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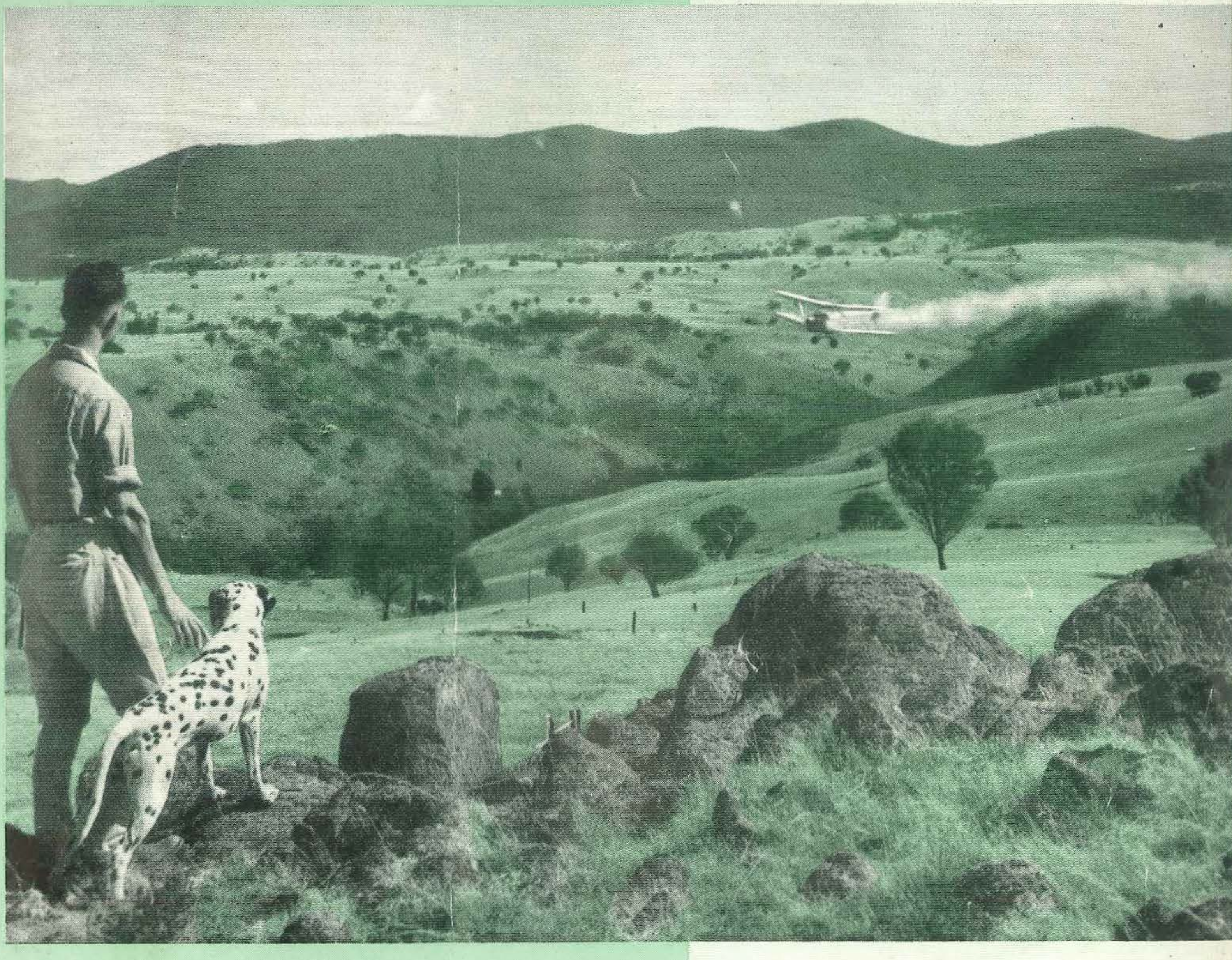
COMMONWEALTH OF AUSTRALIA

