EPILOGUE

By the time you read this another year will have passed, a year which, in passing, will have treated us all to some new experiences in our own particular field of work. In total, these experiences amount to a vast pool of knowledge but only a mere fraction will ever be available to benefit all. For those who have acquired the know-how of using knowledge, whether gained by personal experience or through the experience of others, this is a sad thought..

The purpose of the Digest has been to make available to readers at least the highlights of those experiences which have come to our notice. We are confident that its pages have, at some time, carried an important lesson for each and every one, but there is good evidence to show that the lessons are not always learnt. There could be many reasons for this but we would place foremost amongst them that arch-enemy of safety, the "false sense of immunity." This false sense can only be eradicated from within, there being no foolproof treatment that can be offered by any safety system. To those who are afflicted with this form of hallucination we can only suggest they look back to some encounter that brought them unpleasantly close to an accident and accept our word that their escape was not due to any mysterious protective force but rather to a purely fortuitous arrangement of the circumstances involved.

Procrastination plays a prominent part in preventing people from following their better judgment and often leads to a dismal series of discarded intentions. In aviation those intentions could relate to habits and weaknesses which are potentially dangerous. To those who have cause to be guilty in this respect it can only be said that security in aviation is directly related to the state of preparedness of the individual.

We will continue our aim of improving your knowledge through this publication, but it should be remembered that the quality, quantity and variety of material that can be offered is governed by what we are told or what we can discover. Naturally, we have a strong preference for what we are told because it more often than not relates to some event that has fallen short of disaster. You can make a worthwhile contribution to our aim in the year ahead by making the incident reporting system a true medium of self-help.

Since it is traditional at this time each year to reflect on the past and plan for the future, why not resolve to become a positive force rather than a negative one in the scheme of aviation safety?

COMMONWEALTH OF AUSTRALIA

Aviation Safety DIGEST

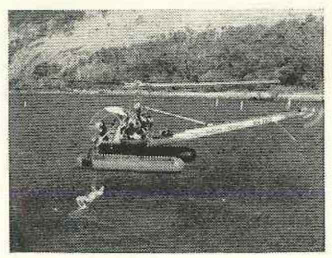
NO. 20, DECEMBER 1959

AVIATION SAFETY DIGEST

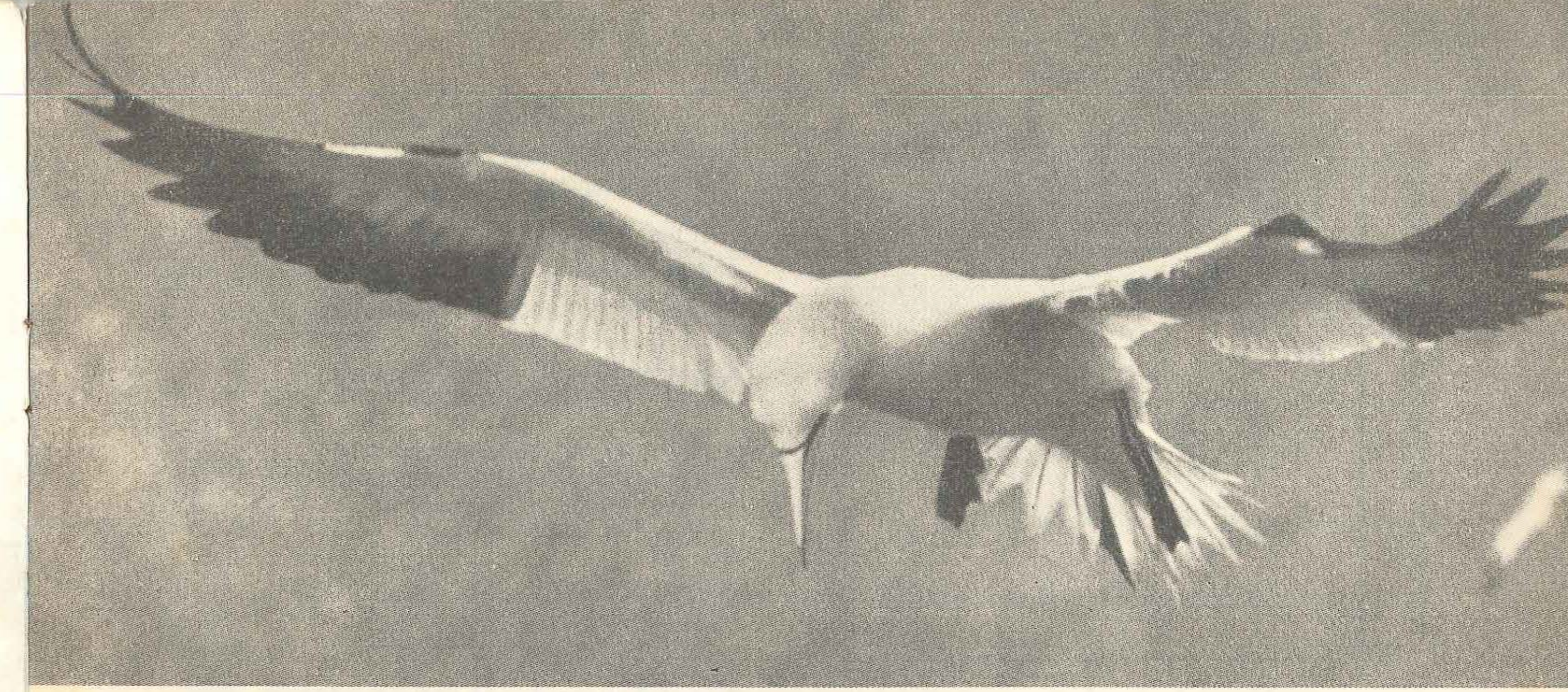
No. 20 DECEMBER, 1959

Prepared in the Division of Air Safety Investigation.

Contents



A Trans-Australia Airlines Hiller H.12C Helicopter demonstrating rescue techniques during the Whitsunday Festival on the Great Barrier Reef.



The STALL

— CAUSE and EFFECT

During the past five years in civil flying in Australia there have been 176 aircraft accidents involving loss of control near the ground, many of them being fatal. The most common cause of loss of control was an inadvertent stall followed by a spiral dive or spin. No doubt there have been many other undisclosed occurrences wherein recovery from the loss of control has narrowly averted their inclusion in this record of accidents.

In some of the accidents there may have been other contributory circumstances, but in nearly every case the accident could almost certainly have been avoided had the pilot possessed a more thorough knowledge of certain factors governing an aircraft's performance in particular conditions of flight. The record shows that manoeuvres have been attempted in circumstances and in a manner which clearly indicate that the pilot did not fully appreciate the degree to which the stalling speed can increase with an increase in either the static loading which is the all-up weight or the dynamic loading or load factor which is induced by acceleration in the pitching plane.

It is when these two factors are in combination that the stalling speed increases most significantly, and we believe that it is in relation to these flight circumstances that the need for improved knowledge is greatest. In some types of aircraft in a moderately steep turn at high all-up-weight it would be possible for the stalling speed to be some 50% higher than for a straight stall when lightly laden. The purpose of this article is to help you to understand the underlying reasons for this behaviour in flight; the article is by no means intended as a complete coverage on the subject.

First of all, what is a stall? It is a condition wherein any increase in angle of attack produces no additional lift and is due to the normally smooth flow of air over the upper surface of the wing breaking down into a turbulent flow. This condition will always occur at the one critical angle of attack for a particular wing form, regardless of airspeed.

In the absence of an angle of attack indicator, visual warning of the stall can be obtained from the airspeed indicator provided that the pilot is aware of the stalling speed appropriate to the manoeuvre being performed. The stalling speed of an aircraft for a given all-up-weight in straight and level flight is the airspeed at which the wing will be at the critical angle of attack. When either the all-up-weight or dynamic load is increased the wing will stall at the same angle of attack but at a higher airspeed.

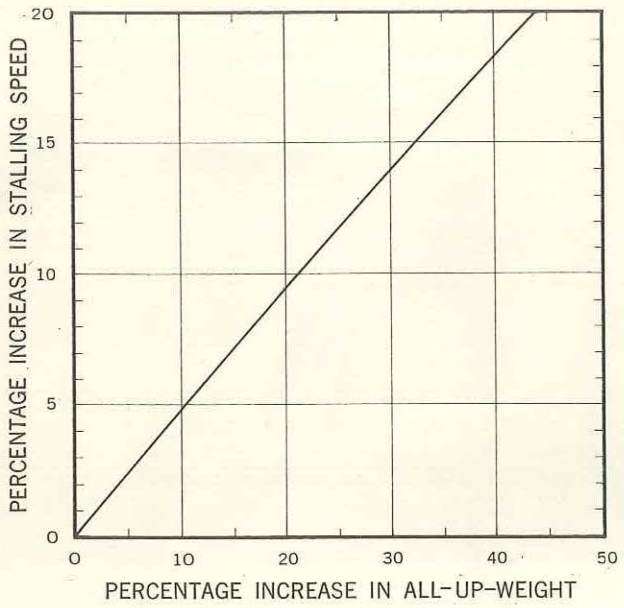


Fig. 1

THE RELATIONSHIP BETWEEN STALLING SPEED AND ALL-UP-WEIGHT

Airspeed and angle of attack are the only two factors governing lift (apart from lift augmenting devices and power) over which the pilot has control, therefore, if the airspeed is reduced the angle of attack must be increased and vice versa to maintain a constant value of lift. The stalling speed for any given weight and power setting is the speed at which the wing is operating at its critical angle of attack. If, at this point, the all-up-weight were to be increased, the lift required to support this additional weight could not be obtained by increasing the angle of attack since a stall would result, so it could only be obtained by an increased airspeed which would be the stalling speed for the new all-up-weight.

It may be said (with acceptable accuracy) that this change in stalling speed is in proportion to the square root of the wing loading and is given by —

$$V_s = V\sqrt{\frac{W_2}{W_1}}$$

Where
V_s = New stalling speed
V = Stalling speed at W_1
W_1 = Initial weight
W_2 = New weight

$$\text{Example} = V_s = 50\sqrt{\frac{6{,}250}{5{,}000}}$$

New stalling speed = 56 knots.

The following figures show the increase in stalling speed for various percentages of increase in all-up-weight for an aircraft having a stalling speed of 50 knots at an initial weight of 5,000 lbs.

Aircraft Wgt. Lbs.	5000	5250	5500	6000	6500	7000
Percentage Increase in Wgt.	—	5	10	20	30	40
Stalling Speed in Knots . .	50	51	52	55	57	59
Percentage Increase in stalling speed . .	—	2	4	10	14	18

It will be readily apparent how the values in this example may also be obtained from the graph at Fig. 1, which is applicable to all orthodox types of fixed wing aircraft.

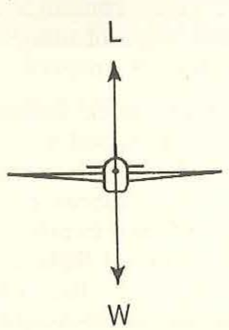


Fig. 2
Level flight.

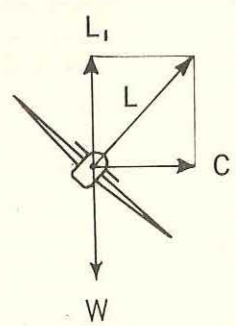


Fig. 3
Medium turn.

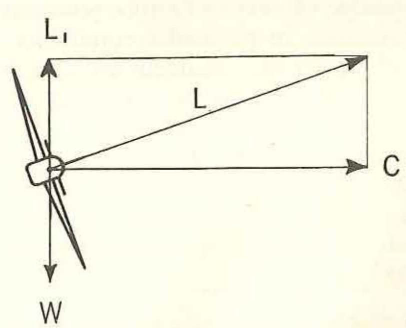


Fig. 4
Steep turn

THE RELATIONSHIP BETWEEN THE LOAD FACTOR AND STALLING SPEED

In the case where an added load factor is present, as in a turn, there is an acceleration towards the axis of the turn. To gain this acceleration or change in the aircraft's flight path a force is required and it can only be provided by the wing. This force is known as centripetal force, which is equal and opposite to centrifugal force and its magnitude varies with the weight and speed of the aircraft and the radius of turn.

The angle of bank required in a sustained balanced turn is governed by the speed and the radius of turn. Increasing the speed or decreasing the radius of turn requires an increase in the angle of bank with a consequent greater rate of turn. Conversely, a decrease in speed or an increase in radius requires less bank, thus giving a lesser rate of turn.

When the wings are banked the level flight balance of forces is changed as is shown in the diagrams

It can be seen in Fig. 2 that the lift vector is opposite to the weight vector, therefore lift need only equal weight to maintain level flight.

In Fig. 3, with the aircraft banked in a level medium turn, the lift, which acts at right angles to the pitching axis, is no longer acting in direct opposition to the weight which, of course, is still acting vertically downwards; consequently, if height is to be maintained, the lift must be increased until its vertical component L_1 is again equal to the weight vector. The vectors for a steep turn are shown in Fig. 4.

It can be seen that as the angle of bank is increased in a level turn the wings must produce a greater amount of lift in order to maintain the height and, simultaneously with this, an increasing proportion of the total lift force L will go into the centripetal force C, thereby giving a greater rate of turn. As the angle of bank and rate of turn increases, the wing is required to develop more lift per square foot than it does during straight and level flight. The load factor will increase and, with it, the stalling speed which, for practical purposes, does so in proportion to the square root of the load factor.

To determine this increase in stalling speed it is necessary to first calculate the centripetal force and then the load factor in the following manner:—

$$\text{Centripetal force} = \frac{WV^2}{gr}$$

Where
W = static weight in pounds.
V = speed in feet per second.
g = gravity rate (32.2 feet/sec.^{2}).
r = radius of turn.

$$\text{Example — Centripetal Force} = \frac{5000 \times 144^2}{32.2 \times 500} = 6{,}440 \text{ lbs.}$$

From this the load factor is obtained by —

$$\text{Load Factor} = \frac{\sqrt{F^2 + W^2}}{W}$$

Where F = Centripetal force in lbs.
W = Static weight in lbs.

$$\text{Example — Load Factor} = \frac{\sqrt{6440^2 + 5000^2}}{5000} = 1.63.$$

This is the load factor, but it can also be said that a force of 1.63 "g" is present.

