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PART I

AVIATION NEWS AND VIEWS

Landing Technique and Safety

(The following extract from Pilots' Safety Exchange Bulletin 56/110, *is reproduced by courtesy of the Flight Safety Foundation. It originated in Circular* 96/1956 *of the U.K. Ministry of Transport and Civil Aviation.)*

"An analysis of accident statistics emphasizes the importance of knowing the significance of such factors as wet surfaces and incorrect approach speeds in relation to landing safety. The following serves to summarize relevant information.

A study of over-run accidents indicates that in a majority of cases the accident resulted from a combination of excessive speed and a slippery runway surface. In many instances the landing distance available, even allowing for the slippery surface, was at least theoretically adequate. A more accurate knowledge of the adverse effect of slippery runway surface, excessive speed and the correct technique to reduce landing roll under these conditions would have prevented the accidents.

When considering the landing techniques suggested here, they should be studied in relation to other phases of the approach. They are not recommended as the only procedures to be employed irrespective of local conditions.

INCREASE IN LANDING DISTANCES

To show pilots the effect on the landing roll of adverse runway conditions and departures from the optimum landing technique, Table 1 has been prepared. It indicates the effect of various techniques and runway conditions on the landing distances of typical present-day piston-engine transports. For purposes of comparison, a basic landing distance is shown at the top of the diagram, and presupposes normal operating conditions and a representative airline technique. Take particular note of the effect of intermittent brake application: on a typical transport a 5-second delay in applying brakes after touch down costs 225 feet on a dry runway.

Characteristics of a typical transport are assumed to be:—

Touchdown speed: 110 knots.

(a) Nosewheel landing gear;

(b) Non-automatic brakes of average power (0.25 g with brakes at limiting torque);

(c) Four piston engines; reverse pitch not used;

(d) Stalling speeds:

landing flap	90 knots
approach flap	91 knots
T/O flap	97 knots
flaps up	105 knots.

Normal operating techniques assume the following values of speed and height:—

Threshold height: height of the wheels over beginning of runway is assumed to be 20 feet in conditions of light wind and with aircraft flown in normal manner.

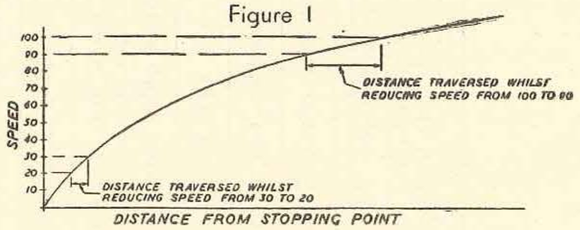
Threshold speed: assumed to be 115 knots.

Touchdown speed: 110 knots.

MECHANICS OF LANDING ROLL

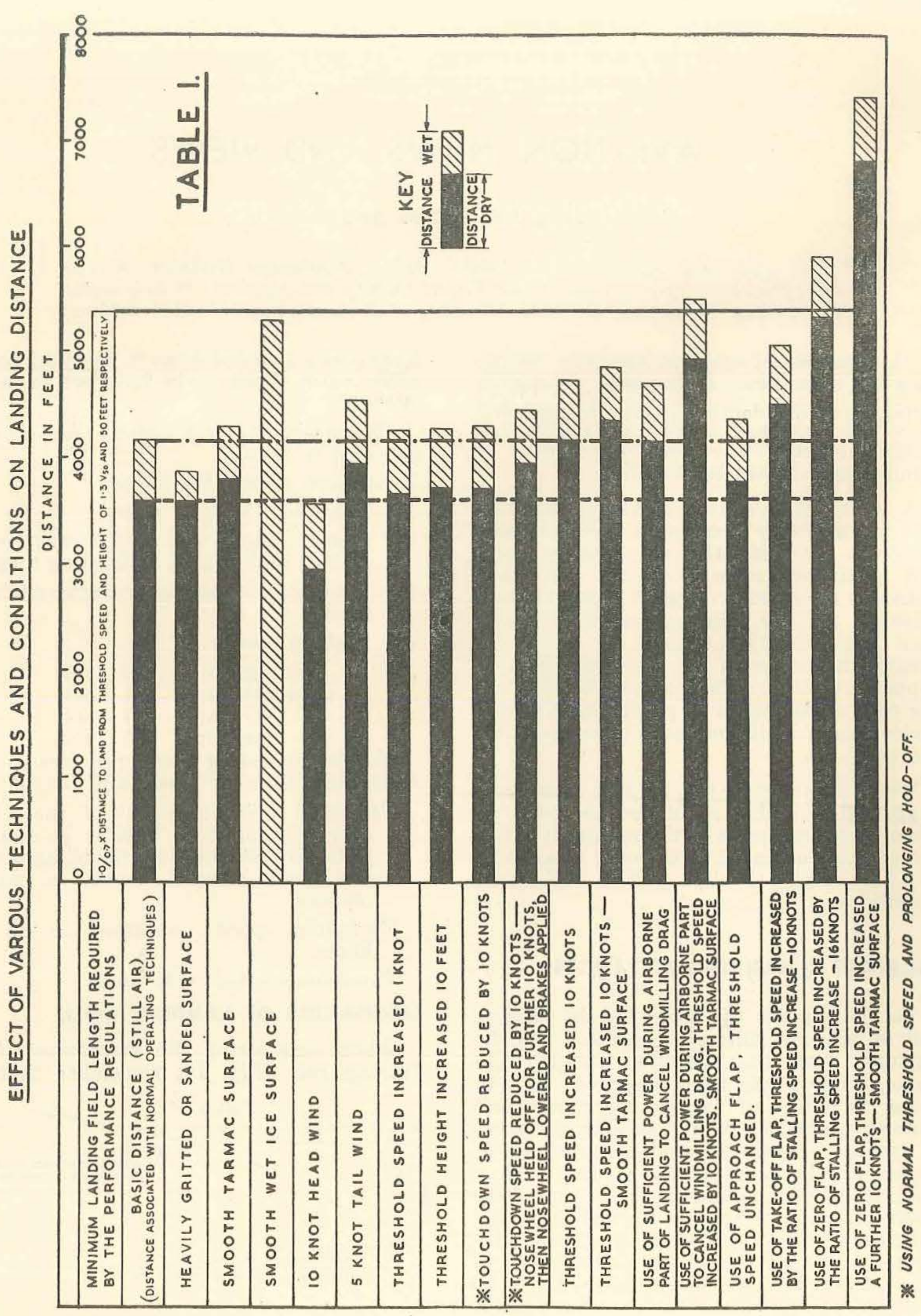
When considering the mechanics of the landing roll (Fig. 1), remember that the

Figure 1



EFFECT OF VARIOUS TECHNIQUES AND CONDITIONS ON LANDING DISTANCE

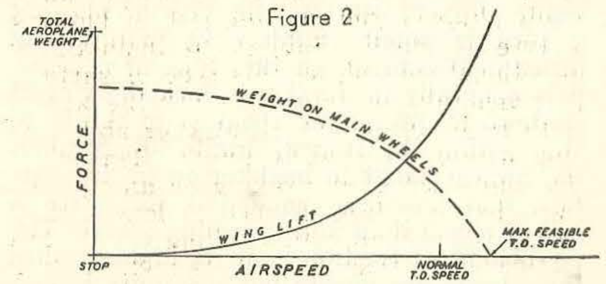
TABLE I.



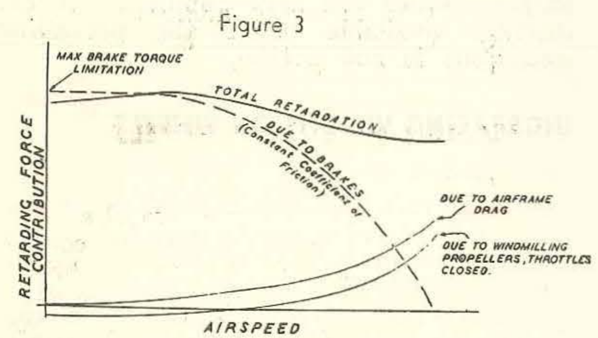
greater part of the roll is covered at a relatively high speed. When the aircraft is slowing down, the time spent in each equal band of speed (100 to 90 knots, 90 to 80 knots, etc.) is roughly the same, but the distance covered is proportional to the mean speed of the band (95 knots, 85 knots, etc.)

EFFECT OF WING LIFT

During the landing roll, the aircraft is retarded by aerodynamic drag and the use of brakes. The aerodynamic drag, excluding that due to the propellers, varies as the square of the airspeed. Wing lift is also proportional to the square of the airspeed. Thus, at higher speeds, the weight on the wheels is considerably reduced (Fig. 2).

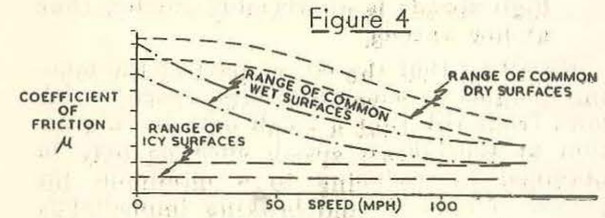


However, for a given coefficient of friction between tyre and runway, the maximum retarding force the brakes provide is proportional to the weight on the wheels (in modern aircraft the brakes are sufficiently powerful to lock the wheels at most speeds on a wet surface). Therefore, the retarding force of the brakes is reduced at high speed. If we were to assume that the co-efficient of friction between the tyre and the runway remained constant, the relative contribution of aerodynamic drag and braking drag to the total retarding force would be that shown in Fig. 3.



SPEED AND FRICTION

Except on icy surfaces, the co-efficient of friction decreases as speed increases, the effect being particularly marked on wet surfaces. Fig. 4 represents an attempt to assess the maximum degree of retardation that a pilot can expect with existing types of brakes not fitted with anti-skid device, and using a technique which avoids locking the wheels. In normal operations, pilot-operated brakes without anti-skid devices are capable of producing a retardation equivalent to 30% of the theoretical braking force on a dry surface, and 45% on a wet surface. A good anti-skid mechanism may permit factors of the order of 70% and 80% to be attained.

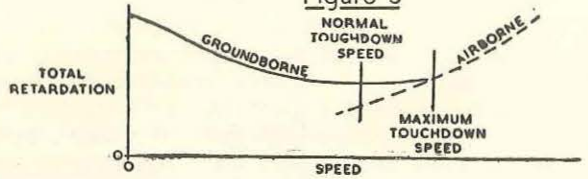


As previously mentioned, the co-efficient of friction on a wet surface decreases rapidly with increase in speed. This is because, as the speed increases, there is less time for the water between the tyre and the runway surface to be squeezed out. Hence, a large portion of the weight on the wheel is carried on a film of water. This can be reduced by grooves in the tyre tread or a rough granular runway surface; or increased by presence of a grease exuded by certain runway material. Although attention is being given to improving adhesion through changes in tyres and runway surfaces, it is doubtful that the effect of water can be entirely eliminated. In the case of wet ice the co-efficient of friction is almost constant, but on dry ice at temperatures near freezing, it may actually fall as speed is reduced and the ice has more time to melt under pressure of the tyre.

SUMMARY

The typical variation of retardation with speed which can be achieved on a landing is shown in Fig. 5. The broken line is the airborne portion from the threshold; the solid

Figure 5



line is the ground portion. Important points to note are:—

(a) If the airplane is held off the runway and touches down below the normal speed, there is a loss in retardation because airborne retardation is considerably slower than that which can be achieved on the ground.

(b) Retardation which can be achieved at high speeds is appreciably smaller than at low speeds.

Recalling that the larger part of the landing distance is covered at high speed, it follows from (b) that a small gain in retardation at touchdown speed, such as may be obtained by reducing to a minimum the period of hold-off and braking immediately on touchdown, can result in a substantial reduction in total landing distance and can be worth more than a large improvement in retardation at low speed.

OPTIMUM TECHNIQUE

In general, the best technique for stopping an airplane in the shortest distance is to touchdown at the earliest practicable moment after crossing the threshold with as much weight as possible on the main wheels, and to apply maximum braking. This does not imply that the threshold should be crossed with less than a safe margin of height. If the airplane's characteristics permit its proper implementation, such a technique will give better results even on a slippery surface than reliance on aerodynamic braking down to a low touchdown speed or to a low nosewheel lowering speed. Although retardation from the wheel brakes is poor at high speeds, the increase over that obtainable with air drag alone is valuable. Where the airplane is fitted with reversible propellers or with props that produce high aerodynamic drag after touchdown, the importance of not delaying the touchdown is increased because these devices are most effective at high speeds. They should not be used before touchdown except in extreme emergency, and then with the greatest care.

