 175 with a tow bar attached to the nosewheel. As the nosewheel was raised during the take-off run the tow bar swung clear, holing the underside of the port tailplane, and the take-off was discontinued. In this instance the pilot had been called to the telephone during his preparations for the flight and, on his return, hurrying because the passengers were already seated in the aircraft, he failed to observe that the tow bar had not been removed.

The history of aviation is crowded with cases where a check, a drill or an inspection has been interrupted before being completed with the result that some item has been overlooked and there have been uncomfortable and sometimes tragic consequences. If you are interrupted in such an important task make sure that the point at which you take up the task again provides for a substantial overlap with what you were doing prior to the interruption.

TROUBLE — ITS SIMPLE BEGINNING

A PILOT CONTRIBUTION

We acknowledge the contribution of a Chief Flying Instructor whose letter provided details of the two personal experiences described below.

One of his experiences concerns the elevator trim indicating system on a PA22 Tripacer. About two weeks before the aircraft was due to be ferried to a workshop for complete overhaul the trim indicator actuating cable broke, rendering the indicating pointer inoperative.

In view of the impending overhaul our correspondent, who was chief instructor of the aero club concerned, decided to postpone repair if possible. Noting that the horizontal stabilizer could readily be adjusted to the take-off position by glancing back from the cockpit with the door held slightly open, he test flew the aircraft and found that there was little difference between the trim settings required for take-off and landing. On this basis he decided to allow the aircraft to be used for normal flying practice with the trim indicator inoperative. Other pilots who wished to fly the aircraft were briefed in the method of setting the trim prior to flight.

Some days later our correspondent had occasion to carry out a short test flight in this aircraft, following rectification of an engine defect. He performed a hurried pre-flight cockpit check but overlooked visually checking the trim setting of the horizontal stabiliser. As take-off progressed past the stage where it could be abandoned with safety he noticed that excessive back pressure was required to rotate the aircraft into the take-off attitude. On becoming airborne the back pressure necessary to maintain climb became "alarming" and could not be relieved by "frantic" operation of the elevator trim. A low level circuit was completed at minimum engine power and a safe landing executed, although both hands were required to operate the control column during landing.

On checking the elevator trim system he found that at some time prior to the test flight the trim control had been wound to the fully nose-down setting with such force that it became jammed in this position. Under these circumstances the actuating cable will slide around the stabilizer jack drum and the mechanism cannot be freed by use of the cockpit control. As our correspondent is a heavyweight and was flying solo, a forward centre of gravity condition combined with the nose heavy trim to produce an almost uncontrollable aircraft.

In his haste to carry out the test flight he performed only the general pre-flight check that had been his normal habit, completely overlooking specific instructions that he had given to other pilots concerning this aircraft.

COMMENT

The CFI has not made it clear whether the hurriedly conducted cockpit check was the primary reason for this incident, or whether he was misled by an erroneous indication from the cockpit indicator. We assume it was the latter.

Under circumstances such as this even the most experienced pilot can fall into error. Every item of equipment on an aircraft is there for a purpose and any reduction in the serviceability of this equipment can result in a reduction in flight safety.

More recently this same pilot, flying a Cessna 172, took three parachutists to 7,000 feet for a combined free-fall delayed-opening jump. On reaching the pre-determined height and position, power and speed were reduced to facilitate the parachutists' exit from the aircraft and all three jumped as planned.

Almost immediately after No. 1 parachutist left the cabin there was a muffled report at the rear of the aircraft and the nose pitched up, causing the stall warning device to function.

Recovering control of the aircraft the pilot manoeuvred into position to watch the parachutists descend and noticed that one 'chute had opened much earlier than the other two. It was later determined that as the No. 1 parachutist stepped out of the aircraft onto the starboard wheel the ripcord caught on the small door retaining clip fastened to the under surface of the wing, causing premature release of the parachute.

Ground observers believe that part of the parachute canopy was at one stage wrapped around the tail plane and that it pulled clear as the parachutist left the aircraft. This would account for the unexpected nose-up pitching described by the pilot.

The pilot now removes the door retaining clips when engaged in this type of operation. He also invited our attention to a recent overseas newspaper photograph of a light aircraft descending earthwards with a parachutist and his gear attached to the empennage. By opening both canopies the parachutist reduced the subsequent impact forces to the extent that he was not injured in the ensuing accident. The pilot suffered no more than a broken leg.

COMMENT

It is extremely doubtful whether two parachutes could be relied upon to prevent serious injury in all such accidents. It is far better to ensure that parachutes will not be released except at the will of the parachutist. Air Navigation Order 29.1, which deals with the requirements for parachute descents other than in an emergency, makes specific mention of this aspect. Both the pilot in command and the parachutist have a responsibility to ensure that there is no risk of the parachutist or his equipment fouling any part of the aircraft.

Captain's Attention Diverted on Take-Off: Aircraft Destroyed

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

(All times stated are U.S.A. Central Standard Time)

AMARILLO, TEXAS

A Viscount Model 812 was landed wheels-up almost immediately following take-off from the Amarillo Municipal Airport, Amarillo, Texas, at approximately 0706 hours on 8th July, 1962. There were no serious injuries to any of the 13 passengers or three crew members but the aircraft was destroyed by fire.

INVESTIGATION

At 0702 hours the aircraft was cleared for take-off on a scheduled flight from Amarillo to Houston, Texas, and departed the ramp at 0652 hours and was cleared to runway 21 which is 13,500 feet long by 300 feet wide. The airport elevation is 3,607 feet m.s.l. The V1 and V2 speeds were computed for this runway under the existing conditions as 92 knots and 109 knots, respectively. Take-off gross weight for the aircraft was computed as 57,464 pounds, well below the maximum of 63,430 pounds allowable for this flight and the centre of gravity was located within limits.

The flight acknowledged the clearance, taxied down the taxi strip and immediately commenced a rolling take-off into a 12 knot wind with the captain controlling the aircraft on take-off from the left-hand seat. According to ground witnesses and passengers, the take-off roll and initial lift off were normal. The tower controller stated that the aircraft climbed to an altitude of 20 to 50 feet. A passenger with piloting experience recalled that after climbing 30 to 40 feet the aircraft settled to the runway and he heard "the sound of metal hitting the concrete", and the aircraft then resumed its climb straight ahead.

The captain stated that the rotation was at 105 knots and lift-off at 109 knots. Upon orders from the captain the co-pilot put the landing gear selector lever in the "up" position. The captain further stated that immediately after lift-off he had become momentarily distracted by rainwater from the window channel falling on his left shirt sleeve but did not remember the aircraft settling to the runway. In addition, he stated that he first sensed trouble because of a severe vibration and an overtemperature condition of the Nos. 2 and 3 engines. At this time the co-pilot feathered No. 2 propeller upon the captain's order. The aircraft continued in a climb to an altitude variously estimately as from 150 to 400 feet.

Several passengers reported seeing fire on the right wing in the area of Nos. 3 and 4 engines. This fire was observed immediately after the aircraft contacted the runway and it continued throughout the duration of the short flight. The tower controller stated that smoke began trailing from one of the engines on the right side immediately after the aircraft had settled to the runway and fire appeared in this area when the climbout was resumed. He attempted to advise the flight of this condition, but received no reply.

Vibration was increasing, the No. 3 engine was indicating extreme over-temperature, and the control of the aircraft was becoming more difficult. The captain elected to execute an emergency wheels-up landing in an open field slightly to the right of the departure end of runway 21. He actuated the flap lever to raise the flaps from their 20-degree position. The aircraft contacted the ground slightly right wing down and in a somewhat nose-high attitude on a heading of approximately 275 degrees magnetic. It slid for approximately 850 feet, yawed to the right and came to rest upright on a heading of 345 degrees magnetic. The time of impact was 0706 hours as recorded in the control tower.

After impact, the fire in the right wing area became more intense and spread until the aircraft was substantially consumed. Fire and rescue equipment from the Amarillo Air Force Base, located on the same airport, reached the scene at 0710 and extinguished the fire.

The 0655 weather observation made by the U.S. Weather Bureau at Amarillo Municipal Airport was:— 6,000 feet scattered; estimated 10,000 broken; visibility 12 miles; temperature 70°F; dewpoint 63°F; wind south-west 12 knots; altimeter setting 30.12 inches; pressure rising rapidly; lightning in cloud and cloud to ground, east; rain showers of unknown intensity all quadrants; occasional light rain showers.

Two parallel series of propeller gouges and some propeller blade fragments were found on the concrete surface of runway 21. The gouges started 5,434 feet from the threshold of runway 21 and continued, nearly equally spaced on both sides of the runway centreline, for distances of 140 feet 10 inches for the left-hand series, and 140 feet 5 inches for the right-hand series. There were 49 propeller gouges to the left of the centreline and 47 to the right — those to the left made by No. 2 propeller and those to the right by No. 3. The average longitudinal distance betwen the marks was 2 feet 11 inches. However, the initial spacing of the left series was 2 feet 6 inches; of the right, 2 feet 7 inches. These runway gouges were quite prominent, deep, and freshly made. A propeller blade tip approximately eight inches long from the No. 3 propeller was found 60 yards to the right of the runway abreast of the gouged area.

Investigation of the wreckage area disclosed small bits of molten aircraft alloy which were found beginning 2,640 feet short of the main wreckage and the particles became progressively larger along the groundpath of the aircraft. Approximately 900 feet short of the main wreckage and before the aircraft had made ground contact, the earth was scorched from the burning of a large quantity of aviation fuel. The No. 4 propeller made first ground contact 898 feet short of the wreckage. There was evidence of progressively deeper blade slashes of propellers Nos. 3, 2 and 1. The main wreckage was 6,930 feet west-south-west of the departure end of runway 21.