To obtain the stalling speed from this —

New stalling speed = Stalling speed for the particular static weight $\times \sqrt{\text{Load factor}}$

Example — New stalling speed $= 50\sqrt{1.63}$ = 64 knots.

For an aircraft having a stalling speed of 50 knots at 1g, the following table shows the increase in both the load factor and the stalling speed for various angles of bank.

Angle of Bank .	0°	20°	30°	40°	50°	60°	70°	80°
"g" or load factor .	1	1.07	1.15	1.30	1.56	2	2.9	5.8
Stalling speed in knots .	50	52	54	57	62	71	85	120
Percentage increase in stalling speed .	—	4	8	14	24	42	70	140

The calculation involved in producing these figures is a little tedious for everyday use, so at Fig. 5 is a graphical presentation of the percentage increase in stalling speed with relation to angle of bank, in which the values obtainable will be applicable to all orthodox types of fixed wing aircraft. The load factor or "g" values are included for information only. Reference to the preceding tabulated example will confirm the method of using the graph.

The marked increase in stalling speeds at the higher angles of bank should be carefully appreciated so that when entering what is to be other than a moderate turn, there will be a proper awareness of the stalling speed appropriate to the turn intended.

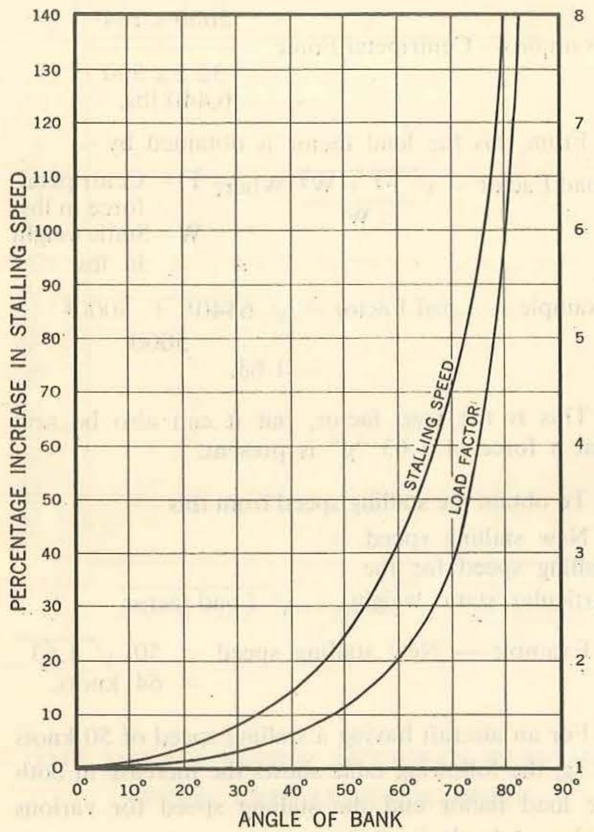


Fig. 5

To avoid the possibility of introducing an error into the calculations and when using the graphs, it is necessary to correct the I.A.S. for position error and instrument error so as to obtain the actual airspeed. When the new stalling speed is established it will be necessary to convert it back to I.A.S., using the applicable values for these two corrections but with the signs reversed.

OTHER FACTORS WHICH AFFECT STALLING

Increasing power in a turn. We have seen how the stalling speed increases at an expanding rate with increasing rates of turn. It is also necessary to appreciate that, simultaneously with this, the airspeed tends to decrease, also at an expanding rate, because of the increased drag due to the greater angle of attack needed to provide the additional lift for the turn. By increasing power at the commencement of a high rate turn, this tendency for the airspeed to decrease will be offset in proportion to the amount of power applied and thus permit a faster rate of turn.

Position Error Correction. Variation of the Position Error Correction throughout the aircraft's speed range can give the impression of a greater safety margin of speed above the stall than actually exists. In the case of an aircraft which stalls at 50 knots I.A.S., at which speed the P.E.C. is + 11 knots, and the recommended climb or approach speed is 75 knots where the P.E.C. is + 6 knots, the actual speed when in the climb or on the approach will be only 20 knots above the stall and not 25 knots as might appear.

Wing Damage. Since a stall involves the change from a smooth to a turbulent flow of air over the wing, it follows that should there be any damage or irregularity particularly on the wing upper surface, the turbulence associated with the stall will be induced at a lower angle of attack and at a higher airspeed than would otherwise occur.

Ice and Frost. In a similar manner to wing damage, ice or frost on the wing can greatly reduce lift and increase the stalling speed. In cases where the accumulation of ice is extensive, the increase in all-up-weight will increase the stalling speed even further.

Turbulence. Due to the inertia of the aircraft, severe up-draughts in turbulent conditions can temporarily change the direction of the airflow relative to the wing and precipitate a stall condition. It should be pointed out, however, that the recommended speed for flight in turbulent conditions for a particular aircraft type is such as to permit a stall to occur before the structural load limits is exceeded.

Spinning. It should be remembered that in a stall a wing may drop and the angle of attack of the down-going wing will thereby be increased and thus stall to a degree greater than the up-rising wing. The increase in drag caused by this greater angle of attack produces a yaw towards this wing which is the incipient stage of the spin and must be recognised and corrected early in its development, otherwise a fully developed spin may result.

If you are not convinced that these principles have any practical application, don't be surprised if, one day, you find yourself confronted with an unexpected flight situation which will add to the statistics quoted at the beginning of the article.

CROSSED CONTROLS

A 50-hourly inspection on an aircraft engaged in agricultural operations was approaching completion at Moorabbin Airport in Victoria when the engineer in charge of the work decided that a check of maximum engine r.p.m. in take-off was desirable before it was dark. Although the full inspection had not been completed the aircraft was made ready for this test circuit and the aircraft was handed to a company pilot with the assurance that it was in a suitable state for this test. Immediately after becoming airborne, the aircraft was observed to assume a very nose high attitude. It climbed steeply to about 40 feet where the engine was throttled off and the left wing dropped, followed by the nose, and the aircraft dived into the ground at an angle of between 40 and 60 degrees and rolled on to its back. The pilot was seriously injured in the impact and an observer, who was being carried to note the instrument readings, received minor injuries. The aircraft was substantially damaged.

A propeller modification had been made during the course of this 50-hourly inspection and this gave rise to the need for a test circuit. During the same inspection the elevators were removed from the aircraft in order to effect repairs and this, of course, involved disconnection of the rear ends of the control cables from the elevator horn. An examination of the wreckage revealed no evidence of any defect in the aircraft or its engine other than that the elevator cables were installed in such a way as to reverse the normal sense of operation relative to control column movement.

The pilot, who had over 4,000 hours of flying experience, including some 200 hours on this type, states that the take-off run appeared perfectly normal until the aircraft became airborne. When the aircraft assumed the nose high attitude at this point he put the stick hard forward and trimmed in the same direction. When the nose continued to go up he throttled back and allowed it to drop. He took other measures to control the aircraft but without success, and he did not appreciate from the feel or behaviour of the aircraft that the elevator controls were crossed. In fact, the pilot remained unaware that the controls were crossed until he was informed of this some time after the accident. In the time available and in the stress of such an immediate emergency, it is well appreciated that he had little time for analysis and no doubt most of his reactions were entirely instinctive. The pilot says that he checked the movement of control surfaces for freedom and sense prior to the take-off, but he points out that, in this type of aircraft, the elevators are difficult to see from the cockpit and it is apparent that his check was insufficient to detect the reversal of these controls.

There can be little doubt that the pressure to get the aircraft serviceable for a test flight before last light meant that some aspects of the inspection work were hurried. The investigation revealed that no dual check of the flight control installation was carried out prior to the flight. Even more remarkable is the fact that the cable ends were connected to the elevator horn in such a way that one cable was left rubbing against a pulley bracket and both cables changed direction at the pulley point in a manner which was in obvious conflict with the installed planes of the pulleys. The fact that these cables can be connected to the wrong ends of the horn does certainly leave an opportunity for "Murphy's Law"* to operate, but to any qualified engineer working under normal circumstances the correct method of connection should have been apparent even without reference to a drawing or instruction manual.

* Murphy's Law — "If a part can be installed incorrectly, someone will install it that way!"

The crossing of control cables has long been recognised as a very potent source of accidents in aviation. This recognition alone by both engineers and pilots has gone a long way towards making this type of accident a rare occurrence. The Department has also recognised the potency of this situation and has required two independent checks of the control systems after any work had been performed on them. In addition, there is a requirement for pilots to check the sense and freedom of controls before take-off. The fact that this aircraft got into the air despite all these precautions can only mean that there was serious negligence on the part of the engineer involved and the pilot. It should not be necessary to emphasise again the importance of close attention to safety when the operation of control surfaces is involved, nor should it be necessary to point out that when work is to be performed in a race against time there is always a danger that the normal precautions will be overlooked and that a serious accident potential will be introduced.

This and previous accidents of a similar nature have shown very clearly that it is almost impossible for a pilot to cope with crossed elevator controls. The only effective remedy is prevention and this requires the utmost care by all persons involved in any work which may lead to such an error. Work that is rushed is never done well and this is one situation where haste can and almost certainly will be fatal.

COLLISION

"The closest target is not necessarily the most dangerous"

(Flight Safety Foundation — Accident Prevention Bulletin, 54-10)

"The behaviour of closure rates and closure angles of two converging aircraft is related to the collision potential present. It is a well known fact that an approaching plane whose closure angle remains constant is on a collision course and that the more slowly the angle changes the closer the approach to a collision course. Parallel statements can be made concerning closure rate: a constant rate is a definite collision indication, and the more slowly it varies, the closer the approach to collision conditions. For example, refer to the cases shown in Figures 1 and 2.

"As the airplanes approach the collision point, the closure angle O and the closure rate remain constant. In the near-miss case shown in Figure 2, the range does not decrease uniformly; the closure angle increases as the planes converge; and plane A arrives at the course intersection before B. The greater the miss-distance the larger the rate of 0 and the rate of change of closure rate.

"In these examples, straight-line flight at constant speeds was used. The conditions stated also hold for curved paths and varying speeds but, in this case, while sufficient, they are not necessary. A collision could occur even though a prior history of rapidly varying closure rate (or angle) had prevailed. But since the greater portion of airline operating time is spent in essentially straight-line flight, the constant closure rate and constant closure angle conditions can serve as useful tools for prior recognition of collision threats.

"In practice, a means must be provided whereby several aircraft may be observed and the most dangerous one singled out. In this respect, the concept of closure time is useful. Closure time is the ratio of range to closure rate, and is defined as the time it would take an aircraft to 'arrive" if it were to continue its approach at a constant rate. For example: a plane ten miles away (range) approaching at ten miles a minute (closure rate) would arrive in one minute (closure time).

"Figure 3 demonstrates how closure time can be used for target discrimination.

"The closure time of A (closing on C) is twelve seconds and the closure time of B (also closing on C) is thirty-six seconds. We can, therefore, conclude that the closest target is not necessarily the most dangerous since A will be the first to arrive."

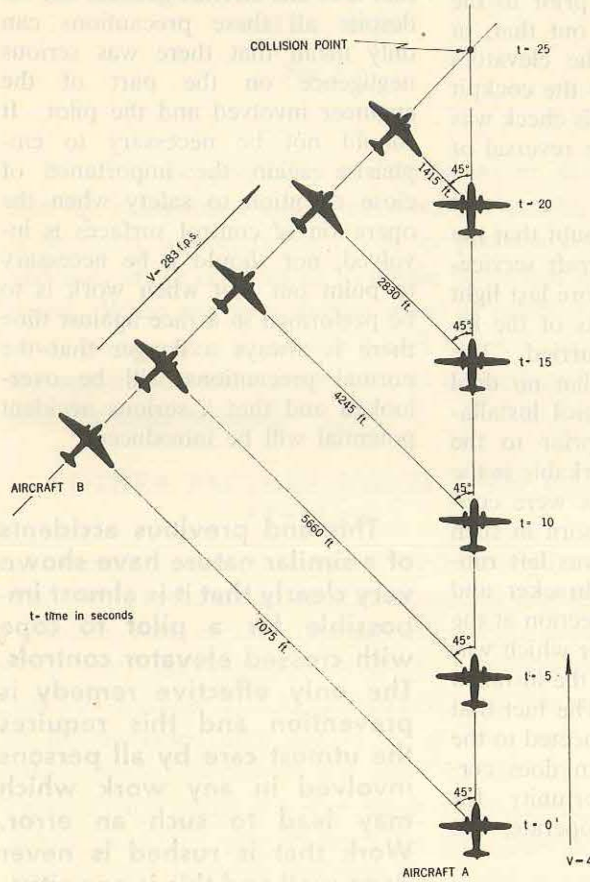


FIGURE 1 — Two aircraft at identical altitudes converging and on collision courses. Note the constant closure angles and closure rate.