TOUCH-DOWN SPEED LIMITATIONS

For some airplanes the maximum touch-down speed is limited only by the time required to perform a safe flare-out. For others it may be limited by:—

(a) Tendency of the nosewheel, if it touches first, to cause the aircraft to balloon off the runway.

(b) Need for some types of tail wheel aircraft to be touched down within a narrow range of attitudes if ballooning or porpoising is to be avoided.

EARLY USE OF BRAKES

With non-automatic brakes, it is easy to blow a tyre if the brakes are applied at high speed on a dry or patchy runway. On a really slippery runway, the risk of blowing a tyre is small. Subject to maintaining directional control, on this type of surface, it is generally preferable to lock the wheels if there is any doubt about your ability to stop within the runway limits. Remember, the improvement in braking on an icy surface that has been sanded is less with a locked wheel than with a rolling wheel. The co-efficient of friction is at its highest when the wheels are nearly but not quite locked, but it is impossible to maintain this condition with an ordinary braking system, and any attempt to do so may result in reduced braking efficiency.

On some aircraft, the brakes tend to fade toward the end of a long landing run if they are used hard right from touchdown. For these aircraft optimum techniques must be established by experiment and from experience.

Wanting to avoid wear on brakes and tyres will influence landing technique in day-to-day operations, but departures from the optimum technique for stopping in a short distance are only admissible if the distance available under the prevailing conditions is not critical.

INCREASING WEIGHT ON WHEELS

Nosewheel aircraft:

For aircraft with soft nose wheel suspensions it is advantageous to push the control column forward as soon as the nose wheel is on the ground. This increases the weight on the wheels and also adds to directional control of the nose wheel which can be useful

when landing cross-wind on a slippery runway because it reduces the need for differential braking which, in turn, reduces the total retardation available. The use of reverse pitch is an effective way of getting weight on the main wheels, even if only idling power is used. But once the props are in reverse, little is gained from using the elevators to put the weight on the main gear.

Tailwheel Aircraft:

With some aircraft it is possible to apply brakes and keep the aircraft in an almost horizontal attitude without risk of bouncing or nosing over. By thus increasing the weight on the main wheels, such a technique usually results in a worthwhile reduction in landing distance and may also make the rudder more effective. However, the primary effect of getting more weight on the wheels may be offset by an inability to apply the brakes hard without risk of nosing over, and this should govern the exent to which this technique is used.

USE OF WING FLAPS

Before Touchdown: Unless overriding circumstances (unusual weather conditions or aircraft equipped with interconnection of throttles and flaps) make it unwise or impossible, full flap should be applied well before crossing the threshold. This permits a lower safe approach speed and reduces the amount of "float" if the energy at the threshold should be too high. The optimum point for the application of full flap varies with the type of aircraft and the differences in the sensitivity to full flap application.

After Touchdown: Once the airplane is on the ground, the effect of full flap in increasing drag may be out-weighed by its influence in reducing the weight on the wheels. With flaps giving high lift for small increases in drag in the take-off position, the gain possible through retraction may be slight in as much as, to satisfy conditions in other phases of flight, the drag will be removed quickly but the lift slowly. With these, it might be profitable to select "flaps up" immediately after touchdown IF the retraction speed is fast enough, if there are no inconvenient changes of trim, and no risk of raising the undercarriage by mistake.

PILOT FAMILIARIZATION

Pilots are cautioned to consider the information provided here in the light of the handling characteristics of the particular airplane they are flying. Through practice landings, pilots should familiarize themselves with the best techniques for dealing with such emergencies as excess threshold speed and slippery runways. However, these practice landings should be confined to airports with adequate runways for such tests and in co-ordination with Air Traffic Control.

NON-CRITICAL CONDITIONS

The majority of landing accidents have occurred in conditions which, theoretically, were not critical even though gustiness, wet runways or poor visibility were factors in some cases. There is, however, evidence which suggests that lack of adherence to the best technique in non-critical conditions was an important factor in these accidents. This may be the result of pilots not appreciating the possible adverse effects of such conditions as wet runways.

In recent years none of the U.S. air carrier over-run accidents has occurred on a dry runway.

It should be borne in mind that a runway which is longer than the required minimum may prove inadequate if the correct technique is not employed.

As a good general rule, unless the runway is much longer than will be required, the plane should be handled at least to the point of touchdown as if the runway were critical. However, this does not imply that a reduction is acceptable in target threshold speed or height below the normal safe and comfortable minima. Fig. 6 shows the penalty incurred by use of aerodynamic braking, i.e., holding the nosewheel high instead of lowering it and applying brakes. Although the use of a tail-down attitude to increase drag reduces the margin necessary for variation in the co-efficient of friction, it also increases the margin needed for variation in threshold speed (since it lessens the ability to dispose of excess speed) and increases the basic distance. Thus, the combined effect increases the total field length required.

THRESHOLD SPEED AND HEIGHT

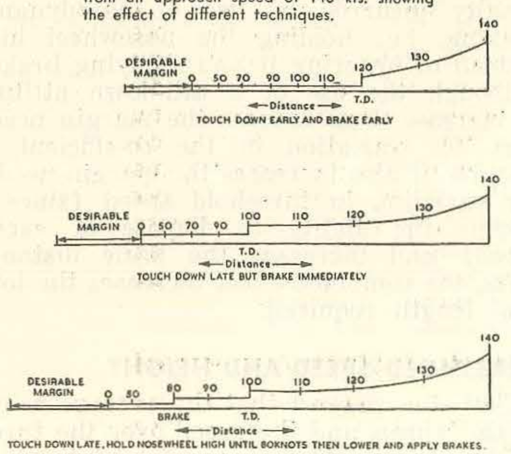
Statistics suggest that the average height of the wheels and the speed over the threshold are some 20 feet and 23 knots above the power-off stalling speed in the final approach configuration. Wind, turbulence, handling characteristics, etc., may cause variations from these values. Pilot techniques represented by the above-mentioned threshold crossing heights and speeds probably have been chosen intuitively. Until there is further research and more becomes known of the relationship between safety and final approach technique, it is not possible to say whether the present pilot technique is, in fact, the safest for the currently available landing distances. However, there is evidence that techniques which produce threshold heights and speeds below 20 feet and stall-plus-23 knots is likely to result in undershoot or heavy landing accidents, particularly with larger aircraft.

While assessing the optimum technique, bear in mind that increasing the threshold height has relatively little effect on landing distance required, provided the threshold is not crossed above the point from which use can be made safely before touchdown of all available aerodynamic drag.

In general, pilots do not vary their approach and threshold speeds with actual aircraft weight, but instead select those speeds appropriate to the aircraft's average landing weight. Where the landing weight is restricted to a value substantially below the average because of field length, it is advantageous to adjust the target speed accordingly. There is evidence, however, that in some cases, perhaps due to the use

Figure 6

Total landing distance of a typical aeroplane from an approach speed of 140 kts. showing the effect of different techniques.



NOTES:—

1. Figures represent speed in knots.
2. The "desirable margin" is the extra distance required with the particular technique to ensure that the theoretical risk of overrunning is not greater than 1 in 100,000, taking into account such factors as variations in the runway coefficient of friction and errors in the approach speed.

of constant approach power settings, regardless of weight, the threshold speed is increased as weight is reduced. This can result in the airplane taking a longer distance to land at low weights than at high.

While the existing mandatory minimum landing distance requirements are supposed to provide for different surface conditions, this can only be achieved within limits. Therefore, the pilot must take special measures to ensure safety where extreme conditions are known to exist. If a flight is planned to an airport where wet ice conditions are apt to exist, an additional margin of distance above the mandatory minimum usually will be necessary if adequate safety is to be ensured. Similarly, when the runway surface is wet and only the mandatory minimum landing distance is available, it will be necessary for the pilot to abandon an attempt to land if his height and airspeed at the threshold are appreciably in excess of those intended. Remember that each knot of excess airspeed has, in the case of typical large piston-engined aircraft, about the same effect on landing distance as 10 feet of excess height. They both add about 1.8% to the total landing distance."

EDITORIAL COMMENT

This article has been reproduced in its entirety as a complete survey of landing techniques applicable from a point over the threshold onwards. It embraces the various landing conditions experienced in Europe.

Australian conditions do not include runways covered with snow and ice, and in any case the landing distance provided under Australian standards is about 15 per cent. greater than that required in the United Kingdom. It will be appreciated, therefore, that when applied to Australian operations this article is inclined to under-emphasize the absolute necessity of avoiding undershoot accidents. Experience in Australia shows that "run-through" accidents are less likely to occur than undershoot accidents. Of course, they also tend to be far less serious in consequence to the aircraft and its occupants.

D.C.A. charts are based on the measured distance to land from 50 feet over the threshold and this height can be used at the correct airspeed with confidence. Pilots should read the article with this vital point in mind. Technique should always provide an adequate margin from undershooting to allow for inadvertent errors.

A Reminder on Take-off Weights and the Take-off Run

Air Navigation Order 20.7 provides that when using a take-off chart the take-off weight may be governed by—

(a) The corrected effective operational length of the runway to be used for take-off and the ambient atmospheric conditions; or

(b) The appropriate seasonal declared density altitude taken in conjunction with either—

  (i) the corrected effective operational length of the main runway for take-off under no wind conditions; or

  (ii) the corrected effective operational length of any subsidiary runway for take-off under the minimum head wind component that may result when the main runway cannot be used due to excessive cross wind component.

The head wind component to be used when computing weights in accordance with paragraph 1 (a) is derived from the wind velocity at the time of making the computation (i.e. at the flight planning stage or at an equivalent stage for intermediate ports). It is worthy of note also that head wind components in excess of 20 knots shall be deemed to be 20 knots. Air Navigation Order 20.7 further stipulates that where, prior to take-off, a significant change occurs in the value of any factor used in computing the permissible take-off weight, which would have the effect of requiring a reduced all-up-weight from that already computed, then a new all-up-weight shall be calculated using the new value for the factor/s concerned; the weight so determined shall be the maximum weight to be used for take-off. On the other hand, it is possible that a significant change in one or more factors permits an increased all-up-weight to be lifted and this may be used to advantage in the interests of company service and economy. Nevertheless, the objective is simply to use factors in the final computation which are as close as possible to the conditions which are eventually encountered in the take-off as this alone will ensure an adequate margin of safety.

The factor which usually has the greatest effect and the one most likely to change after the flight planning stage is the head-wind component. However, changes in head-wind components are quite frequently ignored. Of course, take-off and landing weight charts are factored to cater for the normal fluctuations about the mean head wind component, but where a marked change in head wind component occurs, a check must be made to determine the effect of this change. This obviously involves a new computation.

When there are thunderstorms, fronts or squalls in the area the head wind component at the time of take-off could be very different to that used in a computation made even 15 minutes earlier. When this sort of weather exists it is prudent to determine what the take-off weight would be in no wind conditions and also what the accelerate/stop distance would be under no wind conditions at the weight which it is proposed to uplift. Where runway lengths are critical, having regard to the all-up-weight at take-off, and no proper allowance for any marked change in head wind component has been made, an engine failure near critical speed could result in the aircraft overrunning the stop-way with disastrous consequences.

PART II

OVERSEAS ACCIDENTS

Landing Approach Accident — Constellation: Jacksonville, Florida, U.S.A.

(This summary is based on the report of the Civil Aeronautics Board, U.S.A.)

18/27/79.

AT 0343 hours on December 21st, 1955, a Lockheed Constellation 749 crashed during an ILS approach to runway 5, Imeson Airport, Jacksonville, Florida. The aircraft was destroyed by impact and fire and all 17 occupants including the crew of five were killed.

THE FLIGHT

The aircraft was on a scheduled flight from Miami, Florida, to Boston, Massachusetts, with an intermediate stop at Jacksonville, Florida. Routine en route radio reports were made and at 0315, the aircraft reported over Daytona Beach at 11,000 feet, estimating Jacksonville at 0336. The captain was given the Jacksonville weather report "Thin obscuration, 2 miles visibility ground fog; wind north-north-west 6 miles per hour; 30 per cent. of sky obscured." After this message was acknowledged, the aircraft was cleared by air traffic control to Jacksonville middle marker ILS, cross middle marker ILS at 2,500 feet, maintain 2,500 feet until further advised and contact Jacksonville approach control when over Sunbeam Intersection. The clearance was acknowledged.

