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AVIATION SAFETY DIGEST

No. 31, SEPT., 1962

DEPARTMENT OF CIVIL AVIATION

AVIATION SAFETY DIGEST

No. 31 SEPTEMBER, 1962

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

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At 1505 hours on 5th February, 1962, a Cessna 210 departed Normanton on a charter flight arranged to transport a quantity of frozen fish to Mount Isa. The two front seats of the aircraft were occupied by the pilot and a passenger. When the aircraft failed to arrive at Mount Isa, search and rescue action was initiated and, an extensive air search involving 15 aircraft was carried out until the afternoon of 8th February, when advice was received that the wreckage of the missing aircraft had been located by stockmen at a point 93 miles north of Mount Isa. The aircraft had dived into an area of flat terrain and was destroyed by the impact forces and subsequent fire. Both occupants of the aircraft were killed.

THE FLIGHT

The aircraft and the pilot were based at Mount Isa for the purpose of conducting charter and aerial work operations in the North Queensland area and on the morning of 5th February a flight was made to Normanton via Mary Kathleen and Cloncurry. At Normanton the aircraft was refuelled and 679 lbs. of frozen fish in cartons and bags was loaded under the supervision of the pilot. The containers of frozen fish were distributed on the rear seat and floor and in the rear baggage locker without being secured against movement within the aircraft.

The pilot reported his departure by radio and at 1535 hours advised that the position of the aircraft was 25 miles south of Inverleigh Homestead. He reported "operations normal" at 1605 hours and this was the last transmission received from the aircraft. No message which would indicate an unusual or hazardous situation in flight was received from the aircraft at any time.

Although there was no witness to any part of the accident itself the aircraft was observed in flight at several points between Normanton and the accident site, the last occasion being in the vicinity of Nardoo Homestead at which time it was heading generally in the direction of Mount Isa.

The sound of the impact was heard by two stockmen who were located in a hut at Myally Outstation but they attached no significance to what they heard until the following day when a radio news broadcast made them aware that an aircraft was missing. Over the next two days they made a search of the area on horseback and on the morning of 8th February located the wreckage of the aircraft some four miles from their hut. The nearest place at which communication facilities were available was Kamileroi Homestead, some 25 miles from Myally, and following a journey by motor vehicle involving the fording of a river in flood and an eleven mile walk, one of the stockmen arrived at Kamileroi late in the afternoon.

INVESTIGATION

The wreckage of the aircraft was located on a small timberless plain which comprises a circular area of some three miles in diameter. The area is bounded by sparsely timbered terrain and by two creeks. The direct track between Normanton and Mount Isa lies 30 miles to the east of the wreckage location.

(All times are Eastern Standard Time based on the 24 hour clock and all aircraft speeds quoted are rectified airspeeds).

The daily weather pattern over the area between Normanton and Mount Isa remained constant over a period commencing several days prior to the accident and concluding several days after the accident. Isolated storms developed during the afternoon and produced moderate to heavy rain showers together with varying degrees of turbulence. The tops of the storms rose as high as 30,000 feet and they covered areas up to 30 miles in diameter. It was not difficult for aircraft in flight to avoid the storms as they were generally well isolated. Surface air temperatures were of the order of 100 degrees Fahrenheit.

The maximum permissible all-up-weight of the aircraft was 2,900 lb. It has been calculated that this weight was exceeded by 362 lb. at the time of the last take-off and by 291 lb. at the time of the accident. The maximum load permitted to be carried in the rear baggage locker of the aircraft was 120 lb. but there is evidence that the locker was loaded with frozen fish and the aircraft equipment totalling 332 lb. It was estimated that the disposition of the load resulted in the centre of gravity of the aircraft being 1.32 inches outside the aft limit, both at the time of the last take-off and at the time of the accident. As a result of this unbalanced condition it is probable that the aircraft would be difficult to trim in the high speed cruise configuration, it would have a tendency to tighten a turn of its own accord and it would exhibit poor stall recovery characteristics due to reduced elevator effectiveness.

The aircraft was seen to take-off from Normanton in a normal manner and the undercarriage retracted after it became airborne. After making a climbing circuit of the aerodrome it headed towards Karumba, a coastal town some 18 miles north-west of Normanton. It was seen to approach Karumba from the east-north-east at a height estimated to be not above 1,000 feet and then descended to about 500 feet to follow the course of the Norman River for approximately four miles. When last seen by a witness located at Karumba the aircraft was at a height above 3,000 feet, whilst climbing on a south-south-westerly heading.

A witness located at Inverleigh Homestead observed an aircraft which was probably this one, fly overhead at about 1530 hours. It was "fairly high" and was heading in the general direction of Mount Isa. At the time of the observation there was a storm to the south of Inverleigh.

Several minutes before 1600 hours two witnesses at Nardoo Homestead observed a small aircraft fly overhead "fairly high" heading towards Mount Isa. Another witness who was located two miles from the homestead heard, but did not see, an aircraft in his vicinity at about the same time. This witness gained the impression that the aircraft was at a low height initially and that, prior to climbing away in a southerly direction, it made a wide circuit of the area immediately south of the homestead. All three witnesses at Nardoo reported that storms were visible in the distance but the weather in their vicinity was clear.

The wreckage location was 18 miles south of Nardoo Homestead and a damaged watch recovered from the wreckage had stopped at 1607 hours.

The main part of the aircraft wreckage was located in an area of some 60 feet radius and it had been almost completely destroyed by impact forces and by fire which originated from the explosion of the fuel tanks at impact. The engine was completely buried in the ground and it was obvious that the aircraft had struck the ground at a substantial speed in a near vertical attitude.

The whole of the starboard wing from a point approximately 18 inches outboard of the lift strut attachment fitting to the wingtip was located 2,500 feet north-west of the main wreckage and the outboard half of the starboard aileron was 2,050 feet north-north-west of the main wreckage. The inboard half of the aileron remained attached to the wing structure. Calculations based on locations of the sections of wing and aileron and the probable wind velocity at the time of the accident indicate that the structural failure of the aircraft occurred at a height af approximately 3,000 feet when the aircraft was flying on a southerly heading.

A detailed examination of the main wreckage revealed that the flaps and undercarriage were in the retracted position at the time of impact. The inboard section of the starboard wing was attached to the aircraft structure but, with the exception of the front spar, it had been destroyed by fire. The spar suffered multiple fractures consistent with impact loads and the wing strut, although severely buckled, remained firmly attached to the spar. With the exception of the starboard outer wing and aileron there was no evidence of any component of the aircraft having failed other than as a result of impact forces.

In the area of failure of the starboard wing section which had separated from the aircraft in flight the wing ribs had completely collapsed, the stringers and surface skin were severely buckled and torn and numerous rivets had pulled through the skin. The front spar was twisted, leading edge downwards, through 45 degrees, the top flange of this spar had failed as a result of downwards and backwards bending and the bottom flange was slightly twisted and had failed in compression. The rear spar had failed in two positions due to rearward bending and the auxiliary spar had failed in a similar manner. The leading edge of the wing section was extensively dented and smeared with patches of cream paint identical to that applied to the fuselage. The starboard aileron was fractured slightly outboard of the centre hinge, the top skin having failed in tension and the lower skin in compression.

The evidence obtained from the wreckage examination leads to the conclusion that the starboard wing failure and the separation of the outer part of the wing from the main aircraft structure resulted from excessive leading-edge-down torsion loading. The detached portion of the wing remained temporarily secured to the main aircraft structure only by the aileron control cables and as it fell rearwards it struck the fuselage, the aileron was fractured and the aileron cables failed.

The pilot was aged 25 years and held a current commercial pilot licence endorsed for Cessna 210 and several other types of light, single-engined aircraft. His personal log book was not located but it is estimated that he had accumulated some 1,600 hours total flying experience of which at least 200 hours had been gained in Cessna 210. There was no evidence to indicate that he suffered any physical disability which may have contributed towards the accident.

ANALYSIS

It has been established that if torsional overloading is applied to a Cessna 210 wing due to downwards deflection of the aileron the area of the wing structure in the vicinity of the inboard aileron will fail. As the failure of the starboard wing of the aircraft involved in this accident occurred in the vicinity of the inboard aileron hinge, and as it was generated by leading-edge-down torsional overloading, there is no doubt that the overloading was the result of a down deflection of the starboard aileron.

Consideration was given to several situations which could induce the pilot to apply coarse aileron deflection with the aircraft flying at a high speed. It is conceivable, that following a temporary disturbance to the pilot, turbulence combined with the instability of the overloaded and unbalanced aircraft could bring about a change of attitude likely to lead to excessive speed and an inadvertent application of aileron deflection necessary to cause failure of the wing. The evidence

does not, however, support this or any other proposition to the exclusion of all others.

A further unusual feature of the flight was the deviation of the aircraft from the direct track between Normanton and Mount Isa. As Karumba is a renowned tourist resort it is probable that the pilot flew the aircraft over that area for the benefit of his passenger. As the terrain between Karumba and Mount Isa is relatively featureless it would normally be expected that the pilot would fly directly between these two places and his position report at 1535 hours combined with the evidence of the witness situated at Inverleigh Homestead confirms that up to that point the aircraft was following the expected track.

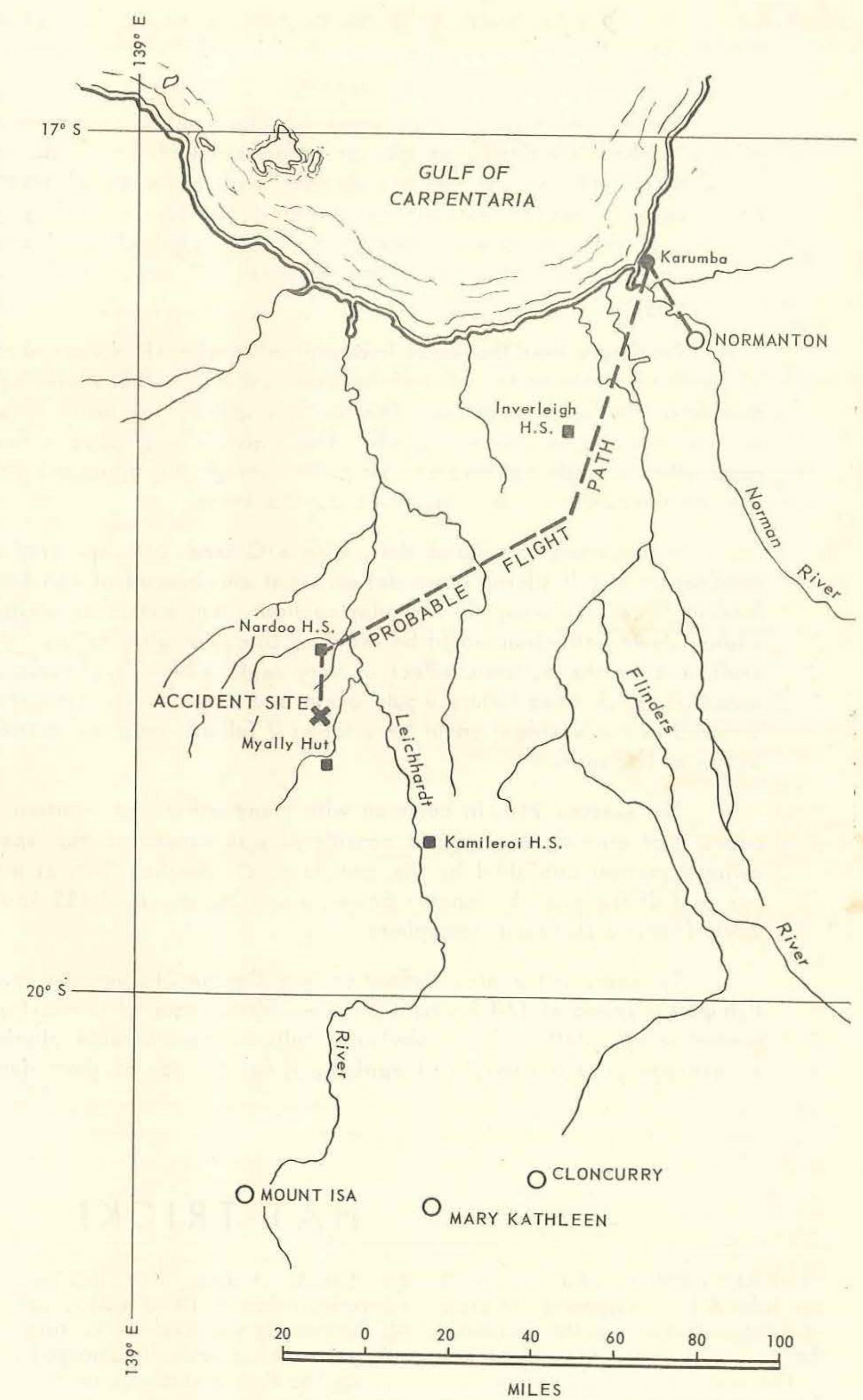
The next known position of the aircraft was over Nardoo Homestead, which is 30 miles west of the aircraft's expected track. Although it is possible that an error of navigation was the reason for the aircraft being in this position, it is considered more likely that the pilot diverted from track to avoid storms which were present to the south of Inverleigh.

