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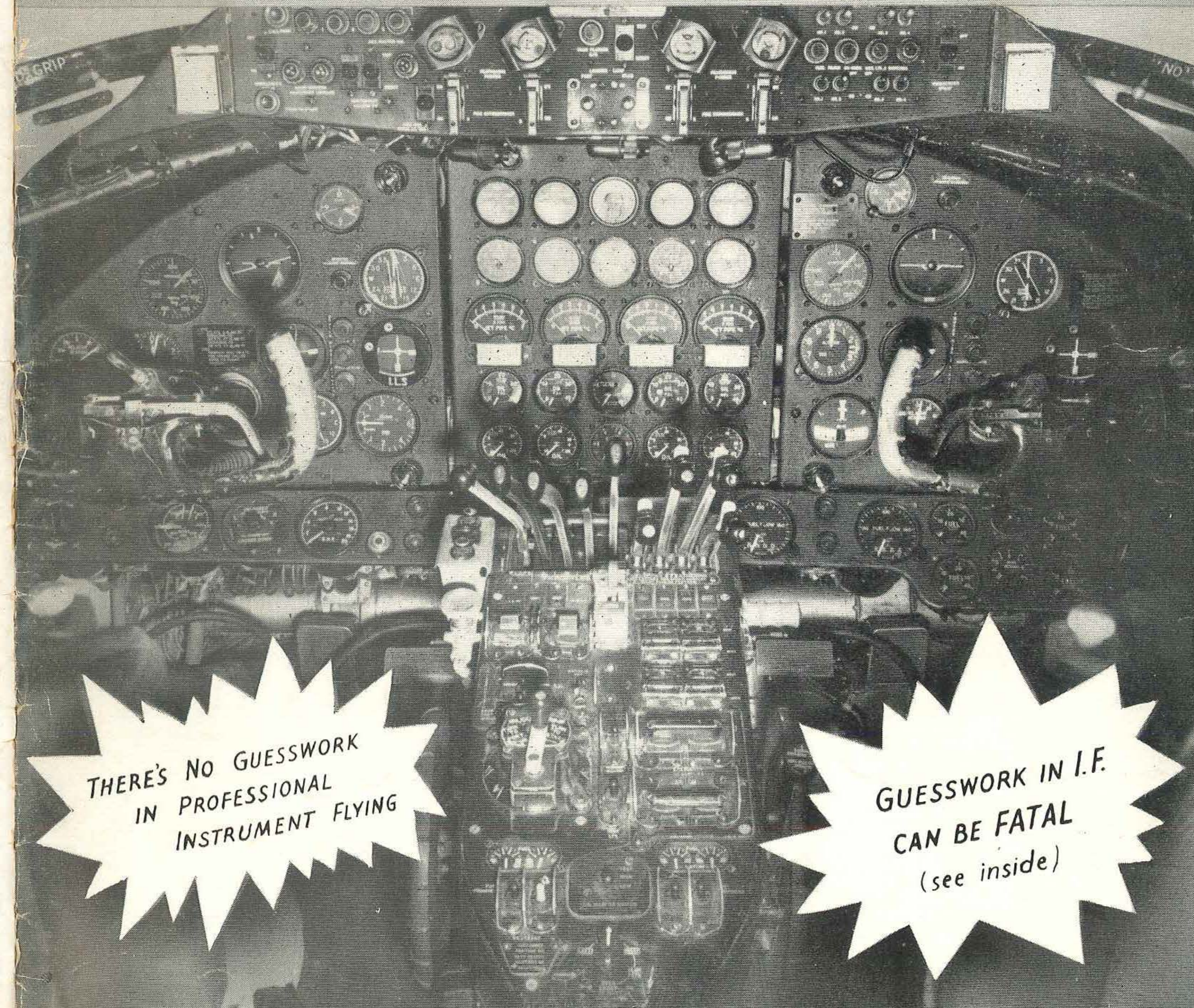
AVIATION SAFETY DIGEST



DEPARTMENT OF CIVIL AVIATION No. 16, DECEMBER, 1958

Aviation Safety Digest

No. 16 December, 1958

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CONTENTS

News and Views

Disorientation in Flight

(This article was provided by our Division of Aviation Medicine)

Pilot disorientation under instrument flight conditions is probably the most common cause of fatal accidents not due primarily to mechanical failure. Flight safety statistics show it to be a major cause of "pilot error", and it has even been the subject of comment in popular publications.

Some such comment has unfortunately left the impression that disorientation is a hazard about which little is known, and against which little if any preventive action is possible. This general lack of understanding appears also to be rather prevalent among pilots. Every experienced pilot knows that while flying on instruments he may experience unusual sensations, and it is a commonly accepted dictum that the pilot must "trust his instruments rather than the seat of his pants". Just why those senses, exemplified by "the seat of the pants", are so unreliable is much less commonly known.

On the ground, the pilot has available a variety of straight-forward cues which orient him with relation to his surroundings, and there is rarely any conflict between them. In general, his orientation problems are two-dimensional in nature, involving distance and direction on flat surfaces. When the pilot takes off from the earth in flight however, he is confronted with new and unique problems of orientation in three-dimensional space. His cues must be three-dimensional, and they may be very limited; he may or may not have visual reference to the earth. At the same time, he is regularly subject to various accelerative forces which can produce for him illusory experiences, making him uncertain of his position and attitude in space. Thus he must learn the complex task of orienting himself by the use of secondary cues obtained from flight instruments; and these indirect visual cues may at times be grossly at odds with his other coexistent sensations.

DEFINITIONS:

The term disorientation has been given many shades of meaning. In this article it will be largely interpreted as pilots understand it, that is as being a state of confusion or uncertainty in the mind as to the aircraft's movement, position and/or attitude in space, or changes of these.

In this context, it is obvious that disorientation in flight is a serious hazard in that loss of control is a likely, though not inevitable, consequence. There is however an additional application of the term which our interpretation as it stands does not include. The pathways of bodily reflexes and reactions concerned with maintenance of control do not necessarily pass through conscious levels. It is possible for the mind to be properly aware of reliable visual information, yet for the effective muscular response of a pilot to follow strongly misleading sensory information derived from other sources. In moments of stress man may be thrown back on his instincts — instincts that have been with him since infancy—to the exclusion of reasoned processes. It would seem that our meaning of disorientation in flight should be extended to cover this contingency.

For the purposes of discussion here, it is convenient to define two modes of disorientation in flight:—

(i) The first and rarer is described by the term vertigo, derived from a Greek word meaning a sensation of rotation or whirling. This term implies that the subject feels he is rotating within his surroundings, or that the surroundings are rotating around him; vertigo is thus a dynamic form of disorientation, resulting in a false sense of rotatory motion.

(ii) The second mode, called spatial disorientation, consists in a false impression of one's position and/or attitude in space with respect to the surface of the earth. As in the case of vertigo, a pilot under the influence of this condition may unintentionally cause or permit the aircraft to assume or maintain an undesirable attitude; but whereas vertigo may cause the pilot to attempt correction of a rotation or turn which is not actually occurring, spatial disorientation will induce him to seek to put the aircraft into a relatively steady "off-course" attitude (e.g., nose up, or wing down) in the belief that he is maintaining straight and level flight.

MECHANICS OF ORIENTATION:

The successful maintenance of orientation by man in any dynamic environment depends essentially on fulfilment of three fundamental requirements:—

(i) There must be adequate availability of sensory information;

(ii) This information must be properly integrated by the nervous system, including the brain, and formulated into appropriate patterns of response; and

(iii) There must be effective execution of such response through the medium of body musculature.

The first requirement is normally provided by three largely independent and relatively reliable sources of sensory information, which have been called the "orientation triad", namely:—

(i) Vision.

(ii) The vestibular apparatus (so called because it comprises the "vestibule" of the inner ear), and

(iii) The muscle, joint and ligament senses, and pressure sensitivity of the skin.

The second and third requirements, integration and execution, are satisfactorily met, so long as the three chief sources of information listed above are allowed to function in man's normal environment on the ground. The mechanisms involved are, however, not well adapted to the new environment of flight, and faulty integration and inadequate response may result in this environment. In some detail, the reasons for this are as follow:—

VISION:

Visual perception is normally the master sense of the "orientation triad". The extremely high acuity of the optical mechanism produces cues which are remarkably accurate. Detail in an object subtending an angle as small as one minute of arc at the eye is readily perceived, and deviations of a line from the gravitational vertical greater than one or two degrees are readily detected. Visual cues to the horizontal and vertical, such as buildings, trees and horizons are plentiful in our ground environment. Hence the accuracy of our visual judgments of the vertical and horizontal when we are sitting or standing is very high. In addition there are visual cues which make it possible to judge the distance from us of objects in our vicinity with great accuracy. An additional phenomenon related to visual orientation is that an object must be in its habitual position in space in order that it may be readily identified. A visual form may be completely unidentified in an unusual position, say upside down. Simple examples of this are to be found in the letters d and q, and b and p.

As has already been noted, there is normally no conflict between visual cues to orientation, and those provided by the two other sources belonging to the "orientation triad". In the general case in the ground situation therefore orientation is based on information from the master sense, vision, the cues from other sources being confirmatory in nature.

In the air, however, visual perception of the external world is by no means infallible. In the obvious case, this results from the complete absence of cues to perceive, as when flying in cloud or on a truly dark night. In the perhaps less obvious case, it results from visualizing an isolated cue, divorced by restricted visibility from its background or surrounding "texture" and insufficient alone to provide visual orientation. How many experienced pilots could not recall the difficulties of orientation with reference to an isolated single-row flare path on a black night, or the erroneous impressions gained from glimpses of the ground through broken low cloud, with a complete overcast above the aircraft?

There is, further, the case in which reflexes derived from another sensory source prejudice stablization of the eyes in the head; this phenomenon is discussed in some detail below.

In all three cases, where visual cues are absent, inadequate or illusory, cues sensed by the normally lesser sources may thus dominate the orientation pattern.

THE VESTIBULAR APPARATUS:

This consists of two bony structures each about the size of a large pea, situated in the inner ears, in close association with the organs of hearing. The two units of the apparatus are identical except for "handedness", each consisting of a set of three semi-circular canals communicating with a common sac, and an otolith or static organ.

(i) *The semi-circular canals* are small fluid-filled tubes lying in

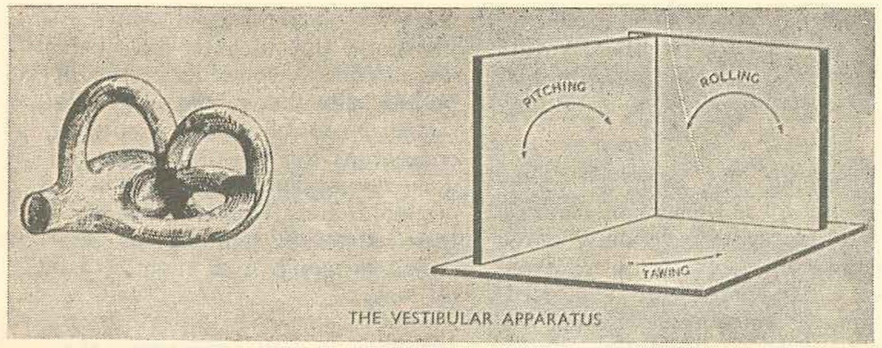


FIG. 1

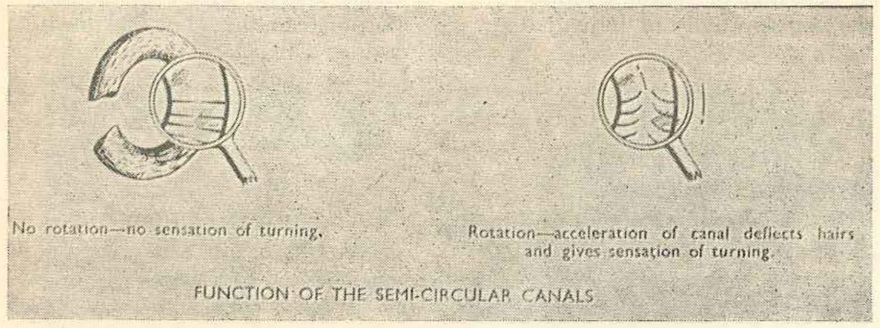


FIG. 2

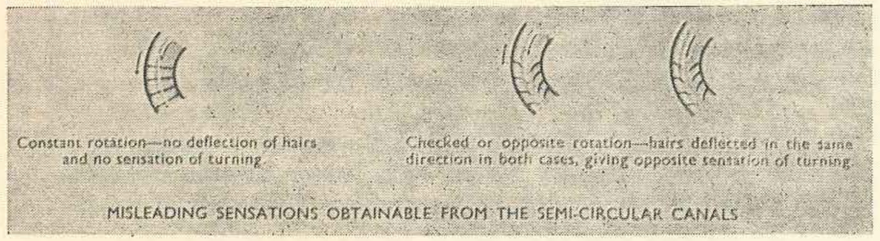


FIG. 3

planes mutually at right angles and so oriented with relation to the head that when a pilot sits normally in his aircraft the canals lie, for practical purposes, in the (horizontal) yawing plane, and in the (vertical) pitching and rolling planes of the aircraft (Fig. 1). At the opening of each canal into the common sac is a tuft of fine sensory hairs. When the head is turned laterally, inertia of the fluid causes it to flow through the horizontal canals. If the flow rate exceeds a threshold value, deflection of the sensory hairs occurs, and a signal is transmitted by the nervous system to the brain, giving rise to a sensation of turning (Fig. 2). However, once a constant rate of rotation is attained (as in a steady sustained turn) the fluid "catches up" and there is no longer relative motion between it and the hairs, which by virtue of their elasticity resume their undeflected position. No sensation of turning is now derived from this source. Further, when the turning motion is stopped, the momentum of the fluid will cause it to flow in the opposite direction, with corresponding deflection of the hairs and production of a sensation of rotation in a reverse direction to the original turn, or contra-rotation (Fig. 3).

The same mechanisms exist in the other two pairs of semi-circular canals which, as we have already noted, lie in planes parallel to the pitching and rolling axes of an aircraft. It has been shown that the frequency of nerve impulses passed to the brain is directly related to the angle of deflection of the sensory hairs. Hence the strength of the signal received by the brain is in normal circumstances directly related to angular acceleration or deceleration applied to the head. The system behaves, in effect, as an angular accelerometer.

There are two operating characteristics of the semi-circular canal system which should be understood:—

(a) The first, which produces the condition of vertigo already defined, is mediated by close nervous connections between the canals and the muscles which move the eyes. If the head is turned to the right, the eyes tend to deviate to the left, this reflex response assisting the eyes to fixate on the outside world. In other words, the canals afford a measure of servo-assistance to the eye muscle mechanism. This reflex is apparent also in the vertical and rotatory axes of eye movement. Such eye movements can, of course, only be continued through a limited displacement, and when this limit is reached, the eyes flick back and recommence their traverse. The resulting sequence of repetitive movements is called nystagmus. The flick-back phase is so rapid that no visual image is produced during it; this has some analogy in the viewing of a motion picture, in which the time interval between frames is so short that the visual image appears continuous. Nystagmus can have for the pilot both desirable and undesirable effects. Desirably, the mechanism will assist him to visually fixate on the external world during, for instance, the first few turns of a spin; but after the rate of rotation has become constant signals from the semi-circular canals will cease, and the nystagmus reflex will no longer be present to assist in visual fixation. Disorientation, principally manifest by inability to focus the eyes, develops; the visible world outside becomes blurred and streaky, and the instrument panel cannot be fixated. This sequence of events is probably responsible for reports that the spin of certain aircraft appears to speed up after four or five turns.