The captain contacted Jacksonville approach control when over Sunbeam Intersection (16 miles S.S.E. of Imeson Airport) at 0331, and was cleared for an ILS approach to runway 5. At the same time the Jacksonville weather was given as "Partial obscurement, visibility one-half mile; altimeter 30.18". Immediately following this transmission another message was passed to the aircraft "Coming out with indefinite 300 obscurement now one-half with fog" (Company Constellation minima for ILS approaches at Jacksonville, day or night, are ceiling 200 feet, visibility one-half mile).

After acknowledging this weather information, the captain reported leaving Sunbeam at 2,500 feet. Following a later query from the captain, approach control advised that there was no other known traffic in the area, and requested the flight to report when over the outer marker inbound. The captain reported over the outer marker inbound and was cleared to land.

Shortly afterwards the tower controller observed a large flash in the vicinity of the ILS middle marker. Calls to the aircraft were not acknowledged and an emergency was declared by the controller. It was subsequently learned that the aircraft had crashed approximately six-tenths of a mile southwest of the threshold of runway 5.

INVESTIGATION

Investigation disclosed that the main portion of the wreckage was 212 feet northwest of the ILS middle marker and 3,486 feet southwest of the threshold of runway 5.

First impact of the aircraft was with the top of a small pine tree approximately 200 feet below the ILS glide path, 260 feet to the left of the extended centreline of the runway, 4,000 feet from the threshold of runway 5, and 420 feet southwest of the middle marker. This was followed by striking a 50-foot oak tree, the upper 20 feet of which was sheared off. The aircraft settled toward the ground, striking other large trees which disintegrated both wings and a portion of the empennage. Ground contact was on a heading approximately 55 degrees magnetic. The distance from the first tree struck to the farthest piece of wreckage was 801 feet. Explosion and fire occurred immediately upon impact.

The cabin and cockpit areas were completely consumed in the ground fire with the exception of the lower fuselage skin and portions of the cabin flooring. The fuselage aft of the rear pressure bulkhead and the centre rudder fin and portions of the stabilizer were

intact, but with surface scorching indications. The tail cone was found in a relatively undamaged condition with the control booster mechanisms in proper position.

Outer portions of the left and right wings had been separated from the main structure during the passage through the trees and along the ground. The "speedpack"* was torn from the bottom of the fuselage at ground impact. Wing flaps were determined to have been in the 60 per cent. extension position, and their positions were symmetrical at the time of the impact.

Control systems were examined and no evidence was found to indicate failure prior to impact.

Separation of the right main gear and part of the nose gear had occurred at ground contact. The left main gear was intact and in the extended locked position; the cockpit landing gear lever was found in the "down" position. Measurement of the right main gear actuating cylinder piston rod revealed the same 15 inches as found on the down and locked left main gear actuating cylinder piston rod.

Cockpit instruments were largely destroyed by fire; readings obtainable gave evidence of routine operation. Radio equipment reflected settings for a normal ILS approach with appropriate frequencies for Jacksonville approach control and Jacksonville ILS, including glide slope and the ILS middle and outer markers.

Several flight checks of ground navigational facilities soon after the accident showed operation of the systems to be normal. Simulated ILS approaches were made to determine the effect on cockpit instruments caused by vehicles parked on the highway below the glide path. The highway is about 100 feet east of the middle marker. On one approach, with a crane-equipped truck parked beneath the glide path, a fly-down indication was noted prior to reaching the middle marker. It was necessary to descend 60 feet in order to centre the needle. However, the glide path indication was found to be normal at the middle marker, where the accident occurred.

The captain and first officer were familiar with Imeson Airport. The captain had made 17 landings at Jacksonville during 1955, five being in the month of December. The records also indicate that the first officer had recently made landings at this airport.

* A large detachable cargo compartment positioned on the underside of the fuselage.

On the night of December 20-21 weather stations from Miami to Savannah, Georgia, were reporting a small spread between temperature and dewpoint. The company terminal forecast for Jacksonville was ceiling and visibility unlimited; this was not amended until 0345 when it was changed to ceiling 300 feet, broken clouds; visibility three-fourths of a mile; fog. During the briefing the company forecaster advised the crew that patchy ground fog could be expected in the Jacksonville area.

Shortly after the flight reached the Jacksonville area the weather was being reported as ceiling indefinite 300 feet; sky obscured; visibility one-half mile and fog. This observation was given to the flight before the ILS approach began.

Exact visibility conditions at the crash scene are not known but all indications are that they were similar to those reported at the airport.

About 15 minutes before the accident occurred an aircraft of another airline was making an instrument training flight in the vicinity of Jacksonville. As a part of this training the flight completed an ILS approach to Imeson Airport and landed there at 0238. Reporting on the weather conditions at that time and the operation of the navigation facilities, the captain stated that the tops of the clouds were approximately 450 feet with their base at 300-250 feet, and that all facilities operated in a normal manner. He also said the airport appeared to be covered by a broken to overcast stratus cloud condition which seemed to him to be caused, in part, by smoke from adjacent mills. He said he entered this obscurement near the middle marker and that the weather elsewhere was spotty to clear.

ANALYSIS

It was evident that all components of the ILS system (outer marker, middle marker, glide path, localizer, approach lights, threshold and high intensity runway lights), were operating normally at the time of the accident.

The crew filed an I.F.R. flight plan prior to leaving Miami and gave as the alternate Orlando, Florida. The flight to Jacksonville was made in clear weather and clouds or obscuration were not encountered until in the vicinity of Jacksonville. From the testimony of other pilots flying in the vicinity a short time prior to the accident, there was a layer of cloud, which included smoke and fog, capping the airport with a general foggy condition existing a few miles to the southwest. All other areas appeared to be clear. It therefore appears likely that the aircraft was clear of clouds from the Sunbeam intersection to the middle marker and outbound to the outer marker, and that it probably did not encounter obscurement until in the vicinity of the middle marker inbound. Although this weather condition has been described as partial obscurement with horizontal visibility of one-half mile, it is apparent from the testimony of the pilots that vertical visibility throughout the area was generally good. Some of the witnesses said the ground visibility at and near the accident was poor. There is no way of determining ceiling height or visibility distance at the accident site. However, the weather information reported to the crew was obtained at the control area. The tower is located approximately one mile north-northeast of the accident scene. At the time of the accident a wind of six knots was blowing from the north-northwest, and it is believed that between the time of the last reporting and the accident the weather conditions at the observation point could have moved to the general area of the accident and therefore should have been essentially the same as that reported to the crew, "Indefinite 300, sky obscured; visibility ½ mile and fog".

Assuming that weather conditions were similar at the crash point and the observation point, consideration should be given to the decrease of horizontal visibility with elevation. Horizontal visibility must have been near zero at 300 feet above the ground. Normally, slant visibility down the glide path should have gradually increased as the aircraft descended.

The radar scope at Jacksonville does not reflect altitude. However, since the radar operator testified that the aircraft was observed to fly beyond the outer marker, make a procedure turn, and return inbound, it is believed that this was accomplished at the normal altitude of 1,200 feet. The propeller slash marks at the scene indicated the speed of the aircraft at impact to be 140 knots. The company's instructions for this type of aircraft show a recommended approach speed of 115 knots from the outer marker to the minimum authorised altitude.

Evidence indicated that the aircraft was flying in a normal manner just prior to impact and there is no known evidence to indicate any malfunctioning of the aircraft or any of its components. The flaps were extended to a position used for manoeuvring and this amount of flap extension is usually used in this type of approach until reaching the middle marker. Although the aircraft was 200 feet to the left of course, this is a small deviation at that point in the approach and only a slight correction would have been required to again align with the runway. The fact that the aircraft was in a slight right turn and almost level horizontally at impact would suggest that the pilot was turning toward the localizer course, further indicating the aircraft was under control.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was that during the final portion of an ILS approach the pilot, for reasons not determinable, either permitted or caused the aircraft to deviate to the left of course and descend below the glide path to an altitude too low to clear ground obstructions.

Stratocruiser Ditched After Take-off

(This summary is based on the report of the Civil Aeronautics Board, U.S.A.) (18/27/129).

ON 2nd April, 1956, a Boeing 377 was ditched in Puget Sound approximately four minutes after take-off from Seattle-Tacoma Airport, Washington State. All 38 occupants evacuated the aircraft, but five of these drowned. The aircraft was a total loss.

THE FLIGHT

At an altitude of 1,000 to 1,200 feet after take-off, power was reduced and the wing flaps, which had been set at the normal 25° take-off position, were retracted at an airspeed of 145 knots. Immediately the crew became aware of severe buffeting and a strong tendency for the aircraft to roll to the left, which the captain believed was due to a split flap condition, i.e., the wing flaps on one side of the aircraft being retracted while the flaps on the other side remained down. Power was reduced momentarily in an attempt to alleviate the buffeting but this was not effective and maximum continuous power was restored. After being cleared by

the Seattle tower for return, the captain decided not to turn the aircraft because of control difficulty and advised that he would proceed to McChord Air Force Base at Tacoma. As the trouble became worse and the aircraft continued to lose altitude, the captain elected to ditch.

Touchdown was on smooth water at an airspeed of approximately 120 knots and there was no abrupt deceleration. During the 15 minutes the aircraft remained afloat all occupants were evacuated and those on the wings supplied with buoyant seat cushions from the cabin. The survivors were rescued by surface craft within 30 to 35 minutes. This was a domestic flight with no requirement for the carriage of flotation gear.

INVESTIGATION

The aircraft sank in water approximately 72 fathoms deep, but was moved to water 40 feet deep for an initial inspection by divers before being raised for detailed examination. It was found that No. 1 engine had been torn off, that the flaps of both wings were fully retracted and that the cowl flaps of the three remaining engines were fully open.

The No. 1 engine was not located but metallurgical examination of its mount revealed no evidence of fatigue failure. Marks on the shank of a bolt in the upper outboard member indicated a load in an upward inboard direction unlike previous failures in flight. It was established that there was no malfunctioning of the power plants prior to impact.

It is the flight engineer's responsibility to close the full-open engine cowl flaps prior to take-off. The captain testified to the flight engineer's challenge and own response: "Cowl flaps—set for take-off." "Set for take-off." The flight engineer later stated that he was not certain that the cowl flaps had been closed at the time. At no time did flight crew members make a visual check of cowl flap positions. The flight engineer had accumulated 1384 hours' flying experience, with 236 hours in B-377 aircraft.

The captain had flown 1557 hours in B-377 aircraft of a total of 14,030 hours. He stated that loss of control was believed imminent because of excessive buffeting, inability to maintain altitude and a tendency of the aircraft to roll to the left which required nearly full use of aileron to correct. A study of the effect of full-open cowl flaps on the performance and controllability of B-377 aircraft revealed no abnormal take-off characteristics with the use of the normal 25° of wing flaps.

When wing flaps are retracted and cowl flaps are fully open, no noticeable buffeting is experienced until the wing flaps are within about 10 degrees of the fully retracted position. Vibration and buffeting then builds up rapidly and becomes severe as wing flaps reach full-up. This vibration is more regular than buffeting in a full stall but is not as violent. With the increase in turbulence over the wings associated with the buffeting, lateral stability is reduced and tends to give the impression that the aircraft is being balanced on a pedestal. Lateral trim requirements will more than likely be abnormal but not excessive. Performance capabilities of the aircraft in the cruise configuration with all cowl flaps wide open and operating all engines at maximum continuous power may be likened to that with one engine inoperative and the cowl flaps in the normal setting. In this regard, positive rates of climb in excess of 600 feet minimum would be possible, and turns in either direction could be made without undue difficulty.

The data further indicates that buffeting with flaps up, although considered severe, is not of immediate concern as a cause of structural damage. The most pronounced effect on control or stability is in a lateral direction and a moderate amount of aileron control for trim may be required, probably to the right, even though all cowl flaps may be open the same amount.

Although the captain and first officer could have seen the cowl flap settings from the side windows of the cockpit they were content to accept the flight engineer's assurance that the cowl flaps were set properly for take-off. Faced with a series of adverse conditions including low ceiling and unfavourable terrain the captain elected to ditch, basing his decision on the belief that a split flap condition existed, that any attempt to continue flight would result in complete loss of control of the aircraft, and that ditching was, consequently, the safest action.

PROBABLE CAUSE

The Board determined that the probable cause of the accident was the incorrect analysis of control difficulty which occurred on retraction of the wing flaps as a result of the flight engineer's failure to close the engine cowl flaps—the analysis having been made under conditions of great urgency and within an extremely short period of time available for decision.

Viscount Accident: Flat Rock, Michigan, U.S.A.

(This summary is based on the report of Civil Aeronautics Board, U.S.A.)