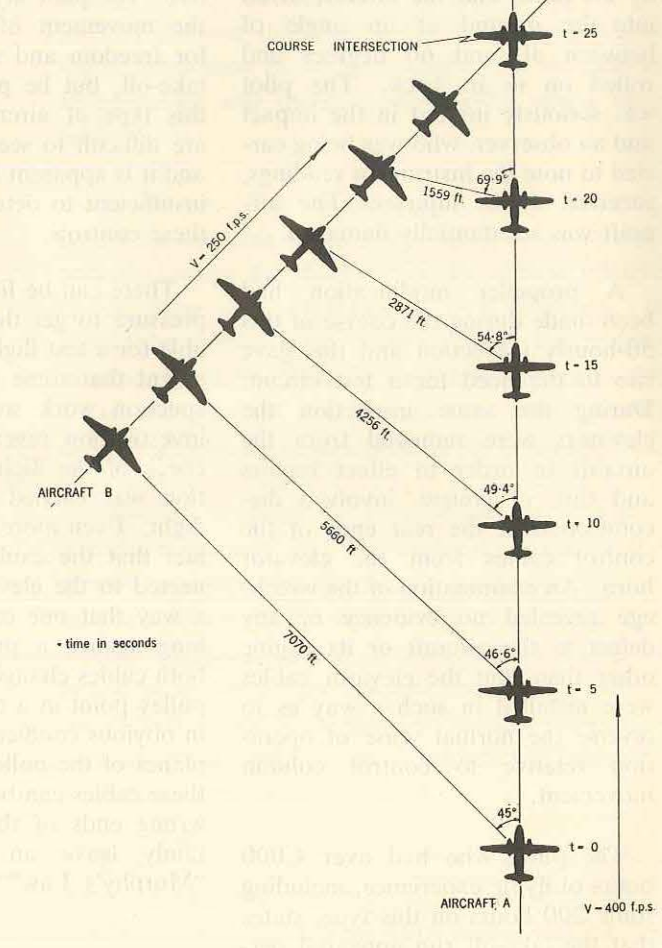


FIGURE 2 — Two aircraft at identical altitudes flying near-miss courses. Note the changing closure angles and closure rate.

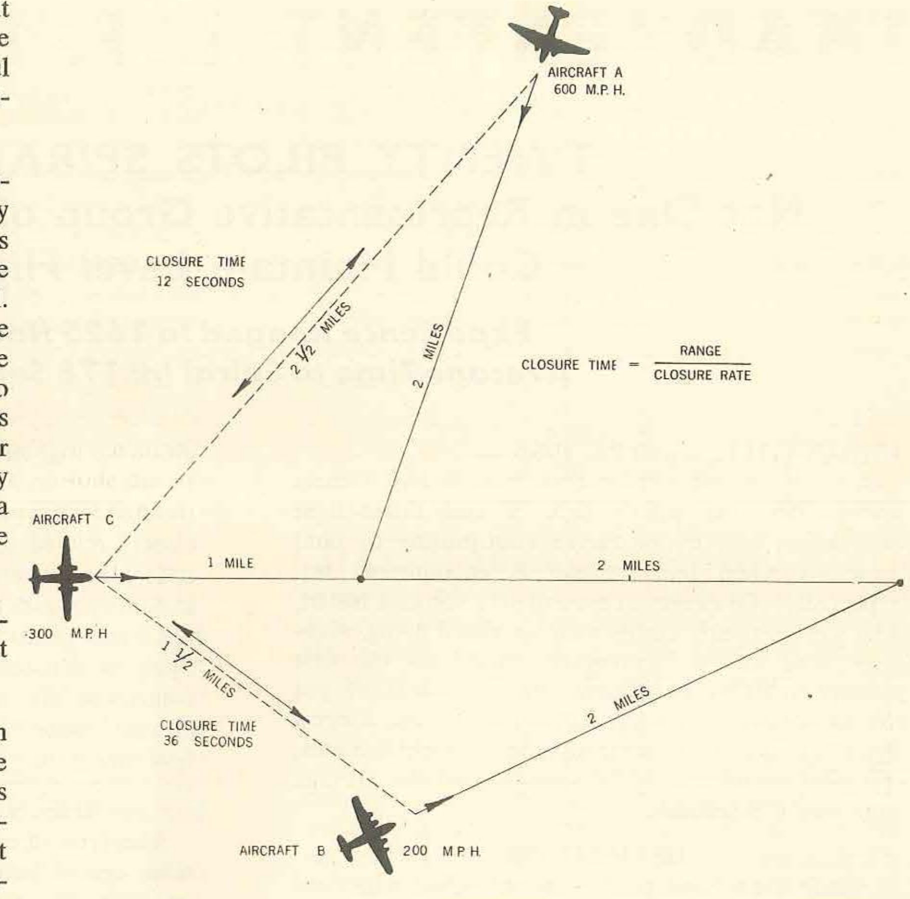


FIGURE 3 — Hypothetical case of "double" collision threat demonstrating that the closest plane is not necessarily the most dangerous.

See and Be Seen

Although closure rates on many modern aircraft can be in the order of a thousand feet per second, "See and Be Seen" is still a sound premise for collision avoidance. It is clear, however, that the time in which to take evasive action grows dangerously shorter as aircraft speeds increase. Never-ending vigilance on the part of everyone who flies is a MUST. The following don'ts must be observed:

Don't fly with a dirty windshield.

Don't go V.F.R. in borderline weather.

Don't forget the limitations to vision brought about by cockpit.

Don't be misled by slant visibility — actual forward vision range may be much less.

INADVERTENT I. F. R. FLIGHT

Extract from Flight Safety Foundation Inc. (St. Peter's Gazette, Vol. 13, No. 13)

TWENTY PILOTS SPIRAL IN

Not One in Representative Group of Private Pilots Could Maintain Level Flight

Experience Ranged to 1625 Hours
Average Time to Spiral In: 178 Seconds

URBANA, ILL., April 23, 1956 —

A study undertaken by the University of Illinois reveals that the pilot's lack of instrument-flight experience is a major factor contributing to fatal accidents when bad weather is encountered unexpectedly. Of twenty representative subjects tested, who were properly certificated for visual flying, nineteen went into a "graveyard spiral" on the first attempt to fly by instruments, and the twentieth put the airplane into a whip-stall attitude. The longest flight before getting into trouble lasted eight minutes; one pilot required only 20 seconds, and the average time was 178 seconds.

DEFINITIONS

A non-instrument pilot is an individual who does not hold a C.A.A. instrument rating or its equivalent. Instrument weather is that atmospheric condition in which the pilot has no visual points of reference outside the aircraft. Most non-instrument pilots can be placed in one of the three following categories:

(a) the non-instrument pilot who knows he could not fly instruments and takes every precaution to avoid instrument weather;

(b) the non-instrument pilot who "knows" he could not fly instruments, takes every precaution to avoid instrument weather, but believes his knowledge and experience would enable him, if caught, to fly out of the instrument weather;

(c) the non-instrument pilot who believes, primarily through ignorance of the problems involved, he could fly through instrument weather.

MISCONCEPTIONS

It seems true that a large majority of the non-professional pilots, untrained in instrument flying, entertain a basic misconception about the nature of instrument flying. This misconception centres around the idea that instrument flying can be learned through a series of flights under progressively lower visibilities, where the technique employed is gradually modified from that used under CAVU* conditions to that employed under instrument conditions. In addition, many of these pilots mistakenly believe that the techniques involved in visual night flying are closely related to instrument flying. However, the difference between visual flying and instrument flying is neither the degree of visibility nor the number of reference points available to the pilot; instrument flying is denoted by the reference points used for controlling the attitude of the airplane which are located inside, not outside, the airplane. It is not how much the pilot sees, but where he sees it.

* Ceiling and visibility unlimited.

THE NATURE OF ACCIDENTS

The type of accident under consideration usually takes one of two forms, either the so-called "graveyard spiral" or the "roller coaster."

The "graveyard spiral" is the most prevalent, and it is abetted by the lack of positive spiral stability in present-day aircraft. The following series of events are involved:

1. Shortly after entering instrument conditions the airplane starts to turn;
2. The pilot fails to note the turn or, if he does note it, fails to correct, usually because of vertigo;
3. The bank increases, causing the nose to cant downward, which results in an increase in airspeed; the pilot recognises the increased airspeed and applies corrective measures in the form of increased back pressure on the yoke or stick;
4. The increased back pressure tightens the turn, the nose cants downward, the airspeed increases, and more back pressure is applied in an effort to slow the airspeed.

To an observer riding along, it appears that the pilot rolls gently into an increasingly steeper bank and allows the degree of dive to increase simultaneously. Under these conditions a very short time is required for the airplane to go from normal flight into a diving spiral, a 60 to 70 degree bank, and the red-line airspeed. The cleaner the airplane, the less time required for this to happen.

THE "ROLLER COASTER"

The second variety, appropriately called the "roller coaster," occurs when the pilot fixes his attention on the airspeed indicator and/or the altimeter. The pilot is inclined to rely on these two instruments in an unfamiliar situation since they are the instruments most frequently used under visual conditions. However, the pilot fails — or is unaware of the necessity — to allow for momentum lag. In an effort to make the indicators show the desired reading, he puts the airplane through a series of increasingly violent climbs and dives. Unfortunately, the "lagging" instruments give the impression that the airplane is at the top of a climb when it is actually in a diving attitude, or vice versa. The final result is usually a structural failure due to excessive G loads.

INCIPIENT DANGEROUS FLIGHT CONDITIONS

Such accidents (1) occur with the greatest frequency in single-engine airplanes of less than 5,000 pounds gross weight; (2) happen in airplanes which are equipped with either partial or full instrument panels; (3) occur with the greatest frequency to non-instrument-rated pilots; (4) happen most often to pilots who have had no previous experience under either actual or simulated instrument conditions; and (5) occur in marginal or sub-marginal conditions.

All authorities agree that non-professional pilots, untrained in instrument-flying techniques, place too much emphasis on instrument-flying equipment and too little emphasis on proper training in the use of instruments. Experts are at a complete loss to explain the enigma of a businessman-pilot, who invests several thousands of dollars in an airplane with a full instrument panel, radio equipment, and even an auto-pilot, but who is unwilling to invest additional funds or the time to obtain instrument experience which would enable him to make the safest and most efficient use of his airplane.

THE CRITERIA

On the basis of preliminary testing it was decided that for the purpose of this study an incipient dangerous flight condition and/or attitude had been reached when the subject pilot allowed any one or any combination of the following situations to develop:

1. A stall, either normal or accelerated;
2. A bank in excess of a medium bank (45 degrees);
3. A speed in excess of normal fast cruise;
4. Obvious and prolonged loss of either altitude or directional orientation.

CASE STUDY PROCEDURE

The twenty subjects selected on the basis of the foregoing criteria were given the course of instruction and the tests. In order to eliminate instructor differences, only one flight instructor was used for the twenty cases studied. Accurate records of the flight time, simulated-instrument time, and performances were kept by the instructor.

Standard altitude for beginning the first simulated-instrument flight was 2,500 feet above mean sea level (1,750 feet actual). Higher altitudes were used during the first flights of the first five subjects; a change was made to the lower altitude because the potential disaster was more apparent to the subject if the ground were literally "staring him in the face" when he raised his goggles.

RESULTS

Nineteen subjects placed the airplane in a "graveyard spiral" on the first attempt to fly by instruments. The twentieth subject pulled the airplane into a whip-stall attitude. Minimum time to reach the incipient dangerous attitude was 20 seconds; maximum time was eight minutes. These results re-affirm the generally accepted premise that the spiral instability of present-day light aircraft, together with the pilot's lack of instrument-flight experience, is a major factor contributing to fatal accidents.

The table below shows the time required by each subject to reach an incipient dangerous flight condition. The time shown is the total time from the point the goggles were placed over the subject's eyes to the moment he was instructed to remove the goggles and observe the dangerous attitude of the airplane.

Subject Number	Time Elapsed in Seconds	Subject Number	Time Elapsed in Seconds
1	170	11	180
2	190	12	40
3	61	13	124
4	150	14	60
5	243	15	20
6	364	16	181
7	20	17	65
8	480	18	58
9	210	19	360
10	180	20	420

The average time was 178 seconds or 2 seconds short of 3 minutes.

COMMENT

This is an American report with a definite Australian application. The subject pilots used in the University of Illinois tests could well have been Australian pilots because our standards are the same. (See "The Inside Story," Aviation Safety Digest, No. 18.) Accept the warning — unless you are a fully qualified instrument pilot flying a properly instrumented aeroplane KEEP OUT OF CLOUD.

Comanche Lost in Adverse Weather

AUCKLAND, NEW ZEALAND

During the course of a transit flight from Mangere to Whangarei, New Zealand, on a V.F.R. flight plan, the pilot of a Piper Comanche initiated a distress call, stating that he was in cloud. During subsequent attempts to home the aircraft to Whenuapai, transmission from the aircraft ceased. The aircraft was later found in the sea 10 miles west of Muriwai Beach, Auckland, New Zealand.

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

THE FLIGHT

On the 13th October, 1958, the pilot hired a Piper Comanche from the aero club at Harewood for the purpose of taking three friends to Whangarei and back. The flight was to be accomplished in easy stages and during the first stage to Paraparaumu, the pilot was diverted to Woodbourne because of adverse weather. The second stage of the flight, to Mangere, was accomplished without incident, but the party was forced to return to Mangere on the two following days due to marginal weather conditions.

The following day the party arrived at Mangere aerodrome where the pilot filed a V.F.R. flight plan with Auckland A.T.C.C. via the eastern coastline to Whangarei designating "return" to Mangere as the alternate airfield. The pilot was advised to discuss the weather situation with the meteorological office. It was noted by the aerodrome staff that the pilot spent some time on the telephone and the call was assumed to be in connection with the weather. Conversation between the pilot and passengers created the impression that one of the passengers had an urgent reason for getting back to Christchurch that evening. The pilot was heard to say that cloud was low over the Waitakeres and he would, therefore, take the easterly route in an attempt to fly around the cloud.