The wreckage of the aircraft was situated within two miles of the direct track between Nardoo Homestead and Mount Isa and it is probable that the pilot, having identified Nardoo, was proceeding direct to his destination when the accident occurred.

CAUSE

The evidence indicates that the cause of the accident was the failure in flight of the starboard wing due to torsional loading in excess of the design limits. The torsional overloading was induced by coarse down deflection of the starboard aileron when the aircraft was flying at a speed considerably greater than the maximum manoeuvring speed specified by the manufacturer.

The circumstances which led to the coarse application of aileron have not been determined.



COMMENT

Aircraft structures are designed to withstand inertia forces which are expressed by their ratio to the normal force of gravity. The ratios are known as "load factors" and the presence of a load factor of 3.5 means that the aircraft structure has inertia forces acting upon it which are equal to 3.5 times those existing in steady flight. The minimum values of load factors are defined by airworthiness

authorities and vary according to the purpose for which the aircraft is used. Clearly the minimum load factors specified for an aerobatic training aircraft will be greater than those required for a heavy transport aircraft.

The maximum load factor which may be applied to an aircraft operating under stipulated conditions, without causing a permanent deformation of the structure, is termed the "proof load factor". It is a design requirement that the ultimate load factor be at least 150 per cent of the proof load factor but it is usual for aircraft manufacturers to achieve slightly greater values so that the actual strength of the structure is greater than that required by airworthiness authorities. In the case of the Cessna 210 aircraft a torsion load of least 157 per cent of this proof load would be required to fail a wing.

To ensure that the loads imposed on an aircraft do not exceed the proof load factors, a pilot is required to operate this aircraft in accordance with the operating limitations specified in the flight manual or the owner's manual. The manuals specify maximum speeds for flap and undercarriage extension, cruising, manoeuvring, etc. The manoeuvring speed is the maximum speed at which the full application of flight controls can be made without the appropriate proof load factor being exceeded and for the Cessna 210 is specified as 113 knots.

It has been calculated that, with a Cessna 210 operated at permissible all-up-weight, the application of full aileron down deflection at an airspeed of 164 knots will result in sufficient torsional loading to fail the wing. In a similar configuration, but at an airspeed of 188 knots, only 75 per cent aileron down deflection would be required to cause wing failure. An overloaded condition of an aircraft, and/or the dynamic effect of very rapid aileron application, would result in a reduction of the speed at which wing failure would occur and it has been estimated that the wing of the aircraft involved in this accident could have failed if full aileron down deflection was rapidly applied at a speed as low as 152 knots.

The Cessna 210, in common with many other fast, modern, non-aerobatic types of aircraft, is capable of cruising at a speed considerably in excess of the specified manoeuvring speed. The owner's manual published by the manufacturer specifies that, at maximum all-up-weight and using 75 per cent of the available engine power, a cruising speed of 152 knots can be expected at a height of 2,500 feet in a standard atmosphere.

To apply full aileron deflection in a Cessna 210 aircraft, loaded to maximum all-up-weight and flying at a speed of 164 knots, a pilot would be required to exert a force of 87 lb. to each end of the control wheel. Although this obviously calls for considerable physical effort, it has been shown that an average pilot is capable of applying it for periods of short duration.

HAT-TRICK!

PHILADELPHIA, 21st May — A hat helped 117 passengers get clear of a crashed airliner in three minutes flat.

The hat — this one was on the flight captain's head — represents one solution to the problems of emergency evacuation of aircraft, described today at the aviation seminar which opened the National Fire Protection Association's 66th annual meeting here.

According to E. J. Burggraf of Denver, Colorado, senior instructor for United Airlines, the incident happened when a DC-8 ended up off the runway with one engine torn off and another severely damaged.

Over the P.A. system the captain instructed passengers to evacuate, donned his hat and walked to the rear door of the aircraft, supervising the operation. He got instant recognition and co-operation, while other — hatless — crew members were ignored.

The hat represented authority, explained Burggraf, and in emergencies passengers need and expect leadership, and direct orders from the flight crew.

"In an aircraft accident requiring evacuation, our educated guess is that about 15 per cent of the passengers will get up and get out with no urging. About 85 per cent will do nothing until or unless the flight crew directs and assists them."

(National Fire Protection Assoc. U.S.A.)

Unexpected Hazard

A light aircraft pilot encountered a serious hazard during take-off at a non-controlled airport due to the slipstream created by a DC-4 while taxying.

The DC-4 was engaged in crew training and the light and variable wind conditions were such that during circuits and landings practice, each take-off was being effected in the reverse direction to the previous landing run.

The light aircraft was not equipped with radio and the pilot states that after delaying his departure as long as possible to avoid disruption to the DC-4, he lined-up on the runway into the light wind. At this time the DC-4 was seen on final approach prior to landing downwind and the pilot of the light aircraft held position until the DC-4 had completed the landing roll and was stopped about 200 feet ahead, facing him. As a precaution, the light aircraft was manoeuvred to the left hand side of the runway to provide ample clearance and the light aircraft pilot indicated to the DC-4 crew by hand signals that he wished to take-off.

On receiving the "thumbs-up" sign from the DC-4 captain, the light aircraft pilot commenced his take-off roll, passing the DC-4, which had remained stationary with engines idling. When the tail was raised into the flying attitude, severe turbulence caused the light aircraft to swing violently and the pilot kept the flight controls neutral reasoning that any coarse movements might result in a reaction opposite to that desired.

The passenger later advised that the pilot of the DC-4 had apparently increased power in order to commence taxying soon after their aircraft had passed.

COMMENT

The airmanship aspects associated with this case are open to question, but we are grateful to the pilot for bringing to notice the hazard created by the slipstream generated by the larger type aircraft particularly to light aircraft operating in the vicinity. In calm or light wind conditions the area of turbulence created by the presence of large aircraft may be more extensive than might otherwise be expected. Further information on this hazard is contained in the article "Wingtip Vortices", page 20 of this issue.

MODIFICATIONS require VERIFICATION

Air Navigation Regulations require that all modifications to aircraft must be approved by the Director-General and undertaken by persons approved for the purpose. In general, this means that modifications must be performed by engineers licensed for the work but approval has been given in the Light Aircraft Handbook for minor modifications to be performed by other types of person. An owner should not undertake any modification, however, without being absolutely certain that it is of such a minor nature that the airworthiness of the aircraft could not be affected. The following incident is an example of the potential danger in the "do it yourself" philosophy when applied to an apparently minor modification to a Cessna 180. The owner seriously underestimated the effect on airworthiness.

After completion of stalls and incipient spins as a part of endorsement training, it was noticed that the control column fouled something behind the instrument panel. It was extremely difficult to effect any movement of the control column in any direction. The aircraft was at 5,000 feet when this fouling occurred and a long approach was made to the field using rudder and elevator trim.

After landing an inspection was made under the starboard side of the instrument panel and it was noted that the pitot static line was positively fouling the control column. The pitot static line was bent well clear, controls checked and the aircraft was flight tested and found OK.

Investigation of the incident disclosed that the owner of the aircraft had installed some minor electrical wiring associated with the fitting of a camera warning light in the aircraft. This work had been undertaken without authorisation and, in the process, the pitot-static line had inadvertantly been deflected out of position. Although control movements were checked after completion of the work, it was not until extreme movements of the controls were made that any malfunction was apparent.

Only after exhaustive assessment of the effects of the modification on the airworthiness of an aircraft, should an owner perform that modification himself. If there is any doubt at all, he should at least consult a properly qualified licensed Aircraft Maintenance Engineer prior to subsequent operation of the aircraft.

SUDDEN DROP

(Extract from "The Mats Flyer")

(1) The Captain went back for a short time, leaving the Co-Pilot in charge of a trans-Atlantic big jet cruising at FL350. Sitting in the right hand seat, he was busy with R/T when he suddently saw the altimeter indication drop rapidly and the vertical speed indicator show a rapid descent of 2,000′/min. Machmeter and airspeed indication dropped as well. His immediate reaction was to disengage the altitude control of the auto-pilot and pull the control column back to counteract the descent. This caused the onset of slight buffet.

The nose-up attitude did not influence the indication of rapid descent on the vertical speed indicator and altimeter. Power increase did not improve matters. Meanwhile the Captain had returned and they scanned the Captain's and Co-Pilot's instruments. This showed:—

	Captain's panel	Co-Pilot's panel
Altimeter	FL 360	FL 330
Vertical Speed indicator	2000 ft./min. climb	2000 ft./min. descent
Machmeter	.810	.700
Airspeed indicator	275 knots	220 knots

A static system failure being assumed, the Co-Pilot's static system was selected from "normal" to "alternate" with no effect on his instrument readings. The cabin pressure was increased and the reaction of the Co-Pilot's vertical speed indicator and altimeter showed his static system was leaking. Cruise was continued on the Captain's instruments.

The airline drew three lessons from this stage of the incident — thus:

- When either pilot finds it necessary to leave his seat the pilot remaining on duty should not be side-tracked from his normal scanning cycle by other duties — if an R/T message comes up the calling station should be requested to stand by.
- Discretion should be used over the time of leaving the controls, i.e., not immediately prior to the sending of an Airep or when entering a terminal or high density traffic area.
- When the pilot's instruments show sudden unusual readings a quick cross-scan should be made to the other set of instruments before instituting recovery action.

There was a sequel to the flight. The instrument failure was reported in the maintenance log as "Leak in Co-Pilot's static line after selector valve alternate/normal". Although the Flight Engineer also verbally informed both the ground engineer and the succeeding Flight Engineer, the complaint was interpreted as "after selecting the valve to "alternate" the system was "normal". For this reason only the static line of the "normal" system between the selector valve and the vents was checked, naturally without result.

Assuming that the right hand static system was functioning properly on the "alternate" source, and knowing that the Captain's was good on both sources, the new crew accepted the aircraft and departed. During the flight it became obvious that the right hand static system was failing, both on "alternate" and "normal". It was later established that the cause of the trouble was a leaking cemented glass-sealing of the Co-Pilot's vertical speed indicator. In 1960 it had been decided to modify all instruments with cemented glass-sealing by incorporating new sealing rings, but the work was qualified as not urgent and a few instruments still had to be modified when this incident occurred. As a result the modification of "old" instruments has been speeded up.

The moral drawn by the airline is that the quality of reporting in maintenance logs should be kept under critical examination. They have introduced a new system of de-briefing Flight Engineers to strive for better liaison between the Flight Engineers and the Maintenance Department.

(2) A big jet was descending from Flight Level 350 when the airspeed indicator and machmeter on the pilot's side gradually started a decrease toward zero. The pilot's instinctive reaction to push the nose down caused the airspeed to exceed the limiting Mach of the aircraft.

Exhaustive alignment checks and correspondence with the constructor finally determined that the aircraft had not been structurally damaged. The aircraft was test flown and released for flight.

Cause of the airspeed failure was that small flaked particles from the pitot heater element had clogged the tube.

From a pilot's standpoint, two things are significant: (i) the pilot's reaction is completely understandable; all of us learned a long time ago that airplanes don't fly so good without airspeed. By publicising this incident, it may be possible for the next pilot who loses his airspeed indications to take a quick check on other instruments before he takes drastic action; (ii) the clean, streamlined jet aircraft accelerates in a hurry when the turbines are wound up. It is easy to exceed the limiting Mach during descents.

NASA Engineer George P. Bates, Jr., told the 1961 International Air Safety Seminar that "NASA has been reporting that turbine-powered airplanes are being operated above placard speeds, considerably more often than reciprocating-engine airplanes, particularly in the limit range . . . There are new rules and training procedures being adopted in the United States which are designed to help eliminate this overspeed problem".

REVERSE THRUST and WET RUNWAYS

In darkness, moderate rain, visibility 10 kilometres, cloud 8/8th at 800 metres, a jet overran a 7,054′ runway by 700′. In stopping it slid sideways on soft ground and sank up to its axles. The approach had been normal, the speed at touchdown was 110 knots. The captain applied wheel brakes just before 90 knots, but gained the impression that he was not decelerating at the normal rate. He increased brake pressure from 500 to 1500 psi. About half way along the runway the aircraft yawed to starboard, the pilot corrected this, then a port yaw developed followed by another yaw to starboard before the aircraft left the runway.

The aircraft was serviceable at the time of landing but no reverse thrust was available. This system had been made inoperative when an electrical fault had developed a week before. The defect had not been rectified on two occasions when the aircraft had been at base since then.

The runway markings, the good condition of the tyres after the incident and the exceptionally long distance required to stop the aircraft indicated that there was very little friction between the tyres and the runway throughout the landing.