(18/27/102)

WHILST in flight near Flat Rock, Michigan, U.S.A., at approximately 1353 hours on 9th July, 1956, a Viscount lost No. 4 propeller and a portion of the forward part of No. 4 engine. One propeller blade passed through the fuselage, killing one and injuring five of the thirty-one passengers. One stewardess suffered a minor head injury. An emergency landing was made at Windsor, Ontario, at 1402 hours.

THE FLIGHT

The aircraft was engaged on a scheduled passenger flight from Chicago, Illinois, to Ottawa, Ontario. The aircraft departed from Chicago on an I.F.R. flight plan at 1304 and climbed to its cruising altitude of 19,000 feet, in accordance with its A.T.C. clearance.

At 1345 hours in the vicinity of Flat Rock, powerplant difficulty developed. During an emergency descent the No. 4 propeller broke loose and one blade passed through the fuselage, killing one person and injurying several others. The aircraft continued to Windsor, Ontario, where an emergency landing was made without further damage to the aircraft or injury to its occupants. Not until after landing did the pilots learn that a propeller blade had passed through the fuselage.

INVESTIGATION

According to the pilots the flight was routine until approximately 1345, at which time they noted a momentary drop in r.p.m. of No. 4 engine, 200 to 300 below the normal cruise r.p.m. of 13,600. Engine r.p.m. returned to and remained normal for about five minutes, then No. 4 engine r.p.m. was observed to increase rapidly to approximately 13,900 or 14,000. Shortly thereafter and concurrently with attempting to feather the propeller, the overspeed increased appreciably and feathering attempts, using both the manual and automatic systems, were unsuccessful.

During the following attempts to feather, the airspeed decreased, as did the sound of the No. 4 engine overspeed. The crew increased power on the remaining three engines and with the resultant increase in airspeed, the sound of No. 4 engine indicated its r.p.m. was rising. Because of this development an emergency was declared at approximately 1351 and clearance to descend was obtained from the Traffic Control Centre at Detroit. Power was reduced on Nos. 1, 2 and 3 engines, then an emergency descent was started and was continued at nearly maximum airspeed. At some time during this phase of the descent the crew depressurized the cabin.

At approximately 1353, at an altitude of about 9,000 feet, the No. 4 propeller broke loose and all four blades separated from the hub. One of the blades struck No. 3 engine, then passed through the passenger occupied portion of the fuselage. Descent was continued to about 3,000 feet, where power was again applied to Nos. 1, 2 and 3 engines. The r.p.m. of No. 3 engine did not go above 11,500 and the fire warning came on. Although no fire was observed, the engine fire procedure, which includes feathering of the propeller, was successfully accomplished.

Examination of the aircraft revealed that the propeller and the front part of the No. 4 engine forward of the propeller reduction gear layshafts had broken away in flight. All of these parts were recovered in the vicinity of Flat Rock, Michigan.

The path of one propeller blade passed completely through the oil cooler of No. 3 engine and the forward portion of the passenger cabin. Major cabin damage occurred in the area of the two most forward rows of seats. A small piece of propeller blade that matched with the No. 2 blade was recovered from the cabin. The remaining propeller blades were found to be intact.

The No. 4 engine revealed evidence of oil starvation throughout. Investigation disclosed that the driven bevel gear of the bevel box drive* had suffered a fatigue failure and rotation of the drive was completely disrupted. Other than the fatigue fracture, this tooth was relatively undamaged, whereas the teeth that remained in place on the gear exhibited gross damage.

The bushing within which this gear rotates had turned and worn panel material away until its thrust face was .030" below the machined surface of the panel on which the bushing flange normally beds. Damage resulting from the bushing turning in its panel precluded a determination of why the bushing was initially allowed to spin. The bushing flange was cracked. Displacement of the bushing resulted in a partial disengagement of the driven and driving bevel gears and thus altered the stresses in these parts.

* The engine fuel pump, propeller control unit, and oil pump are driven by the bevel box drive.

The teeth of the high speed pinion of the propeller reduction gearing were stripped to the extent that the propeller had become uncoupled from the engine. Discoloration from overheat was evident on the high-speed pinion and thrust bearing, with some deterioration having occurred to this latter part also.

Weather conditions in the area of the accident were reported as ceiling estimated 3,500 feet, broken, 8,000 feet, overcast; visibility in excess of 15 miles; very light rain showers. The crew reported that although cruise flight was conducted above a cloud layer, breaks in the clouds permitted the entire descent to be made with visual reference to the ground.

ANALYSIS

It was not possible to determine whether the momentary drop of 200 to 300 r.p.m. in No. 4 engine had any connection with events that followed. The initial overspeed of No. 4 engine to 13,900 or 14,000 r.p.m. undoubtedly occurred when the normally fixed bushing turned and failure of the driven bevel followed to the extent that rotation of the bevel box drive was completely stopped. At this stage of the engine difficulty, the propeller could have been feathered.

Following failure of the driven bevel gear the engine was rotated with no pressure lubrication by the windmilling action of the propeller while the blades were at the inflight fine pitch angle. It was during this interval that the high-speed pinion progressively failed and was deformed so as to damage the propeller oil transfer housing, with the result that feathering oil at the required pressure could not be directed to the propeller; finally, the propeller became decoupled from the engine. No other reason for failure of the propeller to feather was revealed by the investigation. According to the crew the second overspeed occurred just as the first attempt was being made to feather the propeller. At this time, however, damage that precluded feathering had already occurred.

The matter of the uncontrolled decoupled propeller such as occurred in this instance had not been anticipated with respect to Viscount aircraft and was not treated in Viscount training or manual material. However, the fact that the sound of overspeed decreased with decreased airspeed and increased with an increase in airspeed should have alerted the crew to the necessity for maintaining a moderate airspeed during the descent. Maintaining a low airspeed to reduce r.p.m. of an uncontrolled propeller has been for many years the basic procedure in use for reciprocating engine-propeller combinations and is widely known. Despite this, the captain orded that an emergency descent be executed. The Board concluded that had a moderate airspeed been maintained, failure of the propeller as subsequently happened would not have occurred.

Blade retention failure of the windmilling No. 4 propeller occurred when the aircraft was at approximately 9,000 feet altitude and at nearly the maximum permitted airspeed. According to information from the propeller manufacturer, based on the calculated blade retention strength and tests of the propeller, failure of this nature would be expected under approximately these circumstances. There were no indications of faulty material or workmanship.

Failure to obtain power from the No. 3 engine and the subsequent fire warning after levelling off at the lower altitude were the direct result of damage inflicted by the No. 2 blade of the No. 4 propeller when it became detached.

PROBABLE CAUSE

The Board determined that the probable cause of this accident was the inflight separation of the No. 4 propeller as a result of excessive loads induced by a descent at too high an airspeed while the propeller was windmilling decoupled from the engine and its r.p.m. was known to be uncontrolled.

PART III

AUSTRALIAN ACCIDENTS

Missing Wackett Trapped in Mountainous Terrain

(6/256/19)

A Wackett Trainer disappeared on 3rd February, 1956, whilst on a flight from Casino to Armidale in New South Wales. The wreckage was found 13 days later, in timbered mountainous terrain 17 miles east-north-east of Tenterfield, New South Wales. The pilot and two passengers received multiple injuries and were killed instantly on impact. The aircraft was destroyed.

THE FLIGHT

At approximately 1100 hours, the pilot rang Brisbane Air Traffic Control and submitted flight details for a private flight from Coolangatta, Queensland, to Armidale, New South Wales, a distance of 172 miles; the estimated time of departure was 1430 hours. Brisbane A.T.C. informed him that a flight plan was required for the flight and he was referred to the Airport weather office for a route and terminal forecast. The forecast indicated that 2/8ths to 5/8ths cloud with a base of 2,500 to 3,500 feet, scattered showers, visibility 15 miles (reduced to 5 miles in rain) and wind from the east at 10 knots, could be expected along the route and at the terminal. He was further advised that the weather might deteriorate later in the day and it was suggested that he obtain another forecast immediately prior to departure. Following this briefing, the pilot submitted a flight plan stating that there would be two occupants in the aircraft, the route would be via Tenterfield, the aircraft would be flown under visual flight rules and the estimated time interval was two hours. Brisbane A.T.C. approved the flight plan with the instruction that he advise Brisbane of his arrival at Armidale before 1730 hours and on the understanding that he would obtain a further weather briefing before departure; this he failed to do.

Shortly after 1410 hours, the aircraft departed Coolangatta carrying the pilot and two passengers and landed at Casino aerodrome, 49 miles to the south-west, between 1500 and 1515 hours. The aircraft was refuelled and the pilot discussed the flight with two local flight instructors.

At 1545 hours the aircraft was seen taking off and heading towards the west. An eyewitness stated that the climb after take-off appeared to be laboured and the weather at the time to the west of Casino was "very black with rain on the hills".

SEARCH

When the pilot had failed to report by 1800 hours, Brisbane A.T.C. commenced preliminary inquiries and at 1900 hours declared an uncertainty phase. Widespread inquiries failed to locate the aircraft and at 2040 hours the distress phase was introduced. An air and ground search was commenced on the following morning but it was not until 16th February, 13 days after the aircraft had disappeared, that the wreckage was sighted by a pilot on a private search in a light aircraft. The accident had occurred in heavily timbered mountainous terrain 17 miles east of Tenterfield and two miles north of the direct track from Casino to Tenterfield, which the pilot had probably attempted to fly.

INVESTIGATION

The owner/pilot held a private pilot licence with total flying experience of 121 hours accumulated over a period of eleven years. He obtained his Wackett Trainer endorsement a few weeks prior to the accident, and had flown 2½ hours on this type of aircraft. His log book did not show any instrument flight time and there was no evidence of any practical instrument flight instruction.

The wreckage was located among tall trees at the bottom of a steep-sided gully. The aircraft had disintegrated on impact but the wreckage was confined to a relatively small area. It was apparent that it had struck the ground in an almost vertical attitude at a comparatively high speed. All the components were found at the point of impact and an examination of the wreckage did not reveal any pre-crash defects or evidence of malfunctioning.

The route and aerodrome forecast obtained at 1100 hours indicated that the flight probably could be carried out successfully under visual flight rules. However in disregarding the agreement that he should obtain another forecast immediately prior to departure the pilot deprived himself of the opportunity of being advised of a deterioration in the weather. From the testimony of witnesses it was established that the weather between Casino and Tenterfield on the afternoon of the flight was 8/8ths cloud with a base of 2,500 to 3,000 feet and steady rain.

The terrain in the vicinity of the scene of the accident rises over 3,000 feet and cloud covered the tops of the mountains and extended well down into the valleys at the time of the flight. The aircraft was observed over the junction of the Casino-Tenterfield road and a road to Girard's Forest settlement, 39 miles west of Casino. The flight had been unimpeded to this point as the terrain gradually rises from Casino and the flight could have been conducted below cloud and at a safe height above the terrain until nearing the settlement. However, in order to maintain contact with the ground, as the settlement was approached, the pilot would be committed to flying in relatively narrow and steep-sided valleys immediately below the cloud which was now covering the tops of the ridges. These circumstances could easily explain how a pilot of his experience lost control of the aircraft, either whilst endeavouring to fly on instruments or in a violent manoeuvre to avoid high ground. It is apparent that the pilot attempted to fly in prohibitive weather conditions for visual flight in mountainous terrain.

The rear seat which was fitted with only one safety harness was occupied by two passengers. It is almost impossible for two persons to occupy this seat side by side. The rear cockpit was equipped with fully functioning dual controls and in view of the limited space for two persons in the rear cockpit, it is conceivable that the control movements were restricted or subject to inadvertent interference.

CONCLUSIONS

From the evidence it was concluded that:—

(a) The all-up-weight on departure was 98 lbs. in excess of the maximum permissible all-up-weight specified in its certificate of airworthiness.

(b) A person not provided with a separate seat and safety belt as required by Air Navigation Order 20.16 was carried in the aircraft.

(c) The flight plan submitted by the pilot contained incorrect information as to the fuel endurance and number of persons on board.

(d) The probable cause of the accident was loss of control at too low an altitude to effect recovery.

(e) The loss of control probably resulted from the pilot's attempt to fly the aircraft without adequate visual references.

Agricultural DH.82 Fails to Recover from Spin

(6/156/305)

In Aviation Safety Digest No. 6, attention was drawn to the danger of spinning DH.82 aircraft modified for agricultural operations. This warning was prompted by a preliminary investigation of the following accident.

In the course of a display of acrobatic flying, a DH.82 flown by a private pilot crashed and was extensively damaged when the pilot was unable to effect recovery from a spin which had been deliberately entered at a height of approximately 3,000 feet. The accident occurred at approximately 1340 hours on 7th June, 1956, on river flats on the outskirts of the town of Buchan in the south-east of Victoria. The pilot who was the only occupant, was seriously injured.