Undesirably also, when a spin or other rotatory movement of the aircraft is stopped, the resulting sense of contra-rotation already referred to will be associated with a reversed nystagmus, contributing further to disorientation of the pilot. These effects may last several seconds after actual cessation of rotatory motion; in this, the sensitivity of individuals varies a good deal. During this period the pilot is likely to feel that the aircraft is spinning in the opposite direction, and to take remedial control action. In the circumstances this may of course produce resumption of spinning in the original sense. The implications of these effects in spinning or spiral-diving in cloud or at night will be obvious.

(b) The second operating characteristic of the semi-circular canal system which is of importance to the pilot is known

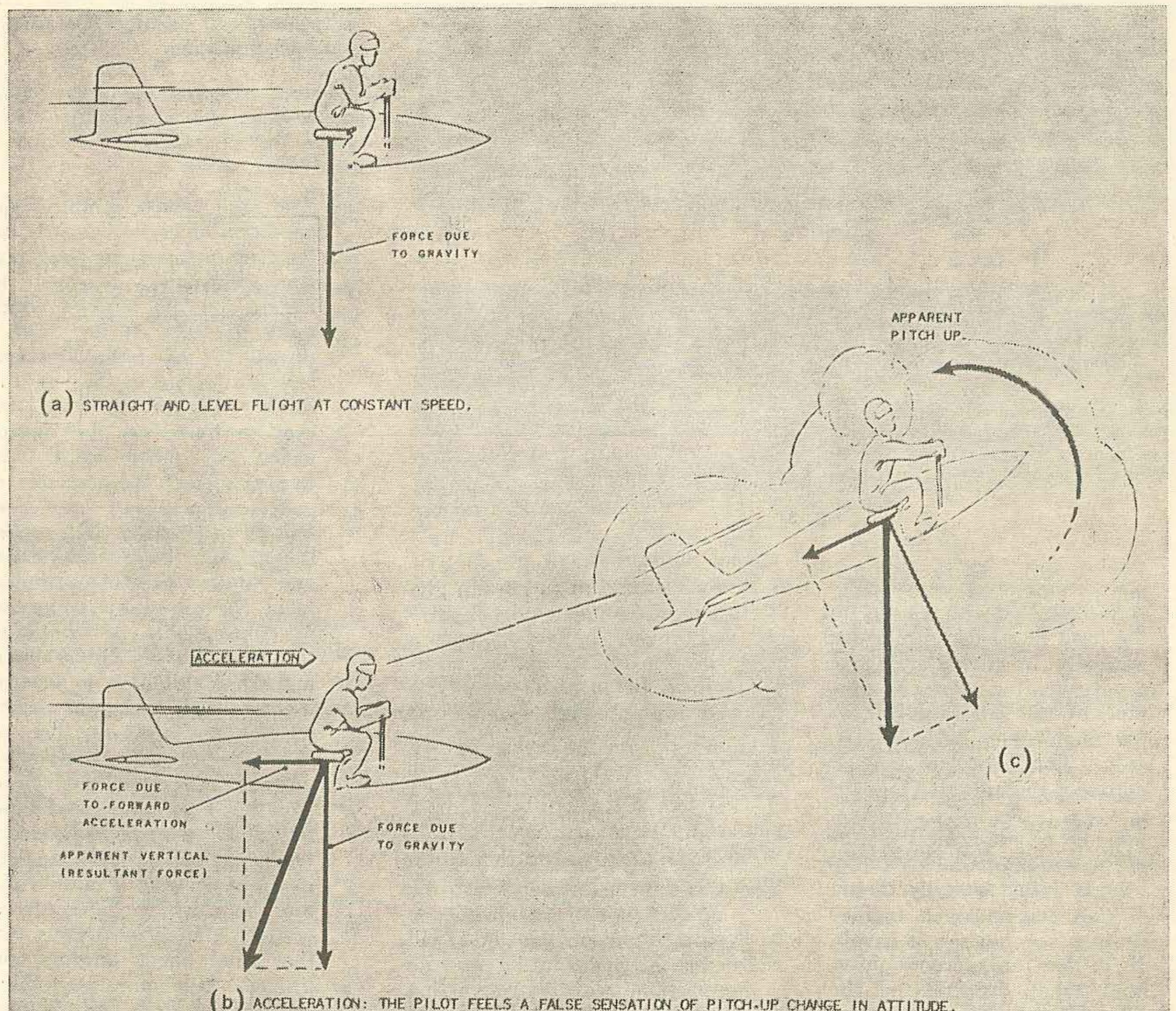


FIG. 4

as the Coriolis phenomenon. It has certain features in common with the well-known precession of a gyroscope in a third plane of space when, while rotating in one plane it is tilted in a second plane at right angles to the other two. If, when the pilot is being turned about the vertical axis of his body, thus stimulating his horizontal semi-circular canals, he rapidly moves his head so as to bring another set of canals into or near the plane of rotation, a particularly disconcerting sense of change of attitude may occur; this is often accompanied by dizziness and nausea. The sense of roll or pitch may be so violent that the pilot will be tempted to ignore his instrument indications, and/or believe his aircraft to be out of control. The Coriolis effect may be produced by such motions as suddenly tilting the head forward, while in a turn, to locate a pencil or pad dropped on the floor of the aircraft.

Since movement of the eyes, independent of head movement, does not normally stimulate the semi-circular canals, rapid scanning during turns is best carried out using eye movement only. If head movement is necessary the Coriolis effect can be offset by making the movement smoothly and relatively slowly. The hazard of this type of disorientation is of course much accentuated when under instrument conditions.

Disorientation arising from the action of the semi-circular canals can be easily demonstrated on the ground. It is strongly recommended that all flight crew familiarize themselves with the illusions of rotation, as described above, by such a simple procedure as having a colleague rotate them on a piano stool, with eyes closed.

(ii) *The static (or otolith) organs* are small fluid-filled chambers in which minute sensory hairs project vertically upward. Small crystals of lime salts (otoliths) are attached to the tips of these hairs. Transverse and fore-and-aft loads applied to the hairs by accelerative forces and/or (probably) by gravity cause their deflection, and transmission of a sensation of tilt, in the rolling or pitching plane, to the brain.

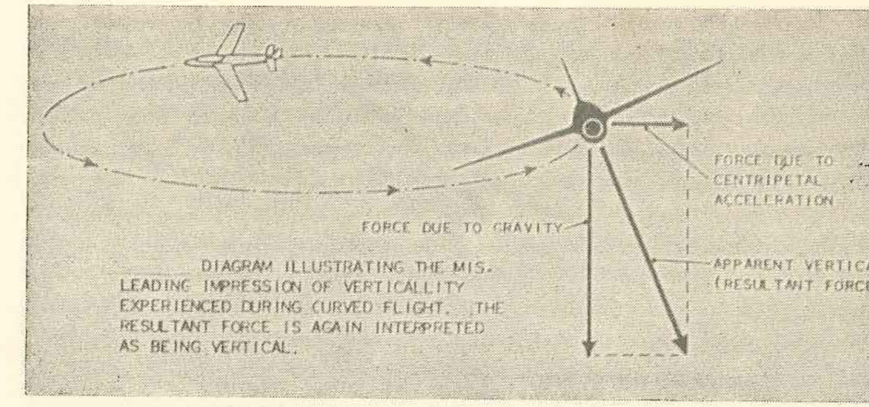


FIG. 5

To understand the function of this "G-sensitive" system, consider first pure translational motion, or motion in a straight line. When an aircraft is proceeding straight and level at a constant speed, gravity acts upon the mass of the pilot in every way as though he were seated in a chair on the ground; it exerts a force on the body mass—(its weight)—which is directed vertically downwards (Fig. 4 (a)). This, however, is the only condition in which a pilot can accurately assess his orientation with respect to the earth's surface by means of his otolith organs. When for example, the aircraft accelerates forward along its straight line of flight, the pilot senses his subjection to a force additional to but indistinguishable from gravity. He experiences a resultant force which is the vectorial sum — (as determined by a parallelogram of forces) — of those due to gravity and to his forward acceleration. As a general rule, this resultant force acts along a line angularly disposed rearward of the line of the earth's gravitational field (Fig. 4(b)). But the pilot, through the action of his otolith organs tends to experience a sensation of pitch-up change in attitude when no such change has, in fact, taken place (Fig. 4(c)). Conversely, on decelerating, he experiences an apparent pitch-down. Similarly, if the aircraft accelerates in a direction other than along a straight line of flight, that is to say, if it flies in a curved path, the apparent direction of gravity experienced by the pilot is the vectorial sum of forces due to true gravity and centripetal acceleration (Fig. 5). Except in two instances only, namely, flying through the lowest and highest points of a vertical loop, this resultant will be inclined to the earth's gravitational field, and again the pilot without visual orientation is liable to be misled as to the direction of the vertical.

The function of the static organs will be clearly understood when an analogy is drawn between the behaviour of the otoliths, in a transverse plane, and the ball of a conventional turn-and-bank indicator. During a perfectly-executed turn, provided there is no fore-aft velocity change, the resultant force on the static organ always acts in the direction associated by the pilot with straight and level flight (Fig. 6 (a) and (b)). Conversely, in a skid or yawing manoeuvre a lateral displacement of the sensory hairs occurs, leading the pilot to believe he is

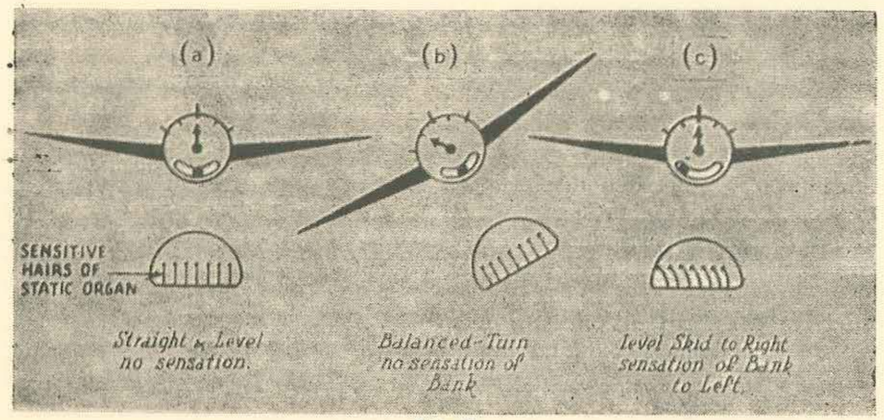


FIG. 6

banked unless he has a visual reference to overrule this sensation (Fig. 6 (c)).

MUSCLE, JOINT AND LIGAMENT SENSE, AND SKIN SENSITIVITY

The effect of the force of gravity, acting vertically downwards, is normally appreciated by pressures on and tensions in various parts of the body. This is especially so in the cases of tensions in muscles, joint loadings, and pressures on surfaces in contact with the supporting medium, for example the soles of the feet when standing, or the buttocks when sitting. Even the "drag" of the internal organs contributes. A continuous flow of nervous impulses from these various regions passes to the brain, producing a consciousness of the attitudes of limbs, trunk and head.

It will be obvious, however, that this system, like the static organ, can assist in orientation with reference only to a resultant force acting on the body, and that it is only in straight and level flight at a constant speed that this will be synonymous with orientation with respect to the earth's gravitional field.

Further, muscle and allied senses cannot be relied on to give a reliable indication of the aircraft's flight path, since accelerations of a similar nature may be imposed in a variety of ways. In "seat-of-the-pants" flying, this system does give some indication of attitude and flight path, and more usefully, of control co-ordination, but only when cross-referred to the less equivocal sense of vision. Slip and skid can produce erroneous sensations of bank, while the common fault of allowing the nose to rise after recovery from an instrument turn can be traced largely to the apparent decrease in the pilot's weight which occurs when rolling out, giving an impression of the nose dropping.

ACCELERATION THRESHOLDS:

Their Implications—

(i) *The Semi-circular Canals*:—

It has already been indicated that angular movement in any of the three planes served by the semi-circular canals will be sensed only if certain threshold values of acceleration are reached. The duration of application of accelerations just above threshold is also important.

The absolute angular acceleration threshold of the system is about 2 degrees/sec./sec., but an acceleration of this magnitude needs to be applied for some 7 or 8 seconds before it is sensed by the brain. On the other hand, an acceleration of 72 degrees/sec./sec. is sensed in approximately 1/50 of a second. From this it is apparent that an aircraft can pass into a steep turn without the pilot experiencing any sensation from his semi-circular canals, provided the entry is sufficiently slow and smooth. For example, the rate of change of heading in a standard rate turn is 3 degrees/sec.; to go into such a turn with an angular acceleration of 2 degrees/sec./sec. would mean transition from straight and level flight to the established turn in some $1\frac{1}{2}$ seconds. In practice, it takes about 10 seconds to establish a rate 1 turn smoothly, so that the angular acceleration involved is much sub-threshold. Since similar thresholds apply to the semi-circular canals lying in the rolling plane, the banked attitude developed in entering the turn would likewise remain undetected.

One of the commonest forms of disorientation in non-visual flight is known as "the leans". This is a strong subjective impression that the true attitude of the aircraft in the rolling plane is at variance with the flight instrument indications, that is, when flying straight and level by instruments, the pilot feels that he is leaning to one side. The cause of this illusion is as follows: The aircraft, in unstable air, rolls slowly through a few degrees at an insensible rate, say, to the left. Due to a further air deflection, it then spontaneously recovers, to the right, at a rate above the threshold value. All that the pilot's semi-circular canals will tell him is that the aircraft has suddenly rolled to the right. He corrects this, still without reference to instruments, to a position which he feels to be wings-level. When he now checks with his instruments he is faced with a disparity between their indications and the attitude he "knows" to be correct. The situation is related to a false "zero-ing" of the semi-circular canals lying in the rolling plane, and can be readily corrected by moving the head to and fro several times in this plane, preferably with eyes closed.

A strictly analagous condition can occur in the yawing plane, in which case it is known as "the turns".

Attitude changes of low rate in the pitching plane will, of course, also remain undetected by the semi-circular canals; it is improbable however that such changes will develop to a gross degree without some other cue bringing them to a pilot's notice.

The implications of these acceleration thresholds, when flying poorly rigged or trimmed aircraft in still air under non-visual conditions, will be readily appreciated.

(ii) *The Static Organ*:

(a) Acceleration along a fore-and-aft axis: The subjective impression of pitch-up, under forward acceleration, has already been dealt with, (refer to Fig. 4). A special case of this occurs when an aircraft accelerates at take-off. The sensation of nose-up attitude, requiring correction, may be very strong under certain non-visual conditions; this is especially so on take-off away from a built-up area on a truly dark night, when there is no horizon reference or ground "texture" visible to provide a cue to orientation in pitch. If, although very dark, weather conditions are clear, even an experienced pilot may be tempted to forsake his artificial horizon and look outside. The aircraft can then insidiously be put into a nose-down attitude, and a situation of "chasing the false vertical" will develop as acceleration increases in this attitude. A number of aircraft have been flown into the ground or sea with power on, under these conditions; five major accidents in Australia in the last ten years are thought to have been due to this cause. In a recent such accident at Shannon, Ireland, the overall linear acceleration of the aircraft during its 39 seconds of flight from unstick to flying into the water was about 1/19G., but because of the time-lag between the onsets of this low rate of acceleration and the pilots resultant sensation of tilt, it may be more correct to consider the initial acceleration as 1/14G. The apparent nose-up tilts corresponding to 1/19 and 1/14G are 3 and 4 degrees respectively, and greater displacement of the false from the true vertical would occur as speed increased in the nose-down attitude. It will thus be seen that illusory displacement of the vertical under these conditions is not small in terms of normal post-take-off and descent angles of transport aircraft.