Aviation Safety DIGEST



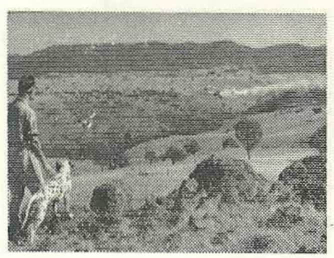
NO. 21. MARCH, 1960

AVIATION SAFETY DIGEST

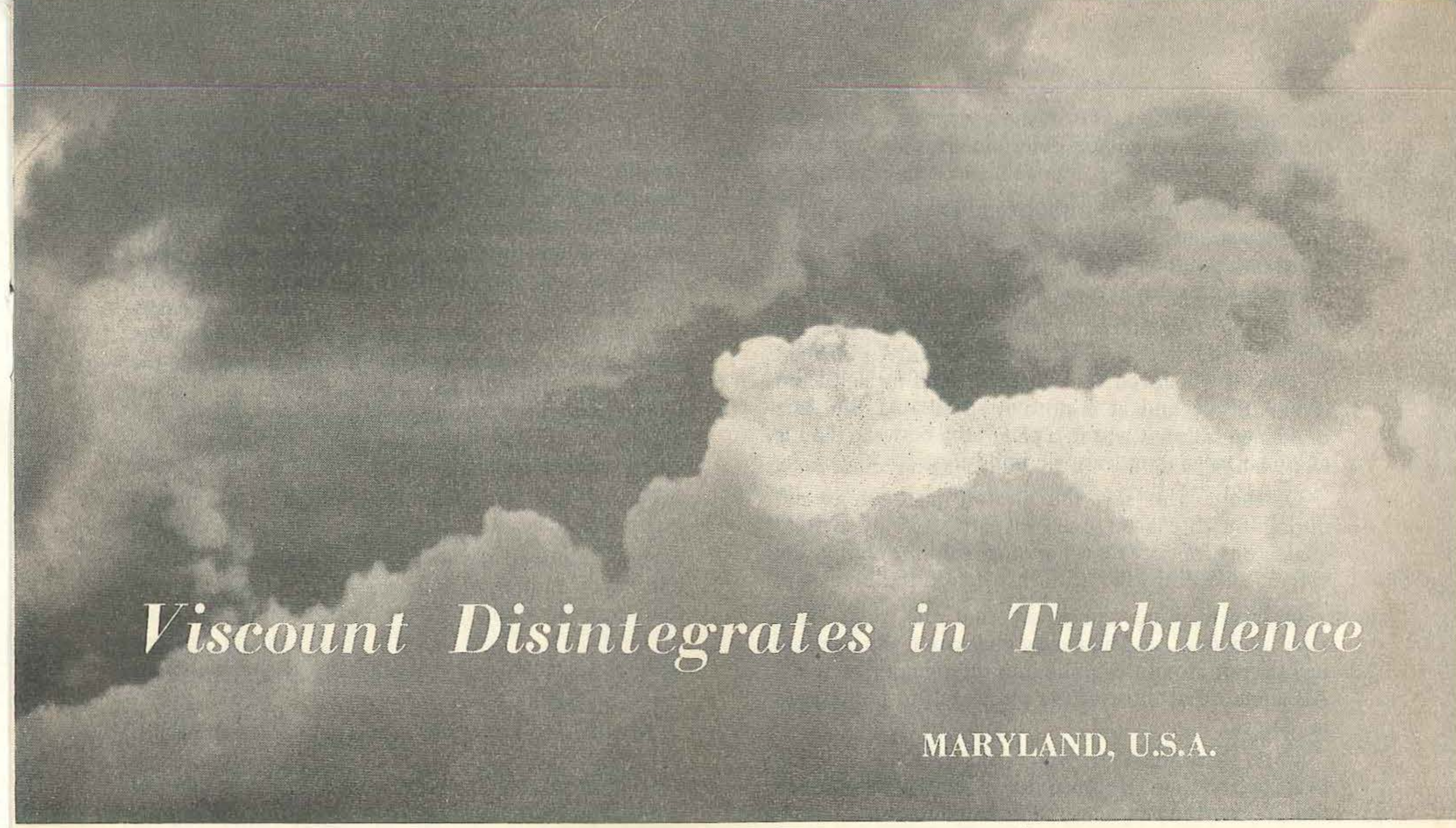
No. 21 **MARCH, 1960**

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

Contents



A DH.82 aircraft spreading superphosphate on "Huntley," a property near Canberra, A.C.T. This is a typical example of the type of pastures involved in aerial agricultural operations in New South Wales. (Australian News and Information Bureau.)