The aircraft took off from Mangere and the pilot established contact with Whenuapai Air Traffic Control on 118.1 mcs. at 1140 hours announcing that he was airborne en route Whangarei. At 1203 hours he again contacted Whenuapai Tower stating that he was in cloud and asking to be located. He was immediately instructed to change frequency to 119.7 mcs. The aircraft was located and attempts were made to home it to Whenuapai. At 1219 all transmissions from the aircraft ceased and at 1220 hours, while a routine sweep for precipitation was being made on the ME7 Radar from Whenuapai, an unidentified blip appeared on the screen. The strength and definition of the blip was exactly consistent with that of an aircraft. The blip appeared at 272°T at a range of 25,000 to 30,000 yards. The elevation was estimated at 2½ to 3 degrees. An object at 2½ degrees at 30,000 yards range would be at an altitude of 3,900 feet. The blip was observed for about half a minute and appeared to be moving parallel to the bearing. The ME7 operator then transferred his attention to the plotting of a shower and a minute later was surprised to note that the blip had disappeared.

The following day an RNZAF pilot searching for the Comanche observed oil slick on the water 10 miles weast of Muriwai Beach. On the 4th November the starboard wheel complete with fork assembly was washed up on the beach at Manukau Heads. Some 23 days later the nose wheel, complete with undercarriage assembly heavily corroded by salt water, was found on the beach at Oakura Beach, seven miles south of New Plymouth. Both of these components were identified as part of a Comanche aircraft. The nature of the damage to the undercarriage indicated clearly that the wheels were lowered when the aircraft struck the sea.

INVESTIGATION

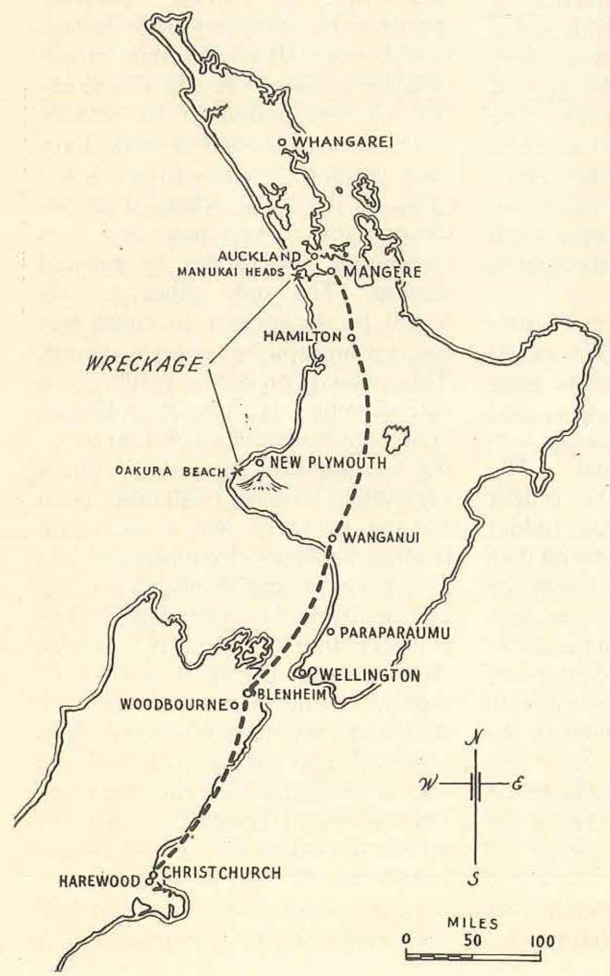
The pilot held a private pilot licence and had flown a total of 191 hours during eleven years, of which nine hours thirty minutes were on Comanche aircraft. By aero club standards, he was a very experienced cross-country pilot, having flown 131 hours 35 minutes of his total flying on cross-country flights, four of which were in the Comanche in three weeks preceding the accident. However, he had **no instrument flying training.**

From the transcript of the radio-telephone transmissions between the aircraft and Whenuapai Control, and from the positive identification and condition of the salvaged components, it is clearly evident that the aircraft was in cloud at 1203 hours and crashed into the sea some sixteen minutes later.

The pilot did not lodge a request with the Auckland Meteorological Office for a route forecast to Whangarei and the duty forecasters cannot recall any telephone inquiry regarding route conditions. From the timing of the telephone call requesting local conditions at Whangarei it would appear that this call was from the pilot. From this he would know that weather at Whenuapai was marginal but improving. When lodging his flight plan, the pilot had been informed by the Air Traffic Control Officer that the first scheduled flight north that morning had been cancelled, due to local conditions at Whenuapai, and that the weather north of Auckland was marginal. In view of this he advised the pilot to consult the Meteorological Office before leaving the ground. There is no record of the pilot having followed this advice except, as mentioned above, to request the local weather conditions at Whangarei, without indicating that he wished to fly there.

To summarise, when the pilot took off he was aware that (a) weather conditions along the route were marginal, (b) weather at Whangarei was marginal but improving if he elected to turn back. He was not aware, however, of the marked deterioration in the weather across his track in the vicinity of Cape Rodney.

The pilot became airborne at Mangere at 1140 hours and initiated a distress call 23 minutes later. During this time he would cover a distance of 57 miles at his planned airspeed of 150 m.p.h. He had flight planned and expressed his intention of proceeding V.F.R. via the east coast. There is evidence from other pilots in the area that weather was marginal along this route and was deteriorating rapidly across this track in line with Cape Rodney approximately 40 miles from Mangere.



It is known from the transmissions from the aircraft that the aircraft was bearing 310°M from Whenuapai at 1203 hours and 240°M at 1219 hours. By plotting these 16 minutes of the flight, it is apparent that the aircraft was over Kaipara Harbour when the distress call was initiated. To have arrived there in 23 minutes the pilot could not have flown the east coast route in accord with his flight plan. To have covered the distance in that time he must have taken the direct route overland, in which case he would have intercepted the deteriorating weather conditions at approximately 1154 hours. At this point the aircraft must have encountered I.M.C. To have maintained visual contact with the ground the pilot would need to have reduced his height gradually, to below 1,000 feet, as the flight progressed northwards. The distress call was made at a height of 4,500 feet. This suggests that he attempted to extricate himself from the situation by climbing, and when he had not emerged above cloud by 4,500 feet he sent out the distress signal.

At this point the controller succeeded in "talking" the pilot on to a mean southerly heading, but the pilot was incapable of maintaining height or airspeed or turning on to a course. This is quite typical of the pilot untrained in instrument flying, and it would be only a question of time before his sensory illusions would lead to loss of control.

It is clear from the damage sustained by the undercarriage that it was in the "down" position when the aircraft struck the water. A likely explanation is that the pilot selected gear down in order to create additional drag at the time he was experiencing difficulty in regulating his height and airspeed in cloud. The nature of the damage to the nose wheel assembly and the shearing of the starboard undercarriage fork from the strut assembly is consistent with a force of impact in excess of 200 miles per hour.

It is evident that the basic cause of this accident was the fact that a pilot untrained in instrument flying entered cloud. The evidence suggests that he did not enter cloud deliberately, as he had turned back on two previous occasions. It seems likely that he went beyond the point of discretion because this was his third attempt to get to Whangarei, and because one of his passengers had an urgent reason for being back in Christchurch that evening. A further factor in precipitating the emergency would have been the high performance of the Comanche compared with the type of aircraft on which he had gained most of his flying experience. While he was perfectly competent to fly the aircraft under visual conditions, its high speed would increase the possibility of accidental entry into cloud.

CAUSE

The accident was caused by the entry into cloud of a pilot who was not instrument trained.

Puzzling Loss of Control in a KINGFISHER GLIDER

On the last day of an annual summer camp at Narromine, N.S.W., in January, 1959, a Gliding Club member set out in a Kingfisher glider to qualify for the distance and endurance requirements of a Silver "C" Certificate. A successful winch-off was obtained at 1122 hours and the glider was observed to climb to some 5,000 feet over Narromine aerodrome before setting course in a northerly direction. The pilot's particular objective was to remain aloft for at least five hours and to endeavour to reach Gilgandra, 50 miles to the north-east. Nothing further is known of the flight until, at about 1300 hours, a glider was seen circling at a low height near Balladoran, which is 30 miles from Narromine and on the track to Gilgandra. Shortly after this sighting the Kingfisher was discovered in a field near the Balladoran railway station considerably damaged and with the pilot's body in the wreckage.

The conditions on the day of the accident were regarded by club members as being ideal for gliding. Two other gliders, flying at the same time in this area, achieved heights of 10,400 feet and 9,200 feet and remained aloft for 6½ and 5¾ hours respectively. There were 4/8ths cloud between 10,000 and 15,000 feet; the wind was from the south-south-west at 15-18 knots; the visibility was unrestricted and the temperature at ground level was approximately 90°F.

The experience of the pilot involved in this accident amounted to 153 flights, 15 of which had been gained on the Kingfisher type. He had been engaged in gliding activities for some five years and was regarded by the Chief Flying Instructor of the club as being a careful, painstaking pilot of above average standard.

The configuration of wreckage and ground marks indicate that the aircraft struck the surface of a freshly ploughed field at an angle of some 40 degrees below the horizontal. The force of impact caused the disintegration of the forward fuselage and cockpit area and the aircraft then rolled slowly on to its back after shifting only six feet from the point of principal impact. There was some evidence that the starboard wing of the aircraft was slightly down and probably the aircraft was turning in this direction on initial impact, but the leading edge of the full span of the mainplane came into contact with the ground before the glider nosed over. The airspeed indicator needle had been impacted into the face of the instrument at a reading of 80 m.p.h. — a speed which was consistent with the extent of damage to the glider.

The only evidence that any structural or mechanical defect might have occurred in the aircraft prior to impact was the finding of the port rudder cable detached from the corresponding cockpit pedal. The securing pin attaching the rudder cable to the inside of the rudder pedal was unfastened and found in the wreckage immediately below the pedal group, which itself was torn from its normal position in the cockpit floor. The relative positions of these items is not inconsistent with the pin becoming unfastened in the break-up of the cockpit area and then dropping out of the hole drilled in the boss on the pedal during the final settling of the wreckage or whilst the pilot's body was being removed. On the other hand, tests have shown that, in certain positions, this pin can be unfastened during normal operation of the rudder pedals either by contact with the starboard pedal or by contact with the perforated strip attached to the port rudder cable end. The question as to whether this pin was unfastened before or in the impact could not be resolved, but the possibility remains that it occurred in flight.

If the unfastening did occur in flight the tension of the balancing spring on the starboard rudder pedal would immediately apply considerable right rudder pressure, probably such, that at normal operating speeds, substantial rudder deflection would occur. It is well nigh impossible for a pilot to relieve this situation by any action in the rudder pedal area, although it may have been possible for him to reach the cable at the point where it passes through the cockpit floor and then manipulate the rudder by manual tension. The only other remedy would be to attempt to counteract the yaw and roll by opposite aileron. This would probably result in a side-slipping descent if sufficient control to maintain a constant heading was applied. It would require a very high level of skill and good fortune to carry out a successful landing in these circumstances and may even be impossible, depending on the degree of turbulence. The evidence that the aircraft was seen circling and diving towards the ground in the vicinity of the accident and that there was some turning motion to the right at impact is not inconsistent with this situation. On the other hand, the angle of impact (40 degrees from the horizontal) and the fact that the airspeed indicator needle was impacted into the face of the instrument at 80 m.p.h., suggest that the pilot had completely lost control prior to the impact. This could have been the result of a loss of rudder control as described above or it could have arisen from other factors.

The question of pilot incapacitation was also considered in the investigation of this accident, not only because the nature of the impact itself could suggest lack of consciousness but also because there was some evidence that the pilot had suffered a minor head injury some six months prior to the accident. The medical evidence makes it quite clear that there is no known reason why this pilot, more than any other pilot, should have been incapacited either from air-sickness or from any other physiological condition. One possibility that should not be overlooked, perhaps, is that the pilot fell asleep. The pilot was known to be physically fatigued because of prolonged overtime in his occupation followed by intense activity at Narromine. In view of the relatively short period of time that the flight had been in progress, however, this possibility can not be held in prominence.

There is also the possibility that the pilot was endeavouring to land in or near the field where the accident occurred, in view of its proximity to a telephone. However, the impact path was downwind and the angle and force of impact was not consistent with a stall at low level. This type of glider in a stall recovery loses only a few feet of height, the nose position barely falls below the horizontal and the recovery time is so short that there is a negligible build-up of speed. In fact, unless it is deliberately held in the stall it will recover automatically and almost immediately. No amount of mishandling short of complete abandonment of control can account for a high speed impact in such a steep nosedown attitude. Even though the aircraft may have been in a descending spiral, arising from loss of rudder control, it was still well within the pilot's capacity to reduce the vertical speed prior to impact by use of ailerons and elevators so as to minimise the impact force. There does not seem to have been any such attempt and since the instinct for self-preservation is very strong, even in the face of tremendous odds, it is difficult to believe that a pilot still in possession of his faculties would abandon all control close to the ground.

The possibilities of defect in the rudder control system and lack of pilot consciousness cannot be dismissed, but it is not possible to say which of the two offers the more likely explanation of this accident. The evidence certainly does not support a conclusion that the pilot, in full possession of his faculties and in a completely airworthy aircraft, mishandled the controls so as to cause the accident. Clearly the real cause of this accident cannot be determined.

Short Cuts Don't Always Save Time

There have been several instances this year where aircraft have taken-off with the undercarriage pins in. In each case this has occurred after the aircraft had initially returned from the take-off point for some minor maintenance. The maintenance had only taken a few minutes, the engines had been promptly re-started and the aircraft taxied out. As the removal of the pins was overlooked it is apparent that the crews had adopted a shortened and/or abbreviated cockpit check, probably because of their eagerness to make up time and because a full cockpit check had been carried out just previously.

The record shows quite clearly that frequently these are the circumstances surrounding mistakes which finally end in accidents. It doesn't take long to run through the full despatch and cockpit check procedures, which are essential if a high standard of safety and economy is to be maintained.

Restricted Control Movement

GRUNAU BABY GLIDER.

In the past three years a number of Grunau Baby gliders have been fitted with an elevator trim spring to improve their general elevator control characteristics.