(b) Lateral accelerations: The threshold for sensing of linear acceleration in both the fore-and-aft and transverse axes is of the order of 1/50G., or 8 inches/sec./sec. This threshold is well in excess of the lateral accelerations due to drifts developed even in extremé meteorological conditions, but sudden yawing motions of short duration are well sensed by the static organ.

MISCELLANEOUS DISORIENTATING FACTORS:

These tend to be contributory, rather than primary, in effect:

(i) *Aural disorientation*: Sounds out of phase in reaching the two ears may give rise to sensations of turning or weaving. Under certain circumstances the sense of hearing, coupled with some imagination, can confuse a pilot, a change in noise level being interpreted as a change in pitch attitude and/or speed.

(ii) *Hypnosis*: This may be described as a condition of "super-attention" or undue anticipatory tension, for the development of which instrument flight conditions are often excellent. Steady engine noise, a sense of remoteness from the outside world, possibly steady signals of a radio beam and particularly over-concentration on a single instrument such as the artificial horizon can induce an hypnotic state in which it is especially easy to disbelieve instrument indications. The technique of cross-reference in itself does much to prevent onset of this state. The complete answer to hypnosis on instruments, however, is relaxation based on frequent practice and familiarity with all phases of I.F.

(iii) *Illusory horizons*: One type of fictitious horizon may be encountered when the pilot, in visual flight in poor visibility conditions, relies on a cloud-bank for horizontal reference. Although most cloud-banks lie in the horizontal plane some do form a substantial angle with it. Disconcerting disorientation is possible under these circumstances.

(iv) *Autokinesis*: One of the first things a pilot learns when he learns to fly at night is that lights in the air and on the ground may appear to move in strange ways; the same confusion with lights may occur as long as he flies at night. The causes of this phenomenon, which is known as autokinesis, are complex, and it suffices to know that the effect exists, and is a potential source of disorientation to be guarded against.

CONCENTRATION AND FAGITUE:

Good instrument flying is a skill which takes practice for its attainment, and in the beginning or after a period of time without practice may be very fatiguing. As any experienced pilot knows, instrument flight in turbulent air is a potent source of fatigue. This is because of the constant attention to attitude correction required, because suppression of disorienting sensations arising in the vestibular apparatus and elsewhere may be difficult, and because an increase of nervous tension under such circumstances is usual.

When fatigue manifests itself, instinct also tends to reassert itself. The higher senses are the first to become fatigued; small errors in a skilled technique creep in, and in I.F. these may be dangerous. When flying on instruments every pilot will experience misleading sensations regarding the aircraft's behaviour. Experience and understanding will make them less noticeable, for in time the brain sub-consciously accepts the visual indications of attitude provided by the instruments in place of the external references on which it originally relied. The master sense, vision, is in fact again in control and just as in everyday life visual impressions suppress the vestibular, so they can now in instrument flight.

This acceptance is, however, based less on instinct than on reason and when mental powers are tired or distracted instinctive physical reactions may regain ascendancy. In fact it is just when the effects of fatigue, nervous tension, or unusual circumstances are distracting our concentration from the instrument panel that these false sensations become strongest, and the unexpectedness of their strength may influence even the experienced at a vital moment.

Overconcentration itself is a prime cause of fatigue and tenseness. The obvious aim of relaxed I.F. can only be completely achieved by frequent practice leading to easy confidence, but there are several practical ways of obtaining relief from tenseness and the onset of disturbing sensations.

Make a conscious effort to relax physically and mentally; maintain instrument cross-reference, and keep only a light grip on the controls; move in your seat; unclench your fingers and shrug your shoulders periodically; sit comfortably; spend time on setting correct trim; do not "overfly" the aircraft.

THE FINAL ANSWER:

To summarize, the following conclusions may assist in avoiding disorientation in flight, in particular under instrument flight conditions:

(*i*) *Understand that misleading sensations in flight, especially on instruments, are normal.*

(*ii*) *Understand their causes and appreciate why they deceive.*

(*iii*) *Make cross-reference the basis of your I.F. and visualize the indications of the panel in terms of attitude. Re-establish vision as the master sense.*

(*iv*) *Practice I.F. at every opportunity. Practice is essential to relaxation and confident suppression of illusory sensations.*

(*v*) *Until you have achieved I.F. familiarity, recognize your limitations. Clearly understand the proper criteria of visual contact and instrument flight.*

(*vi*) *When mixing visual and instrument flight, rely entirely on instruments for attitude. Use ground reference for plan position information only.*

(*vii*) *There are described elsewhere in this digest a number of fatal accidents. Of all of these disorientation and/or inability to control the aircraft under instrument flight conditions is believed, on good evidence, to be the cause. It is worthwhile taking pains to ensure that this does not happen to you.*

Forgotten Something?

Not YOU but the Other Fellow

Aviation Safety Digest No. 10 included an article titled "What Price Check Lists" in which mention was made of a failure of an undercarriage to retract. Aviation Safety Digest No. 13 included an article titled "Door Check" which highlighted a number of incidents of inadequate locking of doors. However, reports indicating that persons are not following published procedures are still coming to notice.

Here is a summary of some of the more recent reports.

UNDERCARRIAGE

A Viscount returned to land when the undercarriage would not retract after take-off. Inspection revealed that the pin between the landing gear selector in the hydraulic compartment and the actuator was not connected. • • •

During descent, the starboard main landing gear green warning light of a Convair 340 did not show until several attempts had been made to lower the landing gear. Inspection revealed that the starboard main landing gear safety pin had not been removed prior to take-off.

• • •

After take-off the nosewheel of a DC.6 did not retract. The undercarriage was lowered and it then retracted normally. Although the nosewheel locking pin was not recovered it was established that it had not been removed before departure.

• • •

A Viscount returned and landed when the pilot found that the undercarriage would only retract when the airspeed lock was overridden. Investigation disclosed that the isolating cock was in the closed position thus preventing the undercarriage circuit from operating.

• • •

After departure the nosewheel of a Dove aircraft did not retract. The undercarriage was selected down but only the starboard main wheel extended. The crew then noticed that the pneumatic cock was in the off position. • • •

Following take-off the crew of a DC.3 were unable to retract the undercarriage. After landing it was found that the undercarriage pins were still in position.

• • •

FLIGHT CONTROLS

After taxying to the take-off position and completing the run-up, the captain of a DC.4 carried out a check of the flight controls for full and correct movement. A restriction in elevator movement was noticed. On return to the tarmac a cleaning brush was found lying in the area between the elevator and tailplane.

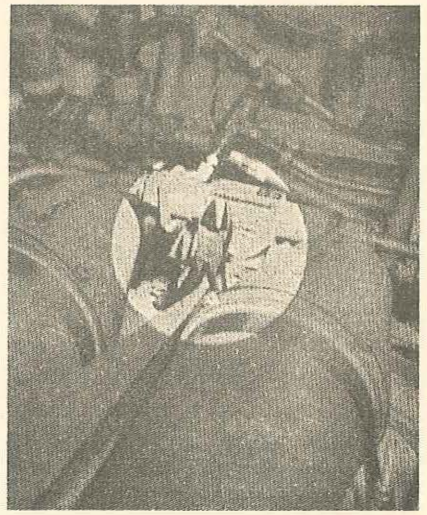
• • •

During flight in a DC.3 the crew noticed some "chaffing" in the operation of the elevators. The flight proceeded normally. After landing a length of 2" x 1" timber was found jammed between the leading edge of the port elevator and the trailing edge of the tailplane. It was established that this timber had been used by an engineer to steady a ladder used while he was working on the tail fin.

N.B. A "loose article" jamming the elevators has already caused one fatal accident overseas this year. • • •

The following incident was reported in the Aviation Mechanics Bulletin May, June, 1958.

"The aircraft commander checked aircraft steering in taxi, take-off and land detent during taxi-out. All was normal. As a water-assisted take-off roll was started, the aircraft turned toward the right side of the runway. After the B-47 rolled 200 to 300 feet with full left rudder it became apparent that the steering mechanism was inoperative. The aircraft captain retarded the throttle to idle and applied brakes at approximately 30-35 knots. Rudders were neutralized and steering ratio was placed to taxi position. At this time the aircraft ran off the right side of the runway, stopping approximately 50 yards off the runway and 500 to 600 feet from the start of take-off roll. A thorough check of the steering system revealed that the handles of a pair of diagonal wire cutting pliers were hanging down



over the T-shaped actuating arm located between the steering actuating cylinders in the forward wheel well. It's the simple things that count. So no matter how simple it may seem, count those tools after a job."

• • •

While a Viscount was climbing away from Rome en route to Athens a clatter was heard and, on inspection, a pair of engineer's metal-cutters was found lodged behind the rudder adjusting wheel. As the rudder control had been tested for freedom of movement more than once, the probability seemed to be that the cutters had dropped down from behind the first officer's instrument panel during flight.

Investigation revealed that, during a transit stop earlier the same day, the first officer's Horizon Gyro Unit had been changed. The electrician concerned had used, and then been unable to find, an exactly similar pair of cutters.

From Canada comes the following report:

A DC.3 departed Port Hardy on a scheduled flight to Vancouver with a crew of three and fifteen passengers on board.

The Company's base engineer and a mechanic's helper were on hand to prepare the aircraft for departure. As the base engineer was placing thermos bottles aboard the aircraft he saw the pilot in command begin removing the external control locks. The pilot was observed by some of the passengers removing the rudder and aileron locks. After the engines were running the base engineer looked at the ailerons and rudder and noticed that the locks were off. He did not check the elevators however to ensure that the locks had been removed.

Five minutes after take-off the pilot informed the control tower that he was returning because of elevator control trouble. The aircraft made a long final approach to runway 15 and then touched the runway and bounced. The aircraft made an exceptionally sharp climb as though full power had been applied. However, at the top of this climb, the aircraft stalled and fell to the ground in a nose-down attitude, almost instantly bursting into flames. The stewardess and three passengers were the only survivors.

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FUEL AND OIL CONTENTS

During flight the No. 3 engine on DC.4 stopped due to fuel exhaustion of No. 3 main tank. Fuel uplift records showed that no fuel had been added to this tank although all other main tanks had been refuelled. Fuel in No. 3 tank was recorded as being sufficient for the flight. Investigation indicated that the dipstick used to check the refuelling was calibrated with Nos. 1 and 4 tanks on one scale and Nos. 2 and 3 on another. The graduation of 375 gallons for Nos. 1 and 4 tanks corresponded to the 125 gallons graduation on the scale for Nos. 2 and 3 tanks. It was apparent that the No. 3 tank quantity had been misread. The captain noticed the low fuel quantity registered on the quantity gauges but after reference to the fuel records considered that the gauge was unserviceable.

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Whilst en-route in a Dove aircraft the starboard propeller was feathered when the engine oil pressure fell to the minimum permissible. Oil pressure on the port engine also dropped but remained above the minimum permissible. The flight was completed without further incident. After landing it was found that the oil tanks had not been replenished before departure, although the pre-flight inspection form indicated that this had been done.

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When about midway to destination the crew noticed that the fuel contents gauges indicated a severe shortage of fuel although the flow-meter readings indicated that fuel consumption was normal. The aircraft diverted to a nearby aerodrome where it was found that the contents gauges were registering correctly. Investigation disclosed that the aircraft had not been refuelled prior to departure as stated on the aircraft papers.

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A Cessna 170 departed on a flight carrying sufficient fuel for 270 minutes flight. Some thirty minutes later the pilot realised that fuel was apparently being consumed at an abnormally high rate and he decided to return to the aerodrome of departure. Fifteen minutes later he was forced to land on a beach due to shortage of fuel. On landing the pilot found that the spring-loaded drain cock in the fuel filter was stuck open. Apparently when the filter was checked for water after refuelling, the main fuel selector was OFF, fuel therefore ceased to flow once the filter was empty and consequently the position of the drain cock was not noticed.

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DOORS

Viscount returned after take-off when the hostess' seat belt was found caught in the cabin door. Another Viscount returned when the door warning light showed after take-off. A piece of rag was found caught in the crew entrance door.

Pilot of a Heron aircraft discontinued take-off when the nose door opened during the take-off run. The door had not been securely latched.

During the climb in a CV.340 the door warning light showed and a definite thump was heard as cabin pressure was lost. The aircraft returned and it was found that the belly locker door was partially unlocked apparently due to the incorrect positioning of the handle before the door was closed.

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COCKPIT

Whilst on the climb the propeller of No. 3 engine of a Viscount was feathered due to torque and r.p.m. fluctuations. When performing the after-feather drill it was found that the No. 3 fuel booster was already OFF. Apparently this had been inadvertently knocked off by a crew member thereby causing the engine power to fluctuate, but no fuel pressure warning indications were noticed by the crew. The engine was restarted and the flight continued.

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En-route in a Convair 440 power fluctuation was experienced due to failure of the crew to switch off the ADI pump following a "wet" take-off.

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There have been a number of cases, in various types of aircraft, where radio failure has been encountered, and consequently unscheduled landings made because of an incomplete check of the system

(i) communications could have been restored by operation of an emergency switch on the cockpit selector box;

(ii) crew inadvertently actuated the MCW switch on an unmodified VHF panel causing jamming of the frequency;

(iii) microphone installed in vacant supernumerary position became entangled and microphone switch was depressed continuously;

(iv) VHF transceiver failed but crew unable to transmit on HF as microphone selector switch was left on VHF.

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Are YOU likely to feature in our next list?

More on Dangerous Cargo

An article in a previous Digest dealt with the carriage of improperly packed lighter fluid.

Almost any inflammable or corrosive material can be carried safely in an aircraft IF PROPER PRECAUTIONS ARE TAKEN; the dangers arising from incorrect handling of these materials are self evident and need no emphasis. However, reports of improperly packed and stowed dangerous goods are regularly received. The following are typical and are presented with the reminder that failure to take the proper precautions can be catastrophic.

1. **DC.3 QUEENSLAND**

Captain's Report — "When unloading the starboard locker a small quantity of yellow fluid was noticeable on the floor of the rear locker. The fluid was from a metal container labelled "De Rust R" which had been loaded on its side. As it was considered that the fluid might contain acid, the affected area was wiped clean and the matter was reported on return to base. The cargo manifest did not indicate and I was not advised that any corrosive materials were being carried".

On return to base the affected area was neutralised and all wiring and components in the vicinity were checked.

The metal container held a four gallon earthenware carboy of a proprietary line of derusting solution with a base of hydrochloric acid. The carboy had a wired rubber stopper and was packed in sawdust. However, the solution had leaked at the stopper and had seeped through the sawdust.

The consignment was made by a chemical company and had been delivered by a driver of a carrying firm. When asked by the receiving clerk if it was flammable or corrosive, the driver replied that he did not know, but to the best of his knowledge it was not. No further efforts were made to determine the nature of the contents and no special precautions were taken in regard to handling.

Since this incident, improved freight acceptance procedures have been introduced by the operator.