Viscount Disintegrates in Turbulence

MARYLAND, U.S.A.

(Summary based on report of the Civil Aeronautics Board)
(All times herein U.S.A. Eastern Standard)

About 1613 hours on May 12, 1959, a Viscount 745D disintegrated in flight over an area near Chase, Maryland. All occupants, four crew and twenty-seven passengers, were killed and the aircraft destroyed.

The Board believes that the in flight disintegration was caused by aerodynamic loads imposed on the aircraft which exceeded its design strength and which were generated by an excessive airspeed combined with turbulence and manoeuvring loads. The Board concludes that there was a loss of control in extreme turbulence in the area of thunderstorms and, after a steep involuntary descent during the subsequent recovery, loads beyond the design strength of the aircraft occurred.

Following the preparations for the flight, the company despatch had received additional weather information affecting the route of the flight. This information was the first that delineated the location of a potential squall line along the route and indicated that the severity of thunderstorms along the line was increasing. Although it was known that the flight did not have assistance of operable radar, no action was taken to ensure that the flight had received this weather information. The Board considers that this information would have been valuable to the flight.

INVESTIGATION

The aircraft, Flight 75, was engaged on a scheduled flight from La Guardia Field, New York, to Atlanta, Georgia.

The aircraft taxied from the terminal at 1520 hours and, whilst taxying, received an instrument clearance according to an instrument flight rules flight plan filed earlier. The airborne weather radar was inoperative, however, it was not a required item under existing regulations or company policy.

At 1529 hours, a normal take-off from Runway 22 was observed. Executing the clearance, the flight made numerous radio communications in the New York area and proceeded uneventfully to its assigned cruising altitude, 14,000 feet, and on to the assigned airway, Victor 3. Regular position reports were made as the flight progressed.

At 1602 the flight contacted the Washington Centre. It reported that it was over Westchester on the hour, 1600, at 14,000 feet, estimating Westminster at 1617, with Herndon next. In the same message it advised, ". . . ah, we've got a pretty good string of thunderstorms along that course . . . ah, if we could stay in the clear and stay a little bit south of Westminster, is that OK with you?" The centre controller replied, "Capital 75, that'll be all right and report passing Westminster." The flight acknowledged. At 1610 the flight advised, "Ah, Washington Centre, this is Capital 75, were reduced to one seven zero knots account rough air." This was the last message from the flight on the centre recorders and the last which could be determined as having been made.

More than 100 eye-witnesses to the accident were interviewed and most provided written accounts of their observations.

According to the evidence, just prior to the disintegration, the aircraft was flying south-west at an altitude estimated as between 3,000 and 7,000 feet. A majority believed it was flying in a straight and level attitude and at a normal speed. At the time of disintegration it was in a clear area between clouds and near large thunderstorm build-ups.

Of those who saw the aircraft just before and during the break-up one was attracted by a loud engine or propeller noise, another said the sound was surging. Several saw a fire just before the break-up.

Observers were consistent that the right wing separated first, and instantly thereafter the remaining aircraft structure broke into three major sections. All agreed that most of the pieces fell to the ground in flames.

From those witnesses who could relate the accident to a specific time reference it was reliably determined that it occurred very close to 1613 hours.

Since most who saw the aircraft break-up estimated it was between 3,000 and 7,000 feet when it disintegrated instead of 14,000 feet, the assigned and last reported altitude, a flight test was made to determine the approximate altitude. A Viscount was flown several times along the probable flight course at different altitudes from 3,000 to 14,000 feet while 11 eyewitnesses watched from their original positions. Each designated the pass on which the altitude of the test plane was closest to that of Flight 75 when it disintegrated. The result averaged 5,500 feet.

The main wreckage was located about two miles north-east of Martin Airport near Chase, Maryland. The area is 49 nautical miles from the Westchester omni on a magnetic heading of 236 degrees. The heaviest portions of structure were found concentrated in a localised area showing an instantaneous break-up of most of the aircraft, although many lighter and smaller pieces were drifted by north-west winds and deposited along a south-east path about 2½ miles long.