The runway was wet and slippery due to rain falling on to a film of dust on a comparatively smooth surface. The captain considered that had reverse thrust been available the aircraft could have been stopped on the runway.

On a previous occasion the Air Registration Board gave a comment on "Reversing and Braking Jet Aircraft" which included this:—

"If one considers the effect of different conditions on the ground stopping distance then the following figures are obtained for a typical jet aircraft:—

"The stopping distances are approximately the same when using reverse thrust and gentle braking on a dry runway or fairly hard braking only on a dry runway. Taking these distances as a reference, the following increases in stopping distance result on wet runway surfaces.

Good surface friction, reverse thrust and	brakes	11%
" " "	brakes only	50%
Poor surface friction, reverse thrust and	brakes	80%
" " "	brakes only	220%

"From these figures it is apparent that using brakes and reverse thrust causes a negligible increase in stopping distance on a runway with good surface friction whereas using brakes alone causes a 50% increase. "Good surface friction" is used in this context to mean a runway whose surface characteristics enable the development of high friction when wet. On the other hand "poor surface friction" represents surfaces whose characteristics are inferior and have deteriorated due to contamination or presence of water films of depth which cause tyres to hydroplane and fail to make proper contact with the runway surface. Under these conditions when using brakes and reverse thrust the increase in stopping distance is of the order of 80% and the failure to use reverse thrust will result in the stopping distance being trebled.

"One might tend to conclude that provided an aircraft is touched down early it is not necessary to use reverse thrust unless the surface friction is poor. Unfortunately poor surface friction is virtually unpredictable and consequently, as stated earlier, all means of retardation should be used until it is apparent that they are working effectively and that the aircraft is going to stop well within the available runway length.

"Although the stopping figures quoted indicate that reverse thrust is not vital for a safe landing on a dry surface, it should be noted that brakes can fail and moreover, under hot, dry conditions, runways can become slippery due to oil oozing to the surface of asphalt runways, so that the general rule concerning use of retardation devices should apply even when landing on a dry runway."

(Flight Safety Foundation Bulletin).

LOSS OF CONTROL . . .

United States Beech "Baron" at Longreach

(All Times are Expressed in Eastern Standard Time Based on the 24 Hour Clock)

At approximately 0930 hours on 12th May, 1961, a Beechcraft "Baron" with United States registration N433T, departed from Longreach Aerodrome, Queensland, for the purpose of making a short local flight The aircraft was under the command of an American demonstrator-pilot and four local residents were carried as passengers. The aircraft was equipped with radio communication apparatus but this was used only to report "taxying" to the Longreach Communications Unit prior to the take-off. The aircraft failed to return to Longreach and, following unsuccessful attempts to establish its whereabouts by normal means, search and rescue action was initiated. An aerial search resulted in the wreckage of the aircraft being located in open terrain 4½ nautical miles west-south-west of the aerodrome. All persons on board were killed and the aircraft was destroyed as a result of the accident. In accordance with the provisions of international Civil Aviation agreements the investigation of this accident was made by the Department of Civil Aviation on behalf of the United States Civil Aeronautics Board and this authority subsequently agreed to the publication of the details of the investigation.

THE FLIGHT

The aircraft was being flown from the United States on a delivery flight via Europe to the Australian Beechcraft agents at Bankstown, New South Wales. Local flights, probably for demonstration purposes, were made at a number of points between Teheran, where the American pilot assumed command of the aircraft, and Darwin. The aircraft arrived at Darwin on 10th May, 1961, where a pilot employed by the Australian agents joined the American pilot-in-command. At Mt. Isa, Queensland, on 11th May, a demonstration flight was made for the benefit of members of the Flying Doctor Service. During this demonstration the American pilot flew the aircraft from the front left hand seat and the front right hand seat was occupied by a pilot of the Flying Doctor Service. The aircraft was then flown to Longreach where an overnight stay was made.

At approximately 0855 hours on the following morning the aircraft took off from Longreach on a demonstration flight which was completed successfully. During this flight the American pilot occupied the front right hand seat, a local commercial pilot the left hand seat, and the remaining seats were occupied by three passengers.

After the aircraft returned from the demonstration flight the pilot in charge of the aircraft offered a flight to a local light aircraft owner/private pilot. An offer was also made to several other persons to participate in the flight and, on departure, all five seats were occupied. The American pilot again occupied the front right hand seat. At 0927 hours a voice which is believed to have been that of the private pilot advised Longreach Communications Unit by radio that the aircraft was taxying out for a local flight. This was the last transmission received from the aircraft but it was seen by several witnesses to taxy to the runway and take-off.

A search and rescue watch was not requested and was therefore not required for the flight. The communications officer on duty at Longreach did not become aware until approximately 1130 hours that the aircraft had not returned, but no concern was held for the safety of the aircraft at this stage as it was thought that a landing had probably been made on a nearby private airstrip. At 1208 hours, when it had been ascertained that the aircraft was not at this airstrip, a search action was commenced. The wreckage was sighted from the air at 1540 hours.

THE INVESTIGATION

The wreckage of the aircraft was located in flat timberless country at a position 4½ nautical miles on a bearing of 256 degrees magnetic from Longreach aerodrome and 2.3 nautical miles from the limits of the town of Longreach. The area between the accident site and the town is uninhabited.

The weather conditions observed at Longreach at 0930 hours were 1/8 alto-cumulus cloud at 15,000 feet, visibility was unrestricted, the wind was from 070 degrees at 10 knots, and the altimeter setting (QNH) was 1017 millibars. The weather conditions remained fine and stable throughout the day and there was little or no turbulence experienced by other aircraft. It is considered that the weather conditions were not a contributory factor in this accident.

It has been calculated that the fuel on board the aircraft at the commencement of flying on 12th May was approximately 97 U.S. gallons. A demonstration flight of about ten minutes duration was carried out immediately prior to the fatal flight, therefore, the fuel on board the aircraft at the time of the last take-off is estimated to have been 92 U.S. gallons. Because fuel was used from all four tanks during the flight from Mount Isa to Longreach it has been assumed that the fuel load during the flights at Longreach was evenly distributed between the front and rear tanks. The maximum permissible all-up-weight for this aircraft was 4,880 lbs. The calculated weight at the time of the accident was 252 lbs. less than the maximum permissible and the centre of gravity position was probably within safe limits.

The aircraft was extensively damaged in the impact but all components were located at the accident site. Detailed examination of the wreckage established that the following conditions existed at the time of the accident:—

- The undercarriage was in the fully extended position;
- The flaps were in the fully extended position;
- The left hand engine was rotating and delivering power;
- The right hand propeller was either in the process of feathering or of unfeathering and the associated engine was not delivering power;
- There was no evidence of pre-impact failure of any of the flight controls;
- There was no evidence that any pre-impact structural failure had occurred;
- Fire had not occurred either before or after the accident and there was no evidence of an explosion;
- The aircraft struck the ground at a high rate of descent in a steep nose down position with the wings banked to the left. There was no evidence of any defect or malfunction which might have contributed to the accident.

The aircraft was seen by witnesses to taxy out to the 041 degrees sealed runway, stop for a short period, and then take-off. Following the take-off the undercarriage was retracted and the aircraft turned left towards the north of the aerodrome.

The earlier demonstration flight had been carried out to the north and west of the aerodrome probably because this was a covenient area in view of the take-off and landing direction. Following the last take-off, several persons at the aerodrome saw the aircraft flying away towards the north but the only persons who reported sighting it after that time were three witnesses who were located 2.2 nautical miles from the accident site (see sketch). Each of them identified the aircraft by its colouring and by the fact that it had two engines, and one witness saw the same aircraft on two occasions. On the first occasion he saw it heading north-west "about the usual height that aeroplanes fly around Longreach" and on the second occasion it was heading west-south-west at a much lower level. It seems that the aircraft was on its first demonstration flight when he first saw it and it was almost certainly engaged on the flight during which the accident occurred on the second occasion that he sighted it. His most vivid recollection of the second flight was that the aircraft was low and very slow.

The evidence of all three witnesses indicates that the flight path on the last flight was in a south-westerly direction and one of the witnesses, who watched the aircraft for a longer period of time than the others, saw it bank to the left with the nose going down. He did not continue to watch the aircraft beyond this point. All three witnesses agreed that, at this stage of the flight, the aircraft was much lower than others which they have frequently observed flying in the vicinity of the Longreach Aerodrome. The witnesses compared the height of the aircraft with that of the Longreach water tower which is 130 feet above ground level. Their height estimations cannot be regarded as completely reliable but it is reasonable to assume that the aircraft was operating at a height substantially less than 1000 feet above ground level.

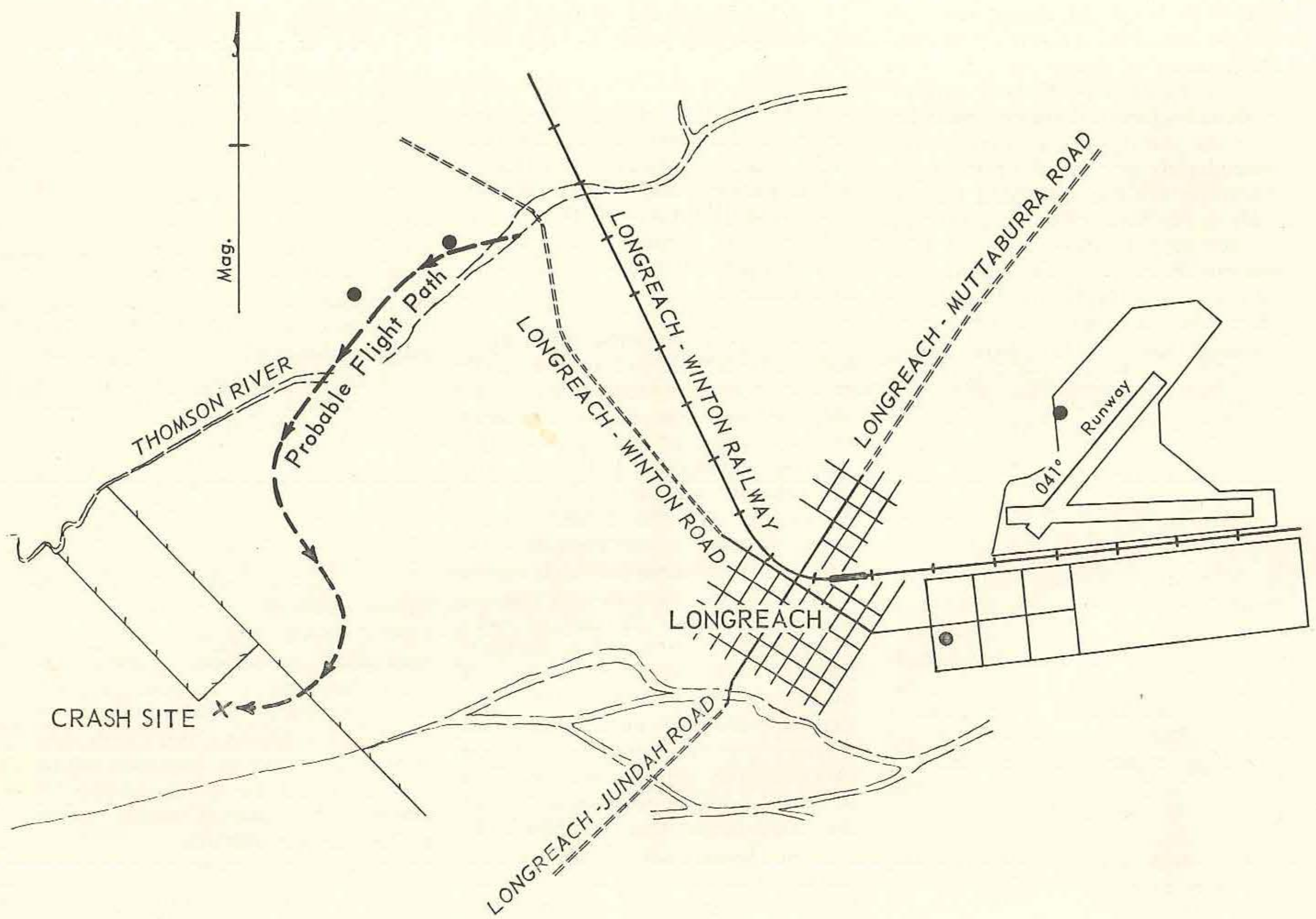
Having regard to the witness evidence, and to the disposition of the wreckage which indicated that the direction of the aircraft's flight path at impact was 290 degrees magnetic, it seems probable that, after passing the three witnesses the aircraft turned to the left and then made a turn to the right as indicated in the sketch.

The owner's manual published by the manufacturer indicates that at an all-up-weight of 4630 lbs., at an altitude of 1000 feet, the aircraft would descend at 180 feet per minute with the undercarriage extended, one engine developing maximum continuous power and the other engine inoperative with the propeller windmilling. In similar conditions, but with the propeller of the inoperative engine feathered and the undercarriage retracted, the aircraft would climb at 350 feet per minute.