The requirements for the carriage of dangerous goods are specified in Air Navigation Order 33 and the I.A.T.A. Regulations. Briefly, the requirements for the carriage of corrosive liquids are that they must be in glass, eathenware, hard rubber or plastic bottles of not more than one pint capacity with sufficient non-flammable cushioning and absorbent material to prevent breakage and leakage, and packed in a metal canister. The bottle and canister are to be securely closed and of such construction as to prevent leakage of the material caused by changes of temperature, humidity and altitude during transportation. In addition, the canister is to be packed in a strong wooden or fibre outside container which must carry the following label.

2. **DC.4 NORTHERN TERRITORY**

Captain's Report—"Dangerous cargo consisting of motor spirit and dieseleum leaked considerably during flight and the fumes caused a serious hazard to the safe operation of the aircraft. The containers were packed in wooden boxes which had been partly lined with water-proof paper. Neither contained sawdust as stated in the Dangerous Cargo Declaration form nor were they marked to indicate which side should have been kept uppermost. Most of the containers — 12 — appeared to have leaked through their filling caps".

Investigation revealed that several of the containers were not adequately sealed to prevent leakage under all conditions to be expected in flight. The matter has been taken up with the consignor and more thorough sealing procedures have been adopted.

The Dangerous Cargo Declaration stated that the containers were packed in sawdust whereas they were actually packed in wood wool which has lower absorption qualities. However, there is no difference between these materials as regards fire prevention. In fact, there is no safe absorbent for flammable fluids. The absorbent materials used are only intended to cope with slow leakage and the escaping fumes should draw attention to any such leakage before a hazardous situation arises. The main consideration is to prevent escape of quantities of flammable liquid into the aircraft structure where it would be impossible to deal with it in the event of fire.

The conditions specified for the carriage of flammable liquids are briefly as follows. Quantities of not more than two pints in metal containers or quantities of not more than one pint in glass or earthenware containers may be carried provided that these containers are packed in a strong wooden or fibreboard outside container with sufficient cushioning and absorbent material to prevent breakage and leakage. Further, the outside container must bear the label as shown on this page.

3. **DC.3 NEW GUINEA**

Captain's Report—"Upon arrival at Goroka a box containing batteries with sulphuric acid was found to have leaked through onto the floor of the aircraft. Although marked "this side up" there were no other markings to indicate it was dangerous cargo. Also, the box was not the regulation shape."

The circumstances surrounding this incident were similar to those reported in 1 above.

4. **DC.3 NEW GUINEA**

Captain's Report — "While carrying fuel drums a strong smell of fuel was noticed in the cockpit. Fuel could be seen on the floor of the cargo compartment so all electrics were switched off. On landing, investigation revealed one drum leaking badly through the sealed cap".

The circumstances surrounding this incident were similar to those reported in 2 above.

Jets: Cleanliness, Precision, Sophistication

(Extract from Accident Prevention Bulletin 58-8, 15th August, 1958)

Might as well begin now to change your working habits for the jets, even if you do not expect to fly or work on them. All the following can cause trouble—because a jet engine is not choosey about what it sucks in!

For example:—

that empty cigarette pack you threw out the cockpit window;

that napkin that wind blew off the food truck;

that rag the cleaner left on the ground;

the worn bolt or washer you tossed away;

the hose nozzle with a little dust on it;

the cap that fits loosely on your head;

the passenger's or spectator's hat that was blown off by the wind;

that debris (from a swept-out transport) that was placed in an open container;

a discarded piece of carbon paper from a crewman's log-book.

Also bits of brown papers, etc., could seal off the ram air intakes of one or several of the sensing devices on a jet transport. A ramp cleanliness programme, complete with posters for reminding, should be started now to prepare for the jet age.

Habits are hard to change. It might help to watch others to see what they do that will make jet operations unnecessarily expensive (though not necessarily dangerous). This might help change you own habits.

There is No Substitute for Alertness

(Extract from Aviation Mechanics Bulletin May-June, 1958)

Damage incurred during the ground run of engines has been an increasing problem since big and powerful engines have come into general use. Several instances have been reported where aircraft have slipped or rolled forward for a considerable distance while the mechanics in the cockpit concentrated on the instruments. In a recent case a nose ladder and a propeller were completely destroyed.

Investigation of another incident revealed that although the aircraft had moved forward approximately eight feet and had started to turn, the men in the cockpit were not aware of any movement. The four wheel chocks had skidded and chattered on the pavement. Evidently wheel chocks are no substitute for alertness.

The airline involved has issued the following alert to its personnel:

(a) Insure that the aircraft is properly chocked.

(b) See that the area for a considerable distance forward of the aircraft is clear of stands, ladders, tugs, etc.

(c) Make sure that at least one man is standing guard on the ground.

(d) Have at least two (2) men in the cockpit—one man standing by the brakes and observing the ground man, one man making the ground run.

(e) Park the ground power unit a few feet forward of the nose gear, not beside it. In the event the aircraft moves forward, collision of the nose gear with the power unit is not likely to damage the aircraft and it will certainly make the operators in the cockpit aware of movement and so prevent serious propeller and engine damage.

(f) During wet and icy weather this problem becomes more critical.

Hotspots

(Extract from "Approach" May, 1958)

When you put a pencil mark on an exhaust system component—you have really "marked" it for failure.

If it's in an area that gets good and hot—and that's practically all over—the carbon of the pencil lead (graphite, practically pure carbon) is absorbed by the material, which makes a localized spot of high carbon steel extra brittle. Then expansion, contraction and vibration cause it to crack. The crack is not confined to the dimension of the original pencil mark; it keeps right on going. This applies to jet compressor blades, reciprocating engine exhaust stacks and manifolds as well.

So you see a very innocent little deposit of any free carbon on a "hot spot" can start a very insidious chain of events.

Overseas Accidents

DH.82 Lost in Cook Strait

(Summary of a report by the Air Department, New Zealand).

A DH.82 became overdue on 28th November, 1957, while on a transit flight from Wanganui, New Zealand to Blenheim, New Zealand, in adverse weather. Wreckage which was identified as part of the aircraft was washed ashore at Ohau Bay two days later.

THE FLIGHT

The aircraft took-off from Hamilton, New Zealand, at 1500 hours on 27th November, bound for Awakino on the first stage of a flight to Stewart Island. The pilot's father was flying as a passenger. At 0745 hours on the following day the aircraft took-off from Awakino for New Plymouth where it landed at 0903 hours. The officer on duty in the tower briefed the pilot on the projected flight and reminded him of his responsibility to obtain a weather forecast. The pilot reported at the Meteorological Office and, in response to his request, was shown the 0900 Aero Reports, however, he refused the Meteorological Officer's offer to obtain a route forecast. The pilot filed a VFR flight plan and took-off for Wanganui 80 miles south-east at about 1000 hours, by which time a strong gusting wind was blowing.

Local light aircraft were grounded at Wanganui on account of wind and turbulence when the DH.82 landed at 1117 hours. The pilot made a good landing and taxied in with wing-tip assistance. He arranged for the aircraft to be refuelled and then visited the tower, where he stated that he had obtained a route forecast at New Plymouth which showed an expected improvement in the weather further south. He filed a flight plan designating Rongatai as a check point, but after sighting the 1100 Aero Reports which forecast turbulence in the Rongatai area he amended this plan to show Paraparaumu as reporting point before crossing Cook Strait. A C.A.A. Flight Testing Officer was present in the tower while the flight plan was being prepared and, being aware of the pilot's over-confident attitude and lack of experience advised him to turn back if the weather deteriorated. The pilot replied, "You know me, I can't go wrong".

The aircraft was cleared to fly the coastal route, but at the last moment this was amended to the inland route on advice from Wellington. This message was passed personally to the pilot as he was seated in the aircraft. At Wanganui it was noticed that neither the pilot nor the passenger was wearing a life jacket, and no form of flotation gear was evident in the cockpit. The aircraft departed from Wanganui at 1148 hours in gusting wind and intermittent rain.

At 1248 hours the aircraft reported overhead at Paraparaumu, approximately 70 miles south of Wanganui, circling the aerodrome twice. The duty A.T.C. officer had the impression that the pilot wished to land, and although he considered that the wind conditions were too rough for the landing of a DH.82, he flashed him a "green". The aircraft, however, eventually turned and headed south. It was next sighted by an A.T.C. officer from his home at Paekakariki. The aircraft was flying at 500 feet and being buffeted by the extreme turbulence. The next sighting was some minutes later by an experienced Air Force pilot from his home at Karehana Bay. He considered the flying conditions totally unsuitable for a DH.82 aircraft. The aircraft was next observed by a fencing contractor working on the hills above Ohau Bay, and by a scrub-cutter working on an adjacent ridge. Both observers were at about 400 feet above sea level and saw the aircraft flying low along the coastline. The attention of one of these witnesses was attracted to the aircraft by a sudden "cough" from the engine. As the aircraft passed the observers the wind was changing from north-west to south, and shortly afterwards rain and low cloud enveloped the area. The aircraft was not seen again.

A starboard front interplane strut and one rear interplane strut, together with a quantity of splintered fragments of wooden structure, were washed up on the beach at Ohau Bay, 25 miles south of Paraparaumu. The distortion of the strut end fittings and the splintering of the wooden portions of wreckage were more consistent with severe initial impact than with subsequent damage by the sea.

INVESTIGATION

The pilot held a private pilot licence and his total flying experience was approximately 100 hours. He had created among aerodrome staff and experienced pilots an impression of extreme over-confidence and intolerance of regulations.

Weather is the prominent feature in the circumstances which culminated in this accident. It is necessary, therefore, to consider whether the pilot was justified in undertaking the flight in the light of meteorological knowledge available to him before departure from New Plymouth. He refused the offer of the Meteorological Officer to provide a route forecast and based his planning on the information contained in the 0900 hours Aero Reports. These reports represented the visibility and cloud conditions as quite satisfactory for the flight, but forecast wind and turbulence of sufficient severity to make conditions borderline for a DH.82. Had the pilot accepted the offer of a route forecast, it would not have contained any information likely to influence him to abandon the flight. The advance of the front in Cook Strait, which was later to become the critical factor, did not become apparent until 1230 hours, and would not have been referred to in the forecast. The pilot's departure on a V.F.R. flight plan from New Plymouth was, therefore, justified as far as visibility and cloud were concerned, but ill-advised for a pilot of his limited experience in face of the forecast wind and turbulence.

It is difficult to justify his departure from Wanganui, which was made when pilots of infinitely more experience considered it expedient to remain on the ground. His journey to Paraparaumu occupied 60 minutes, representing a ground speed of 87 m.p.h. At the same ground speed the aircraft would have reached Ohau Bay at 1315 hours. This timing coincides with the statement of witnesses that the aircraft passed this point between 1300 and 1330 hours.

While the aircraft was in transit the weather situation in Cook Strait changed rapidly by the unexpected onset of a southerly cold front. The associated bank of low cloud and rain reached Ohau Bay a few minutes after the aircraft was seen to pass this point heading directly into the front. The conditions into which the aircraft penetrated can be gauged by the sudden and excessive change in wind. The aircraft had been flying on a southerly heading in a 30 to 40 knot gusting wind from about 300 degrees. The wind reported at The Brothers in the van of the front was 53 knots from 210 degrees. The shear line and turbulence associated with such a wind change could well have serious consequences for a light aircraft. Whether the aircraft was forced into the sea by turbulence, or the pilot lost control in low cloud, cannot be ascertained. The condition of the fragments of wreckage, however, suggests that the aircraft struck the water with considerable force. Although the pilot did not have prior knowledge of the change of weather in the Straits, the low cloud and rain accompanying the advance of the front must have been patently obvious to him in plenty of time to have turned back. To fly from an area of severe turbulence into an advancing front would be a hazardous undertaking for even the very experienced. For a pilot of his experience it was courting disaster.

The accident was caused by the failure of the pilot to make the correct decision in the prevailing circumstances. The degree of difficulty in reaching the decision is, therefore, the criterion of pilot responsibility. The alternatives of continuing the flight into an area of low cloud and rain, or turning back, were presented to the pilot when he was already flying in extremely turbulent conditions. The correct decision should not have presented any difficulty to the average pilot imbued with a sense of responsibility. It would appear that the impression of over-confidence that he had created in aviation circles was fully justified, and perhaps his remark to the C.A.A. Flight Testing Officer before taking-off from Wanganui — "You know me, I can't go wrong"—is a classic example of famous last words.

VFR Flight in Unfavourable Weather

(Summary of a report by the Department of Transport, Canada)

At 1310 hours on 7th October, 1957, a Cessna 180 departed from its seaplane base, Kenora, Ontario, on a flight to Swan Lake, Ontario. At 1330 hours, the pilot reported that he was over Swan Lake, the ceiling was 400 feet and visibility one mile with some fog. This was the last transmission received from the pilot.

The wreckage was located on the west shore of Swan Lake two days later. All occupants of the aircraft — a pilot and two passengers, were killed and the aircraft was destroyed.

The aircraft took-off at 1310 hours and 15 minutes later reported over White Dog, which is about 30 miles north-north-west of Kenora. From this it would appear that the pilot did not fly a direct route to White Dog but possibly had to circumnavigate areas of poor weather. The accident occurred at 1338 hours. Examination of the scene of the accident which was approximately four miles from White Dog, indicated that the aircraft struck the ground at a high speed and at a steep angle.

The pilot, who did not hold an instrument rating, held a valid Commercial Pilot Licence and had a total of 2,800 hours flying experience. His experience on Cessna 180 aircraft was approximately 700 hours.

A forecast issued for the period 1200 hours to 1800 hours indicated that a cold front was expected to lie just east of the area at 1200 hours. The weather was forecast to be ceiling 500 feet, broken with an overcast layer at 1,000 feet, visibility eight miles but three miles in light drizzle, wind north-north-west at 15 m.p.h. The actual weather observed along the flight route was ceiling 1,100 feet, overcast lowering to 200 feet, visibility ten miles lowering to one mile.

It was established that prior to take-off the pilot did not obtain the weather information that was available at the Kenora radio range station.

While the precise cause of the accident was not determined conclusively, a contributory factor was considered to be that the pilot, who did not hold an instrument rating, attempted V.F.R. flight in unfavourable weather.

Pilot Attempts Flight Beyond His Experience

(Summary of a report by the Department of Transport, Canada)

The pilot of a Navion aircraft and two passengers were killed when the aircraft crashed near the summit of Mount Breakenridge, 40 miles north of Chilliwack, British Columbia.

At about 1946 hours on 24th April, 1957, the aircraft, carrying a pilot and two passengers, departed Penticton for Vancouver on a DVFR flight plan with an estimate of one hour and thirty minutes en-route and fuel for four and one-half hours on board. The aircraft reported by Princeton (5 miles north) at 2016 hours, with an estimated time of arrival at Vancouver at 2115 hours. There was only one other positive communication with this aircraft; Abbotsford radio range received a very weak call from the aircraft at 2140 hours.

When the aircraft failed to arrive at Vancouver by 2146 hours an alert was begun and search and rescue procedures were started. The aircraft was assumed to have expended all fuel by 0016 hours on 25th April. On the afternoon of 28th April, the wreckage of the aircraft was located some 64 miles east of Vancouver and 25 miles north of the direct track.