During a recent inspection of a Grunau Baby glider, in which this modification was incorporated, for renewal of its certificate of airworthiness, it was found possible to lock the control column in a forward position. The cause of locking was that the bolt connecting the elevator cable and the elevator trim spring cable to the control column was fouling the "A" frame. The fouling occurred when the control column was moved fully forward and full aileron then applied. In these circumstances the control column could not be moved rearwards.

Although this particular aircraft had been operating for some two years and this particular circumstance had not arisen, there could be no guarantee that this situation would continue trouble-free, so a modification was incorporated in the cable securing method to ensure that fouling would not occur under any circumstance. If you are in any way connected with a Grunau Baby as an owner or pilot and this modification has been incorporated, make certain that full unrestricted control movement is obtainable.

The hazard of control movement restriction can arise in any aircraft. The lesson is obvious: check the full and free movement of all controls in every conceivable combination of movements and ensure that all clearances are adequate to guard against restriction in any condition of load or flight. Remember that frame flexing or component movement can alter these clearances.

This incident also demonstrates the necessity for a full engineering check to be carried out following any revision to a control circuit, no matter how simple it may appear on the surface.

A Veteran Controller, himself a qualified pilot, takes a look at

V. F. R. CONTROLMANSHIP

By Charles A. Kite, Denver Tower

(Flight Safety Foundation Bulletin 59-108)

An airport traffic controller occupies a unique position, perched high in the tower overlooking the runways. From this vantage point, he is daily witness to a solid eight hours of flying — by all types of pilots in every kind of airplane — in good weather and bad. He can tell you with absolute certainty that civil airplanes have won their place in the minds of men as a fast, safe and economical method of transportation. In no other part of the industry does the impact of the airplane on our society stir the imagination so much.

Nearly all pilots are familiar with V.F.R. (Visual Flight Rule), flying in and around the airport when the weather is good. The controller who handles such traffic is the V.F.R., or local controller. Unfortunately, many pilots — and some of our own management in the F.A.A. — tend to overlook this phase of traffic control. The tendency is to place emphasis on I.F.R. (Instrument Flight Rule) traffic, in spite of the fact that V.F.R. operations exceed I.F.R. traffic by a considerable margin. V.F.R. traffic poses many problems that promise to become worse with time.

Describing control work is a great deal like trying to explain combat. Until you discover that someone is earnestly and sincerely trying to put a bullet into your own skull, you cannot really appreciate someone else's description. That's the way it is with control work. You have to face the pattern, mike in hand, with speakers full of voices and sky loaded with birds, before you are impressed. And when you reach that point in A.T.C., no words are necessary.

With thousands of airplanes in the sky every day, regimentation is inevitable, just as it is on our highways and city streets. Laws or separation standards govern the controller for both I.F.R. and V.F.R. traffic. A controller cannot ignore, modify or change these standards, which were established by the combined efforts of the industry as a whole. His Bible is the ANC Manual, Procedures for the Control of Air Traffic. It is quite simple and short, consisting of some 67 pages; but trying to achieve and maintain its standards can often tax a controller into fantastic tangles — not to mention the manoeuvres an airplane is expected to make as a part of this achievement!

Control work has been compared to chess, and I suppose there is a parallel between the two, but only if it is thoroughly understood that the aircraft making the moves are hustling about the sky at speeds from 60 to as high as 500 miles an hour. None of them can stop or retreat without plenty of room. In air traffic control, no one ever meditates on the next move. There just isn't time.

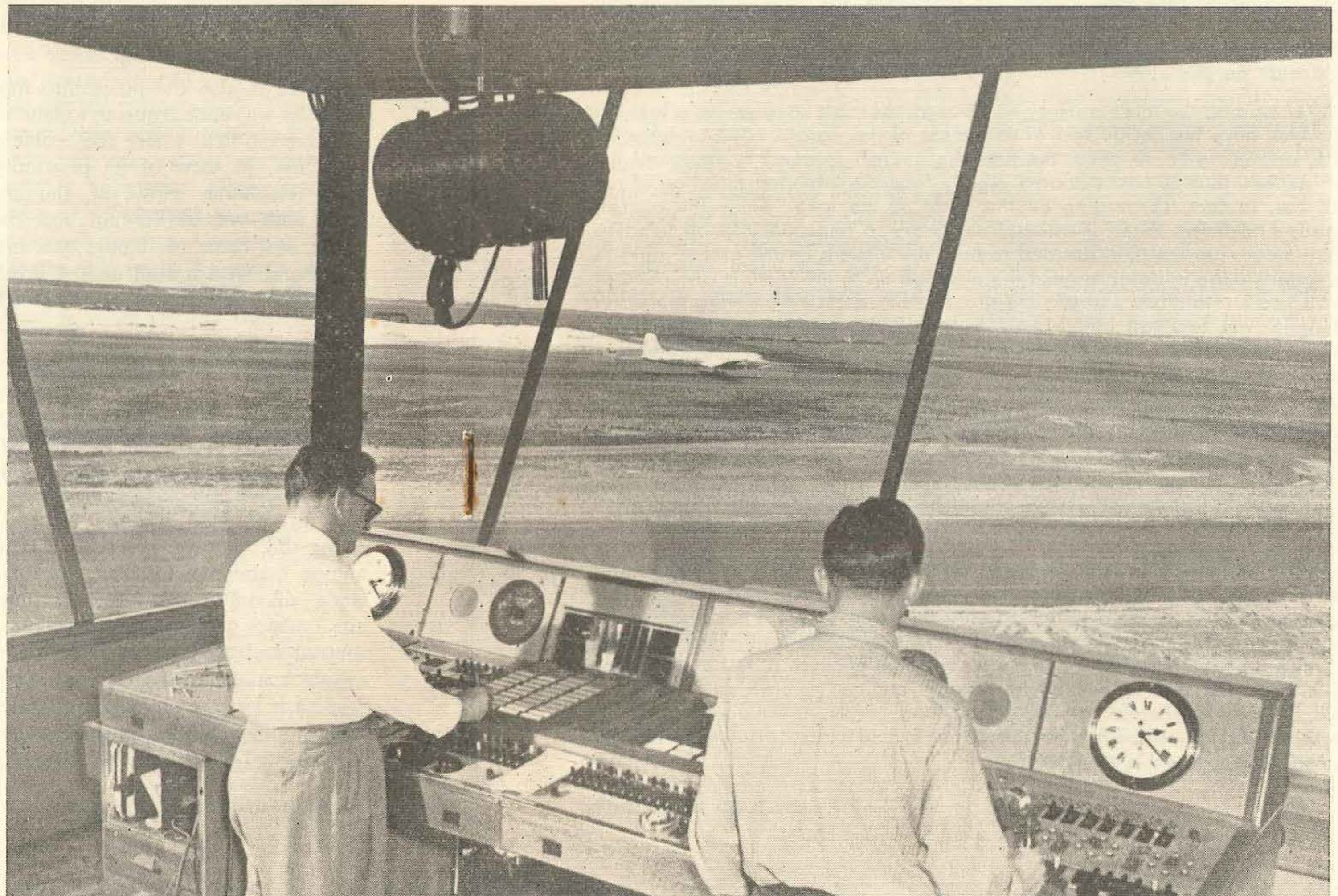
To a pilot in the pattern, concerned with just one airplane and how it will fit in with other airplanes already in the pattern, local V.F.R. control may sound relatively simple. If all pilots entered the pattern from one direction at a specified point and distance, at the same altitude, and using only one runway or direction of landing, this would be almost true, but it rarely, if ever, works that way. There are 360 directions, many different cruising speeds, runway combinations that are absurd in their limitations, pilots who are limited in experience and ability to fly patterns with any degree of consistency, airplanes requesting straight-in approaches, and impatient departures panting to be up and away — all this from a concrete contractor's delight known as an airport. It is neither simple nor easy.

A student controller soon realises that his profession requires raw courage. Controllers never mention it, or discuss it, but they are all aware of that silent, little understood barrier to the faint of heart. With 15 airplanes approaching from all directions, and voices calling constantly on the speakers, it is easy to get the feeling that you are surrounded by an utterly impossible situation. Air traffic control can consume a new man quickly and efficiently, making him half afraid of himself. The results of a wrong instruction issued to an airplane are no small burden to bear. It is not surprising that, with the rise in traffic count, the toll among controllers becomes higher each year.

Early in the game, a controller must develop resistance to "expediting" beyond the bounds of safety and reason. This is a perpetual trap awaiting the student as he masters the fundamentals and becomes confident of his ability. Sometimes resistance develops rapidly, after he had scared the wits out of himself, raised a few eyebrows in the pattern, and brought several fellow controllers in the tower to their feet.

The ability to visualise a 15 to 30-mile area is another prime requisite. The local (V.F.R.) controller has no "posting board" or display of his traffic except the one in his mind, and it must be ready for instant use when needed. Reporting points, for example, are as varied and different as the people who fly airplanes. The local patterns must be fixed in his mind like iron stakes driven into rock. He must know the radio aids used for approaches; minimum altitudes; airways; departure routes; holding patterns and their location; proximity to other airports; and so on. It takes study — and plenty of it — to memorise a complicated high-density control zone.

An unerring sense of timing is, perhaps, the controller's most difficult achievement — and it is this ability that provides pilots with the very best control. Consider the number of airplanes flying today — from jets to Cubs — with speed ranges that vary like a busy yo-yo.



An iron sense of timing is essential for alerting a heavy airplane for a possible go-around as far in advance as is humanly possible.

Light plane pilots may wonder at this; and it is worthy of an answer. A heavy airplane grossing 90,000 to 100,000 lbs., or over, involves considerably more than just pushing throttles to pull up on final. Any alerting a controller can give the crew will gear their thinking to a go-around before it becomes necessary. A heavy airplane requires several knobs, switches and sundry other items to be snapped and turned, pushed and pulled, before there is any response whatsoever. Any one of these items could, conceivably, spoil the captain's whole trip, the passengers' enthusiasm for flying, the airline's future, the fire crew's meal, and the controller's day.

A sense of timing further advances a controller's thinking in terms of how an airplane will fit in with his present traffic. It helps him to formulate, subconsciously, any action necessary when the airplane does show up. He never knows with any degree of certainty how his traffic will be spaced at a given time; and there is always the possibility of a previously unreported airplane suddenly calling in from a position which requires complete reshuffling of the traffic sequence. At such times, a controller must know instantly what to say and how to say it. His instructions must be clear and definite, so that other airplanes in the area will be alerted to the stranger's presence and intentions.

If you watch a skilled controller work an airplane reporting from 20 miles away, you can see proof of his sense of timing: He will invariably start to watch the sky at the precise point where the airplane will appear, seconds before it becomes visible.

Every suspicious move on the part of an airplane is cause for immediate alarm. An airplane turns toward a runway other than the one in use, without saying a word. The pilot makes no response to questions directed to him by the controller. Trouble? The controller has no way of knowing, but in his mind he is immediately readying the go-arounds; reaching for the crash-phone; checking the departures who may have their backs to the wayward airplane.

The controller knows that a pilot in difficulty has no time to announce the next move. He must make the next move. And the controller stands in need of prayer at such a time, so that his own next move may not be the wrong one. When he acts, the controller must act with calmness and complete confidence.

Often pilots do not realise how heavily these crises weigh upon the V.F.R. controller. The position is a trying one, demanding intense concentration. It's a waiting game, and tension mounts as the traffic volume increases. The controller must keep every airplane number straight and in its proper order, at the same time watching every move of every airplane in sight. Nearly all towers attempt to limit the time on the V.F.R. position to one hour, for after that length of time, the controller has passed his peak of efficiency.

A V.F.R. controller must learn to tune himself up, so to speak, to match the pace of the traffic. He must have an instant reply to each call, for if he hesitates, he may lose control of the situation. Unless he develops a sharp, concise delivery, all is lost amidst a jumble of voices, none of which make sense, if he allows himself to get behind in his thinking or planning. He must develop his auditory senses, too, until he acquires the elusive "tone talent" that tells him, when he hears the pilot's voice, just how much help or watching the pilot will need.

Of all the lessons of the sky, a controller soon learns that pilot-co-operation is the one dominating factor in all control work. Without the pilot's backing and understanding, control can become harrowing and exasperating beyond description. Pilots are probably the finest group of people in the world to work with, bar none, and this fact is one of the principal reasons for controllers' dedication to their work. Unfortunately, a controller often finds hemself between two mighty powers — the pilots, and the rules and procedures under which A.T.C. must operate. The squeeze play can become difficult, causing a pressure on the controller that is lively in its existence, yet difficult to define.

The hundreds of controllers I have met in the past 16 years all share a common virtue. Each and every one is dedicated to doing his level best to provide the aviation industry with the best possible controlmanship within the bounds of confinement in which he often finds himself. The controller understands the reasons for these bounds, and tries to stay within them, but sometimes they cause misunderstandings with the pilots we work with every day.

AUSTER OVERTURNS IN LAKE

A joyriding Auster J1/B, with a commercial pilot and three passengers aboard, ran into soft ground whilst taking-off from an airstrip on the edge of a lake. The pilot was forced to pull the aircraft into the air over the water at a low speed and then, being unable to gain speed, he decided to put it down immediately where the water was still shallow. The aircraft overturned and was extensively damaged but, apart from a shaking, only minor injuries were sustained by the pilot and one of the passengers.

A natural surface airstrip, 4,250 feet long and 2,000 feet above sea level was being used for local flying by this pilot, including some joyflights for friends and local residents. The strip ran alongside the southern edge of a large freshwater lake and, during the afternoon, the pilot decided to shift his take-off run a little closer to the water to avoid some high trees in the climb out path. The strip lay east and west and there was a slight breeze from the south-west on this day.

After loading the three passengers aboard, the pilot lined-up for a take-off run which gave him 3,000 feet of strip clear of the water's edge by some 30 yards on the right. At about the time the aircraft reached flying speed the pilot noticed that he had deviated slightly from the intended direction of run and was, in fact, converging on the edge of the lake. Since the aircraft already had flying speed it was not necessary to alter the take-off heading at this stage, but the pilot decided to hold the aircraft on the ground right to the water's edge in order to build the airspeed up to the climb-away speed of 50-55 knots. Naturally enough, the ground immediately bordering the water was quite wet and soft and when the aircraft ran into this area there was a sharp deceleration. The aircraft was lifted into the air over the water, but at a speed below 40 knots and in a very nose-high attitude.