It was apparent that in any asymmetric power configuration retraction of the undercarriage and feathering of the propeller on the inoperative engine is critical to the performance of the aircraft.

The pilot-in-command was aged 46 years and was the holder of a Commercial Pilot Certificate issued by the Federal Aviation Agency of the United States. He held ratings for single and multi-engined land aircraft and multi-engined sea aircraft and he was instrument rated for all these types.

At the time of his last routine medical examination on 13th January, 1961, he had flown a total of 12,000 hours as pilot, of which 425 hours had been flown within the preceding six months. An autopsy revealed no evidence to indicate that he suffered from any physical disability which may have contributed to the accident. He was employed as an executive and sales pilot and had flown a Beechcraft model 65 "Queen Air" aircraft on



WITNESS LOCATIONS AND PROBABLE FLIGHT PATH

LOCATION OF WITNESSES ●

0 1 2 3

NAUTICAL MILES

a demonstration tour in Australia during November, 1960. From the time he assumed command of N433T at Teheran on 18th April, 1961, he had flown the aircraft for a total of 61 hours 50 minutes. This total included 13 local flights in various countries which were probably for demonstration purposes.

ANALYSIS

The wreckage distribution and the impact marks indicate that the aircraft struck the ground at substantial speed in a steep nose down attitude with the wings banked to the left, and that the direction of the flight path at impact was approximately 290 degrees magnetic. The heading of the aircraft at initial impact was probably about 200 degrees magnetic and it came to rest on a heading of 133 degrees magnetic after cartwheeling to the right about the front of the structure. The evidence indicates that it was rotating to the left about the normal axis at a high rate immediately prior to impact. An overseas report of a spin accident involving this type of aircraft indicates that the attitude in a spin is steeply nose down and that the aircraft assumes a near vertical attitude during recovery.

The two surviving pilots to whom the aircraft was demonstrated in Australia have both stated that on the flights in which they were involved the flap was lowered at an airspeed in excess of that specified by the manufacturer. As the flap from the starboard wing was found some 60 feet from the main wreckage, a detailed examination was made of the components of this flap mechanism but no evidence of any pre-impact failure was found. The position of the starboard flap was consistent directionally with other items of wreckage which obviously separated from the aircraft during impact and it is considered that no other significance can be attached to its position in relation to the main wreckage.

All components of the aircraft were located and their positions in the wreckage pattern were consistent with the aircraft breaking up on impact with the ground whilst in a cartwheeling motion to the right.

Although the right hand propeller was in the process of being either feathered or unfeathered the examination of the right hand engine and accessories failed to reveal any abnormality which may have influenced the pilot to close down that engine for any reason other than for demonstration purposes. If a single engine landing had been contemplated, it is considered that the wreckage location is too far distant from the aerodrome for the pilot to have selected full flap as a prelanding preparation unless the aircraft was at a height which was well above normal in such circumstances. The evidence of witnesses indicates that when the aircraft was seen about two miles from the accident site, it was below, rather than above, what could be considered a normal height. On the other hand, the aircraft was reputed to be capable of a very good single engine performance and one flight sequence was to demonstrate the small amount of yaw during the feathering of one propeller whilst the pilot's feet were off the rudder pedals. Another sequence was to demonstrate the docility of the aircraft when stalling with asymmetric power. When a stall was demonstrated at Mount Isa it was performed with the undercarriage and the flaps fully extended.

It is apparent from the evidence of the three witnesses who were located west-north-west of the aerodrome that when the aircraft passed their position heading in the general direction of the accident site, it was at a height below 1,000 feet, the undercarriage was retracted, the flap was probably up and both engines were probably operating normally. Between the time the aircraft passed this position and its arrival at the accident site, the undercarriage and the flap had been fully extended, and action had been taken to feather and, possibly, unfeather the right hand propeller. As the aircraft had a westerly flight path, i.e., away from the aerodrome, it does not seem likely that this configuration was arranged for the purpose of landing, and it seems more reasonable to believe that it was arranged for demonstration purposes. Since stalls with asymmetric power and stalls with undercarriage and flap down had been carried out during earlier demonstration flights there is a possibility that a manoeuvre incorporating all of these conditions was attempted immediately prior to the accident and this proposition is not inconsistent with the evidence.

The pilot for whom the last flight was primarily undertaken, was the holder of a private pilot licence endorsed for a number of light single-engined aircraft types. His total aeronautical experience was approximately 2,800 hours, of which 1,800 hours had been gained during the second world war, mostly on Avro Anson and Liberator aircraft. He did not fly as a pilot from March 1946 until March, 1957. During the flight immediately preceding that on which the accident occurred the pilot to whom the aircraft was then being demonstrated occupied the left hand control seat and, for most of the flight, was permitted to operate the controls. As the private pilot occupied the left hand control seat during the fatal flight, it is likely that he would have been permitted to fly the aircraft for at least part of the flight. The possibility that he operated the controls during asymmetric powered flight, and that he was permitted to fly the aircraft in such a manner that loss of control occurred, cannot be discounted.

CAUSE

The available evidence indicates the probability that, whilst the aircraft was operating in an asymmetric power configuration with the undercarriage and the flaps extended, loss of control occurred at a height above the ground which was insufficient to enable the pilot to carry out effective recovery action.

Trim in Emergency Descents

(Airline Report)

Recently a jet transport entered a practice emergency descent from 38,000 feet. During recovery the control column was eventually pulled back against the stop with no apparent effect. Speed increased to Mach.86. At this point it was noticed that the stabilizer setting was 2° nose down. Attempts to retrim were, for a time, ineffective, but at 25,000 feet a normal recovery was made.

It is possible to mishandle high performance aircraft in such a manner that the stabliser trim actuators, either hydraulic or electric, will slow down or partially stall when exposed to very high horizontal tail loads.

In short, during an emergency descent in any of our aircraft, do not trim further nose down than 0°.

DEAD DUCKS

The need to consider the all-up-weight limitations of your aircraft when undertaking travel flights, is highlighted by a letter received from the pilot of a Cessna 175:

"At the suggestion of a friend, I agreed to use the company Cessna 175 to fly to a likely area for the opening of the duck shooting season. My friend called me back a day or so later with a proposal that he invite two other sportsman who might occupy the remaining seats in the aircraft. I accepted the idea with a strong reservation that the amount of gear to be carried would of necessity have to be kept to a minimum. A victim of airline advertising, I advised that 30 lb. of gear per person would be allowable. I set a time for take-off that would allow 90 minutes before last light at destination with a 15 knot headwind component.

"I thus unwittingly became involved in a train of events which could have led to the loss of a friend or even an aircraft accident involving us all. My friend was familiar with the area chosen for our sporting activity and he advised that the "aerodrome" was close to the town and quite long. I decided to fill the tanks and flight plan using a recognised aerodrome as an alternate, so that if upon aerial inspection, the landing area at our destination looked doubtful, I would divert.

"My friend was the first passenger to arrive prior to departure time. In addition to his 30 lb. of gear, he very thoughtfully brought along three shot guns, 150 rounds of 12-gauge ammunition, field glasses, movie camera and some food supplies. A quick check of his personal weight plus his gear worked out at 335 lb.

"The next arrival, at two minutes prior to our ETD, was six foot two inches of bubbling American enthusiasm. His personal weight was 240 lb. to which 30 lb. of baggage and shotgun had to be added. The other items he produced were sadly declined and locked in his car. At this stage, one shotgun, 100 rounds of ammunition and a camera went back into my friend's car.

"The remaining passenger telephoned that he was delayed and would be 15 minutes late. He finally arrived 50 minutes late (nearly all my time reserve gone). With profound apologies for the delay, he proceeded to produce a voluminous quantity of gear from the boot of his car. He stood six feet in his old army boots. I estimated his weight at 180 lb.

"Despite recriminations from my passengers, I completely unloaded the aircraft and discarded all camping gear and, where possible, made drastic reductions in the weights of other items of equipment. Remarks such as 'what's the use of going duck shooting without guns', 'how do you camp without food', 'Pete Smith carried more gear in his Cessna, why can't you' and 'can't you carry even four men and their baggage'? did not help to improve the predicament in which I found myself.

"Arriving at our destination by aircraft without camping gear but with considerable personal and shooting equipment, gave us a lift upwards on the local social register. We acquired the best accommodation on the station property and enjoyed ourselves immensely.

"The landing area consisted of a strip flanked by undergrowth and some soft sand. Daytime temperatures in the area double the take-off length normally required by Cessna 175 aircraft and we departed on the return flight only after leaving all our gear behind to follow by road.

"The off-loaded gear arrived home by car several days later and when passed over the scales weighed 145 lb. I then decided to seek a solution to the problem of how to organise future flights of this nature without compromising safety in regard to loading limitations.

"A post-analysis of the operation indicated how easily one can be misled on the question of loading light aircraft. In spite of my endeavours to keep the all-up-weight within the prescribed limits, I calculated that the aircraft was 208 lb. above the 2350 lb. maximum permissible take-off weight when we departed from home base. On the return flight, I found that by discarding all baggage and gear, I had to reduce the fuel load to 16 gallons to achieve an all-up-weight just 67 lb. below the maximum for the ambient conditions. Under this arrangement it was necessary to land at a recognised aerodrome en route to top up the fuel and, again without baggage and gear, with full tanks the aircraft was 63 lb. above the maximum all-up-weight for take-off.

"The lesson I learned from this experience is — by all means go shooting — but remember to send the gear on ahead or restrict your load to two passengers whose personal weights are known to you."

COMMENT

This pilot's experience indicates just how easy it is to be caught up and carried away with the insidious philosophy of "just a few more pounds won't matter". This is often suggested by people who cannot be expected to know just how those extra pounds can snowball or how much they do matter. There is a great temptation for the pilot to take the easy way out and seek comfort in some imaginary compensatory factors such as the ideal weather or the excess strip length, but this is how accidents are born. You cannot possibly foresee the emergency situations with which you might be faced and any pilot who plans his flight without regard for such possibilities has an expensive and maybe fatal lesson coming up. Any flight in which the gross weight of the aircraft or the position of its centre of gravity is outside the limits prescribed for it is an unsafe flight before it begins. The pilot who loads his aircraft carefully, firmly resisting the appeals or the chiding of the uninformed, will ultimately gain their respect and, more important, continue to live to enjoy it.

We are grateful to this pilot for his candid and useful exposition.

ALTIMETER CARE

While airline pilots are not master watchmakers they usually have the same respect and even reverence for the delicate mechanisms that are aircraft instruments. Recently a few altimeters on jet aircraft have been removed because of indication errors or because of flight crew reports of a tendency to "hang-up" during climb or descent.

Shop analysis, in many cases, has revealed damaged nylon gears. Research into the problem has indicated that on some models this damage can be induced by rotating the barometric pressure adjusting knob beyond either the 27″ or 31″ setting. The induced error will be of the same magnitude as the degree of rotation beyond the adjustable range limit.

"Slow and Easy" should be the watchword when resetting aircraft instruments and controls.

(Extract from Accident Prevention Bulletin).

Nav. Aids and YOUR FLIGHT PATH

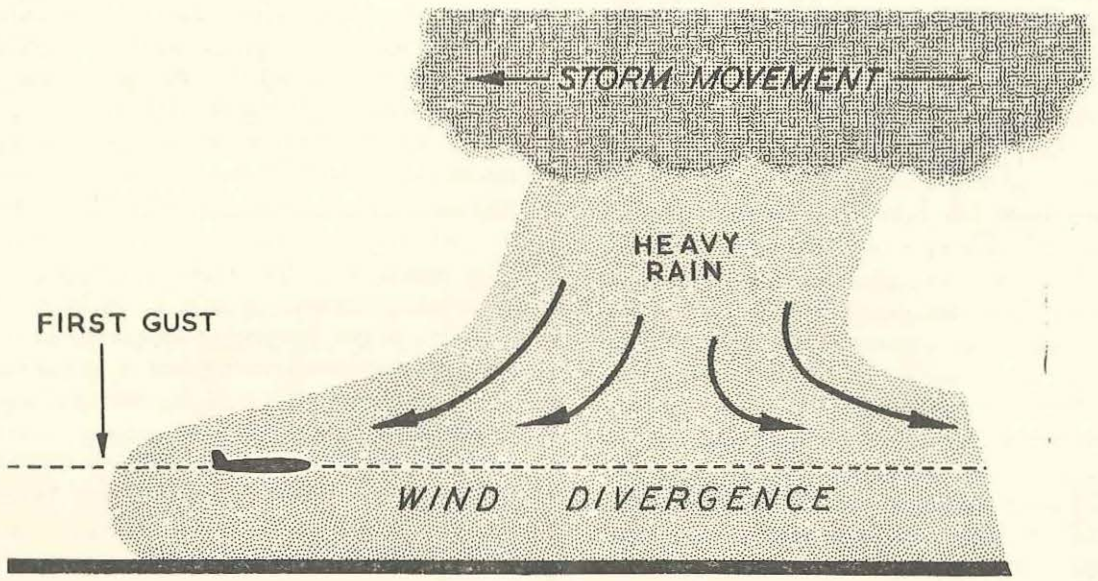
Air Traffic Clearances issued by Air Traffic Control are designed to ensure that adequate vertical, lateral or longitudinal separation is achieved and maintained between all aircraft known to be flying within controlled airspace. Lateral separation between aircraft is applied on the understanding that the radio navigation aids with which the aircraft is equipped are being used by the pilot and that the resultant accuracy in track keeping is within the tolerances allowed. Air Traffic Control should be informed immediately if for any reason a navigation aid which they have been informed is available in the aircraft is not being used, so that due allowance might be made for a possible reduction in the track keeping accuracy being achieved.