The pilot in command held a valid private pilot licence and had accumulated a total of about 240 hours of flying experience of which about 200 hours had been acquired on Navion type aircraft. The pilot's total night flying experience was about 26 hours. He had made 15 night flights either to or from Penticton-Vancouver. He had no instrument experience or training, either under simulated flight conditions or on the Link trainer.

The aircraft was equipped with a low frequency transmitter/receiver, transmitting on 3023.5 kcs. and receiving on 200 to 400 kcs., a 12 channel VHF transmitter/receiver with at least two transmitting crystals (122.1 and 122.5) and an ADF compass. The aircraft was also equipped with an autopilot.

It was determined from an analysis of the weather situation that a slight ridge of high pressure was building up over the Vancouver-Penticton area during the flight. The air mass was moist giving considerable cloud and some snow showers over the mountains en route resulting in marginal VFR conditions. The low cloud would extend upwards to 11,000 feet. The pilot was fully aware of the situation having seen copies of the regional forecast and weather sequences and, also, in having talked to a private owner-pilot who had just completed the flight into the Penticton area from Vancouver a half hour before the pilot's departure. The pilot flight planned at 8,000 feet DVFR. The forecast wind velocity at 8,000 feet for the flight was 320/20 with nil to light turbulence.

It was considered that the pilot became lost and was unable to orient himself in time to make a safe landing.

Underlying cause factors were:—

(a) The continuing of flight into unfavourable weather conditions.

(b) Attempting flight beyond his ability or experience.

Fatal Flight in Instrument Conditions

(Summary of a report by the Civil Aeronautics Board, U.S.A.)

A Beech Bonanza crashed and burned near Hyde Field, Clinton, Maryland, about noon on 25th January, 1958, killing the pilot who was the sole occupant.

THE CIRCUMSTANCES

On the morning of 25th January the part owner of a Beech Bonanza arrived at Hyde Field intending to fly to Cocoa, Florida, a distance of 690 miles. There are no traffic control or U.S. weather bureau facilities at Hyde Field. Clearances and weather information may be obtained by telephone or radio from several sources in the Washington area.

On arrival at Hyde Field the pilot found that the weather was overcast with very low cloud and poor visibility. He telephoned the Washington Airport Meteorological Office and was advised that the weather at Hyde Field could be expected to be overcast with a cloud base of 1,000 feet and occasionally 500 feet with light rain until approximately noon when a slight improvement could be expected.

At 1150 hours the aircraft taxied out and took off into the north-west. The landing gear was observed to retract shortly after the aircraft became airborne and at a height of about 200 feet above the ground the aircraft entered clouds, turning to the left. A few moments later the aircraft was seen through a break in the clouds still turning left at a low altitude. It was then heard to make several left turns with the sound of the engine alternately increasing and decreasing as if power settings were being changed or the aircraft was diving and climbing.

On the last of these turns the aircraft was observed above the airport turning left through a northerly heading at an altitude estimated to be 200 to 800 feet. A short time later it emerged from the clouds south-east of the field in a high speed dive and struck the ground. A large ball of fire rose high in the air from the crash site, a wooded area ½-mile south-south-east of the airport.

Investigation revealed that the aircraft struck three trees during its descent and was on a heading of 135 degrees with its right wing low when it struck the first tree. The angle of descent after striking this tree was 26 degrees below the horizontal.

Examination of the wreckage, which was all within an area 95 feet by 40 feet, indicated that the aircraft was intact until striking the tree. All control cables, except aileron cables, were found to be continuous and connected to their respective surfaces. The separation of the aileron cables was determined to have been caused by impact forces. An examination of the engine, although badly damaged by impact forces and fire, revealed no evidence of malfunction or failure of the engine prior to impact.

ANALYSIS

The pilot was 40 years of age and held a current airman certificate with private pilot and airplane single-engine land ratings. He had accumulated approximately 279 flying hours of which six were in the Bonanza. All available evidence indicated that he had not received any instruction in instrument flight. According to people who knew him the pilot was careful and cautious in his flying, and not likely to take chances.

The weather at Hyde Field when the pilot took-off was not the kind of weather in which a pilot without instrument training should be flying. It was raining and foggy and the clouds were low. There were occasional breaks in the lower clouds but not large ones through which a pilot could safely climb to the top. What prompted the pilot to take-off under these conditions is not known; however, several factors may have contributed to this decision.

Since the ceilings a few miles south of Hyde Field were higher and the weather was generally forecast to improve after noon, it is probable that the pilot decided to see for himself just what the weather conditions aloft were at that time. To do this he may have thought that he could climb through a break in the clouds to their tops and then fly south, or he may have simply decided to test the height of the ceiling and the visibility and return to the field.

Before leaving home that morning he told his daughter that if the weather conditions did not improve by noon he would not make the trip. The fact that he did not have the necessary training to fly by instruments or sufficient night flying experience to feel safe in landing at night at a strange field most probably motivated his thinking at that time.

It is known, however, that he wanted to make the trip in order to visit his wife in Florida. Since the flight to Cocoa, including a refuelling stop, would take more than 5½ hours, he could not leave much later than noon and be assured that an intermediate overnight stop would not be necessary. This would have shortened his stay in Cocoa considerably as he planned to return to Washington, Monday, two days later. These could well have been the determining factors in causing a normally cautious man to make an unwise and dangerous decision.

It was not possible to determine if the pilot intentionally entered the clouds. There is a distinct possibility that he may have done so unintentionally because of his inexperience as a pilot and his meagre knowledge of both the flight characteristics of the aircraft and its cockpit configuration. A climb of several hundred feet could be made easily in the time a novice pilot might be pre-occupied in the cockpit raising the gear and adjusting the propeller controls, etc.

There is little doubt as to what occurred after the aircraft entered the clouds. The engine noise, heard by persons on the ground, indicated that the pilot partially lost control and made a series of turning climbs and dives which culminated in complete loss of control and the final dive to the ground.

PROBABLE CAUSE

The Board determined that this accident was caused by the pilot's attempt to fly in weather conditions beyond his level of ability.

Tri-pacer Lost in Adverse Weather

(Summary of a report by the Department of Transport, Canada)

A Piper Tri-Pacer on a private flight from Fredericton, New Brunswick, Canada, to Moncton, New Brunswick, crashed to the ground in a steep spiral in a thickly wooded area some 40 miles northwest of Moncton. The pilot and two passengers were killed.

The aircraft made a normal take-off at 2054 hours, circled the Fredericton airport three times and then headed in the general direction of Moncton. The estimated lapsed time for the flight as given by the pilot was 55 minutes and his E.T.A. Moncton was 2149 hours. When the aircraft did not arrive on schedule, search and rescue action was effected. However, the extensive search which followed was unsuccessful and was abandoned as a result of heavy snow falls. The wreckage was located some four months later on resumption of the search.

From evidence obtained at the scene of the accident, the aircraft had crashed to the ground at 2201 hours at high speed whilst out of control in a steep right hand spiral.

The pilot in command held a valid private pilot licence and had accumulated a total of about 75 hours and 25 minutes of flying experience of which about 32 hours and 30 minutes had been acquired on Piper PA.22 type aircraft.

No evidence was found to indicate malfunctioning of the engine, airframe or controls.

The route from Fredericton to Moncton on the night of the accident was in warm air with the closest cold front west of Montreal, Quebec. A trough of warm air aloft from the Polar frontal system lay near Montreal but the middle cloud from this system did not reach the area until well after 2130 hours. There was a very strong south-westerly flow of warm moist air over the region causing fog and very low stratus-cloud over the Bay of Fundy, this being blown inland across New Brunswick coastal areas and across into Prince Edward Island.

The weather along the probable track of the aircraft would give a ceiling of approximately 400 to 500 feet above ground with moderate turbulence in the lower levels. Higher ground to the west of the Chipman area would allow only a 300 feet ceiling and visibility would be lowered in drizzle to 3-6 miles occasionally. The winds at the time of departure of the aircraft from Fredericton were strong and would cause considerable turbulence below 1,000 feet, particularly in the area of Grand Lake and around the hills to the east.

The cause of the accident which resulted in fatal injuries to the occupants and complete destruction of the aircraft involved, was that the aircraft was permitted to execute a steep spiral dive to the right from which it failed to recover, resulting in the aircraft striking the ground with terrific impact.

Contributory causes were considered to be:—

(a) Inexperience of the pilot.

(b) The continuing of a VFR flight into deteriorating weather conditions.

(c) Failure of the pilot to maintain his desired track, becoming lost and finally losing control of the aircraft.

Auster Crashes in Cloud

(Summary of a report by the Air Department, New Zealand)

On 22nd December, 1957, an Auster J5B crashed on a flight from Taupo, New Zealand, to Hamilton, New Zealand, when the pilot lost control of the aircraft whilst flying in cloud at a low level. The pilot and three passengers were fatally injured.

THE FLIGHT

The aircraft departed from Napier, New Zealand, at 1515 hours on a VFR flight plan to Hamilton designating Taupo and Rotorua as alternate aerodromes. The endurance was quoted as $4\frac{1}{2}$ hours on the flight plan. At 1615 hours the aircraft landed at Taupo approximately 70 miles north west of Napier where the pilot explained that he had made two attempts to get through to Hamilton but had been forced to turn back by adverse weather which was enveloping the Atiamuri area. During the stay on the ground at Taupo, the pilot discussed the possibility of getting to Hamilton and it appeared to bystanders that one of the passengers had an important reason for getting through. The pilot was strongly advised by an experienced local aero club member not to go via Atiamuri, and alternate routes were suggested. At 1800 hours the pilot ascertained that the destination weather was satisfactory and he decided to attempt to get through via Atiamuri, but if the weather became too bad he would turn back. The aircraft took-off shortly after 1800 hours and was lost to view in the direction of Atiamuri.

At approximately 1845 hours an aircraft was heard to pass low over Maroa Mill, but could not be seen because of the mist. From the noise of the engine the informant judged that the aircraft circled, then headed in an easterly direction.

The wreckage of the aircraft was located from the air on a property near Oruanui, at 0930 hours the following day. The aircraft had struck the ground at an angle of 60 degrees and the engine had become embedded in the ground to a depth of three feet.

INVESTIGATION

The pilot held a pilot "A" licence and had flown a total of 129 hours dual and solo but had had no instrument flying training. He was regarded by the chief instructor of the aero club as a reliable pilot with a keen sense of responsibility.

An appraisal of the weather situation by the Meteorological Office indicates that a cold front moved from WSW to ENE over the area concerned between midday and midnight. The exact time of the passage of the front over various points was hard to determine, mainly because the front had a broad frontal zone. The forward edge reached Hamilton between 1400 and 1500 hours and the weather cleared between 1800 and 1900 hours. The forward edge reached Taupo by 1500 hours. Rain and low visibility varied in intensity throughout the belt.

During the examination of the wreckage the integrity of controls and points of attachment of major components before impact was established. Both petrol wing tanks were severely ruptured and the contents drained. Examination of the cockpit revealed that ignition switches were on, the throttle was fully open and the flap lever was in the up position. Uniform compression damage to the leading edges of both mainplanes indicated that there was little or no rotation about the longitudinal axis in the final stage of the dive.

ANALYSIS

There is ample evidence that the area in which the crash occurred was obscured by low mist and cloud at the time. The pilot was aware that marginal weather conditions were likely, and he set out from Taupo with the firm intention of returning if conditions became too bad. It is probable that he was making the attempt against his better judgment because of the anxiety of one of his passengers to get to Hamilton. The pilot had created the impression of being conscientious with a keen sense of responsibility, and it is, therefore, unlikely that he deliberately endangered the aircraft by blatant disregard for safety. It is more likely that he ventured into the fringe of the bad-weather area and it closed in behind him. The fact that he was circling suggests that the accident occurred while he was attempting to extricate himself from the situation.

The acute angle and the high speed of impact rule out the possibility that the aircraft flew into high ground while the pilot was attempting to maintain visual flight beneath the overcast area, or that the accident occurred while the pilot was attempting to make an emergency landing. The nature of the damage to the aircraft is consistent with loss of control in cloud, culminating in a near-vertical dive under full power.

Do You Still Know?

1. **In what areas are you responsible for your own operational control?**
2. **What fuel reserves to allow when re-computing fuel endurance in flight?**
3. **That you should not report "DEPARTED . . . ." until your aircraft is flying on the authorised departure track.**
4. **That on changing from CONTROL to TOWER frequency you should report your level and flight conditions.**
5. **That the last THREE letters of your aircraft registration normally should be used as the call sign.**
6. **The altimeter setting procedure to be used when carrying out an emergency descent with radio failure.**

(Key to questions on page 27)

Australian Accidents

A Freshwater Ditching in a DC.3

Shortly after a DC.3 was airborne at Sydney Airport for a night flight to Tamworth on 4th November, 1957, the pilot in command detected severe back-firing and feathered the port engine. He attempted to return to the airport but, as the back-firing continued and the aircraft lost height it had to be ditched in a fresh-water lake on The Lakes golf course, two miles east of the airport. All the occupants escaped without physical injury.

THE FLIGHT

The aircraft was scheduled to leave Sydney at 1900 hours E.S.T. on a regular public transport service to Tamworth. The flight preparations proceeded normally and the aircraft was cleared to the holding area for Runway 07 at 1903 hours. It was cleared onto the runway and then for take-off at 1912 hours, which was 25 minutes after last light.

The take-off proceeded normally in the hands of the aircraft captain until a height of about 200 feet was reached. At this stage there was a series of engine noises, identified from the cockpit as back-fires, and the captain noticed that the tachometer reading for the port engine was about 150 r.p.m. below that of the starboard engine. He reduced power on the port engine for a brief period during which there was no evidence of malfunctioning and then advanced it again to a reading of 32 inches. There was a resumption of the back-firing and he immediately initiated action to feather the propeller of the port engine, at the same time instructing the first officer to inform Sydney tower that the aircraft was returning and commencing a turn left with the intention of making an approach to Runway 16 (see diagram opposite).

The primary action for feathering had been completed by the time the aircraft had turned left through 90 degrees. At this point the captain noticed, by reference to the lights of the airport, that the aircraft was losing height quickly and he became aware that back-firing was still occurring. He continued the turn in the hope of reaching the threshold of Runway 25 (i.e., to land on a reciprocal heading to the take-off) but it became obvious that the aircraft would not be able to reach any part of the airport. The captain, realising that a forced landing was inevitable, continued the turn and an area without lights appeared immediately ahead. The landing lights illuminated a stretch of water ahead of the aircraft and it was ditched at 1916 hours (i.e. 3 minutes after the take-off was commenced).

The deceleration forces were only slight and very little damage was caused to the aircraft apart from the effects of immersion. All the occupants escaped without injury and subsequently the rescuers manoeuvred the aircraft to shallow water where it settled on the bottom.

TAKE-OFF AND ACCIDENT CIRCUMSTANCES

The take-off was conducted on Runway 07 which has an effective operational length for take-off in this direction of 7,698 feet.