ANALYSIS

The investigation disclosed no mechanical item which can be linked to the cause of this accident. The weather conditions were not a factor, the runway was unusually long, the take-off was very nearly into a 12 knot wind, and the aircraft was well below its maximum allowable take-off weight and properly loaded. The explanation of this crash can be attributed to the improper operation of the aircraft. It is concluded that this accident had its inception during the moment of the captain's distraction when the aircraft was inadvertently allowed to settle until Nos. 2 and 3 propellers struck the runway. The chain of events from there on can be reconstructed from the physical evidence.

Computation of airspeed based on spacing of propeller gouges is compatible with the airspeed as recorded by the flight recorder at the onset of the severe vibration and this speed was sufficient to maintain flight. Physical evidence shows that an eight-inch section of blade tip from No. 3 propeller was slung into the propeller disk of No. 4 propeller, breaking of a sizeable portion of a blade of No. 4 propeller. Other flying fragments struck No. 4 engine case rupturing and decoupling that engine; combustion chambers separated from the nozzle box allowing the egress of high temperature gases. Also the tank area and/or fuel lines of the right wing between No. 3 and 4 engines was pierced by other highspeed propeller tip fragments with the resultant loss of much fuel. The attendant contact of fuel and high temperature gases from the ruptured No. 4 engine resulted in an intense and uncontrollable fire. A large quantity of burning fuel poured to the ground causing the previously mentioned scorched area.

The severe vibration which started at the instant of the propeller strike was obviously due to high unbalance caused by broken blades on Nos. 3 and 4 propellers. This vibration was intense enough to make the aircraft extremely difficult to control and also make the flight recorder data undecipherable for a 20-second period. Apparently the character of the vibration changed markedly at the end of the 20 second period allowing the flight recorder data again to be decipherable. It should be noted that flight recorder data substantially agree with witness statements.

The sequence of events ending in the destruction of the aircraft started when the propellers initially struck the runway almost immediately after lift-off.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the captain's diversion of his attention during take-off which allowed the aircraft to settle to the runway striking Nos. 2 and 3 propellers.

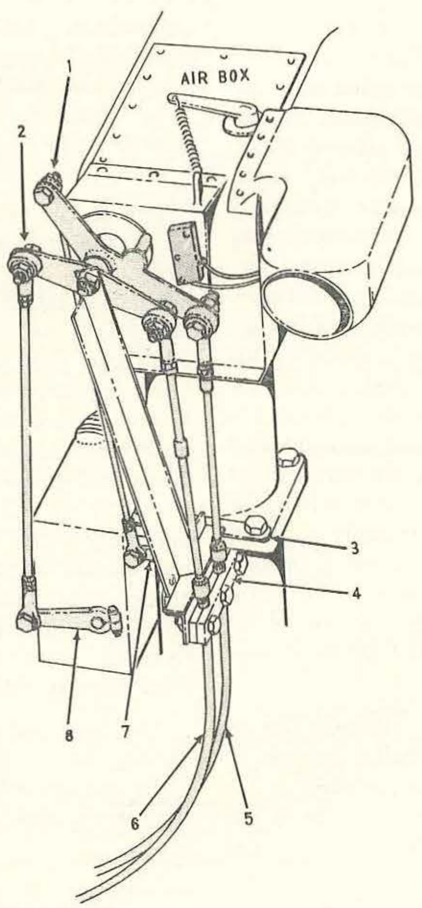
Throttle Fouling — Cessna 210

Cruising at 9,000 feet on a travel flight in the country area of Western Australia, the pilot of a Cessna 210 was forced to abandon the flight due to malfunctioning of the engine control system. Investigation revealed that bolts in the throttle and mixture control levers were fouling one another in certain positions, due to an eye-end on a connector rod being positioned on the wrong side of a lever in the throttle control system.

On the early models of the Cessna 210 the vertical connector rods in the throttle and mixture control linkages forward of the bulkhead connect to respective bell-crank levers which are mounted on a common shaft at the starboard side of the engine airbox assembly. The throttle lever is nearest to the airbox. These levers are so designed and shaped that when the rods are correctly installed the adjustable eye-ends are mounted on the port, or airbox, side of their respective levers as shown below. The bolts should be installed so that the heads are facing one another. When assembled in this way adequate clearance will exist between the bolt heads throughout the full range of lever movement.

In the case under discussion the adjustable eye-end on the throttle rod had been installed on the starboard side of its lever, thus placing it between the two levers and bringing the heads of the bolts closer together. In this position both levers operated satisfactorily when tested independently on the ground. In flight, however, when the mixture control had been adjusted to approximately the half-open position, the bolt heads fouled as the throttle was advanced toward the fully open position.

Although the situation was not critical in this case, correct assembly and rigging of all controls is essential for the safe operation of any aircraft. Licenced engineers are expected to be alert to the possibility of incorrect assembly and, by experience, be able to sense the correct installation position. Errors of this nature do not occur if engineers study the assembly before the linkages are disconnected and, where the correct assembly positions are not obvious, make a written note of the correct position.



1. Throttle Rod End.
2. Mixture Control End.
3. Control Bracket Support.
4. Control Bracket.
5. Throttle Cable.
6. Mixture Cable.
7. Throttle Arm.
8. Mixture Arm.

THE PRICE OF FREEDOM

We hope you remember our last plea for the use of shoulder harness by pilots of transport aircraft, which we made in "Digest" Number 26, June, 1961, under the title "What Price Freedom?" This article was based on a review of all take-off and landing accidents to Australian transport aircraft and a detailed consideration of two recent fatal accidents to such aircraft. The article concluded that accidents which are liable to be fatal to crew typically occur with very little warning time in which shoulder harness could be donned, even were the said crew not busy trying to control the aircraft. We believe that the following cautionary tale, this time from overseas, once again reinforces the conclusions drawn from local experience.

On an afternoon in December, 1961, a pure-jet aircraft of a British airline took off from Esenboga Airport, Ankara, Turkey, bound for Nicosia, Cyprus. The take-off was clearly seen from the ground. Nothing unusual was noticed until shortly after the aircraft was airborne. Its climb then became progressively steeper until from an extreme nose-up attitude at about 450 feet it stalled, striking the ground in a somewhat level fore and aft attitude but at a high rate of descent just short of the runway end and some 400 yards to the left of it. The aircraft was destroyed by impact and subsequent fire. 20 passengers and seven crew members were killed; seven passengers survived. Time from unstick to stall was estimated to have been 8 or 10 seconds; time from stall to impact was probably of the order of 6 seconds; say 15 seconds from calm control to chaotic catastrophe.

Investigation was delegated by the Turkish authorities to the Accident Investigation Branch of the British Ministry of Aviation. At the request of the airline's medical director a medical investigation team from the RAF Institute of Pathology accompanied the M.o.A.-airline-manufacturer party which flew immediately to Ankara.

Examination of the flight instruments recovered disclosed a malfunction of the captain's director horizon which was, beyond reasonable doubt, the cause of the crash. The pitch indicator pointer of the instrument was limited to nose-up indication of 7 degrees by a dial-mask attaching screw which had back-off until its head fouled the pointer carrier. Three and a half turns were needed to drive this screw home from the position in which it was found, and microscopic examination established that it had at no time been properly pulled down onto its locking washer. This mechanical fouling did not activate the warning flag on this type of director horizon.

The medical team's findings, although negative with regard to accident cause, were all too depressingly familiar in their positive demonstration of unnecessary death. It was shown that the three operating crew were incapacitated by injuries which would have been prevented had they fastened the "Teleflex" harness (incorporating an inertia reel) with which each crew seat was fitted, and that they had died in the ensuing fire.

The findings in this investigation resulted in the airline introducing many modifications to the hardware and operating procedures of the type of aircraft involved, among them a requirement that flight crew shall wear the shoulder harness at all appropriate times. But this is of no interest to the operating crew of that ill-fated pure-jet at Ankara. Almost certainly they need not have died on that December afternoon.

Give me AIR!

Recently a light aircraft crashed in New South Wales while attempting an emergency landing in bad weather. The pilot was not wearing a shoulder harness and struck his head on the forward cockpit structure, suffering a fractured skull and brain injury and fractures of the jaw and facial bones. He was unconscious when removed from the wreckage, and remained so until his death over an hour later. The direct cause of death was asphyxia due, at least in part, to obstruction of his breathing by portion of his broken upper dental plate, which at the postmortem examination was found in his larynx, lying across his vocal cords. The remainder of the denture was in the mouth.

There is no certainty that, had the piece of denture been removed, the pilot would have survived his brain injury; but at least he would have had a chance to live.

This story clearly holds a number of lessons for us. One of these is that if an unconscious accident victim has obstructed breathing you will be doing him a very good turn by trying to find out WHY. If you find portion of a broken denture in the mouth, the remainder may of course have been ejected in the crash or even removed by the victim himself before lapsing into unconsciousness; but it may be in the larynx. A bent finger following the contour of the root of the tongue backwards and downwards will tell you. The risk of inducing vomiting in an unconscious person by this manoeuvre is very small.

Downdraft Descent

In mid-summer a DC3 took off from Nullagine, Western Australia, to climb to a cruising height of 4,500 feet. The aircraft had reached a height of 3,200 feet when it flew into rain falling from a cumulo-nimbus cloud with a base of approximately 12,000 feet. The rain was moderate only, to the extent that it was dissipating before it reached the ground. As soon as the aircraft entered the rain whilst on climbing power, it commenced to descend. At one stage the rate of descent reached 2,000 feet per minute and, despite the early application of full power, the subsidance was not checked until the aircraft was 100 to 200 feet above the terrain. Prior to entering the rain and during the complete phase of involuntary descent, only very slight turbulence was encountered.