The aircraft was fitted with a hopper and discharge valve as used for fertilizer spreading. The discharge valve in this installation, a rectangular box shaped unit, was located in the normal position, i.e. projecting from the underside of the fuselage at about the front cockpit position. It was larger than is usual, presenting an unstreamlined frontal area approximately 21 inches wide by 7 inches deep which could be expected to give rise to considerable disturbance to the airflow beneath the fuselage. In common with all DH.82 aeroplanes modified for agricultural applications, the certificate of airworthiness of the aircraft was valid for flight in the "normal" category only, i.e. acrobatic flight was not permitted. This restriction is imposed because of possible deterioration in the handling characteristics of the DH.82 when fitted with the various appendages used for agricultural operations.

Throughout the morning, the pilot was engaged in fertilizer spreading from a field adjacent to the town of Buchan. Having completed this operation he took off at about 1330 hours for a field two miles distant where further fertilizer spreading was to be carried out. In response to a request by children at Buchan he agreed to perform acrobatics before leaving the vicinity. The aircraft was climbed to 3,000 feet and two loops were carried out. The aircraft was returned to 3,000 feet again where the throttle was closed and the aircraft put into a spin to the right. On entering the spin the aircraft failed to pitch down as steeply as is the normal spinning attitude of the DH.82 and, as the spin progressed, the nose position became higher and the rate of rotation became slower. The pilot attempted to recover after three turns but there was no response to the control movements which he claims were initially in accordance with the standard method of recovery, i.e. full opposite rudder and then the control column moved forward. Of the elevators he states they were "completely sloppy and ineffective, I felt they just weren't working". There is no doubt that the spin was abnormally flat; the pilot's evidence on this aspect was confirmed by a rated flight instructor, who was an eyewitness, and by the impact marks and damage to the aircraft. The pilot's observation concerning the feel of the elevators is consistent with the absence of stick forces to be expected in a flat spin.

When he found that the aircraft would not respond to the normal corrective control movement, the pilot tried full aileron both ways and also moved the control column back and forth, but without effect. His recollection of the sequence of control movements following the initial recovery action is not clear but he is certain that full opposite rudder was maintained throughout the descent. After about 1,000-1,500 feet had been lost without any indication of recovery a short burst of power was tried, but its only effect was to flatten the attitude of the spin —the position of the flight controls at this stage is not known. No further attempt to effect recovery by use of power was made as the pilot considered he now had insufficient time to recover and further use of engine might only result in a more severe impact. The aircraft struck the ground with the wings laterally level and the nose down 20 to 30 degrees. It came to rest virtually on the impact point indicating that forward speed was very low and the rate of rotation slow. The number of turns completed during the descent is not known with accuracy but is estimated at about 15.

The pilot held a private pilot licence with a total of 434 hours, 116 of which were gained on DH.82 aircraft. In engaging in aerial work operations whilst not the holder of a commercial or higher category of pilot licence, the pilot did not comply with Air Navigation Regulation 52(6).

The cause of the accident was that the pilot executed a spin contrary to the prohibition of acrobatics contained in the certificate of airworthiness.

SUPPLEMENTAL ANALYSIS

The spinning characteristics of the DH.82 as used in civil flying are generally regarded as excellent, recovery from a normal spin being effected in less than one turn after corrective control is applied. However, as a result of tests conducted during 1941 by the Royal Aircraft Establishment, Farnborough, it was established that the DH.82 fitted with bomb rack rails beneath the fuselage would spin flat if opposite aileron was applied during entry to the spin and that recovery from this flat spin was slower than from the normal spin. Recovery was further delayed, occupying up to four turns, if the ailerons were not centralized during recovery action. This behaviour was attributed to flow changes over the rear fuselage or tail unit created by the bomb rack rails. In this accident it is very likely that some opposite aileron was applied as this aircraft was put into the spin and probably during the initial recovery action. Full aileron in both directions was certainly used in the later stages of the recovery attempts and on present knowledge it appears this would not have been of assistance, and may have had undesirable effects. However, the most significant aspect is that in this accident the aircraft was fitted with an appendage beneath the fuselage which would be expected to create airflow changes over the rear fuselage and tail unit probably having a greater effect than the flow changes created by bomb rack rails. In the R.A.E. tests it was found that, irrespective of aileron position as soon as opposite rudder was applied in the recovery sequence of control movement the nose of the aircraft started to drop, an indication that recovery was being effected. In this instance no such symptom of recovery was apparent. It appears reasonable to associate the fertilizer discharge valve with the abnormal spin attitude and it cannot be stated that recovery could have been effected had the pilot persisted with any one recovery method. DH.82 aircraft equipped with hoppers and various types of protruding discharge valves have been deliberately spun by departmental pilots without abnormal characteristics being observed.

However, so far as could be established the subject aircraft had not previously been spun while fitted with this hopper and valve equipment, nor had the same type equipment been fitted to the other DH.82 aircraft in which spinning tests had been carried out.

DH.82 Strikes Fence During Spreading Operations

(6/256/289)

On 13th July, 1956, at 1140 hours a DH.82 crashed on the grazing property, "Branga Plains", near Walcha, New South Wales, after colliding with a fence shortly after take-off on a fertilizer spreading operation. The aircraft was extensively damaged but the pilot was not injured.

The aircraft, with two other DH.82, had been operating at "Branga Plains" for the preceding three weeks during which time approximately 430 tons of superphosphate were distributed. The landing ground used during the operation was 262 feet short of the required length and the surface, softened by recent rain, had been churned into soft mud to an extent which could be expected to increase the take-off run. Mud intermixed with superphosphate had also accumulated on the under surface of the lower mainplanes, fuselage and tailplane of the aircraft and quite possibly lowered its climb performance.

On the morning of 13th July, the pilot commenced operations carrying 336 lb. of fertilizer and twelve gallons of fuel. This load condition gave an all-up-weight at take-off approximately 40 lb. in excess of the maximum specified in the certificate of airworthiness. Rising terrain off the end of the landing strip necessitated a 90 degree turn to the right almost immediately after becoming airborne. The flight path then followed a small creek and crossed a post and wire fence running parallel to and about 700 feet from the strip. Wind conditions, initially 4-6 knots across the strip from the left, and the right turn after take-off resulted in the climb being made downwind.

After about an hour the fertilizer load was increased to 448 lb. and 8 gallons of fuel were added, raising the all-up-weight to approximately 1943 lb., i.e. 118 lb. over the maximum specified. The aircraft took off and soon after becoming airborne the pilot felt it "dropping and sinking suddenly, caught by a sudden gust and downdraft". He immediately commenced to jettison the fertilizer but insufficient height was gained and the tail caught the top wire of the fence causing the aircraft to settle to the ground 70 feet further on where the wheels sank deeply into the soft earth. The aircraft nosed over and came to rest in an inverted position with the mainplanes spanning the creek. The safety harness release box failed to operate and the pilot remained suspended by the shoulder straps a few inches from the surface of the water until assistance arrived some minutes later. Subsequent examination disclosed that the release box mechanism was jammed by superphosphate dust.

There is little doubt that a gust did occur during the take-off but the weather conditions existing at the time do not suggest abnormal gusts or turbulence in the area. It is considered that the aircraft was being operated under conditions which did not provide a reasonable margin of safety.

The pilot held a commercial pilot licence, endorsed for DH.82 aircraft. His total experience amounted to 4,834 hours, of which

2,050 had been gained on the DH.82 type. He had flown 2,000 hours on agricultural operations.

It is considered that the cause of the accident was that the aircraft was operated under conditions of excessive load, unsuitable take-off area, and adverse wind which precluded a safe clearance over obstacles.

Engine Failure Causes Fatal Wackett Trainer Accident

(6/256/375)

A Wackett Trainer crashed on the Bankstown aerodrome immediately after take-off on 21st September, 1956. At the time of the accident the aircraft was setting out for an aerial photography flight over the suburbs of Sydney. The pilot was killed, the only other occupant was seriously injured and the aircraft was destroyed on impact.

At approximately 1015 hours the aircraft was taxied to the eastern boundary of the aerodrome where it stood, cross-wind, for a short while. Weather conditions were fine and clear with a gusty 15 to 20 knot wind from the south-east as the aircraft was turned into wind and the take-off commenced. Nothing abnormal was observed in the take-off and the aircraft climbed straight ahead until it reached a height of about 150 feet still within the confines of the aerodrome. At this point the engine was heard to stop suddenly and with no apparent change in attitude the aircraft banked to the left, began to turn and then lost height. The angle of bank increased until the nose dropped sharply just before the aircraft struck the ground in a near vertical attitude.

The pilot held a commercial pilot licence and in 6 years of flying had accumulated 1,600 hours on light aircraft. At the time of the accident he had flown 40 hours on Wackett Trainers and in the 90 days preceding the accident he had flown a total of 186 hours including 12 hours on this particular type.

There was no evidence of any structural failure or malfunctioning of flight controls prior to impact, and the aircraft had apparently been maintained in good condition. The manner in which the propeller blades were bent by contact with the ground suggested that the engine was not under power at the time of impact.

The principle evidence of power loss was provided by a groundsman who was working some 2,200 feet from the take-off path. He stated that it was the sudden and complete cessation of the engine noise that attracted his attention to the aircraft. Other eye-witnesses confirmed his statement of the aircraft's behaviour immediately prior to the impact. Nevertheless, a most detailed examination of the power plant, its controls and associated systems failed to reveal any pre-crash condition which might have caused a sudden and substantial loss of power and, although the fuel selector cock was faulty, tests indicated that, in its worst configuration, it would not have seriously obstructed fuel flow to the engine. Since the aircraft's behaviour was consistent with a sudden cessation of power and since the propeller marks and bending indicated that the engine was not developing power on impact, the weight of evidence indicates that there was an engine failure at about 150 feet in the take-off climb.

It appears that control of the aircraft by the pilot was lost very soon after the turn commenced and it is possible that the turn was not a voluntary manoeuvre. However, the pilot was in a very awkward situation assuming that the engine failure occurred at a height of 150 feet. The aircraft was close to the aerodrome boundary and a forced landing could not have been carried out straight ahead without crashing into houses or into the George's River. A turn to the right or left would have placed the aircraft in a strong cross-wind over difficult terrain. If the height of the aircraft was only 150 feet then the chances of safely landing back on the aerodrome were also remote. Despite the witness evidence there must be some doubt that the aircraft had reached only 150 feet after a run of approximately 4,000 feet into a 15 knot wind.

It was concluded that the probable cause of this accident was a complete loss of engine power immediately after take-off when the aircraft was almost over the aerodrome boundary. The terrain outside the aerodrome was not suitable for an emergency landing. The origin of the power loss could not be established. It is probable that the aircraft stalled and was out of control when it struck the ground.

Norseman Overturns in Emergency Landing

(6/456/116)

On 29th October, 1956, a Norseman UC64A departed Port Moresby empty on a flight to Malalaua for the purpose of moving 12 Papuans back to Port Moresby. Malalaua is close to the coast of Papua, some 95 miles north-west of Port Moresby. About 30 minutes after departure and at a height of 2,000 feet, the engine began to vibrate slightly and lost 75-100 r.p.m. The pilot decided to return to the departure aerodrome. A short time later, the engine began to run roughly, discharging oil over the port windscreen, and height could not be maintained even at full throttle due to loss of power.

The pilot decided to attempt a landing on an abandoned wartime airstrip known as Rogers over which he passed a short time earlier. He reached this strip at a height of 500 feet, flying from the right hand seat to avoid the oiled windscreen, and landed on a section of the strip which appeared to be suitable. During the landing roll the pilot returned to the left hand seat, since only in this position can the brakes be applied, and, on the first application, the aircraft nosed over and came to rest on its back. The aircraft was extensively damaged but the pilot escaped without injury.

Examination of the engine disclosed that the exhaust rocker housing on No. 1 cylinder was completely fractured circumferentially at the uppermost cooling fin. This rendered No. 1 exhaust valve inoperative, resulting in loss of all rocker lubricating oil through the fracture and a considerable loss of power. The pilot, although he had over 2,000 hours of flying experience, had flown this type of aircraft for the first time less than three months prior to the accident.

Although the all-up-weight of the aircraft was within permissible limits, the centre-of-gravity was 5.9 inches forward of the safe limit. Considering that the safe range of the centre-of-gravity in this aircraft is only 8.5 inches, it can be seen that the aircraft was dangerously nose-heavy. This factor together with the pilot's short experience on the type and the rough nature of the strip surface all contributed to the accident.