A serious infringement of separation in IFR conditions between an arriving and a departing aircraft occurred recently because the arriving aircraft was substantially outside the track keeping tolerance provided by Air Traffic Control. The air traffic clearance issued to the departing aircraft was based on the understanding that the inbound aircraft was tracking along the VAR. The flight plan, submitted in writing, indicated that this aircraft was VAR equipped. When approving the flight plan, Air Traffic Control accepted that the frequency of the destination VAR was available in the airborne equipment. The true situation was that the aircraft was equipped with only a 6-channel VAR/LOC receiver which did not include the frequency of the destination VAR.

In essence the flight by this aircraft on this particular route was made without proper compliance with the minimum radio navigation equipment requirements set down in Air Navigation Order 20.8. Of even greater significance is the fact that Air Traffic Control was misled, albeit unintentionally, as to the aircraft's track-keeping capacity. This incident has highlighted the fact that there are a number of other aircraft in service equipped only with 6-channel VAR/LOC receivers. Flight plan forms normally contain a check list for use by pilots to indicate to Air Traffic Control those items of serviceable radio navigation equipment installed in the aircraft. An I.F.R. flight plan should be clearly marked to indicate only those items of radio navigation equipment which are capable of being used on the route to be flown.

It is important to keep well in mind that your own safety and the safety of others may be compromised by indifference to the accuracy of the information you provide to Air Traffic Control.

Wind Reversal Below Thunderstorm



Every now and then an aircraft landing or taking off, or even flying low en route, in violent thunderstorm conditions, crashes as a result of loss of height without loss of control. One case was that of an Argonaut at Kano Airport in Nigeria in 1956. The captain of this aircraft had meticulously checked the en route weather, noted the position of local thunderstorms and ascertained from the forecaster that a large cumulo-nimbus cloud, visible from the airport but away from the take-off path would probably move very little and, if it did, only slowly. The aircraft took off normally but after entering heavy rain on the climb lost 20 knots of airspeed despite increase of power, could not maintain height, and was forced to the ground. The Board of Inquiry considered that "The accident was the result of loss of height and airspeed caused by the aircraft encountering, at approximately 250 feet after take-off, an unpredictable thunderstorm cell which gave rise to a strong reversal of wind direction, heavy rain and possible down-draught condition."

The way a thunderstorm cell builds up, maintains itself and decays is still debated by meteorologists. It is a sound generalisation, however, that when a thunderstorm is near an aerodrome, aircraft taking off or landing may be subjected to swift, unannounced shifts of wind direction and strength, plus wet runways.

An important point to realise is that when a thunderstorm cell starts to release its rain a period of danger begins. Typically, two or three minutes after the first measurable rain reaches the surface the rain fall builds up to a peak rate and continues heavy for five to 15 minutes. Just after the surface rain starts, a cold down-draught hits the surface and spreads out in all directions, as would a fluid jet striking a flat plate. Where this happens there is a divergence of surface winds (see drawing). This divergence takes place within the heavy rain under the storm cloud. An aircraft flying through it is likely to move quickly from a headwind to a tailwind condition. If this happens to an aircraft flying comparatively slowly, say just after take-off, there is a risk of a dangerous loss of height, as shown at Kano.

The cold air under the storm cell flows outwards. Were the storm cell motionless it would spread equally in all directions, but normally the down-draught has a lateral motion relative to both the ground and to the existing surface wind. The cold air spreads over the surface from the storm cell, under-running the surrounding warmer air. As the edge of the spreading cold air passes places on the ground there is likely to be a marked change of wind speed and direction. The advancing edge of the cold air is known as the "first gust line" and it moves ahead of the rain centre of a storm cell. The first gust may go as high as 65 knots; on average there is an increase of surface wind speed of 12 knots and a shift of direction of 40°, but there may be a complete reversal of direction.

(Extract from Flight Focus)

COMMENT

The characteristics of thunderstorms are the same in all parts of the world and similar conditions have been experienced in Australia. The risk involved is clearly illustrated in the following report from an airline pilot, which is reproduced verbatim.

"At 1415 on 11th October when flight—— was taxying for take-off at Sydney, a storm was observed approaching from the North-west and appeared to be 2 to 3 miles distant. Bearing in mind the possible hazard of a take-off in such conditions I surveyed the situation and elected to use Runway 16 for take-off. This runway offered a clear take-off path over Botany Bay, completely clear of cloud and virtually away from the approaching squall. The surface wind at the time was given as light and variable. It was raining lightly when the take-off was commenced but near the end of the take-off run heavier rain restricted visibility and instrument take-off technique procedure was adopted. The aircraft was taken off at a few knots above V2 and climbed away at 'best gradient' climb speed (113 knots in this instance). The climb out was normal until about 150 feet when the rate of ascent dropped off rapidly and a descent was indicated for a short time. The speed was brought back to approximately 105 knots (V2 flaps up-103 knots). This arrested the downward trend and normal climb was resumed. Turbulence was only moderate and no difficulty was experienced in controlling the aircraft, nor was it difficult to maintain an accurate indicated airspeed. Maximum power was maintained until normal rate of climb was resumed.

"The control tower operator advised that a slight wind change had occurred during the take-off and had become westerly at 8 knots. This would indicate that the squall had approached more rapidly than anticipated. However, it would not seem that such a small wind change would cause the down-draught through which the aircraft had flown and it is assumed that the subsidence was due to the cumulo-nimbus cloud formation which was still some distance away."

In indicating a descent the vertical speed indicator did no more than reflect the movement of the aircraft relative to ground level. The tower controller was watching the aircraft at the time and confirmed that it lost height rapidly, descending to an estimated 50 feet before the descent was arrested and normal climb was resumed. On the basis of an immediate report from the pilot, coupled with observations from the tower, the aerodrome was closed to all operations for a period of ten minutes, during which the storm moved clear of the airport area.

ALLOWABLE DEFICIENCIES

The modern airline aircraft will tolerate unserviceability in certain of its equipment and yet maintain schedules — usually at the expense of an increased work load on the crew. To ensure that safety is not sacrificed in the interests of maintaining schedules it is laid down by the Department that flights with unserviceable equipment may be made only in accordance with an approved permissive unserviceability schedule. Pilots and engineers have equal responsibility for ensuring that the terms of this schedule are complied with at all times.

The need to remain within the limits of allowable unserviceability was demonstrated in a recent incident which could easily have involved a mid-air collision between two passenger-laden aircraft over a densely populated capital city area.

A Viscount took off on a night flight from Sydney Airport, cleared to depart via a diversion track aligned on 244 degrees. At the same time a DC.3 passenger flight was inbound on the aural VAR track aligned at 275 degrees from the airport. The tracks are so situated that adequate lateral separation exists provided both aircraft do not deviate beyond the normal navigational tolerances allowed for departing and arriving aircraft.

The departing aircraft took off into the south and turned right, to a heading of 315 degrees so as to intercept the required diversion track. Soon afterwards, the DC.3 advised of its position as 21 miles DME on the aural VAR, proceeding to a locator situated slightly north of the VAR track. At 17 DME the DC.3 was cleared to proceed direct to the landing pattern.

Although the responsibility to comply with the A.T.C. clearances rested entirely on the pilots, it so happened that both aircraft were under observation on surveillance radar. By this latter means it was observed that the departing Viscount had proceeded past the diversion track and, still on a course of 315 degrees, was rapidly converging on the path of the DC.3. The Viscount was advised of the situation, whereupon it turned left, into a position where it intercepted and proceeded along the VAR track. Fortunately, the DC.3 had at this time turned left away from the VAR preparatory to entering the circuit pattern, thus providing separation of some three miles at the point at which the two aircraft passed.

The Viscount continued along the VAR until it was again advised of being off its designated track, whereupon it was observed to execute a left turn which was followed by a lesser turn to the right, resulting in it paralleling the required diversion track. Further instructions, based on radar observations, were necessary before the aircraft intercepted the 244 degree diversion and departed according to its flight plan.

Investigation disclosed that immediately after take-off, at the time he was turning to intercept the diversion track, the captain of the Viscount realised that unserviceability in the pressurisation control system demanded that the rate of cabin pressure change be manually controlled by a switch on the first officer's console. Having had previous in-flight experience of this emergency procedure, and knowing that the first officer had not experienced the situation other than under training conditions, the captain elected to operate the manual control himself. Engaging the auto-pilot and setting the aircraft on the approximate heading to intercept the diversion track, he demonstrated the method to the first officer, but, in so doing, neglected to control and navigate the aircraft in an area where accurate navigation and continuous vigilance were essential.

Superficially, it appears that the crew alone were responsible for the errors that produced this situation. A more searching examination of the facts, however, reveals that the maintenance engineers contributed to the cause, for they, as well as the pilots, completely disregarded the instructions contained in the permissive unserviceability schedule relative to continued operation with malfunctioning equipment.

Investigation of the mechanical trip records revealed a sorry history of unserviceability in the unit which automatically controlled the cabin pressure, encompassing at least 12 flights over a period of four days. Numerous engineers had certified the aircraft as satisfactory for unrestricted operations and several crews had accepted it without question, knowing that the cabin pressure controller was not capable of normal operation and apparently without thought of whether such a deficiency was permitted. The applicable unserviceability schedule is quite specific regarding unserviceability of the pressurisation system — the aircraft must operate unpressurised and engineers are required to indicate system unseviceability by a suitable placard. Both these instructions were ignored — not only by individual pilots and engineers, but by those responsible for the direct supervision of both the operational and maintenance activities.

The permissive unserviceability schedule is essential for the safe operation of modern aircraft. Increased speeds and traffic density, together with the complexity of the aircraft, its power plants and the equipment necessary to ensure all weather operations, have created a crew work load which is virtually at saturation point. To reduce this to acceptable limits automatic devices and integrated automatic systems have been introduced to relieve the crew of the need to do other than monitor numerous essential functions. Unfortunately, mechanical equipment of this nature is complicated in itself and the manufacturer has been forced, in most cases, to provide a manual mode of operation which allows the pilot to assume control of a particular function in the event of an in-flight failure of the automatic device. This is an emergency situation and in general is not an acceptable alternative for continued operation.

Man has been endowed with the ability to acquire knowledge and experience which can be applied to manipulation of complicated equipment or to the solution of problems. It is but seldom, however, that he has the opportunity to become other than a specialist in one particular field, with perhaps a working knowledge of others closely allied. This is particularly true in aviation, where the technical advances are such that even the specialist is often hard pressed to keep abreast of current development. No one man, pilot or engineer, can become expert in the many aspects of aircraft operation and engineering, nor can one man be expected to adequately assess the full ramifications of the failure of some particular item of equipment.

In recognition of the need for considering both the operational and engineering aspects where there are involved defects that affect the airworthiness of an aircraft, operators are required to draw up a schedule of permissive unserviceability covering the normal operating defects that are likely to be encountered on a particular aircraft type. There is also in existence a system whereby defects beyond the scope of those included in the schedule can be referred to specifically delegated company personnel or to appropriate officers of the Department for decision regarding the conditions under which the flight may continue. These latter instances are normally dealt with through company channels, therefore, so far as the pilot and engineer are concerned generally, compliance with the schedule is the limit of individual responsibility.

Compiled in an atmosphere unclouded by the need for immediate decision, the schedule of permissive unserviceability reflects not only the combined knowledge of a number of experts, but is based upon known operational experience, thus providing the best possible compromise between safety and the need to obtain the utmost utilisation from expensive equipment. By its very existence the schedule protects the pilot and engineer, relieving them of the need for decisions in circumstances where the dictates of safety may have to be weighed against economic considerations. The schedule sets out the maximum unserviceability that can be tolerated with safety. Where the limit defined in the schedule has been exceeded there can be no argument: the permissive unserviceability schedule must be observed and the flight must not proceed except under the conditions specified therein or unless the fault has been rectified.