At 1600 hours a cold front existed along a line from Philadelphia to Baltimore to near Gordonsville, Virginia. Regional forecasts issued by the Weather Bureau in Washington at 0700 and 1300 hours and the area forecast issued by the Weather Bureau at Idlewild at 1400 drew attention to the possibility of locally severe thunderstorms and extreme turbulence associated with the front. The front was forecast to be virtually stationary. The 1400 hours area forecast also stated there was the possibility of a squall development in advance of the front.

At 1415 hours the Idlewild Weather Bureau office issued the following flash advisory: "Line of scattered thunderstorm activity near Martinsburg-Harrisburg-Poughkeepsie north-eastward is moving eastward about 20 knots accompanied by severe turbulence and conditions locally below 1,000, visibility 2 miles. This line will move to near Providence-New York City-Philadelphia by 1800, increasing in intensity during afternoon. Valid until 1815." The company meteorologist located in Washington marked off the areas covered by the advisory on a blackboard chart located on one wall of the despatch office. The advisory was also available on the teletypes at the despatch sectors positions in the office.

During the afternoon radar reports were issued about hourly from Andrews A.F.B. weather. These reports described the locations of the thunderstorms and indicated they were increasing in intensity during the afternoon along the New York-Washington route of Flight 75. These reports were also on teletype machines located in the company despatch at the sector positions.

About 1548 hours the cold front passed the Baltimore-Chase area. It was indicated by a pronounced wind shift in about two minutes, a pressure jump of .08 inches of mercury in 20 minutes, and wind gusts to about 45 knots.

According to the Civil Air Regulations and the Company Operations Manual, despatch may cancel or divert a flight on the basis of existent or anticipated adverse weather conditions. The captain of a flight has this authority and under emergency conditions may take such action as he considers necessary in the interest of a safe operation. Despatch is also required to furnish the en route pilot any additional available information concerning meteorological conditions which may affect the safety of a flight.

No action was taken by despatch to furnish the flash advisory or radar information to Flight 75. Despatch did not know if the captain had received the advisory prior to departure. It was stated by despatch personnel that they believed the flash advisory indicated improved conditions over those previously forecast and that all of the weather data indicated the thunderstorms were scattered, thus circumnavigable.

Following the accident a study of the weather conditions prevailing in the accident area at the time of the accident was made by a U.S. Weather Bureau research meteorologist. The results of this study showed there were large rapidly developing thunderstorms in the vicinity of Martin Airport, located about 2½ miles south-west of the accident area. Utilising several techniques it was also determined that extreme turbulence most probably existed at 14,000 feet in the thunderstorm cells and areas around them. It was also shown that extreme turbulence may exist not only in the thunderstorm cell but up to five miles around it.

The pilots of another Viscount observed Flight 75 deviate at the Westchester omni. At that time these pilots, using radar, noted no indications of severe thunderstorm cells on airway V-3. Consequently, they continued on the airway and experienced no difficulty.

ANALYSIS

On the basis of all the available evidence it is the Board's analysis that the in flight disintegration occurred as the result of loads imposed on the aircraft which exceeded its design strength. It is the Board's opinion that the forces were from a high indicated airspeed in turbulence. The Board believes that this airspeed was generated during an involuntary descent from 14,000 feet which followed loss of control of the aircraft in extreme turbulence. The Board is convinced that no pre-existing weakness or condition contributed to the break-up and that no malfunction or failure of the aircraft, its systems, or its components led to the circumstances under which the disintegration occurred.

From examination of the major fractures, break-up patterns, and from design considerations it is believed that the initial failure in the destruction sequence was the nearly simultaneous downward failure and separation of the horizontal stabilisers at the No. 2 hinge points. This is confirmed by the fact that the symmetrical stabiliser failures could only occur with both wings intact. Also, under ultimate loadings on the aircraft the stabilisers would be expected to fail first. Furthermore, the break-up sequence and the nature of the mass of fractures are entirely consistent with this as the initial occurrence.