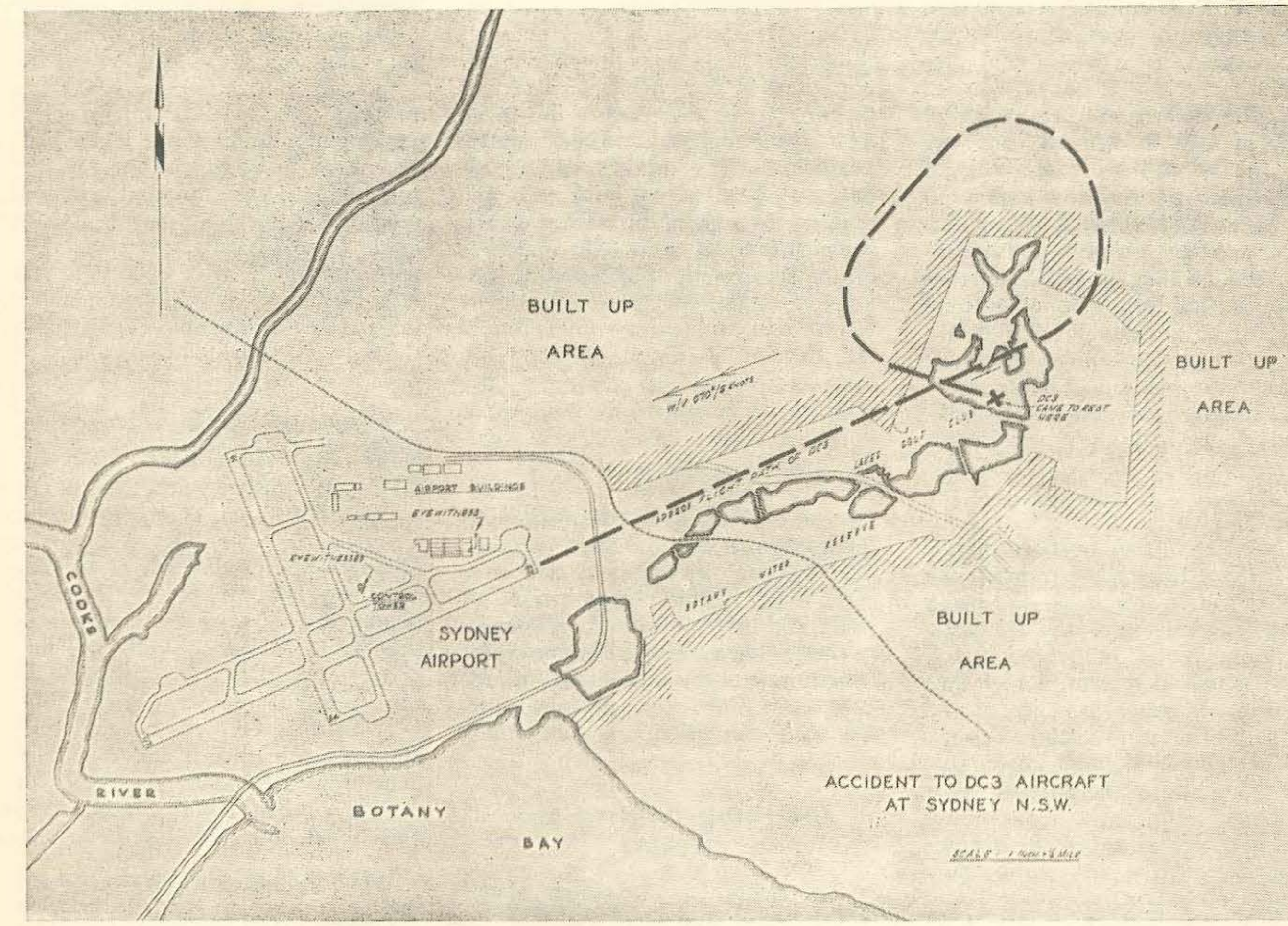
The accident site was in the Botany Water reserve which is approximately two miles long by $\frac{1}{2}$ mile wide. It is situated immediately east of Sydney Airport and is surrounded by densely populated residential areas (see diagram). There is a stretch of open water some 2,000 feet long where the aircraft was ditched and at the point where it came to rest some 150 feet from the nearest bank, the water was 10-15 feet deep.

The weather conditions observed at Sydney Airport five minutes after the accident were — wind 070 degrees true, six knots; visibility 13 miles; weather hazy, cloud 6/8ths stratus at 1,000 feet; temperature 68 degrees Fahrenheit. The density altitude of Sydney Airport at this time was approximately 700 feet.

At the time of the take-off immediately preceding the accident the gross weight of the aircraft was 756 lb. less than the maximum permissible weight for this type of operation The aircraft's centre-of-gravity was within permissible limits. The state of the load at the time of the accident was not significantly different from that at take-off.

EXAMINATION OF THE AIRCRAFT

There was considerable damage caused to the airframe and fittings by immersion in water but only minor damage was caused in the ditching impact. The crew state that the rear fuselage entered the water first and the damage pattern suggests that the port wing tip was slightly lower than the starboard tip at the time of impact. The port wing tip was dished up and damage to the wing flaps was heaviest on the port side, where three turnbuckles had broken and had penetrated the flap itself. The pitot head was torn off and there was some compression distortion in the wing centre section. It is possible that some of this structural damage occurred during the salvage operations.



The port engine and its propeller were subjected to strip examinations and all ancilliary components were functionally tested. There was no evidence of any significant mechanical defect. The blades of the propeller were found undamaged but in the feathered position. From consideration of all the available evidence, it is possible to say beyond reasonable doubt that the port engine of this aircraft was functioning correctly and capable of developing full selected power up to the time that the propeller was feathered.

A strip examination of the starboard engine revealed several internal failures including a badly cracked head on No. 2 cylinder, complete loss of the centre electrode from one spark plug to this cylinder and a major rupture of the supercharger diffuser casting. There was also severe crown depression on most of the pistons and traces of foreign metal adhering to valve faces and the diffuser passages.

All blades of the starboard propeller had been bent rearwards by an approximately equal amount and were found to be set at an angle of 24°, which is 6° above the fine pitch stop. The evidence of blade damage suggests that the propeller was rotating and producing little thrust at the moment of impact with the water.

Examination of the starboard engine confirms that it was this engine that was running roughly, back-firing and losing considerable power prior to the accident. The loss of No. 2 cylinder alone, due to the cracked head and inoperative spark plugs, would by itself, account for a loss of approximately 100 horsepower at take-off power settings. In addition, the evidence of continued back-firing and of very severe dishing of a number of pistons suggests that additional power was also being lost due to abnormal combustion conditions throughout the engine. Further, the large hole in the diffuser casting would have the effect of reducing the manifold pressure available, at full throttle, resulting in a still further loss of power.

Since the engine is reported to have tested quite satisfactorily prior to take-off, it is apparent that neither the crack in No. 2 cylinder head, the defects in the two spark plugs in No. 2 cylinder, nor the hole in the diffuser casting could have existed prior to this flight. On the other hand, there is strong evidence to suggest that the impeller had been rubbing, if only intermittently, on the diffuser for some time prior to the accident, which points to the fact that the diffuser was almost certainly the first component to fail. Prolonged abrasion of the diffuser casting had, over a considerable area, reduced its wall thickness to approximately one third of the original dimension and it is reasonable to suppose that break-up finally occurred under static overload, the thinnest section fracturing and being forced inward into the impeller vanes under the influence of full engine manifold pressure which acts over the complete rear face of the diffuser casting in this model engine. Evidence of metal build-up on diffuser vanes and of particles of metal hammered into valve seats establishes that the failure of the diffuser casting resulted in very appreciable amounts of magnesium alloy being fed into the induction pipes and cylinders. It is considered that ignition of these finely divided particles of magnesium could easily account for a large degree of pre-ignition and back-firing, with associated high cylinder head temperatures and piston distress.

It appears most likely that the initial distortion of the diffuser casting was caused by a fire in the supercharger section during starting of the engine at some stage during previous operations. Although uncommon, supercharger fires in R.1830 engines caused by the use of poor starting procedure (such as under or over priming) have occurred in the past and, if not rapidly detected and dealt with, have resulted in this section of the engine being burnt out. In this regard, it is noteworthy that this particular engine was reported for starting and slow running defects on both 28th and 30th October, 1957, although subsequent ground running checks did not reveal anything amiss, nor was any trouble reported when the engine was started up for the last time before the accident. Nevertheless, it would appear possible for the diffuser casting to have been distorted, and perhaps cracked, by a short duration fire just sufficiently for it to foul the impeller on the subsequent application of full take-off manifold pressure, which would tend to spring the wall of the diffuser casting closer to the impeller. Since full power is only used for a comparatively short time during a normal take-off it is possible that this process could be repeated a number of times before the casting had worn thin enough for final break-up to occur. The diffuser fitted to this engine is of a very early type manufactured prior to 1943, and its rear face does not carry the twelve integral stiffening webs which have been a feature of all later model diffusers produced for the R.1830 engine.

THE FLIGHT PATH OF THE AIRCRAFT

The take-off path was maintained during the initial climb at the request of the airport controller and at some point along this initial flight path the back-firing and other symptoms of engine malfunctioning commenced. One eyewitness who watched the take-off from a hangar adjacent to the runway first heard the back-firing just after the aircraft was airborne, when it had travelled about 5,200 feet (i.e., 2/3rds of the runway length). His evidence is confirmed by the hostess and the company operations manager who were seated in the rear of the cabin and noticed a stream of incandescent particles from the starboard engine exhaust almost immediately after the aircraft was airborne. The captain and first officer heard the noise of back-firing commence at about the point where the second power reduction was made and this normally occurs at a height of 200 feet.

The eyewitnesses' evidence clearly indicates that the aircraft continued to climb after clearing the airport as it flew out for two miles on the prolongation of the runway. It is probable that the aircraft reached the highest point of its flight path where the feathering action and the first left-turn were initiated. The best estimates of height at this point are made by two very experienced airport controllers who agree on 700 feet. Neither of the pilots remember making any assessment of height and the only other estimate is by one witness who suggested 400 feet very tentatively. Since the climb out path impressed the airport controllers as being only slightly lower than normal, it is considered that their estimate of 700 feet can be accepted with a fair degree of confidence. Both the crew and the ground witnesses comment on the rapidity with which height was lost after the first turn to port and yet the aircraft probably travelled another two miles between this point and the point of ditching. For this distance to be covered with one engine feathered and the other delivering little power the height at commencement could hardly have been much less than 700 feet.

When the aircraft captain realised that a landing off the airport was inevitable he immediately searched for an area showing no lights in the hope that this would indicate an absence of serious obstructions and a minimum of population density and thus enable him to make a controlled landing with the minimum of damage to the aircraft or injury to persons. It is apparent that the captain retained the maximum possible control of the aircraft and when, at a later stage, a waterway appeared ahead he was able to go straight into a ditching procedure which caused very little damage to the aircraft and no injury to its occupants. There is no evidence which reflects adversely on his decision to land off the airport and, indeed his early appreciation of the situation was probably an important factor in enabling him to reach an area which was not populated.

Having regard to the evidence that the aircraft reached a height of approximately 700 feet in this take-off, it is interesting to compare this performance with its expected performance on two engines. On the basis of standard data this aircraft should have reached a height of 725 feet above aerodrome level after travelling 3.5 miles from the commencement of the take-off roll (all other circumstances of the take-off being as existed). If, on the other hand, there had been a complete power loss on the starboard engine at 200 feet (assuming zero thrust on the starboard engine from that point and no change to the port engine power setting) the aircraft would have lost all height at 2.8 miles from the commencement of the take-off roll. The degree of power loss in the starboard engine during the take-off run up to the point of feathering (i.e. 3.5 miles out) was, undoubtedly, something between zero thrust and full power. A comparison of standard performance with the observed performance suggests that there was, in fact, very little power loss up to the point of feathering. This is confirmed by the captain's statement that there was no significant yawing of the aircraft in this stage of the flight.

The flight path of the aircraft beyond the point where the port engine was shut down was probably between two and three miles in length. This could be consistent with either a low height (e.g., 300 feet) at feathering and a maintenance of power in the starboard engine or a height consistent with the evidence of the reliable eyewitnesses (700 feet) at feathering and rapidly diminishing power in the starboard engine. The engine strip examination points to the latter condition and this is confirmed by the pilot's descriptions of a steeply descending flight path. There is little doubt that, with the port engine shut down and with power rapidly failing in the starboard engine, there was no chance of the aircraft being flown back to the airport from the position and height which it had reached in the climb-out.

THE AIRCRAFT CREW

At the time of the accident the aeronautical experience of the pilot in command was 4,756 hours which included 2,937 hours of command experience in DC.3 aircraft over a period of three years, some 185 hours being flown in the 90 days preceding the accident. The aeronautical experience of the first officer at the time of the accident was 7,230 hours. Although his command experience amounted to 4,497 hours he had not flown in-command of DC.3 aircraft.

ANALYSIS

The strip examination of the engines shows conclusively that serious defects had developed in the starboard engine which would most probably manifest themselves along the lines of the symptoms observed (i.e., back-firing, surging, roughness and failing power.) This examination failed to find any defective condition of the port engine and, in the absence of any evidence to the contrary it must be concluded beyond all reasonable doubt that this engine was capable of operating normally at all stages of the flight. It was found, however, that the propeller of the port engine was in the feathered condition and this evidence, being consistent with the state of the engine controls found in the cockpit, confirms the captain's statement that he deliberately shut down the port engine and feathered its propeller.

It is considered that the investigation established not only that the starboard engine was defective and that the port engine had been shut down but it also eliminated the remote possibility that simultaneous power losses occurred in both engines, from either a common cause, (e.g., contaminated fuel) or from independent sources. In fact, the overwhelming weight of evidence indicates clearly that the captain, on becoming aware that a serious engine defect had occurred, failed to identify correctly in which engine it had occurred and shut down the port engine when is was operating normally, leaving the starboard or defective engine to operate. This proposition is not contested by either pilot nor is it weakened by any evidence which has been discovered. Having regard to the flight conditions at the time of this feathering and to the performance capacity of this aircraft on one engine, it is apparent that an accident could have been avoided if the pilot in command had shut down the defective starboard engine and utilised the normal power available in the port engine to return and land at Sydney Airport.

In considering the basis of the captain's conviction that the port engine was the source of the back-firing and surging which he could hear, the circumstances in which these symptoms appeared must be appreciated. It was quite dark and, although the weather was fine with a visibility of 13 miles, there was an almost complete overcast at 1,000 feet. The all-up-weight of the aircraft was only 756 lb. under the maximum permissible weight for take-off in this type of aircraft. At the time the engine malfunctioning first became apparent to the captain, the aircraft had probably just reached climbing speed (i.e., 113 knots) but was still only at a height of 200 feet. Although the situation was not desperate it would prompt the captain to take quick and positive corrective action. The sensory evidence of malfunctioning gave him no clue of the engine in which it had occurred. He checked the tachometers and noticed that the needle for the port engine was giving a lower reading than for the starboard engine—it was a single instrument with two indicators operating on the same axis. Although there was no substantial foot pressure required to hold the aircraft straight, his physical sensation was of a slight change of direction to port. There were no signs visible on the port side as might confirm his belief regarding that engine but he throttled it back briefly and slightly (the aircraft's proximity to the ground was still an important factor), noticed that there was no violent signs of malfunctioning in this period, throttled on again to 32 inches manifold pressure, noticed that the back-firing resumed and decided to feather the propeller of the port engine.