It is considered that the pilot acted correctly on detecting engine roughness and in his handling of the emergency landing. Nevertheless, whilst not amounting to carelessness, the application of sufficient brake to overturn the aircraft during the landing run was the direct cause of the accident. The pilot's anxiety to stop the landing roll over rough and unknown ground as soon as possible can be readily understood and the circumstances at the time would impede the normal smooth application of the brakes.

It was concluded that—

(a) At the time of take-off the all-up-weight of the aicraft was within permissible limits but the aircraft's centre-of-gravity was outside the permissible forward limit to such an extent that the longitudinal control of the aircraft would have been substantially affected, particularly during the landing approach and roll. By allowing the aircraft to fly in this condition the operator and the pilot contravened Air Navigation Regulation 227(5).

(b) The forced landing became necessary when the engine lost substantial power due to a complete fracture of the exhaust rocker housing on No. 1 cylinder and the aircraft could not maintain sufficient height to reach the nearest aerodrome.

(c) **Cause:** The cause of the accident was that, whilst carrying out a forced landing in difficult circumstances, the pilot applied wheel braking too severely, having regard to the loading state of the aircraft and the surface conditions.

The Department's search and rescue service acted efficiently as the first rescue aircraft was airborne at Port Moresby with medical equipment aboard within eleven minutes of the accident. A doctor flown in by helicopter reached the pilot in 81 minutes and the pilot was admitted to hospital in Port Moresby for observations only 134 minutes after the accident.

DH.94 Out of Control in Cloud on V.F.R. Flight

(6/156/565)

BOTH occupants were killed and the aircraft was demolished by the impact when a DH.94 crashed at approximately 0600 hours on 5th November, 1956, on a heavily timbered ridge on the southern slopes of the Great Dividing Range near Macedon, Victoria.

The aircraft departed from Moorabbin at 0529 hours on a private flight to Wedderburn, 120 miles to the north-west, carrying a pilot and the owner. About 30 minutes later the aircraft was heard to circle at a low height in the vicinity of Macedon, apparently in the process of turning back towards Moorabbin, and was then heard to crash. Macedon police were alerted and a ground search was organised. Four hours later the aircraft was located in thick timber, on the eastern slopes of a ridge at a point approximately two miles south-west of Macedon township and within one mile of the route Moorabbin to Wedderburn. The aircraft had dived into the ground in a near vertical attitude and, except for the empennage, had disintegrated. The speed on impact as evidenced by the extent of destruction is estimated to have been well in excess of cruising speed. This, in conjunction with the flight path angle on impact, indicated that the aircraft was out of control immediately preceding the accident.

Although invited to use the telephone at Moorabbin to obtain a weather report and to submit flight details to the Melbourne Air Traffic Control Centre, the pilot declined to do so in apparent disregard of Air Navigation Regulation 232(1).

Weather conditions existing at the time and location of the accident, and recorded in relevant routine forecasts at the weather office, were such that flight by visual reference to the ground could not be maintained. The wind was from the south at 15-25 knots, it was overcast with cloud to ground level on the slopes of the hills and there was continuous light rain. The weather at Moorabbin at the time of departure was fine with some high level cloud and a light south-east wind.

Both occupants of the aircraft held current pilot licences. The owner, who held a student pilot licence, had flown a total of 14½ hours. His experience on DH.94's amounted to four hours, his first and only solo flight being made three weeks prior to the accident. The other occupant held a private pilot licence and had a total experience of 165 hours, including 102 hours on the DH.94 type. The latter, by virtue of his qualifications and the limited privileges of the student licence held by the owner, was the person who must be regarded as "in command" of the flight. However, there is little doubt that the owner was taking an active part in the conduct of the flight as dual controls were fitted and from his location in relation to the wreckage it was apparent that he occupied the front cockpit, which is the normal "in command" position in this type; the rear cockpit was not completely equipped with auxiliary controls. With his limited pilot experience, it is most unlikely that the owner was competent to fly an aircraft on instruments. The log book of the other pilot contained no entry relating to instrument flight instruction and, having regard to the nature of his experience, it is most probable that he also was not competent to fly on instruments alone.

It was concluded that the probable cause of the accident was an error of judgment on the part of the pilot in failing to abandon the flight before he was committed to flight by instruments; the aircraft was not equipped and the pilot was not competent for such conditions.

Chipmunk Strikes Trees During Recovery from a Spin

(6/656/132)

DURING recovery from an inadvertent spin at approximately 1135 hours on 13th November, 1956, a Chipmunk struck trees and crashed near the edge of an emergency landing strip at Bulls Creek, 10 miles south-west of Perth Airport.

At the time of the accident, the aircraft was being used for forced-landing practice. The pilot-in-command, a flight instructor, occupied the rear seat and suffered only slight abrasions to the face. A national service trainee in the front seat sustained a broken right leg and minor abrasions. The aircraft was destroyed on impact, the port wing being sheared off, the engine and propeller torn from its mountings, and the fuselage broken into two sections.

The aircraft left Maylands at 1110 hours for general revision flying. Several sequences were completed and then the instructor closed the throttle at a height of 4,500 feet and the student proceeded to carry out a practice forced-landing on the Bulls Creek emergency strip. He made for the north-eastern end of the strip despite a 7 knot northerly wind, and lost height whilst standing close in to the end of the strip. On what he intended to be a right-hand base leg, he found himself still too high considering his proximity to the threshold, so he lowered half flap and commenced a side-slipping turn to the right designed to bring the aircraft, at the completion of the turn, over the threshold at about the correct height for a landing. During this turn the aircraft stalled and spun to the left from a height of about 500 feet. The instructor took over the controls and effected recovery but, in the pull-out from the dive, the aircraft struck trees and came to rest about 100 yards further on, extensively damaged.

The instructor held a B2 flight instructor's rating and had accumulated 455 flying hours including 212 hours as a flight instructor. His total time on Chipmunks amounted to 224 hours. The experience of the student pilot amounted to 47 hours, all within the 90 days preceding the accident.

An examination of the wreckage did not reveal any circumstance or pre-crash condition of the aircraft, power plant or associated equipment which may have contributed to the accident.

It is considered that the student pilot's attempt at a forced-landing was well below the required standard. He chose to approach, and would have landed, with a down-wind component, and he crowded the strip end to the extent that he apparently had to slip-off considerable altitude in the turn on to final approach. He allowed the aircraft to stall in this turn but failed to recognize and correct the incipient spin before the spin proper was entered. No doubt his first error in selecting a downwind landing direction contributed to the subsequent errors.

Since the instructor did not take over before the aircraft was spinning, it appears that he allowed the speed to drop at least 15 knots below the normal approach speed without taking any positive action. It is probable that he was not aware of the low airspeed, being deluded by the higher ground speed. It is hard to conceive that an instructor, exercising normal supervision would fail to notice the approach of a stall in a Chipmunk aircraft. It is even more difficult to understand why his recovery action was delayed until the aircraft had progressed from a turn to the right into a spin to the left.

It was concluded that the accident was caused by the instructor not exercising adequate supervision.

Pilot Unable to Terminate DH.82 Spin

(6/256/485)

UNABLE to effect recovery from a spin deliberately entered at a height of 5,000 feet, a student pilot on a solo training flight in a DH.82 crashed into the north arm of the Richmond River near Wyrallah, New South Wales. The pilot escaped with minor facial cuts and bruises but the aircraft was substantially damaged.

On the morning of the 11th December, 1956, after completing a check flight consisting of take-offs and landings on the Lismore aerodrome, the pilot was approved by the flight instructor for a solo flight in which steep turns and spins were to be practised. The pilot stated that he took off shortly after 0830 hours and climbed to 5,000 feet where several turns were commenced before the aircraft was placed in a spin to the left which was entered from a straight stall. The spin appeared quite normal and after three turns the pilot attempted recovery. He claims to have used the proper corrective control but the aircraft failed to respond. After a further three turns he tried various control positions without success until apparently after some 12-15 turns the nose position of the aircraft became higher in relation to the horizon and the rate of rotation slowed down. The pilot reports that the spin continued in this flatter attitude until the aircraft struck the water a few feet out from the bank of the north arm of the Richmond River at a point about 7 miles S.S.W. of Lismore. The centre section struts bowed outwards, permitting partial collapse of the upper mainplanes and the fuselage fractured at the joint just aft of the rear cockpit which allowed the rear fuselage to hinge downwards to a horizontal attitude with the empennage resting on the bank of the river. The pilot was able to leave the aircraft without assistance and made his way to the bank of the river.

The nature of the crash damage precluded any check being made of the aircraft rigging. There is evidence that its rigging may not have been accurate as it is reported to have flown approximately 4°-5° right wing low "hands off". In addition, to correct a yaw to the left a light metal trim tab had been fitted to the rudder to provide adjustment additional to the maximum obtainable with the standard bias spring system. The possibility that rigging errors so affected the flight characteristics of the aircraft as to produce a dangerous spin reaction has been considered but since normal spin performance had been exhibited by the aircraft on numerous flights within the preceding few weeks this is regarded as most improbable.

The pilot held a student pilot licence and had flown a total of 25 hours since commencing flying training in July, 1956. Of this time all but 45 minutes were flown in DH.82 aircraft. He received his first instruction in spin recovery during August, a few weeks prior to his first solo flight, and received further instruction in the sequence two weeks before the accident. The flight instructor's assessment recorded at the time of the pilot's performance on each occasion was satisfactory. Three days after the accident he was given a test in spin recovery, in a Chipmunk, and his technique could not be faulted. However, it is considered that the pilot's performance both up to and after the accident is no indication that he took the correct action at the time of the accident, which was the first occasion on which he had attempted this manoeuvre unaccompanied by a flight instructor.

It is considered that the probable cause of the accident was that the pilot applied incorrect flight control movements when attempting to recover from a spin.

CORRECTION

In the last issue, Aviation Safety Digest No. 9, in the account of the accident to a glider at Gunnedah on 28th April, 1956, "freezing" in line 6, column 2, page 21, should have read "freeing".

PART IV

INCIDENT REPORTS

On Getting Lost

THE pilot of a DH.82 became lost on 10th November, 1956, during flight from Jamestown to Waikerie, South Australia, a distance of 91 miles, and when the engine stopped, two hours after departure from Jamestown, a forced landing was carried out in a position 150 miles west of Jamestown and 122 miles north-west of Waikerie. The aircraft, owned and operated by an Aero Club, was on a private flight and a passenger was carried.

EVENTS LEADING TO THE FORCED LANDING

Prior to departure the pilot obtained a route and terminal forecast from Adelaide Air Traffic Control Centre and indicated that his E.T.D. would be 1230 hours and that he would report his arrival at Waikerie not later than 1730 hours. The forecast was for $\frac{5}{8}$ strato-cumulus cloud, base 2,000 feet, tops 7,000 feet, over the first part of the route improving to $\frac{3}{8}$ with a base of 3,000 feet over the latter part, visibility—20 miles, and the wind 25-30 knots from 200 degrees true up to 3,000 feet. The pilot, intending to fly via Morgan (situated on the Murray River 19 miles west-north-west of Waikerie — see accompanying sketch) used the forecast winds in computing a course from Jamestown to Morgan of 107°M with a time interval of 70 minutes, and a course from Morgan to Waikerie of 92°M with a time interval of 14 minutes, giving a total time interval of 84 minutes.

Before departure the pilot carried out a pre-flight inspection of the aircraft and reports that the fuel contents gauge showed the tank to be full, i.e., it held 19 gallons giving an endurance of 2 hours 50 minutes. He also signed the operator's "Weekly Aircraft Time and Maintenance Log", which indicated that the fuel and oil tanks were full and that the aircraft was serviceable.

The aircraft departed Jamestown at 1235 hours on a compass course of 107 degrees climbing to a cruising height of 3,000 feet above sea level. Shortly after departure the aircraft passed over the Peterborough-Burra railway line and some minutes later the pilot pin-pointed himself on "two hills either side of the track which I believed to be Mount Bryan and Mount Cone North". At approximately this stage he altered course to 110 degrees and, as the aircraft cleared the north Lofty Ranges and reached the level plains east of these ranges (geographical altitude 100-300 feet), he descended to 1,500 feet. The pilot states that at approximately the time he estimated to arrive over the "Gums" Homestead on the Burra-Morgan road, which is on track, he passed over a road with wells and stations which he believed to be on the Burra-Morgan road and consequently continued to maintain the course.