The number of cases that come to our notice in which pilots and engineers have disregarded the protection offered by this schedule is surprising to say the least. We realise, of course, that there are some who believe the circumstances under which they are placed at a particular time warrant such action and are prepared to back their judgment to the extent of jeopardising their own and other peoples' lives. This, perhaps, is a facet of human nature than can only be eliminated by harsh correctives. It is believed, however, that the majority of these cases are brought about because the people who make the decision to proceed do not appreciate the real function of the unserviceability schedule and regard it as a guide rather than a mandatory requirement.

It is the responsibility of all supervisory staff to ensure that rules such as this are properly understood and are applied at all times so that the intended level of safety is not reduced.

AVOID THAT FLAPPING

Several reports have been received concerning a loud flapping or banging heard by student pilots while flying solo in Cessna 150 aircraft.

In each of the reports it was stated that what was thought to be a sizeable piece of fuselage skin adrift on the starboard size of the aircraft, proved to be the buckle end of an unsecured seat belt which had been left hanging outside the closed door of the aircraft.

It is not difficult to see that distractions of this nature might lead to serious errors in a student pilot's judgment. Proper care on the part of both instructor and pupil during the pre-flight check is the obvious cure.

HAIL IN CLEAR AIR

A recent issue of "the Aeroplane" included an article on hail. We reprint it here, in part, for your interest:

"Since the beginning of aviation, hail has been regarded as one of the more unpleasant meteorological phenomena encountered by pilots. A new aspect, discussed in an article in 'Meteorological Magazine', has a special significance in relation to supersonic flight . . .

Hail has been observed at altitudes between 10,000 and 20,000 feet in clear air as much as six miles away from the thunderstorm in which it originated.

In a downwind direction, hail has been found 10 miles from that part of a storm giving a radar echo; in other directions, the limit is two or three miles.

"The author of the article, A. F. Crossley, M.A., writes that on these occasions there has been a strong windshear, i.e., increase of wind with height. Consequently, the hail, which forms near the top of the thunderstorm, is carried by the upper wind away from the main body of the cloud which travels only at the speed with which the wind is blowing much lower down at 10,000 feet.

"By the time the hail has fallen to this level, it may be miles away from the storm cloud. But the ground wind blows still more slowly, so that the cloud moves faster than the wind and tries to catch up with the hail once more.

"Obviously, the distance from the thunderstorm at any particular level depends on the precise value of the wind shear and the falling speed of the hail, which in turn depends on their size.

"Mr. Crossley says, 'For supersonic aircraft considerable stresses arise in making the required turns and it is important for their design and operation to know by how much the clouds should be avoided in order to make sure of missing all hail larger than some specified size.'

"To obtain the largest likely values of displacement of the hail from a thunderstorm, Mr. Crossley assumes that hail starts falling from nearly 40,000 feet, that the wind shear is uniform and blows 100 knots faster at that height than at ground level, and that the storm as a whole travels at 25 knots.

"A striking feature in his calculation is that the horizontal momentum of the hail never allows it to slow down to the speed of the wind at any level through which it falls. His tables show that a hailstone of 1 cm. (about $\frac{3}{8}$") is displaced horizontally 1 km. (roughly $\frac{2}{3}$ miles) from the core of the storm at 11,500 m. (about 38,000 feet) and 12.5 km. (7 miles plus) by the time it has fallen to 2,800 m. (about 9,000 feet).

"For a hailstone of 4 cm. ($1\frac{1}{2}$") diameter, the displacements are 1.2 km. (about 4,000 feet) at 10,600 m. (35,000 feet) height, and 6 km. (3 miles plus) at 2,400 m. (9,200 feet) height. An 8 cm. ($3\frac{1}{4}$") hailstone is displaced 1.2 km. (about 4,000 feet) at 9,900 m. (32,500 feet) and 2.8 km. ($1\frac{3}{4}$ miles) at 4,000 m. (13,000 feet).

"Thus, the larger the hailstone, the less it is displaced into the clear air outside the storm."

(Extract from Accident Prevention Bulletin).

FIRE CREW SAFETY

Occasionally an engine is shut down during flight because of a suspected fire and fire crew are called out to inspect the engine for fire at the end of the landing run — a wise precaution and a normal part of the fire crews' duties. However, there have been several such instances where fire crews have been called upon to inspect an engine while the other engines have been left operating.

Under these conditions even the inspection of an engine is a hazardous undertaking and, if signs of fire are found, the proper operation of fire fighting equipment in the vicinity of a rotating propeller is extremely dangerous. **Captains are requested to consider the safety of the firemen and shut down the other engines on which the propeller or engine compressor air intake could endanger the fire crew.**

The Narrow Path of . . .

GOOD JUDGMENT

by

Lt. Ralph Richter

There was a time when aviator and daredevil were synonyms. A man who flew was, in the public mind, something of an oddity, a reckless gambler. Some of this old swashbuckling attitude still remains, but only as a gentle tradition, and only on the ground. The aviator of today is a professional man.

What caused the change of the aviator in the public mind from the daredevil to the professional? The answer lies in the path of good judgment. The aviator has, by keeping on this path, proven to the world that he is able to stand side by side with other professionals as one of them. He knows that the path is a narrow groove which has no edges to prevent one from wandering out. He understands that the outline is not clearly defined, but is shadowy, hazy and difficult to distinguish. Although the path is straight, he is fully conscious that it is more often than not clearer through hindsight than foresight.

Specialised training and experience help to give the skill to do the job after a decision has been made. Also through training and experience, the aviator is able to gauge his skill and know his own limitations. But the old stunt fliers had skill, too; so there is something else needed to remain within the path of good judgment besides skill alone.

Responsibility: Certainly a doctor has responsibility; so does the aviator. He always has the responsibility of his own life, of course. The pilot of an aircraft with passengers has several lives in his care, and the single-engine pilot is expected to conduct his flight in such a manner as not to endanger the safety of others. Responsibility is a sobering element that tends to keep an aviator within the path of good judgment.

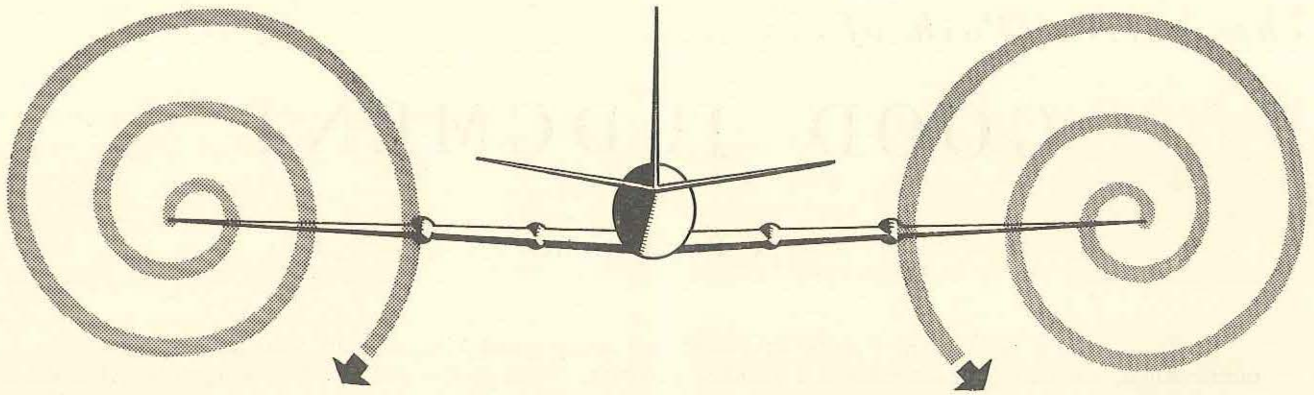
This element is not one that is suddenly thrown upon the shoulders of a young aviator. When a student has earned his medical degree, it is not because he has on some certain day become an expert in the field of medicine. It is simply that, in effect, learned men have said to him:— "We trust your good judgment now. As you continue to learn, you now have the responsibility of making your own decisions." Similarly, a new aviator is not an old pro because he may wear wings as of the date of his designation. He has merely reached a point where his decision can be trusted.

A professional cannot expect to remain on the path of good judgment for long by avoiding decisions. They must be made. An error of deliberate omission is not only cowardly, it can easily be as fatal as one of commission. Because an error in judgment which may have been embarrassing in 1927 or even 1947 can be fatal in 1961, an aviator must also have courage. Flying under a bridge is not courage. It is foolishness. Neither is it courageous to attempt a forced landing with a damaged aircraft (in military aircraft — Ed.) when the odds are stacked heavily against success. To succeed would be no more than luck. Courage is faith in one's own abilities and convictions, and the confidence to act positively upon them — positively and quickly.

A professional can never relax from his conscience when making decisions. His conscience is his personal guide. Through conscience, his training and all the elements that tend to keep him on the path of good judgment are held at their peak of efficiency. The stimulus to go again when the right decision — as it seemed — failed, is backed by the man's own conscience. He must be able to say to himself that under the same conditions and having the same information available, the decision would still be the same.

Because the aircraft of the future will not be any slower or any less mechanically complicated, the professional aviator cannot afford to have a conscience that is satisfied with decisions which only require him to remain in the shadow or hazy portion of the path. He must be clearly within its narrow boundaries. As a professional, he must continue to study and train. And he must realise that, for him, the path of good judgment is not only narrow, it is continuously narrowing.

(Extract from "Approach")



WINGTIP VORTICES

(Extract from "Aerospace Safety" — U.S.A.F.)

"Most pilots have at least a passing acquaintance with the rock and roll in which an airplane engages when operated in air very recently occupied by another moving aircraft. In a well-executed 360- or 720-degree turn, it is common to encounter turbulence created by your own aircraft. Sometimes it is a slight ripple. At other times it may manifest itself quite vigorously and result in a need for considerable control deflection by the pilot.

"In the past, the term 'prop wash' was commonly applied to this situation. Now we know that, although the propeller is responsible for much of this roughness, a greater portion of the turbulence is generated by passage of air over and around the wingtips, resulting in a highly disturbed condition identified as a vortex at each tip.

"It is known that the severity of the gusts encountered is directly proportional to the loading of the wing and inversely proportional to the speed and wing span. Thus, a heavy jet transport, for example, leaves the most severe turbulence behind it while flying at slow operational speeds — immediately after take-off or just before landing. It is possible for the motion of this twisting air to be severe enough that an aircraft entering its path will have insufficient control to overcome its effects. Further, it is possible for the loads which the turbulence will impose to be above those for which the aircraft was designed. Therefore, an airplane may be thrown into an attitude from which recovery cannot be made, if insufficient altitude is available, or it may suffer structural damage which will make control impossible.

"Since a slow flying aircraft leaves the most violent wake, the area around a runway is the most likely place to encounter this turbulence at its greatest severity. The hazard is increased by the necessity for staying within rather narrow confines when departing or arriving at an airport and a particular runway. A following or crossing aircraft which is landing or taking off is flying at low altitude and relatively slow airspeed and may be inadvertently subjected to these dangerous forces.

"There is only one solution to the problem: KEEP YOUR DISTANCE. Horizontal and vertical air movement will aid the dissipation of vortex-generated turbulence. On a rough, windy day it will disappear more rapidly than on a smooth, calm day. Fly if possible on the upwind side of the track of any aircraft ahead of you. Recent investigation into the problem of vortex turbulence generated by helicopters reveals that a similar condition to that of fixed-wing aircraft exists. The higher the 'disc loading' of the helicopter — a term analogous to 'wing loading' on fixed-wing aircraft — the more severe the forces in its vortices. Stay above the flight path of a helicopter to avoid its turbulence. When you are 'cleared for take-off' by a control tower, and suspect that wake turbulence exists, you have the prerogative to request additional delay. This request should be made prior to taxying into position on the runway.

"You cannot see this phenomenon which has been described as an invisible, horizontal tornado, but it is there!"

COMMENT

In 1959 a Piper PA22, flying at approximately 2,000 feet in excellent weather near Dover, Delaware, U.S.A., was subjected to aerodynamic overloads which resulted in failure of the primary structure due to downward acting forces. The pilot, who was the only occupant, was killed. An extensive report prepared by the Civil Aeronautics Board concluded that the accident was caused by structural failure resulting from excessive airloads created by vortex turbulence in the wake of a large aircraft. The Board's report was summarised in Aviation Safety Digest No. 21, published in March, 1961.

In their analysis of the evidence gathered during a searching investigation of this accident the Civil Aeronautics Board expressed the view that the dangers of wake or vortex turbulence is still unknown to many pilots. Engineering studies clearly indicated that vortex turbulence can be great enough to destroy light aircraft, although vortices of such destructive magnitude are generally associated with the heavier types.

The tests and engineering calculations carried out during the investigation indicated that structural failure of a light aircraft can be anticipated upon penetration of the vortices behind heavy civil transports or similar military aircraft due to the large and sudden reversal of forces encountered when traversing the vortices. When an aircraft flies squarely through a pair of vortices at their diameters the loads imposed are up-down-down and up, in that order. The total distance from entering one vortex to leaving its mate is short and would be traversed by a 120 m.p.h. aircraft in less than two seconds. The initial abrupt and powerful up current would normally be met by application of down elevator. Then, within a fraction of a second, a sharp reversal of load occurs, followed by a further reversal after another brief interval.