In the circumstances of a partial and intermittent power loss occurring at night in a DC3 aircraft it is not easy to determine on what side the defect has occurred. The old axiom "pressure left, feather right" is useless in the absence of any substantial yaw. With this type of defect the propeller governor would tend to disguise the loss on the tachometer by reducing the blade angle and maintaining the set r.p.m. figure but, on the other hand, sudden and substantial variations in power should be noticeable on the tachometer when they lead to engine speed changes which temporarily exceed the governor capacity. It is quite possible that the progressive failure in the supercharger did not reach the point of diffuser rupture until after the feathering action and, in this event, the boost gauge would not provide evidence of any value as it would still indicate the desired setting. The first officer states that, at the time of the first power reduction, he noticed the starboard engine cylinder head temperature gauge reading 260°C (i.e., the maximum safe temperature) and the port 230°C. He placed the mixture controls in the emergency rich position. He associated this rise with the high operating temperatures which this aircraft had been showing for some time but it is most probable that this was the first manifestation of the defect in the starboard engine. The first officer did not distract the captain's attention at this stage in the take-off with this information in view of its apparent irrelevancy and the captain did not become aware of the high cylinder head temperature at any stage. It is most unlikely that it would have affected the captain's decision if he had noticed it. The evidence that was available to the captain therefore, did not include any immediate and unmistakable clue as to which engine was malfunctioning. The best information in this case would be conveyed by the tachometer but it is apparent that he noted only a difference in reading between the indicators for each engine and it is quite possible that, at the time of his quick check of this instrument, the starboard propeller was temporarily overspeeding with the sudden fluctuations in engine power and the difference in readings arose, not from reduced engine speed on the port side, but from high engine speed on the starboard side. In such a situation, of course, it was quite dangerous to base a feathering on one quick glance at the tachometer, particularly when no actual reading was taken.

Although incorrect identification is not an uncommon failing detected during asymmetric training in DC.3 aircraft, there has been no such occurrence reported in Australia durnormal operations prior to this accident. The situation, however, which was presented to this captain is very rarely encountered by any one pilot. For instance, during 1956, there were only seven occasions in Australian operations where feathering action was taken during a DC.3 night take-off and, in four of these, there was no identification problem because the action was triggered by a self-identifying symptom such as a fire warning light. During 1957 this particular accident was the only occasion on which a feathering was carried out in a DC.3 night take-off. The problem confronting the pilot in this instance was complicated by the audible signs of engine malfunctioning which, by their intensity and frequency, indicated a serious condition, whereas, it is probable that there was very little power loss in the initial stages. Subsequent flight experiments with at least eight pilots in which surging power was simulated showed that none could identify the surging engine from the feel of the flying controls alone.

The first officer has claimed that there was never any doubt in his mind that it was the starboard engine which was malfunctioning, although his identification was purely by auditory perception. After the port engine had been shut down he mentioned to the captain that he thought the propeller on the wrong engine had been feathered. The investigation revealed that at this time it was far too late for the captain to reconsider his action. At no stage during the take-off and subsequent flight did the captain seek the opinion of the first officer or even enlist his aid in identifying the defective engine. There is little doubt that this neglect of teamwork in the cockpit and the captain's reluctance to use the first officer as a check on his own reactions is not rare in air line operations. On this occasion the first officer had considerable experience but his judgment was not used in any way. The accident may well have been avoided if pilot training had emphasised the value of cockpit teamwork and this captain had availed himself of it.

CAUSE

The cause of the accident was that the pilot in command on becoming aware of an engine defect, took action to feather a propeller on the basis of evidence that was insufficient to ensure correct identification of the defective engine. As a result he closed down the port engine when in fact, it was the starboard engine in which power was failing.

Two Fatalities in a Proctor

On a private travel flight between Moorabbin and Albury aerodromes in May last year, the pilot of a Percival Proctor Mk IV encountered rain and very low cloud in the vicinity of Chiltern, Victoria. In the course of circling at a low altitude in and out of cloud, presumably in an attempt to find a way through, the aircraft struck a tree on the side of a ridge two miles south-east of Chiltern. The aircraft fell to the ground and caught fire. Both the pilot and passenger were killed.

Before leaving Moorabbin at about midday the pilot saw an area forecast which suggested no great impediment for a visual flight to Albury. So far as is known the flight proceeded without incident following the main northern road and rail route until the aircraft reached Chiltern which is on this route and some 20 miles south-west of Albury. Higher and timbered terrain converges on the route at this point such that the highway and railway pass through a small valley flanked by ridges up to 500 feet above Chiltern itself. The aircraft was seen to approach Chiltern at a low altitude but below the cloud base. However, on the northern side of the town witnesses on the ground heard it circle several times and occasionally caught a fleeting glimpse of the aircraft through breaks in the clouds which were virtually down to ground level in this area.

After about six fairly tight circuits on the northern fringe of the town the pilot apparently then made a wider sweep towards the east during most of which he must still have been flying in cloud. In the course of this sweep the aircraft struck a tall white box eucalypt standing well above the general level of trees on a ridge and fell vertically to the ground. To some witnesses on the ground there seemed to be a brief burst of engine power just before the thud of impact.

There were two puzzling features of the impact itself. First of all the tree at the foot of which the burnt out wreckage was found was the only tree struck by the aircraft apart from a small iron bark growing very close to the white box eucalypt which had obviously been demolished in the vertical fall of the aircraft. Secondly, this tree was situated some distance below the crest of the ridge and, considering the probable direction of the final flight path, the aircraft must have crossed higher ground immediately before striking it. It seems to be a reasonable reconstruction that, at the time of impact, the pilot was endeavouring to maintain or regain visual contact and the aircraft was on a descending flight at a relatively low forward speed. This would not only explain the crossing of higher terrain but would also account for the fact that a 3,000 lb. aircraft was virtually stopped in its flight by impact against one tree.

Whatever may have been the circumstances of the final flight path the fact remains that the aircraft should never have been in this situation. Apart from the fact that it was on a clearance only for flight under the visual flight rules, the pilot was not at all practised or competent in instrument flying. Above all else these attempts to press on through cloud at such a low altitude have so often proved fatal that it is a wonder that any responsible pilot could fail to see the folly of such a venture. It has been concluded that in all probability the cause of this accident was the pilot's attempt to continue the flight in instrument conditions at an unsafe altitude.

Chipmunk Wrecked While Low-Flying

A Chipmunk was destroyed and its two occupants suffered serious injury when it struck the ground during a low level steep turn near Newcastle, New South Wales, on the afternoon of 26th March, 1958.

The aircraft was owned by the local Aero Club and was being operated by a club member, with a friend as passenger, on a pleasure flight. The pilot's flying experience was some 350 hours and, of this time, 124 hours were flown in the Chipmunk.

About 25 minutes after it departed from the Club's base at Newcastle the Chipmunk was seen flying low in an area of open country about seven miles north-west of the city. It flew about this area for 10-15 minutes during which it dived a number of times each time levelling out with the wheels barely clear of the ground and continuing for some distance at this very low height.

Eyewitnesses then lost sight of the aircraft for a short time as it passed up a gully. When it reappeared it was just above the tree tops and, at this height, entered what appeared to be a vertically banked turn. During this manoeuvre it lost height until the right wing tip struck the ground and caused the aircraft to crash. The wing was torn off and the aircraft skidded 40 feet along the ground, resulting in extensive disintegration before it came to rest against a fence.

The pilot could not remember anything of the flight or of the accident. Nothing was found to indicate that any pre-crash failure had occurred in the aircraft and it is considered that the pilot attempted a manoeuvre which was beyond his capability to perform safely at the extremely low height.

This flight at extremely low level was not only contrary to the requirements of the Regulations but the carriage of a passenger under such circumstances was completely opposed to common sense and sound flying discipline both of which are essential elements of flying safety. The tragic thing about these lapses which occur so often is that they frequently lead to serious or irrepairable personal injuries to the pilots and, what is even more deplorable, to their friends. A moment's thought is all that is required to avoid such consequences.

A Lesson — Often Taught but Seldom Learnt

One morning in April of last year a pilot with a private licence hired an Aero Club Tiger Moth on the understanding that it would be used for refresher practice in the local flying training area. When the aircraft did not return to the aerodrome at the expected time enquiries were made and it was eventually located on a property 14 miles outside the training area, having struck a tree and crashed whilst the pilot was attempting to drop a letter. The pilot, who was the only occupant of the aircraft, was seriously injured and the aircraft was destroyed.

It is apparent that the pilot made a deliberate deception in the hiring of this aircraft since it was learned later that his intention at the time of hiring was to land on an agricultural strip on his friend's property and deliver the letter by hand. It was only after being warned by an instructor immediately prior to the flight that he decided not to land but to drop the letter from a low level instead. Nevertheless, it had been made quite clear to this pilot that a condition of the hiring was that he spend the time in practising steep turns, forced landings, medium and steep gliding turns in the flying training area and he agreed to these conditions, at least by word of mouth.

It was established that, immediately after take-off, the pilot flew towards his friend's property which is situated in a small valley close to high, heavily timbered hills. On reaching there the aircraft circled over the farm buildings at a height of about 600 feet and then the pilot commenced a descending approach presumably with the intention of dropping the letter while passing in front of the homestead. As it reached this point at a height of about 60 feet the aircraft clipped the top of a tall gum tree growing in front of the homestead and flew straight into the centre of another tree growing nearby. The wrecked aircraft dropped to the ground, rolled over and came to rest. The pilot received facial injuries and his spine was fractured.

One of the first things this pilot said to his rescuers was "I had plenty of height". No doubt this is what he believed but, as happens in so many of these message-dropping escapades, the pilot, at a critical stage of the low pass, probably diverted his attention from the flight path ahead to watch the ground observers or to concentrate on the point of release and did not see the obstructions until it was too late to avoid them.

Downed by a Wasp

Do you close the throttle after shutting down the engine of your DH.82? The occurrence, briefly described here took place in Queensland and suggests that closing the throttle may be a worthwhile precaution.

The DH.82 had been flying about 15 minutes since commencing the days operations and the pupil pilot was carrying out the second take-off of the flight. This take-off followed a touch-and-go landing made off a gliding approach. At a height of about 80-100 feet and near the upwind end of the runway engine power cut out abruptly and without warning and, at the same time, the propeller stopped rotating. Faced with a landing in heavy mangroves and swamp off the end of the runway the flight instructor took over control and turned left in an attempt to land on the aerodrome. There was apparently insufficient height to complete the manoeuvre and the aircraft struck the ground on the port wing tip and nose and turned over, coming to rest inverted. Neither occupant was seriously injured.

On initial examination it was found that the engine rotated freely and no sign of tightness or seizure could be felt. It was then stripped down and this examination disclosed that all cylinder bores and pistons were scored and the piston rings exhibited wear in excess of the amount to be expected for the time they had been in operation. In addition, the oil on the walls of the cylinders was found to be contaminated with a gritty substance. A dislodged and partially disintegrated wasp's nest was found in the induction manifold. The nest was made of a sharp gritty substance, apparently earth, and internal inspection of the manifold revealed that it had originally been attached to the rear wall of the manifold near the No. 4 cylinder branch.

It seems that the grit from the wasp's nest caused an engine seizure of a transient nature. This seizure was probably triggered by the sudden heating of the pistons when take-off power was applied with the engine in a cooled condition resulting from the approach glide.

With the throttle lever in the closed position the flame trap element and the air intake flap effectively exclude unwelcome visitors from the major portion of the induction system. The remaining short section of the air intake passage, from the flap out to the air scoop on the engine cowl, can be examined visually without difficulty.

Human Markers in Agricultural Flying

Preparations were made one morning in September of last year to spray a 100-acre crop on a country property about 100 miles east of Perth in West Australia.

Two DH.82s were to be used and, as the field was about 2,000 feet square, it was decided to use them in a race track pattern with a spraying run on each side of the pattern. This required the use of four markers and the pilot in charge of the operation had to recruit three persons locally for this task.

One of the persons recruited was the property owner, who had had no previous experience of marking, and some verbal instruction was given to him before operations commenced. The general plan was for each run to be indicated by a pair of markers who would move, after the aircraft had lined-up, 15 paces to mark the line of the succeeding run.

Spraying operations commenced with the two aircraft working simultaneously on opposite sides of the same pattern but after 4 to 5 runs the property owner was struck in the face by the end of the spray boom under the starboard wing of one aircraft. He was seriously injured but the aircraft was only slightly damaged and was flown safely back to the landing field.

For some years it was the Department's policy to prohibit the use of human markers in agricultural operations but it has become evident that, in some circumstances, this is the only practicable form of marking and, *IF ADEQUATE PRECAUTIONS ARE TAKEN*, it should be a completely safe practice. It was reasonable to use human markers in this particular operation but it is very apparent that the precautions taken for their safety were inadequate. There is evidence that the pilot in charge of the operation did give some verbal briefing to the markers but it was by no means comprehensive and, in respect of the inexperienced property owner, it relied upon supplementary information from another marker who was himself relatively inexperienced. It now appears that the former did not grasp the point that he should move away as soon as the aircraft had lined up for the run. This is readily understandable when you consider the problem presented to any person, who is inexperienced, in picking the point where the pilot has obtained sufficient indication of the spraying line. The only satisfactory briefing in these circumstances is by practical demonstration.

When the operation began the property owner was placed in the closest position to the commencement of the spraying runs and this would not only make it difficult for him to watch the other markers as a check on his own actions but would give him a lesser time after line-up to move away from the path of the oncoming aircraft. Furthermore, the three markers with some experience donned white clothing, whereas the inexperienced property owner, who was wearing blue overalls, was given no distinctive apparel.

The spraying was carried out in a 10-12 knot cross-wind commencing from the lee side of the field. This meant that, with the aircraft approaching each marker nose into wind, the marker would have to move away behind the nose of the aircraft and out of sight of the pilots. Despite this difficulty, one of the pilots noticed that the inexperienced marker was not moving out of the line until after the aircraft had reached his position and he took special precautions to avoid him on each run. The pilot who had given the briefing and who should have checked the markers' procedures took no such action however, and his aircraft struck the property owner after 4 or 5 runs. It was most fortunate that there was no loss of life in this accident but it is also apparent that there would have been no accident if the pilot in charge of the operation had planned and conducted it with sufficient care to ensure the safety of persons on the ground.

Key to Do You Still know.

(1) AIP/RAC 3-1-15.

(2) AIP/RAC 1-7-6.

(3) AIP/RAC 3-2-1.

(4) AIP/RAC 1-8-4.

(5) AIP/RAC 1-8-3.

(6) AIP/RAC 1-3-2.

Spinning Accident in DH.82

A DH.82 was intentionally put into a spin from which it did not recover and crashed on the railway line at Darwin River, Northern Territory, at 0830 hours on 1st January, 1958. Both of its occupants were injured, the pilot seriously, and the aircraft was wrecked.

The DH.82 was owned by the local Aero Club and was flown by a private pilot who had 105 hours of flying experience, which were all gained on this type of aircraft.

Take-off from the aerodrome at Darwin was made at 0745 hours and the aircraft was next sighted over the camp area of a R.A.A.F. unit located at Darwin River, some 28 nautical miles from the departure point. Both the pilot and his passenger were members of this R.A.A.F. unit.

Two loops were carried out over the camp area at a height in the vicinity of 3,000 feet. On completion of these manoeuvres height was gained in circles over the camp to about 3,200 feet where the pilot decided to spin the aircraft and where it was seen to enter a spin to the right. Although he could not recall whether he made the spin to the left or to the right the pilot described it as a normal spin and likened it to other spins he had carried out.

During the spin the pilot divided his attention between the ground and the cockpit and when he saw what he now believes was a height of 1800-1900 feet registering on the altimeter decided it was time to recover and took the necessary action; from this point on his recollections are even more clouded but he believes that the rotation stopped and that he thereupon opened the throttle. He did not remember whether engine power was obtained.