The water was only 6-8 inches deep in this area but the pilot knew that the depth increased to six feet in the direction he was travelling. The aircraft was not accelerating quickly and, fearing that he was close to the stall, the pilot decided to land immediately in the shallow water. As soon as the main wheels entered the water the aircraft nosed over on to its back.

Although this pilot inadvertently altered the direction of his take-off run by about 10 degrees, this error does not account for the accident since a safe unstick speed had been attained well before the aircraft reached the soft area and the water. His decision to hold the aircraft on the ground beyond this point was the cause of the accident. This is by no means the first occasion on which a pilot has been involved in an accident because of this error. There is nothing to be gained in holding a single engined aircraft on the ground beyond the point where it can become airborne safely. It will accelerate more quickly by being established in the air and held close to the ground until the climb-away speed is attained.

The D.H.82 and its PERFORMANCE LIMITS

Two DH.82 aircraft commenced agricultural spreading operations from a strip where the surrounding terrain made it necessary for a 90° right turn to be made shortly after take-off to ensure ground clearance. The work had commenced early and during the morning the pilot of one of these aircraft found himself dangerously close to the ground as he followed the lowest available terrain and immediately dumped the load and turned towards an open area. This involved a 180° turn to the left crossing a creek with the intention of landing up the slope of cleared country above it. Despite the continued use of full power and the loss of 2/3rds of the load in the dumping operation, the performance of the aircraft was still not good enough to reach this area and it struck the bank rising from the creek. The undercarriage was wiped off and considerable damage was done to the forward section of the fuselage. The pilot escaped with only minor injuries.

The total flying experience of this pilot amounted to over 3,300 hours which included some 2,000 hours on the DH.82 type including almost 300 hours on agricultural operations as well as being the holder of a current A2 flight instructor rating; thus he was a very experienced pilot on this type of aircraft and in this type of operation.

Quite apart from the fact that the strip used did not meet the prescribed requirements it is apparent that, having regard to the climb path after take-off, the aircraft was being operated to the limits of its performance capacity. It is true that a number of successful flights were made prior to the one on which the accident occurred but, on each occasion, the terrain clearance must have been very small, so much so that on any one of these flights a relatively small change in wind velocity, turbulence or a loss of engine power would have resulted in the aircraft being forced on to the ground. Operations commenced at 0730 hours and the accident occurred some three hours later. It is not improbable that the natural temperature rise also had an influence on the course of events on this day.

There is good reason to believe that this pilot's appreciation of the performance of the DH.82 would be better than most and his manipulative skill above the average. It seems, therefore, that either he chose to ignore or failed to make a proper appraisal of possible variations in operating conditions. In a number of other accidents, it has been noted that the pilots concerned have taken off grossly overloaded for the particular operating conditions, and have relied on dumping to escape trouble if the aircraft failed to perform as expected. This sort of situation probably existed on this occasion. Not infrequently in these cases, however, the load fails to dump satisfactorily, the dumping has been left too late or there has not been time to dump after the emergency arises.

Clearly in this accident the aircraft was being operated in circumstances which did not provide adequate margins of safety and this is a frequent cause of agricultural accidents. It might reasonably be expected that the more experienced pilots would not be involved in this way but, unfortunately, this is not the case. From this it seems obvious that avoiding such accidents depends not so much on the breadth of knowledge of agricultural flying but the application of whatever knowledge exists in a way that is realistically related to the circumstances of the moment. Many pilots do make an assessment of what they believe are the hazards involved in any operation, but frequently these assessments are faulty because they have not appreciated all the factors involved. It is also clear from our investigations that many of these pilots operate with no margin for safety simply because they deliberately choose to accept the risks entailed. *The end of the road is usually not far distant for those in this latter category.*

The results of many of these inadequacies are impressive when viewed against the background of deaths and serious injuries resulting from them. We believe that it just is not reasonable to accept the risks involved but, at the same time, appreciate that it depends on how you value your life and the welfare of your family. Irrespective of your assessment of the risks involved, and the means by which you arrived at it, if you are one of those who are prepared to operate with little or no margin for safety then, in our view, it is only a matter of time before you become an accident statistic. We can't guarantee that you won't be among the *fatal* statistics and we don't believe that you can, either.

Fatal Accident in Fletcher FU24

A Fletcher FU24 engaged in superphosphate spreading operations struck trees and rising ground shortly after take-off. The aircraft was completely wrecked and the pilot did not survive the injuries which he received.

Operations were being conducted from a strip of adequate dimensions in undulating country near Armidale in New South Wales. The pilot was quite familiar with the area and commenced work at 0730 hours on the morning of this accident. By 1630 hours the task had almost been completed and up to this point 73 separate sorties had been flown, with rest breaks every two hours. On each trip the pilot turned left after take-off to avoid rising ground followed by a right-hand turn through some 270° on to the line of the spreading run which was parallel and adjacent to the take-off strip. On the last take-off the aircraft was observed by eye-witnesses to follow the usual pattern initially, but almost immediately after the left turn the engine noise increased and the aircraft was seen to be descending rapidly with superphosphate streaming from the hopper. The starboard wing struck a high tree, was torn off, and the aircraft then rolled on to its back and skidded along before coming to rest against another tree and a fence.

The pilot's total flying experience amounted to some 5,700 hours, of which almost 500 hours had been gained on the FU24 type in agricultural operations. He had gained considerable experience as a flight instructor and, at the time of this accident, he was undoubtedly the most experienced pilot in Australia on the FU24 type of aircraft.

A thorough examination of the aircraft failed to reveal any evidence of a condition or defect which might have contributed to this accident. In view of previous experience with the particular propeller installation in this aircraft and the evidence of unusual engine noise immediately prior to impact considerable attention was paid to the condition of the propeller and its governing system. This revealed that power was being developed at the time of impact; however, it was not possible to determine conclusively whether the engine and propeller were operating normally or not.

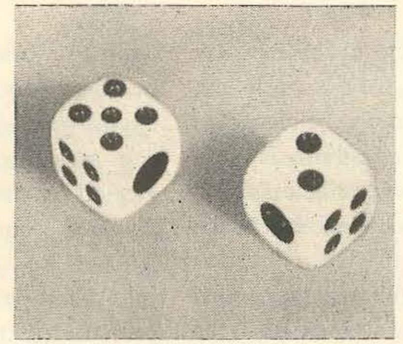
There is reliable evidence that at the time of the accident the gross weight of the aircraft was some 105 lbs. in excess of the maximum permissible weight for the type. It was also evident that this pilot was in the habit of operating in an overloaded condition and on many occasions the overload must have been considerably greater than in this instance. It has been reported that on numerous occasions this pilot had been forced to dump his load in order to avoid dangerous situations and this suggests that his loading of the aircraft was designed purely to achieve a high rate of spreading and took little account of the terrain conditions in which the operation was being conducted.

It was also discovered during the course of this investigation that the pilot had frequently exceeded the prescribed flight time limitations. In the seven days preceding this accident he had flown 37 hours. On this particular day he had been on duty for at least nine hours and although it is very difficult to measure physical fatigue and its effect on pilot performance the possibility that this was a factor in this accident cannot be dismissed.

Although the cause of this accident has not been firmly established it is evident that the whole operation was being conducted with very small margins of safety. In such circumstances, it only requires one unexpected event or some slight miscalculation to put the aircraft in a situation where successful emergency measures must be taken if an accident is to be averted. Not always will the pilot's skill be equal to the occasion and the greater his exposure to these situations the greater his chances of failure.

There is every indication that this pilot had been allowing himself to go beyond reasonable limits all too frequently.

LUCK'S A FORTUNE



While It Lasts

During August of last year in Western Australia an agricultural DH.82 aircraft struck a telephone line during an approach to land in a field 100 miles north-east of Perth. It fell on to a road, slid over a mound, through a fence and stood on its nose in low scrub bordering the field. Fire broke out but was quickly extinguished by a bystander as the pilot released himself from the wrecked aircraft.

When a 50-hourly maintenance inspection became due on his aircraft this pilot, who had been engaged on aerial spraying work, decided to travel south looking for an engineer. He had not gone far when light rain began to fall from a lowering cloud base and then he noticed another DH.82 aircraft and a caravan parked in a field alongside the highway which he had been following. In the hope that an engineer would be available and, if not, that a stopover might see an improvement in the weather, the pilot decided to land. Although the field was quite a large one and there was very little wind he elected to follow a curved approach path, taking the aircraft over the caravan across the highway with its bordering telephone lines and trees before putting down in the field. Since there were some 2,500 feet of straight run ahead there was absolutely no need to cut things fine on the approach; nevertheless, the aircraft struck the top of an 18 foot telephone post with its left lower mainplane and went through the very noisy, expensive, and highly dangerous sequence which has been described above.

The aircraft came to rest with the fuselage standing almost vertical and with very considerable damage to the mainplanes and forward fuselage. Almost immediately fire broke out in the engine area and quickly spread to the fabric on either side of the fuselage. Although the pilot suffered only a cut nose, he experienced some difficulty in releasing himself from his harness because of the attitude of the aircraft, and during this time the quickly spreading fire was a very real threat to his life. It so happened that the pilot of the aircraft, which was parked on the field, watched the approach and the accident occurred only some 30 yards from where he was standing alongside his caravan. By a strange coincidence there had just been a small fire in the caravan and the extinguisher he had used was in a handy position just outside the door. He raced to the aircraft with it and within 10-12 seconds of the foam being applied, he fire was out. He then assisted the pilot involved in the accident out of the cockpit. To add to the hazard of the situation the hand fire extinguisher in the aircraft was jarred loose from its retaining bracket in the impact and was thrown forward beneath the spray tank out of the pilot's reach.

This pilot has said that his view was obscured by rain and mist on his goggles. The remedy for that seems simple enough, but the fact remains that the approach was carried out over obstructions in the approach path with far less than a safe clearance. He could have flown over the telephone lines and trees with 50 feet to spare and still have been able to land straight ahead with more than ample room for the landing roll. It has been concluded that the cause of this accident was that the pilot attempted to make a landing approach with less than a safe clearance over obstructions and failed to fly the aircraft with the precision which this attempt demanded.

BUSH FIRES AND AIRCRAFT

Seasonal Note for Aircraft Owners and Pilots who operate from Grass Fields

We all know that there are prohibitions and restrictions for the prevention of bush fires and that there are severe penalties for violations of these regulations. However, it is probably not generally realised that these regulations can apply to aircraft operations, either directly or indirectly. The regulations differ in the various States and it would not be practicable to list them all here. Copies of the regulations for the State in which you operate can be obtained either from the local police station or from the State bush fire authorities, and it is strongly suggested that you familiarise yourself with the requirements applicable to your area.

We know of one instance where an aircraft has caused a bush fire, and although it must be accepted therefore that the possibility is fairly remote, the risk in nonetheless a real one and the consequences can be disastrous. Except when dusting with an inflammable substance, such as sulphur, it is considered that the fire hazard due to aircraft in flight is negligible. During ground operations, however, there are several conditions which present a fire risk. Refuelling is obviously one of them and the release of burning petrol from the exhaust during starting is another. There is also the possibility of the release of sparks and/or particles of incandescent matter from the exhaust, especially during the high powered operation of the engine take-off and this condition can be aggravated by prolonged ground running prior to take-off. Another conceivable source of ignition is by direct contact between tall grass or stubble and red hot portions of the exhaust system.

Modification of exhaust systems to minimise the risk of grass fires has been considered, but to date no simple, practical and fully effective scheme has been found. The only safeguard that can be offered, therefore, is the application of sensible precautions whenever a risk is apparent.

REMEMBER, IF YOUR AIRCRAFT CAUSES A BUSH FIRE YOU COULD BE LIABLE FOR HEAVY DAMAGES.

It has Happened Before

(Summary based on the report by the Department of Transport, Canada)

A Canadian DC.3 departed Fox at 1706 hours on a flight calling at various stations and intending to return to Fox, North-west Territory. At 2157 hours, the captain called Fox tower and gave the E.T.A. as 2207 hours.

In his statement the captain said that he passed over Fox and made a descending turn to the left to join the circuit on the downwind leg for Runway 36. Shortly after levelling off the aircraft lost altitude (700-800 feet) and struck the ground in what appeared to have been an almost straight and level attitude. The aircraft was substantially damaged and the pilot-in-command suffered minor injuries, no other injuries were sustained.

At the time of the accident the captain and co-pilot had been on duty for 17 hours, during which time they had flown for about 10 hours and made 20 take-offs and 19 landings. No evidence was found to indicate malfunctioning of the airframe, engine or controls. The weight of the aircraft was well below the maximum permissible and the centre-of-gravity was within limits. No definite reason could be found for the aircraft's loss of 700-800 feet of altitude. The weather was considered not to have been a factor in the accident.

It was concluded that while trying to fly visually at night without adequate reference to instruments, the pilot allowed the aircraft to lose altitude while on the downwind leg of the circuit; the aircraft struck the ground with wheels down in a slightly nose down attitude.

COULD IT HAPPEN TO YOU?

That Dark Night Take-off Accident — AGAIN!

Back in 1956, the Civil Aviation Journal ran an article called "The Dark Night Take-Off." It was about a series of accidents which all took place on dark, moonless nights when the direction of take-off was away from any ground lights.

The acceleration of the aircraft during and just after take-off can cause an illusion of nose-up tilt. The sketches show how this happens. The article pointed out that this illusion could account for all but one of these accidents if the pilots had been trying to do a visual or semi-visual take-off.