The Western Australia Divisional Office of the Bureau of Meteorology has provided an appreciation of the meteorological aspects of this particular incident.

"On 1.1.63 at 0700 GMT there was a low pressure trough orientated WNW to ESE just south of Nullagine which aloft sloped to the south-west. Surface air temperatures for the region were high — Nullagine 114°F, Wittenoom 107°F and Mundiwindi 106°F while dew point temperatures on the north of the trough and towards its centre were also high — 61°F and 67°F at Wittenoom and Nullagine respectively — but lower — 44°F at Mundiwindi — to the south.

"In this situation very unstable atmospheric conditions could be expected resulting in strong convection with the vertical motion being increased by the convergency in the trough. Normally such conditions would lead to the development of large cumulus or cumulo-nimbus clouds, thunder and rain, and reports of alto cumulus castellatus at Nullagine and large cumulus from Wittenoom and Mundiwindi at 0700 GMT accord with the conditions to be expected on theoretical grounds. It is further confirmed by the pilot's observations of large cumulus developing with the base at 12,000 feet — a consideration of the dry bulb and dew point temperatures suggests a cloud base slightly above 10,000 feet — when he took off from Nullagine.

"In the immature stage of the cumulus cloud growth there are no downdrafts but, as it develops into large cumulus or cumulo-nimbus when rain commences the downdraft of cold air is initiated by aerodynamic drag forces of the falling rain drops on the air. The beginning of the rain falling and the commencement of the downdraft from the cloud are nearly simultaneous. This downdraft at upper levels is limited to the area of falling rain but as it nears the ground the speed decreases as well as the vertical component while the flow tends to be parallel to the ground and outward from the rain area.

The strongest downdrafts are in the area of heaviest rain and towards the front of the rain area. A typical sectional view of the downdraft associated with a comparatively low level thunderstorm is shown in the sketch below. This represents a thunderstorm cell in the mature stage moving from left to right. In a moving cell the cold air spreads out considerably further downwind of the cell than upwind.

"The speed of these downdrafts not only varies across the rain band but also depends on the stage of development of the cell being greatest in the mature thunderstorm. The speed of the downward moving air is of the order of 5 ft/second in the early stages of cloud development with light rain and up to 35 or 40 ft/second with heavy rain in the more mature storms. These values may be exceeded on occasions.

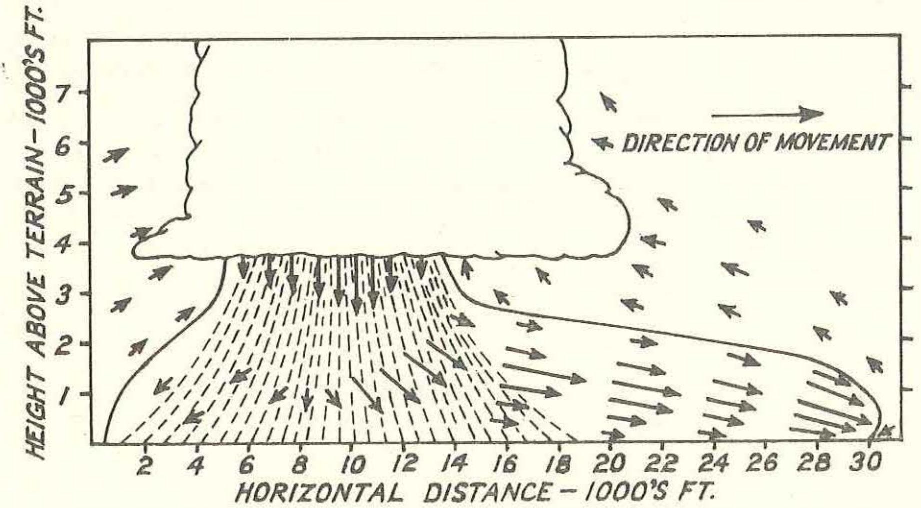
"The report indicates that as the aircraft flew into the moderate rain area the involuntary descent started at a speed of about 8 ft/second despite the fact that at that stage the aircraft was in the climb position.

"Since the cloud was moving, according to the pilot's report (and this is supported by an analysis of the winds above the cloud base), from NE to SW and the course to Bamboo Springs from Nullagine is roughly SW then the line of flight was apparently from the back to the front of the rain area of the storm and hence (see sketch) along the path over which the intensity of the downdraft would normally increase. The aircraft was probably nearing the front of the rain area when the rate of descent reached about 33 ft/second. Then as the aircraft approached the ground it reached the region where the lateral spreading and hence the reduced downward speed of the draft enabled the pilot to climb away.

"This incident illustrates that strong downdrafts can occur beneath cumulonimbus clouds from which only moderate rain is falling. In fact quite strong downdrafts can occur beneath thunderstorms in which the rain has evaporated before reaching the ground. This is evident from the strength of the surface wind gusts frequently experienced beneath dry thunderstorms."

COMMENT

Most pilots are aware of the dangers of flying **into** large cumulus or cumulo-nimbus clouds although in recent years storm warning radar has taken some of the hazards out of this practice for those aircraft so equipped. The detailed study in recent years of the thunderstorm life cycle and structure has clearly pointed to the likelihood of encountering strong downdrafts below this type of cloud where no radar warning of dangerous conditions will be obtained. This incident amply illustrates the dangers of flying below cumulus or cumulo-nimbus cloud formations at relatively low altitudes.



Mustang Destroyed in Dandenong Ranges

At 1018 hours Eastern Standard Time, on 12th April, 1962, a British registered Mustang aircraft departed Moorabbin Aerodrome, Victoria, for Bankstown Aerodrome, New South Wales. The only occupant of the aircraft was the pilot whose intention it was to fly to Bankstown for the purpose of having some items of radio and navigation equipment serviced. Six minutes after departure the pilot advised Air Traffic Control that he was returning to Moorabbin because he was unable to proceed in conformity with the visual flight rules. Three minutes later again, he advised that he was having trouble and was flying in cloud at 3,000 feet. Air Traffic Control requested the pilot to maintain 3,000 feet and to home on the Moorabbin N.D.B. but soon after this request, the aircraft was seen to emerge from low cloud in the vicinity of Kallista and strike trees and the ground in a steep dive. The aircraft was destroyed by impact forces and the pilot was killed.

In accordance with international agreements the investigation of the accident was made by the Department of Civil Aviation on behalf of the British Ministry of Aviation. Upon receipt of the Departmental report the British Ministry agreed to the publication of the details of the investigation.

The pilot, Mr. W. R. Flockhart, proposed to fly the aircraft from Australia to England in an attempt to better the existing record flying time for a solo flight between the two countries. On the day of the accident he arranged to fly the aircraft from Moorabbin to Bankstown where some items of radio and navigational equipment were to undergo maintenance in preparation for the record attempt. At Moorabbin Aerodrome he obtained a route and terminal meteorological forecast and submitted an abridged flight plan which was valid only for flight under the visual flight rules. The flight plan provided for the flight to be conducted at at an altitude of 2,000 feet to Lilydale which is some 18 miles distant from the departure point, thence to Bankstown at varying heights up to 5,000 feet. The aircraft took off at 1015 hours and, after completing one circuit of the aerodrome. set course for Lilydale at 1018 hours.

At 1023 hours the pilot reported to Moorabbin tower that he was over Lilydale and, one minute later, advised that he was unable to continue the flight in accordance with the visual flight rules and was returning to Moorabbin. At 1027 hours he reported that he was "having trouble," had "lost" his compass and was "in cloud at 3,000 feet". On request, he advised that automatic direction finding equipment was available in the aircraft, whereupon he was given the Moorabbin N.D.B. frequency and was instructed to home on this beacon and maintain an altitude of 3,000 feet. This message was acknowledged by the pilot and the tower controller immediately instituted the alert phase of search and rescue procedures.

At 1029 hours the pilot was requested to confirm that he was homing on the Moorabbin N.D.B. but no reply was received. Further calls to the aircraft were not answered and at 1033 hours the distress phase of search and rescue procedures was instituted.

INVESTIGATION

The accident occurred on the south-eastern slope of a hill rising to an elevation of 1,640 feet near Kallista which is situated in the Dandenong Ranges and is 15 miles north-east of Moorabbin and 7 miles east of the direct track between Moorabbin and Lilydale. Kallista is situated on the western side of an area of low terrain which is surrounded by hills on all but the eastern side. The Dandenong Ranges include peaks which rise to a maximum elevation of 2,078 feet.

The meteorological forecast issued to the pilot at Moorabbin indicated that he could expect to encounter up to 8/8ths of strato-cumulus cloud at 3,000 to 4,000 feet and up to 3/8ths of cumulus at 2,000 to 3,000 feet above mean sea level, with the cloud tops between 6,000 and 8,000 feet. The general conditions on the route were forecast to be fine and hazy, slight turbulence and visibility 15 miles. The pilot of a light aircraft which departed Moorabbin for an aerodrome in Northern Victoria some seven minutes after the departure of the Mustang has stated that the cloud base between Moorabbin and Lilydale was predominantly 1,500 feet with patches down to 1,200 feet whilst to the north of Lilydale it was approximately 2,000 feet above sea level. Another pilot, who flew over the area near the accident site some 20 minutes after the time of the accident, has stated that the cloud was on the hills with the cloud base generally at 1,000 feet but rising to some 2,000 feet to the west. His statement is supported by a number of residents of the Kallista area who have stated that the cloud base was very low with many of the hill tops obscured and that the surface visibility was variable but generally good. There seems no doubt that the base of the cloud between Moorabbin and Lilydale was lower than that which was forecast.