Following separation of the right and left stabilisers the aircraft pitched down violently so that all four nacelles broke upward from combined inertia and gyroscopic loads. Immediately thereafter both wings were subjected to extreme downloads under which the right separated and the structural integrity of the left wing was destroyed. With the nacelles, right wing, and stabilisers gone, drag induced by the left wing yawed the fuselage violently to the left. Forces to the left tore off the vertical fin with portions of the fuselage attached, the latter already weakened when the left stabiliser stub tore away. During the subsequent gyrations the left wing broke up, its fuel cells were opened, and the flash fire occurred. At the same time the remaining fuselage disintegrated. The Board believes that the major disintegration sequence took less than one second and that during the latter part of the sequence occupants of the plane were exposed in a random manner to the flash fire and attendant high concentration of carbon monoxide.

The high indicated airspeed which the Board believes existed at break-up is suggested by several singular factors which, in their cumulative value and with the overall patterns of evidence, make the existence of excessive speed nearly irrefutable.

An important consideration is that unless an airspeed in excess of cruising was present the strength of the Viscount is such that forces causing the horizontal stabiliser failures which occurred cannot be developed. Below cruising speed the horizontal tailplanes will stall at loadings less than those necessary to cause failure.

The high indicated airspeed is also suggested by the structural damage to the passenger seats, propeller reduction gearing assemblies, the engine mount "W" struts, and possibly by the ante-mortem injuries to two or three passengers. The damage and the injuries resulted from pull-up loads, which were in the opposite direction to the loads imposed on these subjects by the break-up forces. This damage had to be made prior to the break-up and is compatible with a descent in which high speed was attained, followed by a recovery in rough air in which positive "g" forces had to have occurred.

A further indication of an excessive airspeed and one more definitive of the amount was the blade angle of the No. 3 propeller, 52 degrees. It is believed the indications of blade angle were made during break-up, therefore, airspeed calculated from the blade angle would be valid at that time. From technical data relating to airspeed and propeller blade angles it was shown that with the 52-degree angle there is no throttle position at which true airspeed could be less than 295 knots. Because this airspeed is excessive it is entirely logical to assume the throttles would have been closed to slow the aircraft. With the throttle closed a 52-degree blade angle reflects a true airspeed of 335 knots, which is 15 per cent in excess of the Viscount never-exceed or about 5 per cent in excess of V_D, the maximum speed demonstrated in certification. Loads at such an airspeed, combined with gust and/or manoeuvring load, could easily exceed the strength of the aircraft.

From the evidence of a high airspeed, combined with pull-up forces, it is the Board's opinion that an involuntary descent occurred before the in flight disintegration. The foregoing conclusion is supported by the fact that the break-up occurred at about 5,000 feet and it is not reasonable, under the circumstances, to believe that a voluntary descent would have been made. The configuration of the aircraft at break-up — gear up and flap retracted — is also inconsistent with a voluntary descent under the turbulent conditions known to have existed. Finally, believing that Flight 75 was at 14,000 feet about 1610 hours and that the aircraft disintegrated some 5,000 feet above the terrain about 1613 hours, a descent of 9,000 feet in three minutes or less is evident. Again, a descent occurring under these factors of time and altitude would not be less than 3,000 feet per minute and not less than V_{ne}. This evidence serves to confirm the aforementioned speed indicated by the propeller blade angle.

The evidence clearly shows the existence of large, rapidly developing thunderstorms in the area of the accident and that extreme turbulence most probably existed in and around the thunderstorms. From all evidence the Board firmly believes extreme turbulence was encountered and a loss of control occurred, resulting in an involuntary steep descent. During the final stages of the recovery, loads in excess of design strength were imposed on the aircraft causing disintegration.

The Board knows of no evidence in this accident from which it can determine the sequence of events and factors immediately attending the situation in which loss of control of the aircraft occurred at 14,000 feet. Such factors may be numerous and varied. The Board recognises the possibility that the captain may have been attempting to cross the line of thunderstorms to re-establish the flight on V-3 airway. In doing so he may have selected an opening in the thunderstorms which closed, causing loss of visual reference, and then entered a thunderstorm which was obscured. It is considered possible, under a similar occurrence, that the captain attempted to manoeuvre out of such a situation and placed the aircraft in a turning configuration in which the aircraft could more easily be placed in an unusual attitude, and in which control techniques would be more critical. Under any consideration the pilot's technique and psychological approach to thunderstorm penetration are important factors. In its considerations the Board was also unable to rule out with complete definitiveness the possibility of a cockpit distraction or instrument failure at a critical moment.