Several accidents overseas seem to have been due to the same mechanism. One was on take-off at Shannon, Eire, on a dark, moonless night, towards the Shannon Estuary where there were no lights. The take-off seemed normal until the aircraft struck the water.*

In this aircraft type, retraction of flap causes an actual nose-down pitch change of 3½ degrees. On this occasion the aircraft lost height because this change of attitude was not corrected. It was not corrected probably because the pilot had no visual horizon and because his sensation of 3½ degrees pitch down was exactly cancelled by one of the apparent nose-up tilt of 3½ degrees due to acceleration.

Another recent accident is a clear example of the effect of this illusion. Again it acted through an actual nose-down change of pitch due to flap retraction. The pilot said in evidence that he was making a visual take-off.

The accident occurred at Minneapolis on August 28, 1958, at 0329 local time. The sky was clear, but visibility was reduced by a ground fog prevailing to three miles.

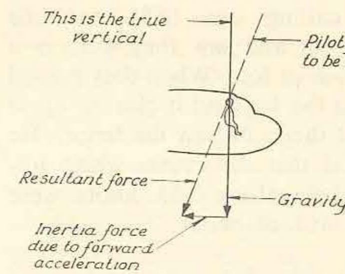
The captain applied take-off power and the aircraft, a DC6B, responded, accelerating normally. The co-pilot called the airspeeds, identifying V_1 (105 knots). The aircraft continued to accelerate and shortly before the co-pilot called V_2 (115 knots) the captain applied back pressure on the control column. After accelerating through V_2 speed the aircraft lifted off the runway. When definitely airborne the captain called for gear up and the co-pilot complied.

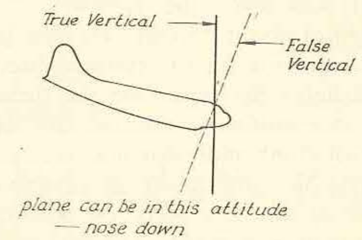
The aircraft continued to accelerate in its climb and the co-pilot continued calling off the airspeeds. At 135 knots the captain called for flaps up and again the co-pilot complied. The aircraft was performing normally in all respects. Engines were developing full power, and the aircraft was accelerating to normal climb speed.

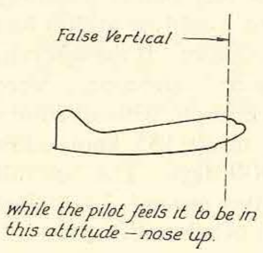
At 155 knots the captain called for reduction of power to METO. At the same time his outside vision was obscured by the bright reflection of the landing lights against clouds or fog. He said he looked back into the cockpit and that his instruments appeared normal and still indicated a slight climb. He then turned the landing lights off. Almost simultaneously, and when the flight engineer had started reducing power, the co-pilot saw a fence ahead of them, shouted "pull it up" and at the same time pulled back on the elevator control.

Almost simultaneously with the co-pilot's action the aircraft hit the fence at the airport boundary. Immediately thereafter it struck the ground, skidding to a stop about 1,600 feet beyond.

Several witnesses saw the aircraft taking off. They said it appeared to climb normally and reach a height of about 75-100 feet at a point near the end of runway 22. It then nosed down gradually and began to descend. The descent continued without noticeable change until the aircraft struck the ground. All agreed that the engines sounded normal. They estimated the top of the drifting patches of denser fog to be about 50 feet high. All of the witnesses saw the aircraft clearly. None noticed any dense fog in the take-off area and no one saw the aircraft enter clouds of any kind.







* See Aviation Safety Digest No. 5, Feb., 1956.

The captain stated that the take-off was made under visual conditions. His only reference to his instruments was for monitoring the performance of the aircraft. He said the performance was normal and after the aircraft broke ground a normal climb was established by visual observation and by reference to the rate-of-climb instrument.

The co-pilot said that he had called the airspeeds at 5-knot intervals and at V_1 and V_2. Although his attention had been directed inside the cockpit, he did not note any of the flight instruments other than the airspeed, nor did he see the reflection of the landing lights off the fog. After calling out 155 knots he looked out and saw they were in a formation of fog. When they passed through the fog and it cleared up in front of them, he saw the fence. He also said that the events which followed his calling 155 knots were almost instantaneous.

Both the pilot and co-pilot said there was no apparent change of attitude in the aircraft when the flaps were raised. The captain said he did not recall having to change the trim or attitude as the flaps came up. He thought that at the time of encountering the fog the aircraft was over the runway at a height of about 75 feet. He said he was watching for the runway threshold lights but never did see them. He intermittently referred to the rate-of-climb indicator and recalled seeing no indication of descent. *None of the crew members felt any sensation of descent.* The first realisation that the aircraft was going down was when the co-pilot saw the fence.

Using the airlines' standard take-off procedure the aircraft would cover 15,000 feet before reaching 155 knots and would be at 300 feet altitude at this point. If the aircraft, after becoming airborne, were allowed to accelerate without climbing it would reach 155 knots after covering 9,400 feet. The aircraft actually hit the ground 7,600 feet from the start of take-off.

It was determined that the landing gear, flaps, and the landing lights were fully retracted. No evidence was found of inflight structural failure. Separation of the various components was caused by contact with the fence, overloads encountered during the skid, or by contact with objects on the ground.

From the testimony of the crew and examination of the power-plants it was determined that the power-plants in no way contributed to the cause of this accident.

Evacuation of the passengers was accomplished mainly through a break in the top left side of the forward fuselage. With the aircraft lying almost on its left side it was impossible to utilise any of the emergency exits on that side. One exit on the right side was used by a number of the passengers and several others left the aircraft through the co-pilot's sliding window in the cockpit.

Most of the seats remained attached to the floor, but several broke loose and hampered evacuation somewhat. The interior was dimly lighted by the emergency lights and several small fires. These fires, fed by fuel, gradually increased in intensity and engulfed the entire fuselage a short time after the last passenger was evacuated. Fire-fighting equipment which arrived on the scene about this time was unable to save anything other than a small portion of the wreckage.

The crew of N 575 were highly experienced, said the C.A.B.'s report, but both pilots thought the aircraft was climbing out normally and neither realised it was, in fact, descending. With this in mind, the Board studied the phenomenon of pilot sensory illusion to determine whether such is applicable to this accident.

The report goes on to describe the particular illusion of false pitch attitude due to acceleration, quoting a Flight Safety Bulletin based on the original Journal article.

"The forward acceleration of the aircraft after take-off causes a sensation of nose-up-tilt because the pilot cannot distinguish between the direction of gravity and the resultant of gravity and aircraft acceleration. If the pilot is not fully on instruments, this can cause him to lower the nose, and the acceleration in the resulting dive perpetuates the illusion. The aircraft can enter a shallow dive, with or without warning, and the pilot will still experience a sensation of steady climb. If it is also very dark and the direction of take-off is away from a built-up lighted area, there is nothing to be seen which can give a horizon reference and the pilot is now very likely to get this false impression of the attitude of the aircraft in pitch. Because it is too dark to see the ground, loss of height is not apparent.

"The Board believes that the conditions which existed at the time N 575 took off were ideal for the propagation of this illusory effect. Visibility was reduced by fog and take-off was made away from a built-up area toward a very dark unlighted space where the pilot had no reference to a horizon by which to determine the attitude of the aircraft. It is important here to recognise that sensory illusions will not necessarily cause a pilot to dive the aircraft but can completely conceal the fact that a descent has commenced."

A pilot with the experience of the captain, said the C.A.B., must be familiar with night take-offs in conditions of reduced visibility and, therefore, should have realised that full use of all the aircraft instruments was mandatory. The rate-of-climb instrument is not a primary instrument during initial lift-off, because of ground effect and the inherent lag in its indications. It would require approximately 15 to 20 seconds for N 575 to reach a height of 100 feet from lift-off, by which time the rate-of-climb instrument would be indicating correctly. Moreover, the artificial horizon, the airspeed indicator and altimeter are instruments which will give positive and immediate indications of attitude. To monitor one instrument to the exclusion of all others indicates a lack of the normal alertness and attention demanded of a pilot.

In addition, continued the report, all normal procedures require that a positive climb be established before flaps are retracted. In order to maintain this climb, some positive control action must accompany the flap retraction. Again it is elementary that where visual reference to the ground is precluded, the use of flight instruments is necessary in order to ensure proper control of the aircraft.

One further indication, which should have been apparent to the pilot through normal alertness, was the extremely rapid acceleration of the aircraft. Under normal operating procedures it would require approximately 85 seconds for the aircraft to attain a speed of 155 knots and it would have travelled a horizontal distance of 15,000 feet. Here the aircraft speed was 155 knots when it first hit the ground about 7,600 feet horizontally from start to take-off. According to the captain's testimony he thought he was still over the runway as he had not seen the threshold lights. To have attained a speed of 155 knots in this distance also should have alerted him that the acceleration was far greater than normal.

The C.A.B. concluded that the condition of restricted visibility which existed at the time of this accident is not unusual and in no way affected the execution of a safe take-off; however, under such conditions, the pilot should utilise all of the flight instruments available in the aircraft. In this case, if the pilot had devoted his attention to the flight instruments rather than attempting to maintain visual contact during the take-off, the accident could have been avoided.

Further, the co-pilot did not exercise the best judgment under the circumstances. One of the fundamental reasons for requiring a co-pilot in transport-type aircraft is to provide assistance to the pilot. Such assistance is not limited to that of monitoring the airspeed only, as was done in this case. If the co-pilot had given normal attention to the flight instruments he would have seen indications that the aircraft was descending and alerted the pilot to this fact. The accident might have been avoided had this been done.

In view of the foregoing, it was the Board's recommendation that the company re-emphasise through its training procedures the proper operating techniques for night take-off when weather conditions or other factors restrict visibility.

Subsequent to this accident the company revised its take-off procedures. All pilots are now required to climb the aircraft immediately after take-off at V_2 speed to an altitude of at least 50 feet. The landing gear is retracted when the aircraft is definitely airborne. At 50 feet the aircraft is allowed to begin to accelerate while still continuing a positive climb. The climb is continued until reaching 200 feet. Upon reaching 200 feet and a speed of at least 125 knots, flaps may be raised. The aircraft is then allowed to accelerate to 140 knots before take-off power is reduced. In addition, the co-pilot is now required to monitor the altimeter and call off altitudes every 100 feet until the aircraft reaches 500 feet.

DOOR JAM

During the turn-around of a DC.3 at an outstation, the door clip was found to be broken, so a piece of wood was jammed between the door and the door frame to hold the door open. After the passengers had boarded the aircraft the door was closed but the door warning light did not go out. An inspection revealed that the door had been closed on the piece of wood with the result that the hinges were sprung and the door could not be opened. The passengers were off-loaded through the front cargo door and the aircraft flown to base empty — an embarrassing and expensive temporary measure. Safety could also have been compromised had any situation arisen requiring a quick disembarkation of passengers.

Those Tyres Need More than a Kick

The pilot of a DH.82 when pushing the aircraft out prior to take-off thought that the tyre pressures were low. He pumped them up with a hand pump without the use of a gauge and then commenced to taxi. On arrival at the holding point the left hand tyre went flat.

Investigation revealed that the valve had pulled out of the tube and that the right hand tyre was inflated to 20 p.s.i. The excessive pressure, above the 12 to 15 p.s.i. required, caused the balloon type tyre to grow and lose grip on the hub, thus allowing the tyre to creep when turning the aircraft on the ground.

It was, perhaps, fortunate that the trouble occurred on taxi-ing and not during a landing.

What does a bounce tell you?

An Auster aircraft engaged on charter work in northern Queensland overturned on a station airstrip after the second part of a "touch-and-go" testing of the strip had to be abandoned. The aircraft was extensively damaged but, fortunately, there was no injury to the pilot or to the two passengers aboard at the time.

The station airstrip had been closed for some days due to soft surface but the Auster pilot, after receiving some unofficial and unconfirmed reports that the strip was serviceable, set out to test this report and the strip. Two passengers and a quantity of freight were on the aircraft. Arriving over the top, the surface looked wet and boggy, and a sheet of water covered 300 feet of the strip at one end. The pilot decided to test the surface by bouncing the main wheels on the most likely looking area. He says that he intended to assess the strip for landing by the feel of the surface on contact and by flying a further circuit and inspecting the wheel marks made.

The aircraft approached the selected point with flaps in the take-off position, but the pilot found he was overshooting and so reduced power. At approximately 75 feet beyond the selected point the aircraft contacted the ground, the tail-wheel touching before the main-wheels. The pilot applied power and pulled the nose up sharply and the aircraft bounced into the air. The engine pick-up was slow, possibly because the approach was made at a low throttle setting, and the aircraft settled back on to the ground. After rolling under power for a further 300 feet in an attempt to take-off, the pilot saw that he would not clear the airstrip boundary, so he closed the throttle and applied the brakes. The aircraft ran into water at the end of the strip, overturned and slid backwards, upside down for about 50 feet before coming to rest.

Apart from any other consideration, it is fairly obvious that this pilot's technique for the touch-and-go was not of a high standard and, as a result, the aircraft was very close to the stall when it contacted the ground. The slow throttle response and the soft surface were then sufficient to prevent the aircraft regaining flying speed in the distance available. However, this accident again brings up the question of bouncing on airstrips. It is quite a widespread practice and is not only confined to light aircraft. Sometimes it is done to test the airstrip surface and sometimes to test the undercarriage in circumstances where the pilot is not certain that it is locked down. The value of these tests is questionable, to say the least.

Where it is intended to test the airstrip surface the area tested is so small as to be of negligible significance. It is noteworthy that most accidents associated with surface conditions occur due to substantial variations in bearing strength or smoothness during the landing roll and it would need an awful lot of bounces to detect these variations. The practice can be dangerous if the surface is bad because a sudden dragging effect on the wheels can either turn the aircraft over, or rob you of the speed margin which you had carefully held in hand for the fly away.