Pilot reaction during these reversals can only be surmised. If the elevator control were moved forward upon encountering the first up draught, as would be instinctive, the forces which followed from the subsequent reversals might well be intensified. This secondary shock can be severe enough to destroy light civil aircraft even though they are designed to accepted standards for normal category flight.

In the course of a study on the effect of wake and vortices, American aircraft manufacturers found that a light aircraft flying at 100 m.p.h., penetrating the vortices of a large jet aircraft at 90 degrees and one mile behind, recorded accelerations of plus 2.5 "g's" and minus 3.5 "g's". Other aircraft, operating at speeds higher than 100 m.p.h., measured structural loads as high 9 "g's" in the wake of large jet aircraft. It was also established that the severe turbulence is created predominantly by wing tip vortices and the energy produced is not related to the type of power plant installed in the heavy aircraft.

Experiments conducted with aircraft upon which smoke generators had been installed at the wing tips showed that the energy of the vortex does not weaken appreciably for 35 seconds. The highest velocity within the vortices occurred 33 seconds after their origin. The velocities then gradually decreased for 60 seconds which was the longest interval measured during the experiments, but the vortex still retained a relatively large amount of circulation after this time. In relatively still air the turbulence can persist for several minutes. Theoretical calculations, based on the experiments, indicate that the vortices may still be present after some thirty minutes.

From these figures it can be seen that the peak turbulence activity can be approximately $1\frac{1}{2}$ miles behind an aircraft cruising at 180 m.p.h. and that a relatively large circulatory velocity will persist for at least three miles astern. A large jet aircraft climbing at 420 m.p.h. will leave its peak velocity $3\frac{1}{2}$ miles astern, whilst a relatively high degree of turbulence will exist for some seven miles. The conclusions drawn, from the experiments, was that negative load factors higher than the ultimate design requirements for normal category private aircraft can reasonably be expected in the wake of modern transport aircraft. If the wake is penetrated whilst executing an evasive manoeuvre, then load factors greatly in excess of design values could be induced.

These compact and fast spinning air masses, stretching back from each wing tip, remain close together and parallel, although they may sometimes undulate slightly as a pair. They gradually weaken and die but can remain highly dangerous until their birthplace is far out of sight.

Because the vortices are neither thick nor wide the probability of a chance encounter whilst conforming to the practices of good airmanship is not great. Although we have no record of any accident or serious incident having arisen from vortex turbulence in this country we do have reports of incidents where pilots have encountered the hazard.

It is of interest to note that our early records of some thirty years ago refer to an aircraft being affected by the slipstream of another. Elsewhere in this issue also, we have invited attention to the hazard created by the slipstream of a taxying aircraft. Another recent report dealt with an incident in which a pilot engaged on agricultural operations was forced to take avoiding action when he encountered the vortices in the wake of military aircraft engaged on low level exercises.

It is a safe and practical generalisation that the bigger an aircraft is, the more violent and long-lived will be the vortex turbulence in its wake. The severity of the forces which are felt by any aircraft which penetrates this wake will depend largely on the speed of entry. Consequently, if the circumstances are such that crossing the path of another aircraft cannot be avoided it is best to ensure that you are at least 100 feet higher or lower, preferably higher, and to slow down. Where vortex turbulence is encountered the best procedure is to ignore altitude changes and not use elevator control.

It is a safe working rule to allow at least two minutes before crossing the path of another aircraft and then to do so at a higher level. The wisest plan of all is to avoid places and altitudes traversed by heavy transport aircraft.

YOUR DECISION

by Col. C. J. Cochrane, Dir., Flying Safety, U.S.A.F.

This will, we hope, be a thought piece. If it achieves its goal, you will read it, consider what you would have done and apply the results to future decisions.

One thing more. Visualise yourself as the pilot in command in each case. As each situation is presented, decide what you would have done — not should have, necessarily, but would have — then go on and see what happened in the actual case.

● You are pilot of a twin-engine, radar-equipped, transport-type aircraft. You are on the east coast preparing to depart for your home base on the west coast. You have been out all week. It's Friday morning. You and your passengers are all anxious to get home. Several of the passengers have indicated that they hope you can make it all the way. There is a line squall in the midwest, followed by a cold front. Both extend from border to border.

In this case the pilot planned and flew a flight to an airport short of the cold front, RON'd and cleared out the next morning.

● The pilot of a light personnel transport planned a flight over mountainous terrain. The weather was unfavourable — severe turbulence and thunderstorms. He had no anti-icing or de-icing equipment. He was well qualified in the aircraft. There was a possibility of getting through VFR.

In this case the pilot decided to go. A routine position report over an Omni station along his route was the last ever heard from him or his passengers.

● A pair of pilots checked weather. The planned route of flight would take them through a severe weather warning area. Thunderstorms and tornadoes existed. Conditions were not expected to improve for several hours.

They flew their flight planned route; that is, they did until they got into the area of bad weather, then something happened. Both were killed in the crash.

● The crew of a twin-engine transport checked weather during a refuelling stop at Albuquerque. Weather was clear, except for roll clouds over the mountains and a 2,000-foot ceiling at destination. Severe turbulence was forecast at all altitudes from the surface to over 20,000 feet. Ground stations along the route were reporting surface winds up to 50 knots.

This crew and all passengers spent the night in Albuquerque.

● Forty passengers were on a four-engine transport due to arrive at destination within a severe weather warning area before noon. Indications were that it would be possible to vector around the areas of turbulent weather and get in before the weather got too bad.

This trip operated, but not quite to planned destination. Short of destination the pilot could be heard calling for routing to a base north of the intended landing area because of turbulence that was being encountered. He made it.

On the basis of what you have read so far, it might be concluded that this was no day to fly. Actually, not so. Many flights were made. Most, as is usually the case, operated uneventfully. Possibly several even operated in the severe weather warning area without incident.

This brings us to the crux of our story. There is a point at which the pilot must make a decision. This we could depict as a balance point. Sometimes — a 200 mag drop, binding controls, high EGT on start — the decision is simple. Sometimes — mag drop of 70 instead of 65 maximum, a slight stiffness in the controls, EGT just slightly above normal — the decision isn't so simple. After all, we only have to live with our own conscience in such cases. If we've just been called from the office to fly a part to another base, the slight stiffness may cause an abort; if we've delivered a part and this is the going home leg, the stiffness would probably have to be more pronounced. The EGT decision is going to be affected the same way.

Now let's go back to the real examples we used in the beginning. Except for one instance, all these events happened on the same Friday. Are homeward bound crews and passengers a little more prone to press on a Friday than on, say Tuesday or Wednesday?

Let's consider the light utility plane pilot. A crew from his same base had crashed and killed themselves not six months before trying to fly VFR in marginal weather. Are pilots egotists? Do they believe the bad things always happen to the other guy?

And the two pilots killed in the crash when they attempted flight through the thunderstorm area. How bad was the weather, really; was that what got them, or did they experience some other emergency that, coupled with the weather, was too much?

The pilot with the 40 passengers found out the weather was bad. He found out by flying into the area, then calling for help to find him a route out of it and a destination where he could land.

What causes one pilot to go — another to stop; or the same pilot to go one time, when, another time, he wouldn't under the same set of conditions? Do you consider facts, then base your decision on facts alone — no emotion, no whim, no outside pressure or influence?

(Extract from "Aerospace Safety")

Check Compass Serviceability!

Shortly after setting course on a charter flight the pilot of a Cessna 175 noticed that there was a considerable difference in the heading indicated by the standard magnetic compass in comparison with the heading registered by the magnesyn compass. In-flight checks made against known landmarks established that the magnesyn compass was indicating the correct heading and the flight was completed without further incident.

Subsequent ground checks revealed that the magnetic compass was in error by 40 to 60 degrees on all headings, so the compass was removed from service. Investigation by an appropriate overhaul organisation established that the compass card pivot cups had worn to the extent that the card could strike the lubber line.

Similar defects have been experienced in magnetic compasses and were the subject of a circular letter to light aircraft owners some two years ago. In this letter owners of aircraft in which the Airpath Type C2400 magnetic compass is installed were advised to inspect the compass immediately and at regular intervals for signs which could be indicative of imminent failure. Flakes of aluminium sediment and an iridescent appearance in the liquid, or the presence of a shiny ring showing round the lower edge of the compass card, are the earliest signs of failure that can be detected during routine inspections. If either of these are evident the unit should be examined in an appropriate workshop to ensure that the compass card is secured correctly, is properly balanced and that adequate clearance exists between the card and the lubber line.

The pivot cup serves two purposes in the magnetic compass. It acts as a guide to lead the compass card pivot into the jewel cup which supports the card and also as a retainer for the jewel, which is spring loaded from below. The normal diameter of the hole in the pivot cup is one-sixteenth of an inch, but on the compasses that have been found defective the wear had progressed to the extent that the pivot had vibrated out of the jewel and had danced round inside the concave upper surface of the cup. This results in an unsteady compass card and permits the edge of the card, below the graduations, to strike against the lubber line. Unfortunately the extent of the wear in the pivot cups cannot be gauged without dismantling the compass. For this reason it is important that the compass be closely inspected at regular intervals.

Experience has shown that wear in the pivot cup is only the immediate reason for the compass defect and it is believed that excessive vibration brought about by deterioration of the anti-vibration mounts is the primary cause of the trouble. If, at the time the compass is overhauled, excessive wear is evident in the pivot cups, the overhauling agent should advise the owners to examine the anti-vibration mounts and replace them if there is any doubt regarding their serviceability.

The magnetic compass is normally one of the most reliable and trouble free instruments in an aircraft and for this reason is not always paid the respect that is due to it during routine inspections. If careful pre-flight inspection of the compass does not reveal any of the signs mentioned above it is unlikely that a compass will give trouble during the course of a flight.

Lower than Low . . .

INSTRUMENT APPROACH

JACKSONVILLE, FLORIDA

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

At 0938, on 2nd December, 1961, a DC7B descended into trees about eight-tenths of a mile short of the runway during a surveillance radar approach at Imeson Airport, Jacksonville, Florida. The aircraft although substantially damaged was climbed and circled to land safely with a portion of the left flap torn off. There were no injuries to any of the 15 passengers or to any of the five crew members.

FLIGHT

The aircraft was engaged on a scheduled passenger flight from Miami, Florida, to Cincinnati, Ohio, with intermediate stops including Jacksonville, Florida.

The flight had been routine since take-off from Miami and at 0928 hours the pilot contacted Jacksonville Approach Control and was cleared to Shiloh Intersection, to maintain 4000 feet and to depart Shiloh on a heading of 270 degrees for a radar vector to the ILS Approach course for runway 5. Jacksonville weather was given as "clear, visibility three miles; ground fog and smoke; wind calm."

At this time the flight offered to accept radar vectoring for a straight-in approach to runway 30 to expedite its landing. The first officer made the approach occupying the right seat and was instructed to turn to a heading of 340 degrees and descend to 1,500 feet. The flight complied, maintaining a speed of 150 knots. The controller gave headings of 340 and then 320 degrees to bring the flight to the extended centreline of runway 30. As the flight reached specific distances from the runway it was advised of the recommended altitudes. These were, 5 miles — 1,500 feet; 4 miles — 1,200 feet; 3 miles — 900 feet; and 2 miles — 600 feet. These recommendations were received. After the flight passed the three-mile point, the following advisory was given by the radar controller. "Drifting slightly left of course, right to 305, 305, two miles from end of runway, altitude should be 600 feet. Still right* of course, right to 310. Considerably left of course. Right to 315. Further right to 320. Considerably left of course and 1½ miles from end of runway, approaching ASR minimums, you should have runway in sight at this time.

(All times herein are Eastern Standard)

The ASR minimums for this approach are 400 feet altitude and one mile visibility. According to crew testimony, the flight was slightly above the recommended altitudes up to and including the two-mile position. At approximately this point dense smoke from a paper mill, mixed with ground fog, was encountered. The crew testified that they entered this smoke and fog at an altitude of about 680 feet.

The aircraft was not levelled off at the ASR minimum altitude and continued descending prematurely until the tops of trees were struck. The captain took control immediately before striking the trees, applied full power, and pulled the aircraft up. There were no injuries to any of the 20 occupants. A portion of the left flap was torn loose by impact and remained in the treetops. Loss of power and increase in oil temperature of No. 2 engine was followed by vibration and prompted feathering of the propeller. The pilot circled the airport visually and landed on runway 9. The crew requested and received from the tower the altimeter setting of 30.36, the same setting as given earlier during the approach.

* The controller testified that the word "right" should have been "left" and the crew testified that the error was not significant.