Because Flight 75 was released at 1435 hours with 1400 hours weather attached to the release, and because the crew was apparently at the aircraft considerably before flight time, the Board believes that the captain did not receive the 1415 hours flash advisory. While the flight was en route no action was taken to ensure the flight had this information or to provide it with available radar information concerning thunderstorms along the route. The advisory would have delineated the position and movement of the line of thunderstorms along the route and would have indicated that they were expected to increase in intensity. Radar information could have indicated the individual positions of the thunderstorms. While it is not possible to state the action the captain would have taken had he received the information, the Board believes it would have supplemented substantially what he could see, thus providing him with more information on which to base his decisions. Certainly, according to the carrier's operations manual, this information fitted the description of information which should be furnished a flight.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was a loss of control of the aircraft in extreme turbulence resulting in an involuntary steep descent following which aerodynamic loads from high airspeed, recovery, and turbulence exceeded the design strength of the aircraft.

Experienced factory mechanic sucked into jet

(Extract from Aviation Mechanics' Bulletin, November-December, 1958)

Jet intake accidents are no longer limited to the military. We have just learned that an experienced factory mechanic was sucked head first into the No. 3 engine of a commercial jet transport which was being trim-checked prior to delivery.

What happened? When making adjustments from one side to the other, for some reason he elected to go under the engine instead of out and around the guard fence. When he was directly in front of the intake, and facing away, he was raised up and drawn backwards and headfirst into the intake. His sound protector helmet wedged into one of the inlet guide vane openings and buckles, microphone and other hardware were sucked into the blades. The fact that he has survived this experience is in the nature of a miracle.

Why did it happen? In an accident of this fearful nature, the person involved is often the poorest witness. It may be that the high sound pressure level caused him to lose his bearings, although he was wearing a sound suppressor helmet. It is also possible that for one thoughtless moment, he elected to disregard the safety procedures established for the job. This, to us, is the more probable answer, and the moral of the story should be vividly plain.

During the course of a regular public transport flight a DC.3 aircraft carrying 17 passengers was unintentionally flown to within 300 feet of the ground when descending at night towards its destination, which was seven or more miles distant.

Low Approach at Night

There was no official report made on the incident at the time and it was not investigated until three months later when the company heard of it by chance. Due to the confusion which sometimes exists at the time when an incident occurs, it is often difficult to obtain an accurate account of the circumstances. This was so in this case and was further aggravated by the long lapse of time between the occurrence and the investigation, with the result that the captain's and first officer's versions of the occurrence conflicted in many ways.

Apparently after departure the aircraft was cruising at flight level 95 and due to arrive at its destination, in the dark, some 45 minutes after sunset. The first officer was flying the aircraft from the right-hand seat and when the descent was commenced the captain was in the passenger cabin. Sometime later the captain resumed his seat and immediately he had done so, saw the reflection on the ground of the flashing white fuselage light and noticed that the left-hand altimeter indicated a height of 2,000 feet. Simultaneously the first officer noticed the left-hand altimeter indicating 2,050 feet and he immediately put the aircraft into a climb. The height of the ground over which this occurred is approximately 1,690 feet above sea level, therefore, the aircraft was probably within 300 feet of the ground at this time.

It was thought to be significant that the aerodrome being approached is the only one at an elevation substantially above sea level included in this company's services where a night landing is made. The first officer, however, was adamant that he had allowed for the aerodrome elevation and, as proof, stated that he had done the pre-landing check at a height of 3,700 feet, that is, 2,000 feet above the aerodrome elevation as is required by his company's regulations. The reason which he gave for having descended the aircraft to such a dangerously low level was that he must have misread the right-hand altimeter because of the nature of the cockpit lighting at the time. If such was the case then it differs but little from the usual pattern of circumstances wherein the altimeter's shortcomings are blamed.