The pilot did not sight Morgan or Waikerie at the expected times and so he continued on the course of 110 degrees "with the belief that I would eventually reach the river . . . and return along the river to Waikerie". At this stage he was flying over flat, relatively featureless and uninhabited terrain and when he had not sighted the Murray River by 1415 hours, that is 15 minutes after the E.T.A. Waikerie, he realised that "things were drastically wrong". He immediately checked his navigation and found an error of 40 degrees in computing the course and consequently was a considerable distance from the desired track. At this stage he also found that, although he had only been flying for some 1 hour 45 minutes, the fuel contents gauge indicated that only three gallons remained in the tank, giving a maximum further endurance of some 30 minutes. The pilot thereupon searched for a homestead and, as the "most likely area for habitation appeared to be to the north, headed in that direction". At 1435 hours the engine stopped at a height of 1,700 feet and a successful forced landing was carried out on the "only available piece of land".

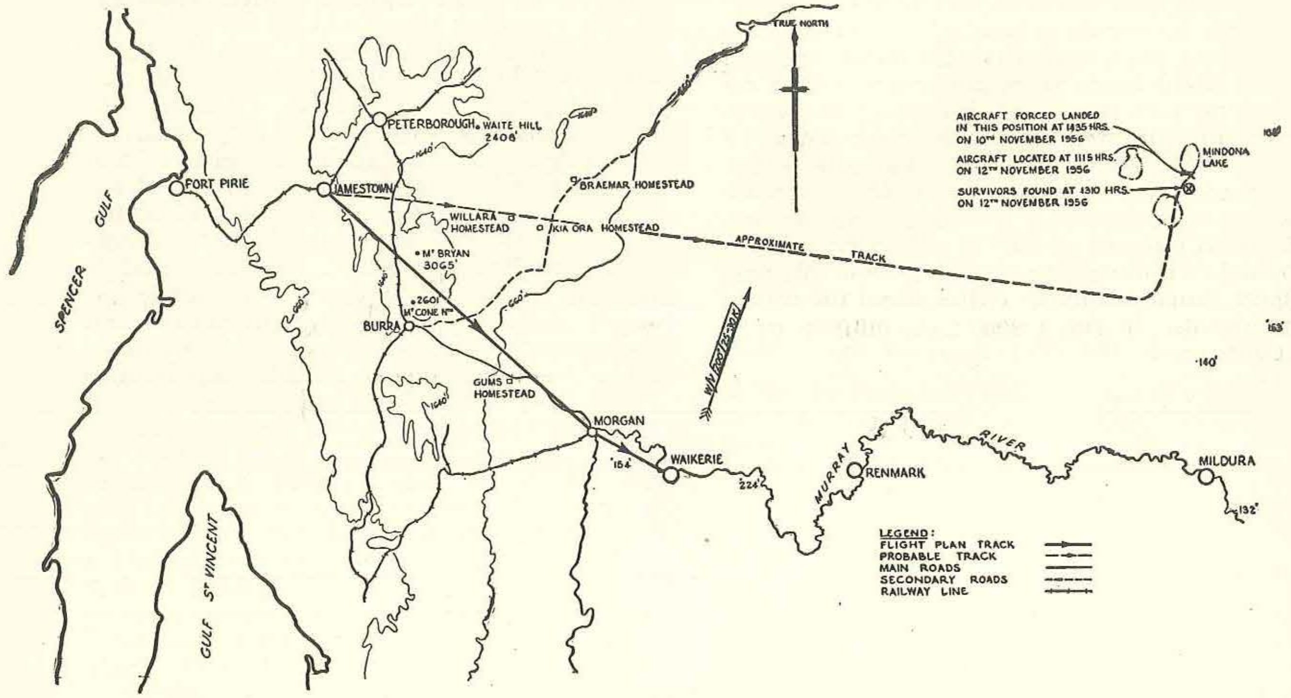
The pilot and the passenger remained with the aircraft until 1100 hours on 11th November, 1956, the following day, and then set out in an attempt to reach a homestead which had been sighted prior to landing, some 10-15 miles south-west of the position in which the forced landing had been carried out.

When the pilot had failed to report by 1730 hours on 10th November, the Adelaide Air Traffic Control Centre introduced the uncertainty phase of the emergency procedures and, when enquiries to numerous places failed to locate the aircraft, the distress phase was declared at 1812 hours. A R.A.A.F. search aircraft located the aircraft at 1045 hours on 12th November in a position about one mile south of Lake Mindona in New South Wales and 122 miles north-east of Waikerie. The pilot and passenger were sighted about two hours later, some six miles south-west of the aircraft, and were picked up later that day and flown to Mildura. The pilot and passenger had not suffered any ill effect from their ordeal and the aircraft was undamaged.

INVESTIGATION

It was established during the investigation that the last refueling of the aircraft prior to this flight had been carried out on 4th November, when the tank was filled. Subsequently the aircraft was flown for a period of 45 minutes and thus the fuel tank would have contained approximately 14 gallons on departure from Jamestown, giving an endurance of only just over two hours. This, and the distance flown by the aircraft, confirm the pilot's statement that the power failure, after two hours in the air, resulted from an empty fuel tank. Although suitable landing areas were few and far between, the pilot made no attempt to land until the engine failed despite the fact that he knew the fuel quantity was very low. Exhausting the fuel supply in this manner is contrary to good airmanship as in slightly different circumstances an immediate forced landing could easily result in an accident.

The refuelling of the aircraft on 4th November and the subsequent flight of 45 minutes were entered on the operator's Weekly Aircraft Time and Maintenance Log by the secretary of the Club on 10th November. The secretary also recorded in this log that the fuel and oil tanks were full after this flight. This entry was made in the belief that the aircraft was refuelled to capacity after that flight in accordance with the normal procedures. No action was taken by the secretary to check that the fuel tank was full nor has the club any requirements for the person compiling the log to check the fuel.



Inspection of the fuel contents gauge revealed that, because of a minor calibration error and the inherent limitations of this type of gauge, when the aircraft was in the tail down attitude, it indicated that the fuel tank was full when it held 14 gallons or more fuel. This confirms the pilot's statement that the gauge showed the tank to be full prior to departure from Jamestown. It is considered that the pilot took reasonable precautions in determining the fuel quantity on board prior to the flight.

At the time of the incident the aircraft was operating under current certificates of registration and airworthiness and a current maintenance release. However, the maintenance release was not carried in the aircraft, contrary to the requirements of Air Navigation Regulation 113, and no compass correction cards were fitted in either cockpit. As a correction card is an integral part of an aircraft magnetic compass it is considered that the pilot displayed poor airmanship in undertaking a cross country flight when the compasses did not have correction cards attached.

The last compass swing of both front and rear cockpit compasses prior to this incident was carried out on 3rd February, 1956, when correction cards were raised showing compass deviations of 0 to 5 degrees. A compass swing carried out a few days after this incident revealed deviations of 8 to 19 degrees in the front cockpit compass and 2 to 10 degrees in the rear cockpit compass. These deviations are outside the permissible limits for card correction. As there was no circumstance between the last swing and the check swing after the incident which would have necessitated a re-swing, the difference in deviations at these two swings is abnormal. However, an investigation of this aspect failed to find an explanation for these differences. In the absence of compass correction cards the pilot assumed there was no deviation and consequently if the deviation found in the check swing after the incident was present at the time of the flight, there would have been an error of 6 degrees in the compass course flown to maintain the intended track.

ANALYSIS

An analysis of his pre-flight planning confirms the pilot's statement that he used the reciprocal of the forecast wind in computing the course and ground speed, with the result that the computed courses from Jamestown to Morgan and Morgan to Waikerie were 43 and 45 degrees, respectively, to the left of the correct courses and the computed ground speeds were approximately 10 and 14 knots in excess of the correct estimates of ground speeds. The wind can easily be applied reciprocally in such a problem unless care is taken; for this reason it is impressed upon pilots during their training that it is essential to check that the computed course is on the correct side of the track in relation to the wind. On this occasion a simple mental check* would have indicated to the pilot that he had applied the wind incorrectly.

The pilot reported that the weather encountered was consistent with that forecast except that the visibility was only 7-8 miles due to haze. The track made good by the aircraft is shown on the accompanying sketch and it can be seen that this track crosses the Peterborough-Burra railway line at an angle of approximately 90 degrees whereas the correct track crosses the line at an angle of about 45 degrees. Although the geographic features at the points where both tracks cross the railway line are somewhat similar, and the actual arrival time at the line would not in itself have been very significant, it is considered that the pilot should have appreciated the significance of the angle between the track of the aircraft and the railway line. Shortly after crossing this line the pilot believed he had pin-pointed himself on track between Mount Bryan (3,063 feet) and Mount Cone North (2,601 feet), which are about 12 miles apart when, in fact, he was between Mount Bryan and Waite Hill (2,407 feet), which are some 29 miles apart. This error is attributed to poor map reading. Similarly, the pilot mistook the Kia Ora Homestead area for the Gums Homestead area (situated on the intended track), which again indicates poor map reading, as the major road near the Kia Ora Homestead runs north-east - south-west

* SUGGESTION:

This "simple mental check" is simple only when your power of orientation is good. Aviation-wise, your power of orientation will be good when direction, whether it be of aircraft movement or wind, relative to the compass rose can be clearly envisaged in your mind. When you can do this, you will then have no difficulty in visualizing the general effect that wind from any given direction will have upon an aircraft on a particular heading.

Why wait until you are flight planning or are in flight to practise orientation? Much less expensive and equally effective practice can be carried out in the comfort of your armchair!

whilst the major road near the Gums Homestead runs north-west - south-east. Furthermore, the intended track follows the road from Gums Homestead to Morgan and it is considered that when the pilot was unable to find a road running south-east from Kia Ora he should have realised he was off track at this stage. After passing Kia Ora Homestead the path of the aircraft was over relatively featureless terrain and map reading would have been extremely difficult.

It will be seen from the accompanying sketch that the intended track, running approximately south-east, was towards a railway line running west to east from Eudunda to Morgan, and towards the Murray River. Because of the position and prominence of these features, it is difficult to understand why the pilot, when he had not sighted Morgan, the railway line or the river at the time of his E.T.A. Morgan did not alter course at least 10 or 20 degrees to starboard in an endeavour to intercept the railway line or the river. For the same reason it is considered that when he had not sighted the river or Waikerie at the E.T.A. Waikerie, he should have turned due south to intercept the river. His decision to continue on the course of 110 degrees beyond the E.T.A. Waikerie appears to be illogical. From an analysis of all the aspects of this incident it is considered that, although the initial error of applying the wind incorrectly in computing the course undoubtedly contributed to the incident, the prime cause of the aircraft becoming lost was poor en route navigation. At no stage of the flight did the pilot record any navigational data and thereby failed to comply with Air Navigation Regulation 78A.

The pilot learnt to fly with the Royal Australian Air Force and on discharge in March, 1944, had a total of 707 hours flying experience, mostly on multi-engined aircraft. He did not fly as a pilot from that date until June, 1956, when he was issued with a student pilot licence. On 22nd October, 1956, he was examined for the issue of a private pilot licence. He passed the flying tests for this licence satisfactorily but failed in the oral navigation examination. Subsequently he passed an oral navigation examination given to him by the chief flying instructor of the Aero Club and, after satisfactorily completing a cross country flight with that instructor, was issued with a private pilot licence, on 2nd November, 1956, eight days before this incident. A few days after being issued with this licence he carried out a local solo flight of 45 minutes and this incident occurred on his next flight. In the 90 days preceding this incident he had flown a total of 13 hours.

CONCLUSIONS

1. At the time of the flight, correction cards for the aircraft's magnetic compasses were not carried in the aircraft and the compass deviations were probably in excess of the permissible limits. However, these discrepancies had very little bearing on the incident.

2. The fuel contents gauge had a minor calibration error which, in conjunction with the limitations of this type of gauge, indicated, when the aircraft was in a tail down attitude, that the tank was full when it contained a quantity of 14 gallons or more.

3. The pilot believed from a check of the operator's Weekly Aircraft Time and Maintenance Log, and from the fuel contents gauge, that the tank was full prior to departure, giving a fuel endurance of 2 hours 50 minutes, when in fact, it only contained 14 gallons, sufficient for two hours. This discrepancy had no bearing on the flight.

4. The power failure was due to fuel starvation resulting from an empty fuel tank after being airborne for two hours.

5. The pilot was aware that the fuel quantity was very low prior to the power failure but delayed carrying out a landing, thereby displaying poor airmanship.

6. The pilot failed to maintain a log of all navigational data contrary to the requirements of Air Navigation Regulation 78A.

7. The standard of pre-flight navigation preparation and en route navigation displayed by the pilot on this flight was below that to be expected of a private pilot.