The maximum permissible all-up-weight of the aircraft was 10,500 lb. It has been estimated that, at the time of the last take-off, the all-up-weight of the aircraft was 9,287 lb. and that the centre of gravity was within permissible limits throughout the flight.

Examination of trees and aircraft wreckage at the accident site revealed that the aircraft had first struck a tree at a height of 55 feet above the level of the ground impact point. The impact with this tree was made initially by the propeller and then by the starboard mainplane. The starboard fuel tanks disintegrated and the starboard drop tank was dislodged. The pattern of damage to trees along the final flight path indicated that the aircraft was descending at an angle of at least 45 degrees immediately prior to impact. After striking the first tree the aircraft traversed a horizontal distance of 69 feet until the port mainplane struck a second tree at a height of 11 feet above the ground impact point. The aircraft then struck the ground 26 feet beyond the second tree in a near vertical attitude. The engine was buried in the ground to a depth of some six feet and wreckage of the airframe was scattered over an area measuring 210 feet by 150 feet.

The scope of the examination of the wreckage was limited because of the extensive damage but no evidence of any defect or malfunction which may have contributed to the accident was found. The examination of the flying control systems revealed that all damage was the result of impact forces and there was nothing to suggest fouling, incorrect assembly or pre-impact failure. It was not possible to perform any functional tests of the aircraft instruments or the automatic direction finder because of the damage they had suffered. The propeller blade angle, and the manner in which the blades had been damaged, was consistent with the delivery of substantial power by the engine at impact.

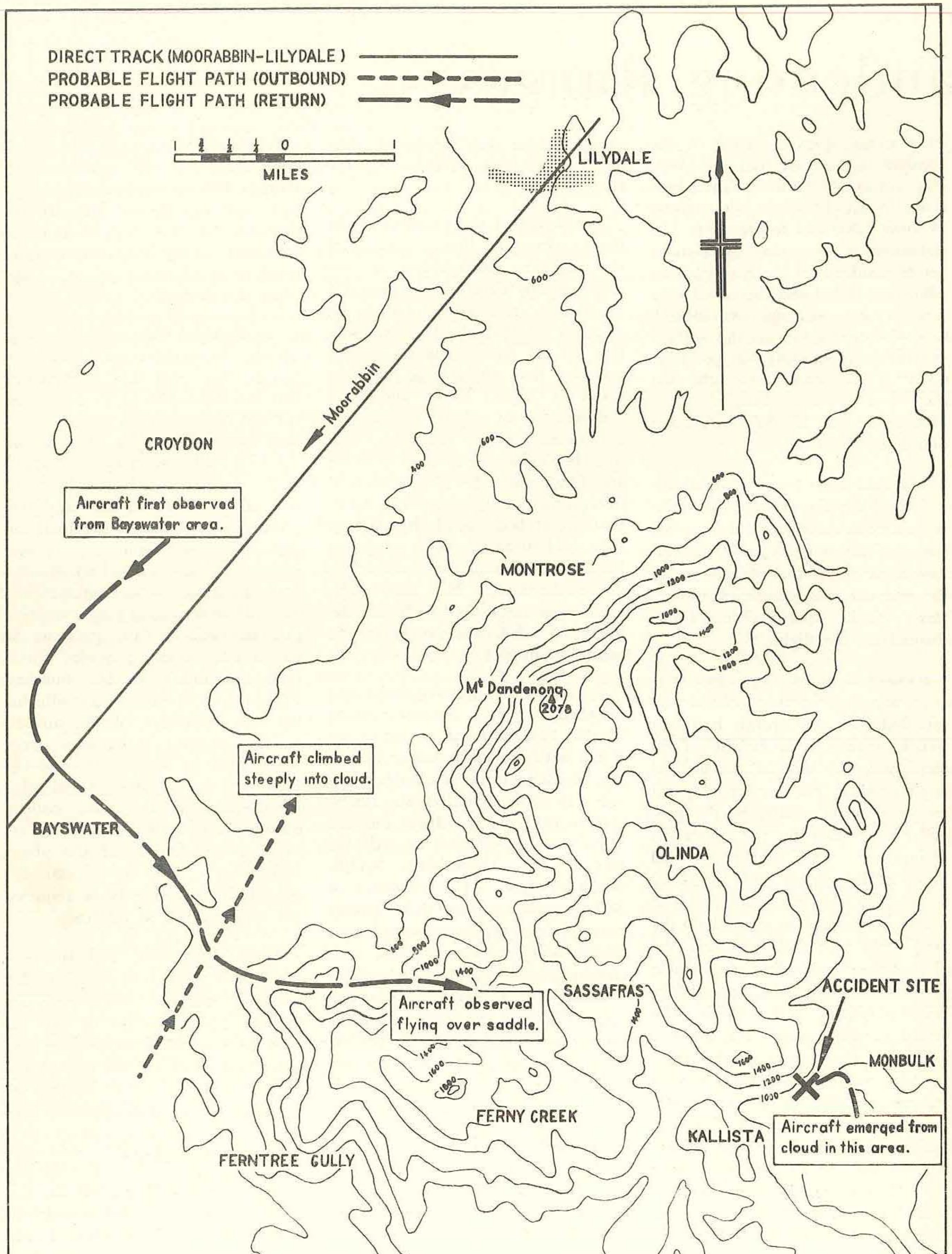
An automatic direction finder was installed in the aircraft during March, 1962, and was operative but it had not been calibrated and could not be used to obtain reliable bearings. It appears that it was necessary to tune the A.D.F. to indicate approximately 420 kc. in order to receive the Moorabbin N.D.B. which transmits on a frequency of 380 kc. and further that, having been so tuned the direction indicator would swing back and forth continuously and would not precisely indicate the direction of the station. There is no requirement for an aircraft engaged on a V.F.R. flight to be equipped with a serviceable A.D.F.

The basic instrument for the directional navigation of the aircraft was a Magnesyn remote reading magnetic compass which is known to have operated satisfactorily during the several flights immediately preceding that which culminated in the accident. A Pioneer B16 magnetic compass was also installed in the aircraft for standby use but its proximity to electrical wiring is known to have resulted in errors of up to 15 degrees during flight.

An abridged flight plan was lodged with Moorabbin air traffic control by the pilot and it indicated that the flight was to be conducted without reliance upon radio navigation aids. The pilot had shown the total fuel carried by the aircraft as 212 gallons, which was the capacity of the tanks in use, and had erroneously computed the total endurance as 436 minutes. It was established that the actual amount of fuel carried by the aircraft was 202 gallons which, at a consumption rate indicated by the pilot as 50 gallons per hour, provides for a total endurance of 242 minutes. These errors would not have affected the safe operation of the aircraft as the planned flight time from Moorabbin to Bankstown was 110 minutes. An abridged flight plan is accepted by air traffic control only in the case of flights which are to be conducted under the visual flight rules. No operational approval of such flights is required nor was it given in this case.

The Moorabbin N.D.B. was serviceable when tested on the day after the accident. No reports regarding malfunctioning of this aid were received from monitoring personnel or pilots on the day of the accident and it can reasonably be presumed that it was operating normally over the period during which the accident occurred.

The last observation of the aircraft by the Moorabbin aerodrome controller was made when it was



some three miles east-north-east of the aerodrome, apparently on track to Lilydale, and at an altitude estimated to be between 1,000 and 1,500 feet. The aircraft was next seen by a group of witnesses who observed it flying just below cloud at a position some eleven miles from Moorabbin and 2½ miles east of the Moorabbin to Lilydale direct track and heading in the general direction of Lilydale. The height at this time was deduced to have been 300-400 feet above the highest terrain beneath the aircraft and, when last seen on the heading, the aircraft was entering cloud in a steep climb. A few minutes later it was observed in the vicinity of Bayswater over a position slightly west of the Moorabbin to Lilydale direct track, but on this occasion was heading towards Moorabbin and descending from an altitude of about 1,500 feet above sea level. It then turned left on to an easterly heading as indicated in the sketch and was seen to pass through a saddle in the hills heading towards Kallista at an altitude of some 1,300 feet.

Sixty three persons reported having heard and/or seen the aircraft in the Kallista area and, although their statements regarding the aircraft's movements vary considerably, it is obvious that several manoeuvres were conducted in cloud. The reports of these witnesses also indicate that the height of the aircraft varied during the turns and, at some points, the aircraft was clear of terrain by only a small margin. The small area (approximately 1.3 square miles) embraced by these sighting and hearing reports also suggests that the aircraft was engaged in steep turns. A number of witnesses reported variations in engine noise but it is considered that these were the result of either throttle manipulation or terrain effects rather than of engine malfunctioning. The aircraft emerged from the base of the cloud at an estimated altitude of 1,300 feet heading towards a hill which rose to 1,640 feet above sea level. From this point it was observed by 18 witnesses who variously reported that it was "in a steep descending left hand turn," "in a right hand turn," straight and level" or "inverted." After considering all the available evidence it seems most likely that the aircraft, on emerging from cloud, was descending in a left hand turn and that it commenced a slight right hand turn shortly before it struck the trees. Most witnesses reported having heard a sudden loud increase in engine noise during this stage of the flight. Only two witnesses appear to have observed the aircraft at the time of impact and they reported that it was descending steeply with the nose some 50 degrees below the horizontal.

The pilot was 38 years of age and he held a current British private pilot licence endorsed for single-engined landplanes under 12,500 lb. maximum permissible all-up-weight. He had accumulated a total flying time of 961 hours of which 69 hours had been gained on Mustang aircraft. During the 6½ months immediately prior to the accident he had flown a total of only 5 hours, all of which were on Mustang aircraft. He was not rated for instrument or night flying and his last known night flight was in a Mustang on 2nd March, 1961, between Singapore and Rangoon during a previous record breaking attempt. Towards the end of 1960 he had undergone some 21 hours of link trainer instruction on ADF, ILS and VDF procedures but his log book contained no record of any instrument flying or link trainer instruction since that time.