The only completely safe thing to do is have the strip inspected from the ground. If this is impossible and a landing is imperative then greater safety is not likely to be achieved by going beyond a precautionary inspection, using an orthodox low pass over the field.

The practice of testing undercarriage down-locks by bouncing the aircraft on the ground is equally questionable. The severity of the bounce required to prove anything is so great that you might well cause the accident you are seeking to avoid. If you must land with the wheels up it is better to do it when everyone and everything is nicely prepared for it.

Since the accident the operator of this Auster has outlawed the practice of bouncing wheels on strips for any purpose. We believe that this is a wise decision and one which should be followed by all operators and pilots.

Beyond the Limit in a CESSNA 180

During March of last year a Cessna 180 aircraft was engaged in superphosphate spreading in hilly, timbered country near Nundle, New South Wales. Late in the day and probably on the last run of the particular task, the aircraft was observed to climb very steeply up the face of a mountainside, stall, and drop into the trees. The aircraft was badly damaged and then almost totally destroyed by fire. The pilot did not survive the severe injuries and burns he received.

The area being fertilised consisted of a fairly wide valley enclosed by steep timbered ridges. The valley floor was undulating and only partly cleared. Little is known of the spreading runs which preceded that on which the accident occurred, but two eye-witnesses observed this final run. They have both described how the aircraft was flown directly towards the steep side of one of the ridges and at a very late stage the aircraft entered a steep climb up the face of the ridge. At the top of the climb it appeared to them that the aircraft stalled and they then saw it drop vertically into the trees on the ridge. The aircraft was found with the major part suspended in a tree with scattered wreckage below and there was every indication that the aircraft did, in fact, drop almost vertically to this position. The fire damage seriously limited the value of the wreckage examination, but no evidence of any defect was found and the witnesses report that the engine note sounded quite normal right up to the stage where the stall apparently occurred.

The pilot's total flying experience amounted to 1,700 hours, of which 415 hours had been gained on Cessna 180 type aircraft on agricultural operations. The pilot was regarded as above average in competence and he had previous experience as a flight instructor.

There are several possible explanations of this accident but there is no doubt that the flight path selected by the pilot involved a very real collision hazard with the high terrain unless it was broken off at a safe distance. The engine power reserve of the Cessna 180 is such that quite steep climbs can be achieved in a pull-up on full throttle and this may well have induced the pilot to continue the spreading run to a point very close to the side of the ridge. It is also possible that some pre-occupation with another aspect of the work may have forced him into a position closer to the ridge than he had intended. Whichever of these two situations was present in this accident the fact remains that the aircraft was set a task beyond its capacity and the inevitable stall resulted. In this type of operation a stall usually has only one result and if you wish to avoid it you must be continually on the alert to avoid flying beyond the capacity of your aircraft. In the final analysis it does not much matter whether a departure from this rule stems from the pilot's intention or from his lack of attention — fate makes no distinction. Bad planning or bad flying leads to the same kind of exposure to the "Reaper's" whim.

Action precedes Reason in Propeller Overspeed

In October of last year a DC.4 freighter aircraft departed Dacca, in East Pakistan, at 1900 hours local time bound for Singapore with a load of monkeys destined for the Commonwealth Serum Laboratories in Australia. After setting course, the aircraft climbed to a cruising altitude of 7,000 feet with the captain occupying the left hand seat, the first officer in the right hand seat and the second officer off-watch. After about 40 minutes' flying the aircraft encountered bad weather which persisted for almost 2½ hours. When the aircraft finally emerged from this weather still cruising at 7,000 feet, the captain called the second officer on watch to relieve the first officer and he himself changed to the right hand seat, where he settled down to sleep. At this stage the aircraft's engines were drawing fuel from the auxiliary tanks and the captain had briefed the second officer with regard to fuel, heading and altitude before ceasing to supervise the flight.

About 40 minutes later severe engine detonation was heard and, almost immediately, the distinctive sound of a propeller overspeeding was detected. The captain, who was immediately aroused from his sleep by these sounds, throttled back the four engines and placed the engine fuel selectors in the "Mains" position. Although there was no fuel pressure warning evidence in the cockpit, his first reaction was that one or more engines had run out of fuel on the auxiliary tanks. Meanwhile, the second officer in the left hand seat deduced from the yawing of the aircraft that the power loss had occurred on the port side, but he was unable to determine which of the engines was malfunctioning and he decided to feather the propellers on both Nos. 1 and 2 engines. The propeller of No. 1 engine feathered in the normal manner, but No. 2 engine continued to operate and the sound of overspeeding continued unabated. When the captain endeavoured to isolate the overspeed condition he found that both the Nos. 1 and 2 tachometers were reading zero and the M.A.P. gauges about 25". At this stage it was apparent that the No. 1 propeller was already feathered as a result of the action of the second officer and the No. 2 engine had stopped with the loss of valve and ignition timing. The instruments for Nos. 3 and 4 engine indicated normal operation. The captain, being unaware of the second officer's action, was still unable to decide which of the two port side propellers was overspeeding.

At this time the first officer arrived on the flight deck and he soon noticed that the No. 1 propeller was feathered and he thought he saw the reflection of a fire on the inner cowls of that engine. Believing that there was a fire in the No. 2 engine he took the required action and was successful in feathering the No. 2 propeller. Shortly afterwards and with the concurrence of the captain he assisted to re-start the No. 1 engine, which continued to operate normally thereafter.

Whilst these actions were going on in the cockpit over a period of 60-90 seconds, the aircraft had descended in a fairly steep spiral to a height of 3,500 feet. At this stage and at about the time that the No. 2 propeller was feathered, control of the aircraft was regained and the aircraft resumed course. The heading was changed to the R.A.A.F. Station at Butterworth, Malaya, which was reached without further incident.

An examination of the No. 2 engine revealed that the reduction gear drive hub assembly had failed and this meant that the propeller had de-coupled and there was a simultaneous loss of ignition and valve timing. This condition readily explains the detonations which were heard and the overspeeding condition of the propeller.

The nature of the engine defect suggests that indications of an overspeeding propeller must have been apparent at an early stage in this emergency. However, the second officer-on-watch was not able to isolate the defect by reference to the cockpit instruments. Undoubtedly the captain was seriously handicapped by being wakened from a sleep to face an immediate emergency and his initial diagnosis of the trouble was incorrect. His further action was seriously handicapped by the independent feathering action of the second officer. It is not clear from the evidence how much attention was given to flying the aircraft by either pilot during the period of the emergency but its flight path clearly suggests that it was quite insufficient. The situation was not brought under control until the first officer reached the flight deck — even his first diagnosis of the trouble was incorrect but the action he took was successful probably because, at this stage, control of the aircraft had been regained and speed reduced such that the No. 2 propeller would respond to a feathering action.

The actions of the second officer who was on watch at the time the emergency arose are also worthy of comment. His training had included the emergency procedures for dealing with a propeller overspeed condition. However, he did not apply these procedures and his attempt to feather both engines on the port side was based on a belief that it was better to have two engines out on that side rather than one in an overspeed condition. The need to reduce power and speed so that the overspeeding propeller could be kept within or brought back to the capacity of the feathering circuit was forgotten in the excitement of the moment. The essential need, that control of the aircraft be retained by at least one of the pilots on the flight deck, seemed to be overlooked also. The descending flight path that developed indicates that speed was not reduced and explains the initial inability to feather the No. 2 engine. Although the captain had been criticised for his part in this incident it must be said in fairness to him that he received very little assistance from the second officer who, in fact, took action other than in accordance with the proper emergency procedures without reference to the captain.

An aircraft captain is expected to tackle any emergency in a cool and efficient manner designed to ensure that control is retained and that the emergency is diagnosed and overcome at the earliest possible moment. There are many conflictions in the evidence given by the pilots involved in this incident and, to some extent, this is not surprising since all these events occurred in a shorter length of time than it now takes to recount. Because many of their actions were spontaneous, it is to be expected that there would be some difficulty in recalling precisely what was done, seen or considered in such a situation. Despite these conflictions, it is clear that neither the captain nor the second officer handled the situation effectively in the initial stages.

This particular occurrence revealed serious weaknesses in the competencies of a captain and a second officer despite the fact that the operator's training organisation had gone through all the required motions for their refresher training and checking. The prime object of any training organisation is to detect these weaknesses, and yet this one slipped through their fingers. The lesson must be very clear to pilots who wish to retain their hard-earned status and to operators who desire to preserve their safety records.

AMENDMENT TO ISSUE No. 16

At least one of our readers has experienced difficulty in interpreting figure 6 of the article Disorientation in Flight, Aviation Safety Digest No. 16, December, 1958. After examining the points raised by our correspondent it could be seen that the presentation of figure 6 was somewhat ambiguous and the terminology used in the caption under item (c) of that figure also was not conducive to clear interpretation.

In order to eliminate any doubt that may still exist we are presenting below a completely new unequivocal presentation of figure 6. The size of this diagram is such that it can be transferred to the earlier issue as a replacement if desired.

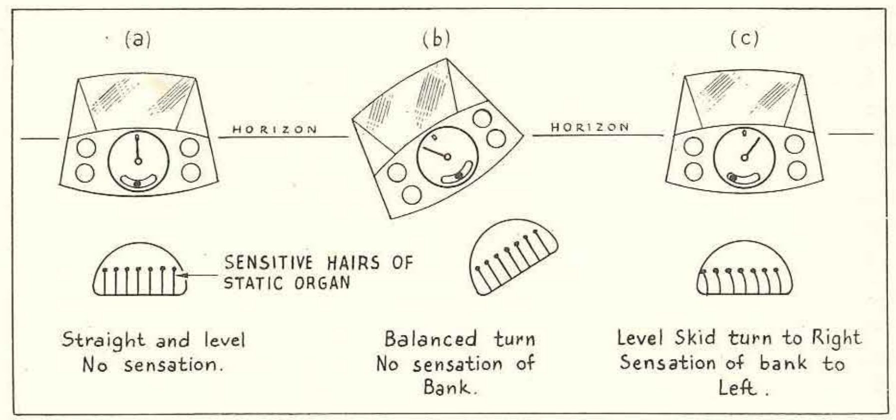


FIG. 6

One Cannot Always Believe What is Seen

As everyone knows, it is extremely difficult to visually estimate the relative positions of lights at night. For this reason, controllers have always been required to exercise care when visually identifying aircraft for separation purposes and, in cases of doubt, they have been required to have aircraft alter course, extinguish lights and take such other action to positively identify the aircraft. However, it was not generally realised that the problem presented in estimating the relative positions of lights during darkness also made it difficult to determine when to apply the measures necessary to identify the aircraft and thus establish their positions relative to the aerodrome and to each other. This weakness was recognised as the significant factor in the development of the incident described here and, as a result, immediate steps were taken to prevent a recurrence.

Two aircraft of similar size, shape and speed were approaching an airport at night on approximately the same track and both were estimated to arrive at the same time. Their assigned altitudes were 3,000 feet and 4,000 feet respectively. The weather was fine and it was a moonless night and there were two controllers on duty in the tower. The anti-collision beacons of both aircraft were sighted when the aircraft were some 16 miles from the airport. At this time the aircraft were estimated to be about two miles apart on parallel tracks approximately abreast and the controllers agreed, and were positive, that the aircraft on their right was the higher and, therefore, the one assigned to 4,000 feet. The observed relative positions did not change as the aircraft needed the airport and when they were about eight miles away approach instructions, intended to result in a divergence of tracks as the aircraft descended, were issued. Shortly after these instructions were given, however, the paths of the aircraft converged and the aircraft crossed with approximately 250 feet vertical separation.

It transpired that the aircraft on the controllers' left was, in fact, the aircraft which had been assigned the higher altitude. Further, it was conclusively established that the aircraft were at their assigned altitudes throughout their approaches and the situation was entirely due to the fact that the controllers had erred in their observation as to which was the higher aircraft and, because of this, had incorrectly identified them.

Both controllers were experienced in aerodrome and approach control and had handled similar situations on many previous occasions. In this instance, they were very confident that the aircraft on their right was the higher of the two and nothing in the situation suggested to them that they could be in error. It was for this reason that they did not take any other action to confirm the identity of the aircraft and their positions relative to one another.

The relative positions of the aircraft during their approaches were such that, providing there was no optical displacement of their lights, the vertical separation should have been quite noticeable. An examination of the optical and sensory aspects involved was inconclusive in determining whether the vertical separation could have appeared reversed on this occasion. However, it was confirmed that, in some situations, an observer can be quite confident of his assessment of the relative positions of lights when, in fact, he is in error. It is now required that controllers will always take positive identifying action, such as asking an aircraft to extinguish lights or change heading and any other action which may be necessary before vertical separation is relaxed.

D. M. E. DISTANCE — From Where?

The importance of frequent monitoring of D.M.E. identification is emphasised by occasional reports of the D.M.E. ceasing to indicate distance to the selected beacon and "locking on" instead to another equidistant from the aircraft. In other cases the D.M.E. may not immediately "lock-on" to a selected beacon but indicate correct distance to a nearer beacon on another channel. In either case, this can be due to the reflection of pulses from terrain or buildings producing a pulse-pair with that spacing necessary to trigger the unwanted beacon. Replies are therefore transmitted by two beacons and the D.M.E. will give the distance to the nearer beacon. Fortunately, such incidents are rare and when they do occur the D.M.E. code lamp and aural identification are infallible indications of the beacon interrogated.

Incorrect distance indications can also arise from "Range Stealing," a term given to the phenomenon of false distance indication due to the reflection of signals from terrain, buildings, etc. In this case, the coding will be mutilated and, therefore, the condition is easily recognisable. System faults which give incorrect distance indications will also cause code mutilation.

In all these cases the condition is revealed by the coding, and the code lamp provides a convenient visual indication of the beacon identification and code quality. Providing the identification is monitored frequently a critical situation can be avoided. Remember, the distance indication can only be accepted as correct if the D.M.E. code is clear. Check it visually, often, and verify aurally.

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