The trees at point of impact are approximately 4,000 feet from the approach end of runway 30 and approximately 1,300 feet to the left of the extended centreline of that runway. The heading from the point of impact to the approach end of runway 30 is 320 degrees. The published altitude of the airport is 52 feet m.s.l.; the altitude of the approach end of runway 30 is 37 m.s.l.; and the treetops were struck at a point 56 feet m.s.l., or 19 feet above the altitude of the approach end of the runway. A line of trees slightly higher than those struck extended across the direct approach to runway 30 about 1,000 feet farther on.

Testimony by the flight crew indicated that:

(a) They saw portions of the airport shortly before entering an area of dense smoke and fog across the approach path.

(b) They entered this smoke at about 600-700 feet altitude at a rate of descent of about 600 feet per minute.

(c) The two altimeters were not cross checked during the approach, as required by company procedure.

(d) The captain was not looking at his altimeter because he expected to break out into the clear at any second. The first officer and the flight engineer could not recall any altimeter readings.

Altimeter malfunctioning was suggested by the nature of the accident and by the reported erratic behaviour of the altimeters during the ferry flight of the aircraft from Jacksonville to Atlanta on December 3rd, 1961. Accordingly, this possibility was explored and it was found that none of the six pilot log sheets preceding this flight carried any suggestion of altimeter trouble and both altimeters indicated properly upon leaving Miami and upon arriving at and leaving West Palm Beach. In addition, several tests conducted after the accident revealed that both altimeters were functioning within acceptable tolerances.

Both of the aircraft's autosyn compasses were tested following the accident and neither showed any significant irregularity. The maintenance of the aircraft had been satisfactory, according to company records.

The possibility of radar malfunctioning was raised and this matter was also explored. Approximately three hours after the accident, and in accordance with established procedure, the FAA flight-checked the Jacksonville ASR facility. Results indicated that the radar functioned properly, well within tolerances on both azimuth and range (direction and distance) during four test approaches, three to runway 30 and one to runway 9. No other incoming flight at or about the time of this accident reported any difficulty with any communication or navigational facility.

ANALYSIS

Investigation of this accident revealed no defect in the aircraft or in any of its components or in any of the ground services and equipment utilised during the approach. The responsibility for the accident must therefore be in the manner in which the aircraft was flown.

Apparently both pilots ignored the altimeters after the aircraft entered the smoke. The altimeter is the only source of altitude information available during this type of instrument approach because the radar controller does not have the means of determining altitude information.

Not only was the aircraft not levelled off at the 400-foot minimum flight level but its rate of descent must have been increased. There is no other way to account for the great loss of altitude in such a relatively short distance. According to the captain, when two miles from the end of the runway and at an altitude of about 680 feet the smoke area was entered. The distance from that point to the point of impact, as flown, is about 8,200 feet. At the testified speed of 150 knots, an average rate of descent of about 1,200 feet per minute must have prevailed. The aircraft was also markedly to the left of course just before impact despite continuing advisories to that effect.

The Board believes that the presence of smoke in the impact area may not be considered as extenuating because descent through the smoke was continued unnecessarily. The Board further believes that there was no misunderstanding by the crews as to the type of approach they undertook.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the pilot's improper execution of an instrument approach.

STUCK MIKE BUTTON

A case recently was reported in which all communication reception was lost because a microphone button had stuck down. When this happens, the symptom is complete silence in all headsets since the mike button being down mutes all receivers on the panel to which the microphone is selected. Futhermore, since there is no reception at all, no background noise will be heard even when the squelch is turned off.

The fastest way to isolate the offending microphone is to immediately turn all cockpit mike selector buttons to intercom, then try them, one at a time, on the desired transmitter.

(Flight Safety Foundation)

SPIN AT LOW LEVEL

Agricultural Piper, Marlborough, N.Z.

(summary based on the Report of the Air Department, N.Z.)

During a top-dressing operation a Piper PA18A was seen to enter a spin and in the initial stages of recovery it struck the steep downward slope of the near side of a hill. Fire broke out after impact and the pilot was fatally injured.

THE FLIGHT

At 1610 hours on 25th February, 1962, the pilot arrived at the airstrip on the Farnell property located on Mount Riley Road, Okaramio, Marlborough. He was briefed at the strip by his senior supervising pilot and began top-dressing operations at 0620 hours. The operation continued until 0815 hours when the pilot transferred his operations to another adjacent property while the supervising pilot continued with the original operation in order that both pilots would finish their respective jobs at about the same time.

At about 0845 hours, the pilot took-off on the last flight of the contract with a hopper load of 5 cwt., the remainder of the bulk supply of superphosphate.

INVESTIGATION

When the accident occurred the pilot had just been sowing the steeply sloping face of a hill which rose to a height of some 600 feet above the level of the strip. The position of the strip was such that the strip party could see the aircraft as it lined up for each top-dressing run across the face of the slope and until such time as it disappeared from sight behind the edge of the hill. The sowing technique adopted involved making a series of parallel runs across the face of the hill, the first run having been started at the base of the hill and following ones at a progressively higher level. At the end of each run the pilot turned to the left away from the face of the slope.

This technique was followed, i.e., turning away from the slope at the end of each sowing run, until shortly before the accident when the aircraft was seen to appear over the crest of the hill at its highest point and to make a topdressing run down the line of the ridge in a direction opposite to that of the former runs. This procedure must have involved making a right-hand climbing turn at the end of the previous run, a manoeuvre which can be understood when it is explained that the hill face being topdressed was roughly pyramidal in shape. After the particular run described, the pilot reverted to his former technique until the last flight when it appears a right-hand turn was made because the aircraft was again seen to appear over the crest of the highest point of the hill.

On this occasion it was seen to be flying at a high angle of attack, the entire underside of the fuselage being clearly visible to one witness who was standing on the strip. Immediately after the aircraft crossed the crest the nose dropped and the aircraft went into a left-hand spin, completing almost one full turn before it disappeared from the view of the witness. A nearby spur prevented the witness from seeing the actual impact with the ground.

It was equally clear, however, that when the aircraft struck the ground it had recovered from the left-hand spin. The wing tips were virtually undamaged, the undercarriage had been forced upward and rearward, and the clear impression of the bottom of the hopper control box on the steep slope indicated a direct downward strike. This evidence was fully consistent with the aircraft having squashed bodily onto the slope at a comparatively high rate of descent in such a manner as to suggest that the pilot had made an effort to recover from the dive after auto-rotation in the spin had ceased.

The condition of the propeller and its mode of detachment were consistent with some power being delivered at the moment of impact. It is unlikely that the pilot would have left the throttle open while the spin was progressing, but it is quite likely that he opened it at some stage in the recovery in a vain effort to get the nose up.

The immediate cause of the accident is clearly attributable to an involuntary spin at a height which precluded complete recovery before the aircraft struck the ground.

The pilot was inexperienced in total flying and very inexperienced in agricultural flying. The operation in which he was engaged was quite within his capability provided that he conformed to the procedure of flying a series of parallel runs, starting from the same end, across the slope, and of turning away from the hill at the end of each run. It is evident that he departed from that procedure on two occasions. On a flight a short time before the accident he must have turned on to a reciprocal heading over the top of the hill to make a run down the steeply sloping fence line which marked one end of the property being dressed. Such a run would be made to "fill in the sowing gaps" at the beginning of each parallel run. In considering this particular manoeuvre it is obvious that at the end of the dressing run across the slope the aircraft would not have sufficient reserve performance to justify a climbing turn over the crest of the hill. On the first occasion the pilot succeeded, but on the second it is apparent that he stalled in the climbing turn over the crest and the aircraft spun as a consequence. Absence of superphosphate in the hopper suggests that he may not have intended to make a run down the fence line to fill in the sowing gaps; he may well have been attempting to take a short cut back to the strip. His reason for making the final climbing turn must remain conjectural.

Making a climbing turn onto a reciprocal heading has been the cause of many accidents in the past, even when the aircraft have been engaged in top-dressing operations over comparatively "easy" country. Sound judgment is always needed in such manoeuvres and that judgment must be even sounder in steep, hilly country where, for one thing, absence of a true horizon to act as a plane of reference for making a turn is a feature. The judgment required to make a turn of the character apparent in this case could only be acquired from a good deal of experience — which the pilot did not have. This accident again points up the necessity for specialised training in agricultural flying techniques.

CAUSE

The accident was caused by loss of control at a height which precluded recovery before the aircraft struck the ground.

PROPELLER HANDLING

Agricultural Aircraft

Recent propeller defects and one failure associated with a fatal accident have again drawn attention to the probability of propeller mishandling during ground manoeuvring of agricultural aircraft.

Many agricultural operators make a feature of fast tight turns during ground manoeuvring, often with high propeller R.P.M. A fast rate of turn induces severe gyroscopic loads on the propeller and it is possible that severe ground manoeuvres could stress the propeller beyond its design limits and result in fatigue failure.

Recent cracking of blade clamps on Hartzell constant speed propellers and hubs of McCauley propellers all show characteristic fatigue marking.

Agricultural aircraft on the ground have been observed to turn through 180° in as little as $2\frac{1}{2}$ seconds, i.e., a mean rate of turn of 72° per second. The instantaneous maximum rate of turn is probably about 90° per second. This is more than double the maximum rate of turn in the air under Normal Category manoeuvring limitations and such severe ground handling is considered the probable cause of fatigue cracking.

Any mechanical equipment will suffer when operated outside its design limitations. Pilots and ground staff are warned of the dangers inherent in excessively severe ground manoeuvring and the following recommendations are made.

All turns on the ground should be made slowly with a large radius and with the lowest necessary propeller R.P.M. As a general guide it is recommended that 180° turns should never be made in less than ten seconds.

Note that in many cases of propeller cracking warning has been given by increased vibration. Any increase of propeller vibration should be cause for immediate special inspection. If in flight, power and R.P.M. should be reduced as far as possible and rates of turn should be as low as possible so as to reduce the gyroscopic loading.

Note also that fatigue cracking of Hartzell propeller blade clamps usually initiates from the inside and there may be very little external indication prior to final failure. If these clamps are suspect for any reason the only satisfactory means of crack inspection is by dismantling at an approved propeller overhaul shop for complete crack detection of the clamps.

(New Zealand Civil Aviation Information Circular)

Collision with Power Lines

Agricultural DH. 82

An agricultural pilot was detailed to spray a tobacco crop on a property in Victoria. Accordingly he flew a DH.82 aircraft to the property and on his arirval decided to commence spraying operations the following morning. He then made an inspection from the ground of the area to be sprayed and particularly noted the existence of power lines situated along a road on the western boundary of the area. He assumed the power lines continued along the road in a northerly direction.

On the following morning an early start was made and the aircraft was taken into the air at 0515 hours. Before commencing spraying two and a half circuits were made over the property at a height of 100 feet in order to orientate the obstructions and to decide the direction in which the spraying runs would be made. The pilot concentrated his attention on the power lines he had observed from the ground the previous day but he failed to notice that they traversed the field immediately to the north of the tobacco crop.

He decided to make the spraying runs into the south and the approach to his first run was commenced from a point approximately ¼ mile north of the area to be sprayed. When some 200 feet from the edge of the tobacco crop, with the pilot's attenton concentrated on the marker ahead, the aircraft collided with the previously unseen power lines, and, after skidding along the lines for 300 feet, fell to the ground and came to rest in an inverted position. The aircraft was substantially damaged but the pilot fortunately escaped injury.

Whilst the pilot complied with the requirement that an aerial survey be carried out immediately prior to commencing agricultural operations, the survey was inadequate in that it did not cover the approaches to the area to be treated. The accident would probably not have occurred if a more extensive and careful survey had been completed. The lesson should be obvious to all.

Hangar Fire

The aircraft was undergoing a major change in seating arrangement. This involved removal of the linoleum from the buffet floor. The night-shift had applied a brand solvent and acetone to the floor in an effort to remove all linoleum and adhesive. Two hours later the day crew began work. One mechanic entered the plane, remarked that the fumes were too strong for him, and left. About 45 minutes after the crew had begun work one of the men near the centre of the cabin saw out of the corner of his eye, a spark at an extension cord junction box. A ball of fire formed on the floor nearby. Someone alerted those in the plane to the danger. One man spied the small flame, and turned to get a fire extinguisher. When he turned back towards the fire, it had grown considerably and was advancing toward him. All the men in the plane left it quickly, yet smoke was pouring out the cockpit door before everyone had cleared the plane.

The city fire service, after arriving at the hangar had to wait about seven minutes for the hangar doors to be open before they could enter to deal with the fire.

The entire aircraft interior was gutted. There was extensive structural damage.

Investigators concluded that the initial fuel for the fire was the volatile cleaning solvent vapours which filled the cabin. The ignition source is believed to have been an electrical spark.

FOR YOUR SAFETY

Use flammable solvents only in accordance with a published procedure.

Follow all recommended cautions.

Provide adequate ventilation.

Use electrical equipment suitable for use in hazardous areas.

Be sure it is in safe condition.

(Flight Safety Focus)