ANALYSIS

Soon after reporting over Lilydale the pilot reported that he was "unable to proceed VFR" and that he was returning to Moorabbin. The evidence of witnesses located in the Bayswater area confirm that, in this area, the aircraft was below cloud and was initially heading towards Moorabbin. All of the reports of weather conditions, between Bayswater and Moorabbin, leave little doubt that visual flight along this track could have been continued below cloud over relatively flat terrain. For some unknown reason the aircraft, on reaching Bayswater and whilst in visual contact with the ground, turned some 90 degrees to port on to a south-easterly heading. Shortly after this it again turned to port on to an easterly heading and entered the mountainous area of the Dandenong Ranges through a narrow saddle between cloud-obscured hilltops. Having regard to the pilot's declared intention to return to Moorabbin, and the position that the aircraft had reached in so doing, it is difficult to understand why he should deliberately turn into an area of high terrain

There is evidence which indicates that the pilot was well aware of the limitations of the A.D.F. equipment installed in the aircraft. With the aircraft established on the return track to Moorabbin and in visual contact with the ground there was no need for the pilot to refer to the A.D.F. equipment for navigation purposes at that stage. Even if he had done so, it seems unreasonable to believe that the deviation towards the east was induced by any misleading information derived from the A.D.F. equipment, as this would imply that the pilot was prepared to accept information from equipment which he knew to be unserviceable and, at the same time, ignore the almost certain conflict with the indications of other directional instruments available to him as well as the pattern of prominent landmarks within his view.

Having regard to evidence that the pilot was aware of the previously described deficiencies of both the Pioneer magnetic compass and the A.D.F. equipment it is believed that he was referring to the Magnesyn compass when he reported that he had "lost his compass". The Magnesyn compass is not known to have had any fault which could have induced the change from a heading of approximately 215 degrees to one of 090 degrees. It is believed that the pilot would almost certainly have maintained direction by reference to the directional gyro as well as to the compass and that he was unlikely to have been misled to the extent of deciding that such a turn was necessary for continued flight to Moorabbin. Reports regarding the flight up to the stage of completing this turn indicate that the aircraft was completely under control and that no manoeuvres had been conducted which would have affected the proper operation of any of the flight instruments. The possibility that malfunctioning of the Magnesyn compass led to a turn to the east at Bayswater is, therefore, unlikely. In view of the prominent topographical features in the area it is also unreasonable to accept the possibility that the turn was made as the result of an error in map reading.

The aircraft was in the last stages of preparation for the proposed record flight and the pilot was probably most anxious to reach Bankstown on the day of the accident to have the final work done on the aircraft. Although there is no reason to doubt that the pilot had every intention of returning to Moorabbin at the time of turning back from Lilydale, one possible reason for not doing so was that, whilst in the Bayswater area, he noticed that there were clear gaps between the hilltops in the Dandenong Ranges which lay parallel to, and east of, his track. It is conceivable that he may have been induced to attempt a penetration of the mountainous area to the lower terrain on its eastern side with the object of making a new approach to the area beyond Lilydale. The pilot, because of his lack of local knowledge, would probably not be alert to the dangers of entering the area of the Dandenong Ranges under conditions of low cloud or to the probability that conditions would not be better for visual flight over the very limited area of low terrain on the eastern side.

Having entered cloud after crossing the saddle leading to the hills, it is probable that the pilot made several attempts to re-establish continuous visual contact with the ground with the object of returning to the Bayswater area via the saddle or by any other available route. This probability is supported, to some degree, by several witnesses who obtained glimpses of the aircraft operating at heights very close to the terrain. Although it appears that the pilot, at this stage, had visual reference to the ground for short periods only, it seems that these references were frequent enough to enable him to maintain control of the aircraft. It is probable that, following his unsuccessful attempts to establish continuous visual contact, he climbed the aircraft in cloud to at least 3,000 feet, the height at which he informed Moorabbin Tower that he was "in cloud," was "having trouble," and had "lost" his compass. As the aircraft apparently remained within quite a small area during this period it is likely that relatively steep turns were conducted during the climb. It is possible that this type of manoeuvre would result in erratic behaviour of the aircraft's compasses and could account for the pilot reporting that he had lost his compass.

The evidence leads to a strong implication that, despite the instruction from Moorabbin Tower to maintain 3,000 feet, there was a sudden loss of height at a rate substantially greater than that which might be expected of a pilot flying in cloud and endeavouring to regain visual contact over mountainous terrain. The fact that the pilot did not comply with the instruction to maintain 3,000 feet suggests that the descent was involuntary, and the high rate of descent suggests the possibility that there was at least a temporary loss of control. If there was a loss of control it is nevertheless obvious from the witness reports that at least partial control had been regained at the time the aircraft emerged from cloud in the last stage of the flight. At that time the direction of flight was towards a hill, the top of which was above the level of the aircraft and it is probable that the left hand turn observed was made in an attempt to turn inside the hill whilst remaining in visual contact with the ground. The evidence that during this turn the nose dropped to a near vertical attitude, and that the aircraft commenced to roll and turn to the right, suggests that the impact was preceded by a stall which was probably induced by the pilot's efforts to turn away from the rising terrain.

Whilst there is insufficient evidence to conclusively establish the cause of the accident, the possibility that the pilot temporarily lost control of the aircraft whilst circling in cloud, and that it subsequently stalled during the recovery and turn to avoid high terrain, cannot be excluded.

Another Low Level Aerobatic Accident

In the March 1963 issue details were given of a fatal accident which followed low level aerobatic manoeuvres in a DHC-1 Chipmunk aircraft on a dual training flight. Here are the details of a similar accident which occurred late last year in Western Australia.

The pilot of a DHC-1 "Chipmunk", together with his son, conducted a private flight to a country airstrip in company with a Cessna. Having arranged for his son to return in the Cessna the pilot of the Chipmunk took off and carried out a circuit whilst the Cessna departed. During this circuit he descended from some 800 feet and flew along the take-off path past his friends on the ground at an altitude estimated as being 6 feet. This was followed by a steep climb to between 200 and 300 feet where what was described as a stall turn was attempted. The aircraft reversed direction but did not recover from the ensuing dive, striking the ground in a steep nose down attitude. The aircraft was destroyed by impact forces and the pilot suffered very serious injuries. He confirmed that a stall turn was, in fact, being attempted when the accident occurred.

The requirement that aerobatic flight shall not be conducted below 3,000 feet is designed to protect the pilot and the general public.

The lesson was learnt the hard way in this accident — this is your opportunity to learn it the easy way.

Exhaust System Failures in Light Aircraft

An article appearing in the March, 1963, issue of "Aviation Safety Digest" under the title of "Fire in Muff Heater System" described a serious incident involving the failure in flight of a critical section of a PA-24 exhaust system. The concluding paragraph drew attention to the frequency of such defects in a variety of light aircraft types and to the necessity for making very careful and frequent inspections in accordance with the manufacturers' instructions and Air Navigation Orders.

We now wish to repeat the warning with even greater emphasis in view of a more recent accident to an agricultural Piper aircraft. In this case, the aircraft caught fire in flight and was totally destroyed by fire on the ground following a hurried forced landing. Initial investigation points very strongly to an exhaust muff heater failure as the cause of the fire.

An important lesson to be learned from the two occurrences mentioned above is that there would probably have been little chance of detecting the failures at an early stage without dismantling the exhaust systems, especially the heat exchanger elements, and making the detailed examination of the different parts, as recommended by the manufacturer. Whilst regular inspection of this nature can be expensive and time consuming, the record shows that they are clearly necessary in the interest of safety.

If exhaust odours are detected in the cabin whilst in-flight pilots should discontinue the use of the cabin heater and open all available cabin ventilators. The aircraft should be landed as soon as possible and the source of the leak corrected before further flight.

Flag Alarms are not Infallible

Although most of the failures experienced with VHF radio navigation systems are indicated by the flag alarm, designers have apparently found it impracticable to produce a completely foolproof warning system. Isolated cases can still occur where the warning flag fails to indicate malfunctioning. One instance of this nature that occurred in Australian operations was recently brought to our notice.

An aircraft making a practice ILS let-down drifted into the blue sector of the localiser pattern despite the fact that the localiser track indicator needle showed a steady "on-course" indication. The flag remained invisible, thus failing to warn the pilot of an abnormality in the system.

The equipment was switched off and then on again, whereupon it operated correctly during two practice approaches. The receiver was later changed and the system checked for correct operation.

On a subsequent training flight a similar situation occurred when track was being maintained by reference to a VAR. The indicator needle assumed the "on-course" position as the range was intercepted and continued to indicate "on-course" as the aircraft was manoeuvred on either side the VAR track. Again the warning flag failed to indicate any abnormality in the equipment.

Investigation revealed evidence of intermittent failure in a pair of relay contacts associated with the change-over mechanism thus resulting in the track indicator needle meter-movement being intermittently disconnected from the receiver. When the contacts failed to "make" correctly, the track indicator needle assumed it's "at rest" position, which corresponds with an "on-course" indication. The electrical arrangement of these relay contacts within the equipment is such that the intermittent fault produced no affect on the current which activates the warning flag.

In most VAR/Localiser receivers the current which withdraws the warning flag from view is developed in the output stages of the receiver in such a way that maloperation of any preceding stage of the receiver, or failure of the VAR or localiser signal, will cause the flag to show. The flag will therefore provide a reliable warning of equipment malfunctioning up to the stage where the output current is developed irrespective of the track indicator needle position at the time of failure.