The aircraft was observed to be spinning when it was within about 100 feet of the ground and it was somewhat lower when the nose appeared to come up. It then struck the ground with the lower right wing tip followed by the nose. The point of impact was approximately 150 feet from a building near which one of the eye witnesses was standing.

A detailed examination of the aircraft wreckage revealed no evidence of any fault in it which would have prevented or delayed recovery from a spin. It was noted that both altimeters were set to a datum of 1006 millibars and that they both registered zero.

It is clear that the pilot deliberately continued the spin below the minimum height of 3,000 feet at which aerobatics are permitted and it is probable that in paying attention to his audience on the ground he delayed taking recovery action to a much lower height than he believed and to a point from which the manoeuvre could not be completed.

INCIDENTS

Flight in a Danger Area

(Accident Ingredients were mixed into this)

The captain of a Super Constellation flight planned to proceed from Sydney to Darwin on the direct route and this was approved by Sydney Operations. This route passes through the R.A.A.F. Richmond Training Area which lies approximately 20 miles west north west of Sydney Airport, and through which aircraft are prohibited from flying without prior approval. In this case the R.A.A.F. withheld approval for the aircraft to overfly the area; consequently A.T.C. instructed the aircraft on departure to proceed direct to Lithgow and thence to Darwin but at this time the reason for the alteration to the flight plan was not conveyed to the aircraft. (The direct track from Sydney Airport to Lithgow runs parallel to and some six miles south of the southern boundary of the Richmond Training Area).

The aircraft took-off into the east and set course from a point about five miles north of the airport. Some fifteen minutes later the R.A.A.F. reported to Sydney A.T.C. that a Super Constellation was over the Richmond Training Area.

When the R.A.A.F. approval to enter its training area was refused, Sydney A.T.C. assumed that the aircraft would set course from the vicinity of the airport, and that on the direct track to Lithgow the aircraft would be outside the Richmond Training Area, and for this reason it was deemed unnecessary to inform the aircraft that approval had not been given to fly through the area. As no restriction on flight through the area was mentioned in the air traffic clearance, however, the captain assumed that approval of the flight contained permission to fly through the area.

The direct track from Sydney Airport to Lithgow is just outside the southern boundary of the Richmond Training Area.

When standard navigational tolerances are applied to this track, however, it infringes the training area. That is, even if the aircraft had set course from the airport it is possible that it would have penetrated this area. Immediately following this incident, Sydney A.T.C. took action to route aircraft from Sydney to Lithgow on a track that is clear of the Richmond Training Area.

Although the aircraft may have infringed the subject area even if it had set course from over the top, the fact that it set course from a point some five miles north of the airport made such a possibility almost inevitable. It has been generally accepted that, unless the set course point is specifically designated by A.T.C., an aircraft would set course from a point not more than two miles from the airport. Subsequent observations, however, have shown that some aircraft, particularly overseas aircraft departing from Sydney Airport, frequently set course from points significantly more than two miles from the airport. As such a procedure can lead to this type of incident, the need to define the departure point became apparent during this investigation. Rather than increase the controllers' work by requiring them to nominate the departure point in all cases, the flight procedure to be adopted in setting course has been specified in AIP/RAC/3-2-1 and is as follows:

"Unless otherwise authorised by A.T.C., a pilot in command shall establish flight on the assigned departure track as soon as practicable after take-off, and at no further distance from the airport than five miles. When flight has been established on the assigned track (e.g., the appropriate N.D.B. bearing or V.A.R. track) he shall report his set course time, which will be the current time minus an adjustment for any distance from the flight plan commencement point."

Mud Damage to Auster Propellers

Three occurrences have been reported in recent months involving damage to the propellers of Auster aircraft during take-off.

In each case the take-off was being or had been conducted on a muddy surface and it seems most probable that the damage was caused by mud being picked up by the wheels and thrown into the propeller disc.

In the first reported instance the pilot noticed the mud being thrown into the propeller and very wisely abandoned the take-off. An inspection revealed that each blade had a longitudinal split from the tips extending some eleven inches towards the hub. If the flight had been continued it is very likely that the propeller would have broken up in flight with a possibility of much more serious damage to the aircraft considering the terrain over which the operation was being conducted.

In the second instance a bump followed by extreme vibration was felt whilst the aircraft was cruising at an altitude of 800 feet. The pilot stopped the engine and carried out a successful forced landing. He then discovered that some seven inches was missing from the leading edge of one blade of the propeller. In this case the evidence is not conclusive but the most likely explanation is that the blade was damaged during a previous take-off from a muddy field.

A take-off in another Auster aircraft was being conducted on a very muddy field when the pilot noticed unusual engine vibration. He continued with the take-off and flew at minimum engine revolutions to a better field 13 miles away and after landing found that both propeller tips were damaged.

Fortunately, none of these experiences resulted in a serious accident but who will deny that the potential was there? The obvious precautions are:—

(1) Don't operate on muddy fields.

(2) During taxying and in any take-off watch closely for objects being thrown into the propeller disc.

(3) Take appropriate heed of any unusual vibration — especially during take-off.

(4) During walk-round inspections keep a close eye for cracks or damage in propeller blades.

Don't Keep Your Problems to Yourself

Are you irritable? On that last flight did you encounter some problem in procedures, notice a hazard to safety, either en-route or on the aerodrome? Possibly you have encountered these identical things on quite a number of flights over the years and have come to accept them as inevitable. You don't have to suffer all these things, let us see how many we can rectify. In doing so you will not only make your own job easier, you will help others too. Anything to contribute?

A simple item contributed by a pilot was a complaint that tarmac floodlighting at a particular aerodrome distracted pilots when on final approach for landing. This lighting had been in use for some months, but on investigation, the complaint was well founded. The cure was simple, the lights were re-angled. Then there was the pilot who attempted to land on the highway near the aerodrome, the highway being illuminated by sodium type lights and easily confused with the runway lighting. There is no positive cure for this but at least the possibility of confusion has been mentioned in the Aeronautical Information Publications.

The following are a few examples of what can be achieved when we know the problem.

Early this year a report was received that a DC.3 experienced considerable difficulty due to the effect of slipstream when trying to taxy out of one of the run-up bays at Sydney Airport, the leading bay being occupied by an L.1049 completing engine run-up. It was established that the L.1049 was incorrectly positioned in the bay. A few weeks later this was followed by two more almost identical reports.

Investigation disclosed that the pilots of the larger aircraft preferred to complete the engine run-up back from the correct holding position for, at the holding position, the outboard engines were overhanging the inner edge of the sealed surface. Action is now in hand to widen the sealed shoulders of the inner side of the pavement by approximately fourteen feet.

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During April, 1958, the captain of a DC.3 on a regular public transport flight to King Island reported that the weather necessitated an instrument let-down on arrival during which he became visual at 1,000 feet with visibility reduced due to drizzle. He was advised that a non-radio equipped Anson aircraft was proceeding VFR to King Island and was due about the same time as the DC.3. The Anson was not sighted by the DC.3 crew or communications officer but after touchdown the Anson was observed on final approach for the same runway. It transpired that the pilot of the Anson had the DC.3 in sight throughout the circuit but it was considered that this incident highlighted an undesirable situation, that of non-radio equipped aircraft flying in marginal VFR conditions in the vicinity of aircraft making instrument approaches.

Obviously this situation can arise at any aerodrome where there are let-down aids but no control zone, however, at the majority of these aerodromes the density of traffic is not high. During the investigation it was realised that over recent months there has been a marked increase in the number of Anson flights to King Island and Flinders Island together with an increase in regular public transport movements.

Also, about this time a number of search and rescue actions were initiated over the non-arrival of Anson aircraft at their destination, the pilots having elected to return to the departure point due to weather or engine failure.

In approving the operation of non-radio equipped Ansons over Bass Strait the Department had taken cognisance of the fact that the

proposed use of the Anson was during the developmental phases of the service and, in relation to that aircraft, a requirement for the carriage of H.F. equipment would have imposed an impracticable weight and economic penalty. However, V.H.F. coverage over these routes can now be obtained by aircraft flying at 3,000 feet or higher. Therefore, having regard to the search and rescue incidents together with the increased density of traffic at King Island and Flinders Island it has been decided to require the carriage of VHF communication equipment in all Anson aircraft operating over Bass Strait.

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Incidents continue to be received concerning L.T.R.A.'s. Having trouble in meeting the time you stated? Can't locate the telephone? The Department of Civil Aviation has no obligation to provide telephones, or other means of communication, at aerodromes but telephones are generally available at government aerodromes. It is a requirement that the licensee of a licensed aerodrome displays a prominent notice stating the location of the most readily available means of communication. It would appear from some of the incident reports being received that this is a requirement which is not always met. It is also apparent that such notices should be erected at all government aerodromes and action is in hand to ensure this is done.

This, of course, will assist you when you arrive, but is of little use in helping you to determine an L.T.R.A. when flight planning. If you don't know what facilities are available for reporting your arrival, whether it be at a government, a licensed, or an authorised landing ground, ask the air traffic controller, or communications officer, to whom you submit the flight details. As a direct result of difficulties disclosed by incident reports all airways operations units now hold copies of the Post Office Guide and they will assist you.

Forecast Cloud Heights

Recently a pilot set out on a V.F.R. flight from A to B over terrain rising to 1,000 feet. The route forecast gave 4/8ths cloud with a base of 1,000 feet and 7/8ths cloud at 3,000 feet. He was forced to divert from track when he encountered what he described as fog and subsequently landed at an intermediate aerodrome with ten minutes fuel remaining.

As cloud heights, base and tops given in aviation forecasts are related to mean sea level, the forecast given to this particular pilot accurately predicted that the higher terrain along the route would be obscured by cloud. It seems apparent that this pilot believed that the cloud heights were heights given above the terrain. In fact, the only cloud heights given above the terrain are those in an aerodrome forecast.

After a little thought it is easy to see that the forecaster would have to go to a lot of trouble if he had to relate cloud heights to terrain heights. On the other hand his task is greatly simplified if he merely has to relate cloud heights to heights above mean sea level.

It may be of some consolation to this pilot to know that there are others who still think the same as he did and that his experience has presented the opportunity to enlighten them.

Volcanic Dust

The following occurrence is the first of its kind reported in this country and is included as a matter of interest.

A DC.3 en-route from Madang to Wewak entered cloud shortly after reaching its cruising level of 6,500 feet. The cloud, which was of strato-cumulus type, was a dark reddish colour inside. The flight through the cloud was uneventful but on emerging about 35 minutes later, the crew noticed the windscreens had a frosted appearance. When an attempt was made to wipe this away the glass was found to be rough. An inspection of the aircraft after landing at Wewak revealed that in addition to the windscreens, all leading edges were "pitted" as though they had been subjected to "moderate sandblasting."

The track from Madang to Wewak, which is over the New Guinea mainland, passes about 30 miles south of Manam Island on which is located an active volcano. It was learnt after the completion of the flight, that this volcano was "blowing" to a height of approximately 20,000 feet and that the dust was drifting south and entering the cloud over the mainland. On receipt of this information a Notam was issued warning pilots that there was a high concentration of volcanic dust in the vicinity of Manam Island.

The engines were examined after the flight and subsequently a close watch was kept on them but no evidence of any adverse effects from the dust was found.

DESIGN NOTES

SURFACE CONTROLS

Aileron Control Pulley Installation

Loose Pulley Endangered Flight Controls

the Situation

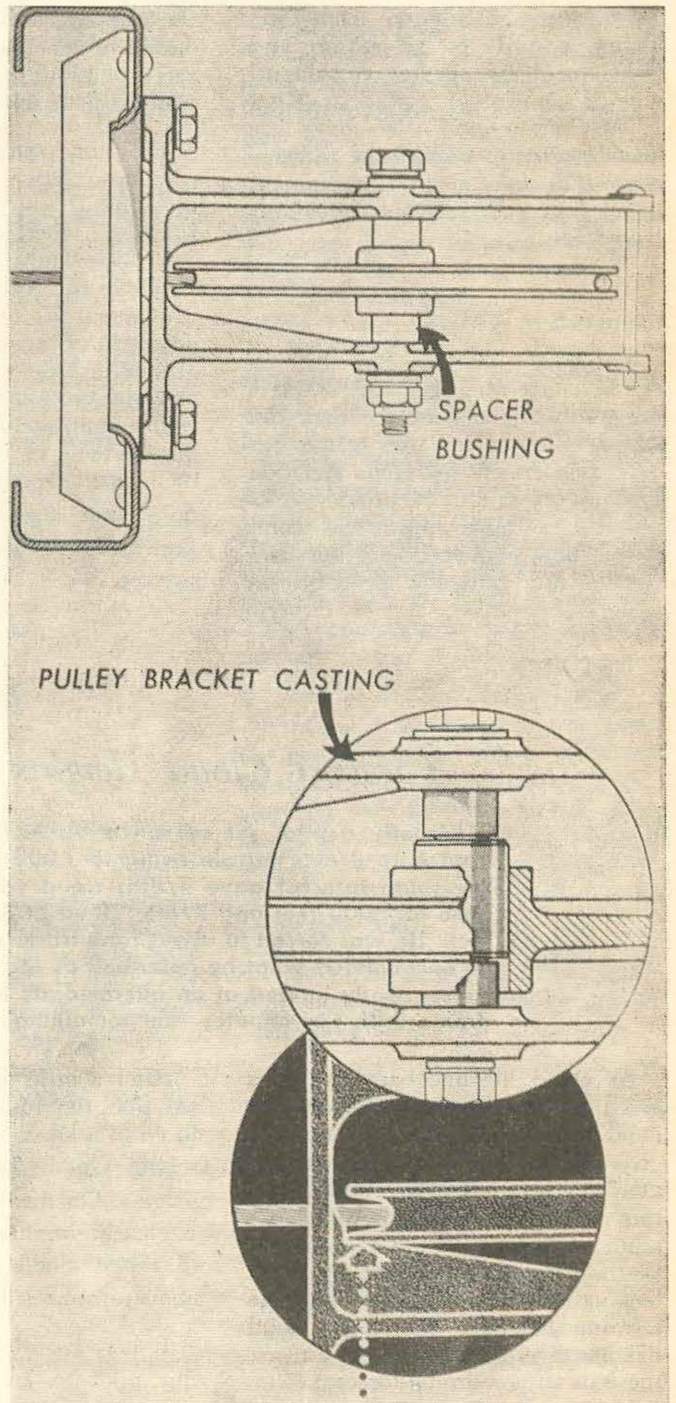
The pilot of a commercial transport experienced some difficulty in operating the aileron controls. When the flight controls were checked, inspectors found a cable pulley in the aileron control system which had loosened from its bearing, slipped down over a small-diameter spacer bushing and was rubbing on a rib of the pulley bracket. Both the metal pulley and the bracket were severely damaged by the resultant abrasion.

the Hazard

The pulley and ball bearing had been assembled by staking the bearing in the hub. This method of joining proved to be inadequate in this case as the staking failed to hold the two parts together. After the highly-stressed pulley became loose, there was nothing to keep it from slipping down and riding on the bracket. This would have been prevented had the spacer bushing been larger in diameter and a more reliable method used to join the parts.

PRECEPT

To design only for applied loads is not enough — the effect of vibration and repeated stress reversal on parts and assemblies in service must be considered also.



Slipped pulley, wearing against bracket, cause of excessive friction in control system.

(*By Courtesy Flight Safety Foundation, Inc.*)