CAUSE

This incident is attributed to errors in en route navigation on the part of the pilot, to which carelessness in pre-flight navigation preparation contributed.

Modification to DC.3 Elevator Trim Tab Inspection Plates

(6/556/8)

IMMEDIATELY after taking off from Port Pirie in a DC.3 the first officer, who was flying the aircraft at the time, became aware that abnormal movement in the elevator control was developing and he passed the control of the aircraft to the captain. The aircraft had a nose heavy tendency accompanied by an increasingly severe fore and aft hunting movement of the control column, which caused the aircraft to pitch rather violently. This motion was rather difficult to control as any deliberate movement of the control column by the pilot tended to over correct the aircraft. On reaching approximately 300 feet the severity of the pitching seemed to have reached its maximum and did not appear to be increasing. Although this pitching could not be prevented the pilot considered that he had sufficient control of the aircraft for a gentle turn and a landing back at the aerodrome. He considered this to be a more attractive proposition than landing straight ahead although the countryside was flat and unobstructed. A full circuit of the aerodrome was not attempted and the aircraft was landed without further incident on the cross-wind runway.

Examination of the controls after landing revealed that the two screws on the front edge of the inspection plate on the underside of the starboard elevator were missing, the plate being retained by the two rear screws, one of which was very loose. The plate was bent back at an angle of 60°-70° to the surface of the elevator and in this position was acting as an airscoop probably inflating the elevator as well as causing considerable drag on the control.

The incident occurred because an aircraft mechanic failed to properly secure the inspection plate after performing a 100 hourly inspection on the aircraft, and the licensed engineer who signed out this inspection, did not actually survey the work after it was completed. The inspection plate is so positioned that it would not be visible to the flight crew during the course of a normal pre-flight inspection even when hanging down.

The inspection plate is of conventional design and consists of an oblong light alloy plate positioned with its greater dimension fore and aft and secured to the elevator structure by four brazier headed screws, one at each corner, which are driven into anchored elastic stop nuts. This arrangement is a common one and perfectly satisfactory provided that the screws are inserted and properly tightened. However, as demonstrated by this incident, it cannot be assumed that this will always be done. Consequently, a simple modification to the existing inspection plates (which was suggested by the pilot in this incident) has been developed by officers of the Department, which will ensure that, if the screws are inadvertently omitted or back out in flight, the forward end of the plate will not project into the airstream. The modification, which has been tested and proven satisfactory, requires not more than two man-hours per aircraft to incorporate and material costs are negligible. As there is no record of other similar incidents with DC.3's within Australia this modification has not been made mandatory. However, copies of the relevant drawing have been forwarded to all DC.3 operators with the suggestion that the modification should be incorporated at the earliest opportunity.

Investigation is still proceeding to determine whether or not such a modification would be warranted on other types of aircraft engaged in regular public transport within Australia. Meanwhile, operators have been recommended to incorporate the modification on any other inspection plates of this type which could effect air flow and controllability should they become loose in flight.

What Price Check Lists?

(6/157/130)

AT approximately 0830 hours on 19th January, 1957, a Viscount aircraft commenced a take-off from Melbourne Airport on a regular public transport service. Immediately after becoming airborne the undercarriage was selected up but failed to retract. Action was taken to ensure that the nose-wheel was centred, a requirement for retraction, and the relevant fuses were checked and found serviceable. At the captain's instructions the first officer inspected the undercarriage operating units in the hydraulic cupboard located on the flight deck and reported that everything appeared "normal". The captain then abandoned the flight and returned to Melbourne Airport.

Inspection of the undercarriage system after landing revealed that the electric actuator was not connected to the landing gear hydraulic selector valve. The actuator is mounted above the valve and the actuator ram is connected to the valve piston through a lever hinged at a point below the valve. The lever extends above these units, which are located in the hydraulic cupboard, to form a manual handle in the case of actuator failure. Movement of the landing gear selector lever on the pilot's control pedestal causes the actuator ram to move the hydraulic selector lever backwards or forwards and so move the valve piston. In the case of actuator failure, the ram is disconnected from the lever by removal of a quick-disconnect pin. The lever, and consequently the valve piston, can then be operated manually. The pin is also removed when maintenance is being carried out on the undercarriage electrical system to avoid inadvertent electrical retraction and can be placed in another hole in the lever to lock the lever, and consequently the valve piston in the down position.

Prior to this flight the aircraft had been on overnight servicing during which period work had been carried out on the undercarriage system and, in accordance with standard practice, the quick-disconnect pin had been removed from the ram-lever connection and used to lock the lever in the "Down" position. However, the pin was not replaced in the normal operating position on completion of this work and the aircraft was returned to service with the pin still out of position.

The operator's despatch check list, the responsibility of the tarmac foreman, requires that the quick-disconnect pin be checked for security before despatch. Further, the pilot's pre-flight check also requires an inspection to ensure that this pin is properly fitted. It was evident from the investigation that neither party completed a proper check of the pin and thereby failed to ascertain that it was not properly installed.

The emergency procedure in the event of the failure of the undercarriage to retract includes a check to ensure that the quick-disconnect pin is in place. On this occasion, the first officer checked the position of the pin, after the undercarriage had failed to retract, and reported to the captain that it was "normal". It appears that he observed the pin in the "down" lock position hole in the lever but apparently failed to realise that this was not the correct position for operation of the undercarriage.

Aircraft in Close Proximity During I.F.R. Flight Near Ross, Tasmania

(6/156/357)

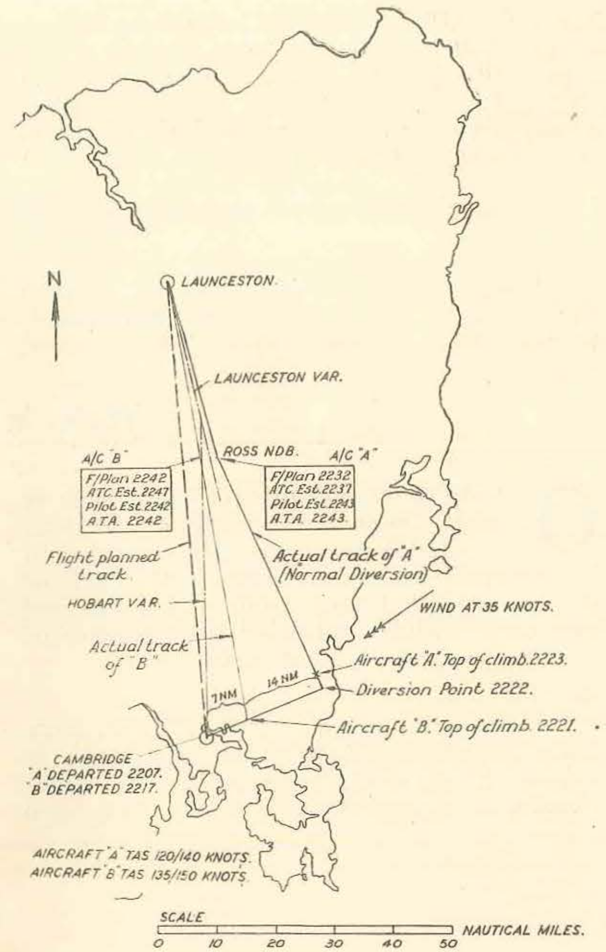
TWO DC.3's, whilst proceeding in the control area between Hobart and Launceston in the same direction at the same altitude and on similar tracks, passed one another in the vicinity of Ross without sighting, when flying under instrument conditions. At the time of the incident air traffic control believed the aircraft to be separated longitudinally by ten minutes —the permissible minimum on this route section.

CIRCUMSTANCES

Both aircraft departed from Cambridge and flight planned to proceed via the direct or V.A.R. route, aircraft "A" to land at Launceston and aircraft "B" to overfly Launceston en route to Melbourne. Aircraft "A" departed at 2207 hours but due to conflicting traffic inbound on the V.A.R. proceeded via the standard 052°M diversion climbing to 7,000 feet. Due to the direction of take-off the aircraft was on-course almost immediately after take-off when at a height of a few hundred feet. It was intended that the aircraft would rejoin the V.A.R. track on passing through 6,000 feet but due to an oversight this clearance was not passed to the aircraft. However, this omission was immaterial because of the relatively poor rate of climb achieved by the aircraft; due to high all-up-weight and turbulent conditions the aircraft was still climbing on reaching the end of the diversion track.

Aircraft "B" departed at 2217 hours (10 minutes separation with aircraft "A") also proceeding via the standard 052°M diversion and climbing to 7,000 feet. Due to a different take-off direction to that used by "A", aircraft "B" set course over the airport at approximately 1,500 feet and slightly north of the track of "A". Shortly after setting course "B" was cleared to rejoin the V.A.R. track on passing through 6,000 feet. "B", a lightly laden freighter aircraft encountered moderate up-currents during the climb, therefore the cruising level of 7,000 feet was achieved in a few minutes and the distance flown along the diversion track was about seven miles. The pilot did not advise air traffic control of any variation from the flight planned rate of climb as required by the Aeronautical Information Publication. Although the aircraft reached 6,000 feet shortly after take-off, the pilot was not required or requested to notify Air Traffic Control when he was rejoining the V.A.R. track.

Aircraft "B", which had departed from Cambridge 10 minutes after "A", passed the first reporting point of Ross at 2242 hours, the flight planned time for the direct route; this was one minute before "A" and five minutes earlier than the time assumed by air traffic control. Aircraft "A" passed Ross at 2245 hours which was eleven minutes later than the flight planned time for the direct route and six minutes later than the time assumed by air traffic control. Although it has no bearing on the incident it is noteworthy that aircraft "B" passed Ross at 2242 hours but did not report the position which was obtained both by visual observations and radio compass, until 2247 hours.



ANALYSIS

Both aircraft had flight planned to proceed via the V.A.R. route. The diversion track of 052°M on which the aircraft were instructed to depart involved 21 miles of flight almost directly into a 35 knot wind as against an abeam wind on the flight planned track of 340°M; also, the diversion track was 17 miles longer than the flight planned track. Despite these factors air traffic control did not request any amended time intervals from the aircraft but based control on the assumption that both would take an additional five minutes to the first reporting point (Ross) over the flight planned time. This five minutes was an estimate based on past experience of the time difference for this type of aircraft to fly the diversion track as against the V.A.R. track. During the investigation it was discovered that the issuance of air traffic clearances between Launceston and Hobart air traffic control units, and Hobart air traffic control and aircraft was not conducted in a positive manner. Action has been taken to rectify these matters.

The assumption that as the aircraft were of similar type the performance would be similar, and therefore if ten minutes separation existed on departure this would be maintained throughout the flight, was incorrect for, on the basis of the flight planned information available at the time the clearances were issued, aircraft "B" could have been expected to have reduced the separation by about five minutes. During the investigation it was established that the actual true airspeeds flown by aircraft "A" were five knots lower than flight planned and aircraft "B" was flown 10 knots higher on the climb than flight planned. "A" took sixteen minutes to climb to 7,000 feet and flew into wind (040/35 knots) on the diversion for fifteen minutes whilst "B" reached 7,000 feet in about five minutes, and only flew into wind on the diversion for four minutes. Using these actual figures and the forecast wind, time intervals can be calculated which are within one minute of the actual times taken by the aircraft (see accompanying sketch).

Whilst every precaution is taken to ensure that separation standards are maintained, human errors can occur in air traffic control as in all other phases of operations, air traffic controllers being human are not infallible. Pilots must assist in ensuring the safety of operations by complying with the requirements of the Aeronautical Information Publication and by advising all changes to flight plans, particularly E.T.A.'s. Such advice ensures that air traffic control reviews the traffic pattern and issues appropriate instructions in the light of the changes notified. Obviously, if an error has been made previously there is every possibility it will be detected at this stage and corrective action taken.

Water in the Petrol

(6/557/52)

ON 15th March, 1957, after refuelling at Leigh Creek, the captain of a DC.3 reported a large quantity of water in the aircraft tanks. A subsequent check of the underground tank from which the fuel had been drained indicated the presence of water in substantial quantities.

Investigation revealed that the fuel company agent displayed gross negligence in failing to carry out the prescribed water checks, and disciplinary action has been taken against him by the Company concerned.

Action is being taken to install at Leigh Creek two electronic water detecting probes in the 3,000 gallon storage tanks. This action will provide substantially improved protection by facilitating the detection of water contaminated fuel before refuelling.

The final check is at the aircraft weatherheads. It is the responsibility of the pilot to ensure that this check has been carried out correctly; it paid dividends in this case.