The track indicating needle and the flag are actuated by two separate meter-movements which are contained within the indicator unit and are motivated by appropriate electrical outputs from the receiver. Although most of the receiver is common to the outputs of both track and flag circuits it is necessary that the actuating currents for these meter-movements be separated at some point in the receiver and fed individually through the aircraft wiring to the respective meter-movements in the indicator unit. For this reason, a fault in the wiring to one half of the unit, or failure of a meter-movement itself, will result in that particular meter-movement returning to the "at rest" position, but will have no effect upon the other meter-movement. In the case of a flag circuit a fault causes the flag to move to the OFF position. Where failure occurs in the track indicator meter-movement circuit the needle assumes its "at rest" or "on-course" position and no positive warning is provided.

Most transport aircraft presently in use in Australia are equipped with relatively uncomplicated VAR/Localiser systems. In these aircraft a fault of this nature can be produced only by some uncommon defect in a small section of the receiver, or by open circuits in connectors and interwiring associated with the track indicator. Where aircraft are equipped with VAR/LOC/VOR receivers, or alternatively, VHF communication receivers used in conjunction with ancilliary units to provide equivalent navigation information, an additional potential source of such a failure is introduced. This is due to the necessity of switching the indicator track and flag actuating currents between the VAR/LOC or the VOR component of the navigation system, whichever is selected.

Switching is achieved automatically by the receiver frequency selector, through a pair of relays which, in the subject case, are situated in the VOR component. These relays are wired in such a way that, should the solenoid of either one fail, or there be an interruption in the actuating current, then the flag will indicate an OFF condition. It is necessary to employ separate contact points for the flag and track indicator currents and if one set of points should fail, as it did in this case, failure of the track or flag actuating currents will occur in isolation.

Experience has shown that although faults of this type occur infrequently, pilots should be suspicious of a completely stationary track indicator. Under most circumstances the condition will become apparent before there has been a significant deviation from the desired track. If such a condition should occur during an instrument let-down and other aids were not being utilized for monitoring purposes, a critical situation could develop.

In some types of transport aircraft the pilot and co-pilot track indicators are motivated by separate receivers, consequently two completely independent sources of track guidance are normally available during let-down procedures. In other types of aircraft the two indicators are connected in parallel to the one receiver and a failure such as occurred on this occasion will result in both needles assuming an on-course indication. In aircraft with this latter type of equipment, continuous monitoring of the ADF, tuned to the locator, provides a cross reference on the ILS indicator as well as a secondary track aid.

PERSONAL DANGER IN ELECTRICAL SYSTEMS

Readers will, we hope, recollect the article which appeared in "Digest" No. 32, December, 1962, under this title. In the fifth paragraph (p. 18) this statement was made:

> "Currents . . . from 100 to 200 milliamperes passing in the region of the heart can cause a fatal heart condition known as ventricular fibrillation, for which there is no known practical remedy."

A Sydney surgeon who is a good friend of the Department (and himself a private pilot) has suggested that recent developments in the treatment of cardiac arrest make our statement less than 100 per cent true. He writes:

> "Ventricular fibrillation is certainly serious but it is not necessarily fatal. If compression or massage of the heart is started promptly, the blood can be kept circulating. If respiration is maintained either naturally or artificially, the victim can often be kept alive until he arrives at a hospital where a defibrillator is available. It is possible to restore the normal rhythm of the heart and so save life. External cardiac massage and mouth-to-mouth resuscitation are now established first-aid measures and posters are available, with instructions about what to do."

Readers will agree, we believe, that this chance of survival now afforded in what was an invariably fatal condition does not give us licence to slum our work or relax the vigilance of our inspection. Rather, it challenges us to learn and practice the first-aid measures mentioned. Comes the day of a colleague's misfortune, defibrillation or any other technique available at a large hospital can be of no avail unless we get him there alive!

Collision with Lone Tree

Ag. Piper at Otago, N.Z.

(Summary based on the report of the New Zealand Air Department)

During a flight from an agricultural airstrip to a spraying area, a Piper PA-18A "Super Cub" collided with an isolated pine tree. As a result of the collision, the port mainplane was detached and the aircraft crashed into a ravine some 300 feet below. The aircraft was virtually destroyed and the pilot was killed.

THE FLIGHT

At 0540 hours on 29th January, 1963, the aircraft, with the pilot and a loader/driver on board, departed from its base at Clyde bound for an agricultural airstrip at Tuapeka West, Otago. The flight was conducted in fine weather conditions and the aircraft landed at the destination at 0615 hours. The engine was kept running while the loader/driver pumped 60 gallons of spray mixture into the spray tank and the aircraft took-off on the first spraying sortie a few minutes later.

The loader/driver did not observe the aircraft after it became airborne and he did not hear it's engine noise because the pump on the loading vehicle was running. He expected the aircraft to return to the airstrip within five minutes of the take-off time and, when it became overdue, he instituted a search with the assistance of the property owners. The wreckage of the aircraft was subsequently located on the bed of a narrow ravine.

INVESTIGATION

The focal point of the terrain in the area of the accident was a pine tree, some 91 feet tall, located on promontory overlooking a deep ravine. This was the only tree in the entire area and it was a well-known landmark and could be seen from all directions. The tree was severed at a point 78 feet above ground level where the circumference of the trunk was 21 inches. The severed portion was in two pieces and the larger piece had a propeller slash mark on it at an angle of 50 degrees to its centre line.

The port undercarriage leg and wheel, together with the larger of the two detached pieces of the tree, were located in scrub 220 feet from the base of the tree, on a steep slope leading down into the ravine. The area between these items and the tree was strewn with numerous pieces of the shattered windscreen and flakes of paint. Some pieces of windscreen had a film of dried spray mixture on the exterior and/or the interior surfaces.

The port mainplane, which had suffered only minor ground impact damage, was located on the bed of the ravine at a point some 600 feet beyond and some 300 feet below the tree. The leading edge at the root end had a deep vertical indentation, the radius of which was identical with that of the detached portion of the tree trunk. The surface of the indentation was smudged with green colouring and had a strong odour of pine resin. A cavity in the leading edge of the mainplane, adjacent to the indentation, contained a small pine branch and some pine needles. The centre section attachment fittings had failed in a manner consistent with the mainplane having been forced rearward.

The main portion of the aircraft wreckage was located 120 feet beyond the detached port mainplane and was substantially damaged by ground impact forces. The engine had penetrated heavy earth to a depth of some 2 feet 6 inches and the cabin structure was telescoped forward. The fuselage had suffered a compression fracture immediately aft of the spray tank and the empennage had come to rest at right angles to the horizontal axis of the aircraft. The leading edge of the starboard mainplane had struck the ground and the mainplane was severely compressed chordwise as far back as the rear spar. There was no evidence of any defect in the engine or the airframe which may have contributed to the accident.

The pilot held a current commercial licence and chemical rating and had flown a total of 7,710 hours, most of which had been on agricultural operations. He had considerable experience on Piper PA-18 aircraft. There was no evidence to suggest that he had suffered any physical incapacitation during the flight which culminated in the accident.

ANALYSIS

The accident was clearly the result of an in-flight collision with the pine tree. The pilot had operated from the agricultural airstrip at Tuapeka West on many previous occasions and he was well aware of the nature of the surrounding terrain. The collision point was well above ground level and the tree would have been outlined against the sky and clearly visible to the pilot. The dark colour of the tree was in great contrast to the colour of the surrounding terrain and, at the time of the accident a high overcast cloud layer would have prevented the sun from creating windscreen reflections or glare.

The indentation made by the tree trunk on the leading edge of the port mainplane indicated that the aircraft was in level flight when the collision occurred. The complete severing of the tree trunk, the shearing of the port mainplane and undercarriage leg and the distance travelled by the main portion of the aircraft after impact suggests that the aircraft was flying at least at its normal cruising speed. It seems either that the pilot did not see the tree or that he saw it too late to commence evasive action prior to the collision.

The pine tree was located some 600 yards short of the boundary of the area which was to be sprayed and it would normally be expected that, in this vicinity, the pilot would be preparing for the first spraying run. Had the pilot kept a normal lookout ahead he could not have failed to observe the tree, and it is therefore likely that his attention was concentrated on something behind or within the cockpit.

It would not be unusual, particularly on the first spraying sortie for the day, for the pilot to ensure that the mixture was flowing correctly through the pressurised system before he reached the spraying area. The spraying system of the aircraft could be primed on the ground or in the air and the loader/driver had not primed the system whilst the aircraft was on the ground and he did not observe the pilot do so. When airborne, priming could be accomplished by opening the main valve and closing that valve again immediately a dribble of spray solution appeared at the boom outlets. There was evidence that, on several previous occasions, a satisfactory pressure build-up had involved a delay of up to 30 seconds from the time the main valve had been opened. It could be expected that any pilot experiencing difficulty in achieving a satisfactory pressure build-up would concentrate his attention on the spray boom outlets and this would require him to turn his head at least 90 degrees to the line of flight and to look downwards and rearwards.

Consideration was given to the possibility that a spray system defect had permitted spray mixture to enter the cockpit and divert the attention of the pilot. Examination of an identical spray installation in another PA-18 aircraft indicated that an escape of pressurised spray solution into the cockpit would be unlikely and if such a defect occurred it would be most likely that the solution would be sprayed on many components within the cockpit. As a residue of spray solution was found only on some pieces of the shattered windscreen of the aircraft involved in the accident and not on any cockpit components, it was concluded that, following the collision with the tree, spray mixture escaped from the fractured port boom and settled on some portions of the windscreen as they fell to the ground.

The possibility that loss of engine power led to the accident was also considered but the propeller slash on the severed portion of the tree trunk indicated that the engine was delivering considerable power at the time of the collision and there was no evidence of engine malfunctioning. There were several suitable areas in the vicinity where a successful forced landing could have been made if engine trouble had developed.

The aircraft was flying directly towards the spraying area and, except for the solitary pine tree, the approaches to that area were devoid of any obstructions. The pilot would have seen the tree unless his attention had been diverted and it is unlikely that he would have voluntarily diverted his attention on reaching the immediate vicinity of a clearly visible obstruction. It is probable, therefore, that if pre-occupation was the factor which prevented him from maintaining an effective lookout, then that pre-occupation had persisted for some time before the aircraft collided with the tree.

That pre-occupation at the expense of maintaining an adequate lookout allowed the accident to happen must remain conjectural but it is offered as the most probable cause of the accident.

Bird Strike causes Viscount Structural Failure

ELLICOTT CITY, MARYLAND

(Summary based on the report of the Civil Aeronautics Board, U.S.A.)

At approximately 1224 hours on 23rd November, 1962, a Viscount, Model 745D, crashed in a wooded area six miles west-southwest of Ellicott City, Maryland. All thirteen passengers and a crew of four were fatally injured. The aircraft was operating at an assigned altitude of 6,000 feet when it apparently penetrated a flock of whistling swans.

INVESTIGATION

The flight departed Newark at 1139 hours on an I.F.R. clearance to Washington National Airport with an estimated elapsed time of one hour at a true airspeed of 260 knots. Following a position report at West Chester at 1203 hours, control was transferred from the New York to the Washington Air Traffic Control. At 1214 hours the aircraft was cleared to descend from 10,000 to 6,000 feet. The following advisory was issued at 1219 hours: "Be advised there's been numerous reports of a considerable amount of ducks and geese around this area". This report was acknowledged and a radar handoff to Washington Approach Control effected at 1220 hrs. After reporting at 6,000 feet, the aircraft contacted Washington Approach Control for radar vectoring on to final approach course. Altimeter setting and landing instructions issued by approach control to the aircraft were acknowledged. An additional vector to 180 degrees was transmitted at 1223 hours but no reply was received from the aircraft. At 1224 hours it was determined that radar contact had been lost.

The nearest official weather observing station to the scene of the crash was at Friendship International Airport, Baltimore, Maryland. The 1200 hours weather report from this station indicated scattered clouds at 5,000 feet, 20 miles visibility. This was followed at 1300 hours by a report of clear skies and 20 miles visibility.

Statements were obtained from several eyewitnesses of the accident. Their vantage points bracketed the crash site. A consensus of their observations is that when first sited, the aircraft was at a very low altitude turning to the left on an east or south east heading. The aircraft abruptly rolled inverted and disappeared through the trees in a near vertical attitude. Some shiny objects later identified as part of the aircraft, were observed falling in the immediate area of the crash.

A statement was also obtained from a pilot who was flying in the vicinity of Beltsville, Maryland, at approximately 1230 hours on the date of the accident. He reported sighting a flock of approximately 50 very large white birds flying within a maximum distance of eight miles from the crash site. He was uncertain of their flight path, because of insufficient relative motion. There were also reports from airline pilots flying in the area that radar contacts reported to them by Washington Centre were, in fact, large flocks of birds. The Weather Bureau radar log at Washington National Airport indicates echoes described as "birds" or "angels" which were sighted throughout a period from 0815 hours until 1705 hours. At 1245 hours these echoes were described as scattered over a 30 miles radius from the station moving from the north-north-east at 30-40 knots. The crash site is approximately twenty-three miles from the radar site.

Examination of the main wreckage indicated that the aircraft struck the ground in an inverted attitude, at an angle of 46 degrees from the horizontal. There was no evidence of inflight fire, but a severe ground fire following impact consumed the major portion of the fuselage, right wing and the left wing inboard of the No. 1 engine. Parts of the left and right horizontal stabilizers and elevators separated in flight. The left horizontal stabilizer and elevator parts were located in an area ranging from 930 feet to 2,050 feet and the right horizontal stabilizer and elevator parts were recovered in an area ranging from 1,272 feet to 2,098 feet, from the main crash site.

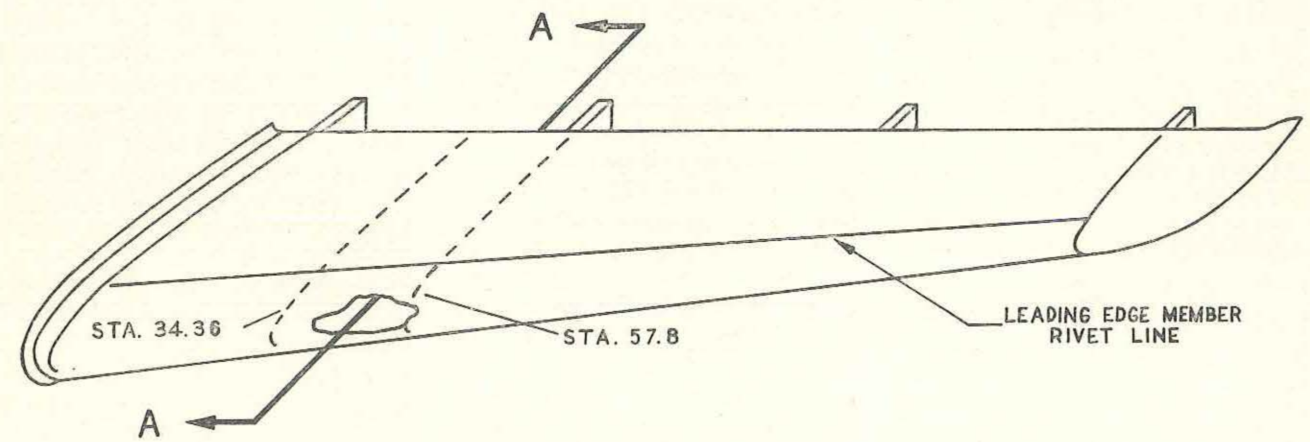
Bird remains were found on both horizontal stabilizers, indicating two distinct bird strikes on these surfaces. Superficial damage occurred on the right horizontal stabilizer, 22 inches outboard of the fuselage. This strike was a glancing blow and did not result in penetration. The other strike was on the left horizontal stabilizer, approximately 49 inches outboard of the fuselage (see sketch). In this instance the bird penetrated the leading edge and passed through the leading edge member. Continuing aft, the bird fractured the spar web, partially separating it from the top and bottom caps, and then made final contact with the lower leading edge of the elevator, which resulted in denting but no penetration.

The left horizontal stabilizer and elevator failed along a chord plane generally following the travel of the bird through the structure. The direction of failure was downward and slightly aft. In addition to this failure, the right horizontal stabilizer and elevator separated downward and aft approximately 57 inches from the fuselage. Subsequently, the weakened inboard portion of this horizontal stabilizer also failed.

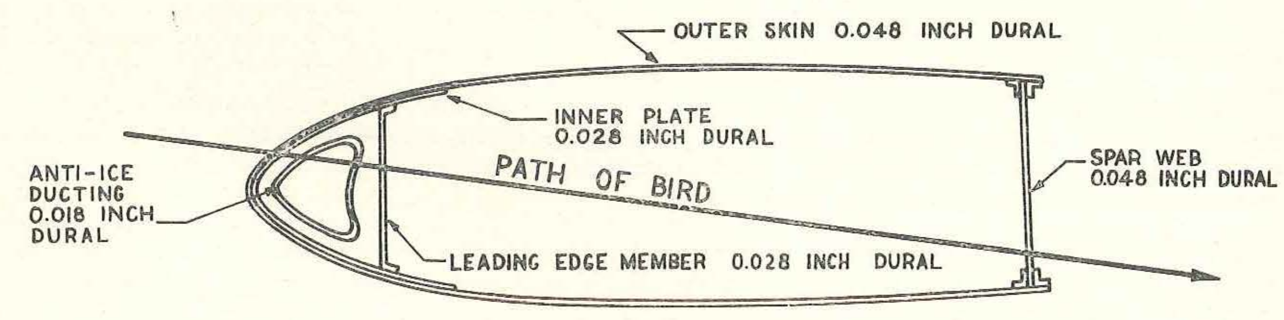
The severe ground fire damage following impact eliminated any possibility of discovering evidence of additional bird strikes which might have occurred on other portions of the aircraft.

There was no evidence of bird ingestion or any abnormal conditions in the operation of any of the engines prior to impact.

Subsequent to the accident, a partial bird carcass consisting of a large piece of skin covered with white feather, measuring 19 inches by 9 inches, was found 10 feet from the separated section of the left horizontal stabilizer. Specimens of white feathers, tissue and blood taken from the separated parts of the aircraft were identified by the U.S. Department of the Interior,



LEFT HORIZONTAL STABILIZER



SECTION A-A

NOT TO SCALE

CROSS SECTIONAL VIEW OF STABILIZER IN BIRD STRIKE AREA

Fish and Wildlife Service, as belonging to an Olor Columbianus (whistling swan). The average weight of similar birds available at the Fish and Wildlife Service was 14 pounds for the male and 11.5 pounds for the female; however they are known to attain weights in excess of 18 pounds.

The aircraft was equipped with a Lockheed 109C flight recorder and the information obtained from the readout indicates that heading, airspeed, vertical acceleration and altitude traces became suddenly excursive at approximately the same time. In less than one minute from this point the altitude went from approximately 6,000 feet to ground level and the airspeed increased from 240 to 365 knots I.A.S. and then dropped sharply into an unreliable range. The heading varied erratically generally in an area of 210 degrees to 180 degrees and the vertical acceleration changed from a reading of 1.7 positive to a variable 3 negative G's.

ANALYSIS

As a result of the numerous radar contacts by Washington Centre, which were identified as bird flocks, other pilot reports and ground observer sightings in the entire general area of the accident, there is no doubt that a definite hazard of in flight collision with birds existed at the time of the accident.

Investigation disclosed that the aircraft struck two birds, one on the left horizontal stabilizer and one on the right. The damage inflicted by each of these birds is at great variance, and therefore was the subject of close examination. The determining factor in the degree of damage was the angle of impact in relation to the surface of the airfoil at the point of impact. If the bird's line of force was elevated above or below the most forward point of the leading edge of the horizontal stabilizer, the angle would become more oblique, thereby diminishing the force imposed, and consequently the likelihood of penetration.

The point where the bird struck the right horizonal stabilizer coincided with the leading edge surface 2-3 inches above the most forward point. Curvature of the aerofoil in this area resulted in impact over a surface sufficiently oblique to the line of force to produce bird deflection rather than penetration. The result was superficial damage only.

In contrast to this, the bird strike on the left horizontal stabilizer was concentrated nearly at the most forward point of the leading edge. At this point the angle between the line of force and the stabilizer skin resulted in penetration. The damage sustained in this instance weakened the structure so that the normal down load initiated immediate failure of the horizontal stabilizer and elevator along a chord plane directly aft of the initial impact point. As these parts failed downward and slightly aft, a violent instantaneous nose-down pitching moment was generated. During the left horizontal stabilizer failure sequence, the elevators were displaced beyond their limit, trailing edge upward, thus imposing a severe download on the right horizontal stabilizer which also failed downward. As the outboard 11 feet of the right horizontal stabilizer and elevator were in the process of separation they weakened the structure of the remaining inboard stabilizer section, which subsequently separated prior to impact. This breakup rendered the aircraft uncontrollable.

THE BIRD STRIKE PROBLEM

Recognising that collisions with birds has been a problem to aviation for many years, the Board reviewed some of the earlier studies undertaken by the Civil Aeronautics Administration in search of information which might be re-valuated in the light of present day conditions.

It was accepted that in earlier years of aviation bird strikes were predominantly of nuisance value as the slower speeds of the aircraft then operating permitted some degree of evasive action to be taken by pilots and damage was usually of a minor nature. The prime point of vulnerability — the windshield, was required by regulations to be strengthened and this resulted in improved protection for the pilot.

One notable study was undertaken by the Civil Aeronautics Administration between the years 1942 and 1946 during which time bird strike data was collected and analysed. The report showed that of all bird strikes, 28 per cent were to windshields and that, of the strikes resulting in damage classified as severe, windshields accounted for 37 per cent of the cases. Some additional figures quoted indicated that bird strikes to other parts of the aircraft did not pose a serious hazard:

Strike Area	**Per cent of Total Strikes**
Fuselage	31
Powerplant	9
Wings	23
Other (e.g. antennas, landing gear, and empennage)	4

Only 1 of 473 reported bird strikes caused considerable damage to a tail surface.

In consideration of the fact that serious damage to such items as antennas, dents and even holes in wings, cowlings, and fuselage do not in themselves render an aircraft incapable of further flight, the industry was justifiably satisfied at that time that further "bird proofing" requirements were unnecessary.

The report, written in 1949, contained among its conclusions one which remained valid for many years:

"No record exists of any fatality in air carrier operations in the United States caused by collision of aircraft with birds".

The validity of this statement ended with the crash of a Lockheed Electra at Boston, Massachusetts, on October 4th, 1960. This accident clearly demonstrated that even small birds, if in sufficient numbers, could precipitate a chain of events which could render a modern aircraft uncontrollable.

The Viscount accident of 23rd November has, in the opinion of the Board, revealed a more perplexing problem. The Board determined that the probable cause of the Boston Electra accident was the unique and critical sequence of the loss and recovery of engine power following bird ingestion resulting in loss of airspeed and control during take-off One might even reason, and with some logic, that if the initiating conditions were to be repeated over and over, another accident probably would not result. In the accident involving the Viscount, however, one bird caused immediate separation of a horizontal tail surface, rendering the aircraft permanently out of control. Unlike the Boston accident, the ensuing chain of events was a product of, instead of contributory to, the cause of the accident, and no change in these events would have altered the outcome to any meaningful degree.

The Board, in the analysis of this accident and its effect on the industry and the public, has made the following observations which it considered are of interest in relation to the bird strike problem:

The low incidence of tail strikes noted in past surveys may no longer be a true indication of the probability of this type of occurrence today, because of the changes in aircraft design. The horizontal stabilizers of transport aircraft of the earlier era were shielded by propeller discs and wings and were relatively protected from strike damage. Many of the prop-jet aircraft have the tailplanes mounted higher than the top of the propeller discs. Jet aircraft, of course, have no propellers and their high mounted tails make them even more vulnerable. The trend toward the T-tail and the canard supersonic design is interesting in that the horizontal stabilizer has no protection afforded by the fuselage, wings and powerplants.

The considerable higher climb and descent speeds of current generation aircraft can result in a higher percentage of severe structural damage strikes than reported in earlier surveys.

Although the subject strike involved failure of the tail surface, conceivably tomorrow some other vital component such as a spoiler, wing flap, control surface, control tab, etc., could be involved. Impairment of a vital control function could have equally catastrophic consequences. Clearly, therefore, consideration should be given to broadening the present requirements to ensure overall protection against catastrophic damage from bird strikes.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was a loss of control following separation of the left horizontal stabilizer which had been weakened by a collision with a whistling swan.

COMMENT

It seems clear to us in Australia that aviation may have to live with this problem for a long time; in fact, it may never be completely free of the risk.

The chances of a catastrophic strike of this nature are no doubt slight and in Australia, where the incidence of flocks of large birds is generally much lower than in some other parts of the world, the chances of such a happening are probably extremely remote. On the other hand statistical probabilities offer bleak comfort to the man who finds himself in the midst of a flock of large birds during flight.

Every step that can be taken to alleviate the problem should be taken, and there is, perhaps, one lesson that might well be plucked from the facts of this accident. It seems there may be considerable merit in reducing the speed of fast modern aircraft to the lowest safe minimum consistent with the flight circumstances whenever penetration of an area reported to contain bird concentration is anticipated. Although such action would give no guarantee against a strike it would undoubtedly reduce the impact forces involved in any that did occur. A delay in schedule because of reduced air speed would be a small price to pay for survival.

A Check in Time

On take-off roll recently the pilot of a supercharged light-twin detected an unusual vibration or sound, he wasn't sure which, just prior to rotation. He aborted the take-off and turned off the runway for further run-up. During the full-power engine check, he discovered the static rpm on the right engine was 400 low. Suspecting a prop or prop governor failure, he taxied back to the line. Much to his surprise he was met by an excited line crew pointing fire extinguishers at the aircraft's right nacelle which by now was emitting a great cloud of smoke. The engine was quickly shut down but, since no flames were visible, foam did not have to be used.

Upon inspection, the generator was found to be completely gutted, and all that remained in the case was the shaft and a handful of shredded wire-like material. The armature had completely disintegrated, and the case had broken an inch from the flange and rotated a full quarter of a turn. Evidently the rear bearing had failed and allowed the armature to contact the side of the case. The shaft had not sheared, as it had been designed to do, with the result that during run-up this heavy friction had drained off enough horsepower to reduce the rpm by 400.

Had the pilot continued his take-off, he'd have been in trouble. A serious emergency could not have been avoided. The moral here is that all changes in sound, feel of the controls, or vibration level should be investigated even though instruments at the moment indicate normal operation.

(Flight Safety Foundation Bulletin).

Altimeter Reading

Recently, while a pilot was resetting his altimeter to field pressure altitude, he noticed the 10,000 foot pointer was halfway between zero and one (this would be a reading of 5,000 feet). However, the thousand foot pointer was on zero and the 100 foot pointer was on 186 feet (field elevation). This is not a case of turning the set knob up 5,000 feet but rather indicates an internal malfunction of the 10,000 foot pointer itself (the 10,000 foot pointer can be moved independently). The altimeter was taken to the instrument shop and a vacuum check was made up to 40,000 with the defective altimeter's 10,000 pointer maintaining a 5,000 foot error the entire time. The altimeter had been installed three flights prior to discovery and had flown 52 hours with no discrepancy noted. Speculation exists that the 10,000 foot pointer stuck between zero and one on final letdown and landing of the previous flight and remained undected until preflight.

All crew members beware!

In at least one model the 10,000 foot pointer can malfunction independently of the other pointers.

(Extract from Flight Safety Foundation Bulletin)

COMMENT

A similar case occurred in Australia when a small washer was omitted during assembly. This allowed the gear on the 10,000 foot pointer to ride up and come out of mesh with its drive pinion, soon after the instrument was installed in the aircraft.

Flight crews and engineers should make it habit to check all three pointers for correct alignment during preflight and routine inspections.

ORGANIC PHOSPHATES!

According to an F.A.A. study, 20 per cent of American agricultural accidents are associated with, if not all directly caused, by toxic pesticides.

In this respect agricultural flying in this country is very different — we do not have one documented agricultural aircraft accident caused or contributed to by impaired pilot performance due to pesticides. This happy state of affairs exists because there has been relatively little use of the more toxic pesticides — particularly the organic phosphates — by agricultural operators, but organic phosphates now seem to be coming into increasing use. We have recently learnt of operations in several states with this class of pesticide. The operations include spreading treated pelletised seed, and application of malathion and phosdrin.

Safe use of these pesticides requires special precautions, techniques and equipment. These are set out in detail in the medical section of the Agricultural Pilot's Manual. We particularly draw attention to the advisability of regular blood tests, the first to be done *before* use of the organic phosphates.