It was not possible to establish with certainty which of the cockpit lights were in use and to what intensity they were adjusted at the time and, for this reason, the exact conditions of lighting remain unknown. The investigation did not establish whether the pre-landing check, which embraces both altimeters, had been done either fully or in part. The captain asserts that it was not done at any time whilst he was in the cockpit, whereas the first officer was certain that the captain was present when he performed it. The captain felt sure that up to the time of the incident the drill had not been done and to substantiate this he said that the "No Smoking" and "Fasten Seat Belts" signs in the cabin were not illuminated and these are part of the drill. The exact location of the incident could not be established since the captain stated that the aircraft was at a distance of 16 miles by D.M.E. from the destination, but the first officer felt sure that the distance was seven miles. When in the cabin talking to the passengers, the captain was aware that the aircraft was descending. He did not immediately return to the cockpit so as to be there during the descent, as is required by his company's regulations, nor did the first officer consider delaying the descent until he returned. There was no suggestion of either fatigue or any form of distraction having contributed to the situation.

Although the true circumstances of this incident are not known to us, there is ample evidence to show that procedures specifically designed to preserve safety were ignored either because of bad operating habits or because their significance was not fully appreciated. The nearness of an accident in this case should show only too clearly how little room there is for untidy human performance in aviation.

A Wake of Destruction

DELAWARE, U.S.A.

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

(All times herein are U.S. Eastern Standard)

A Piper crashed following structural failure near Dover, Delaware, at approximately 1400 hours E.S.T. on September 23, 1958. The pilot, the only occupant, was killed. The aircraft was en route from Long Island, New York, to Charlottesville, Virginia. While at an altitude believed to be approximately 2,000 feet and during excellent weather, the aircraft was subjected to aerodynamic overloads causing failure of the primary structure.

Evidence strongly indicates that the overload was caused by the destructively energetic vortex in the wake of a large aircraft.

INVESTIGATION

The pilot took off in a Piper PA.22 from Zahn's Airport, Amityville, Long Island, at 1240 for Charlottesville, Virginia. The aircraft had ample fuel to fly non-stop a distance of about 350 miles, and the weather over the entire route was ideal for visual flight.

No record exists of the filing of any flight plan, however the flight planning of the route was witnessed. It was to be south from New York, east to McGuire Air Force Base, and then by Victor Airways to Charlottesville. Victor 16 airway is nearly straight from Coyle VOR, about 50 miles south-east of New York to the Gordonsville VOR, 15 miles east of the University of Virginia Airport, the destination. The accident site is on this course.

The pilot had a reputation for planning his flights carefully and most probably chose an altitude in consideration of the winds. These were light and variable offering the most help at an altitude of 2,000 feet over most of the route, including the accident area. This is based upon the winds aloft information for the Philadelphia area which the pilot most probably received. Above 3,000 feet he would have had to fly in accordance with the hemispherical provisions of the air traffic rules, which would have made it necessary to fly at 4,500 or 6,500 feet or higher. It is customary for pilots of such aircraft to fly under 3,000 feet in good weather over such flat and relatively open country. Thus, it is likely that the pilot was flying at approximately 2,000 feet.

The proposed time en route was 3 hours 15 minutes, making a ground-speed of about 115 m.p.h. for the 350 miles. From Zahn's Airport to the Kenton VOR, about 1 mile north of the crash site, is approximately 160 miles. As the accident occurred about 1 hour and 20 minutes after take-off, the ground-speed was calculated to be about 120 m.p.h. He must have been navigating by the Kenton VOR as his omni receiver was found tuned to that frequency. Major parts of the aircraft were found within 100 yards of the wreckage. This also indicates that the aircraft was relatively low at the time of disintegration.

A careful search of the accident area yielded only five lay witnesses. One had immediately called police, establishing the time of the accident as 1400. All had seen the aircraft falling and shedding parts after some had heard a loud noise. None had seen the aircraft prior to that time and none witnessed the actual failure. All thought that the fall was "straight down." One witness stated that only one wing appeared to be still attached and it seemed to be folded back. Three witnesses saw no other aircraft in flight at the time and place. However, the two remaining witnesses did see another aircraft which they described as "large." One of these two said, ". . . I then saw a large airplane so close I throught the larger airplane was towing a target and that was what was falling. . . ." No smoke or fire was seen with the falling wreckage. Visibility was excellent with a light ground wind.

Most of the wreckage was some 300 feet west of Delaware State Route 9 in Muddy Branch Swamp. This site is six miles north-east of Dover Air Force Base, on the edge of the Dover control zone, as stated and about one mile south of the Kenton VOR. The badly broken fuselage was embedded in mud in such a way that initial ground contact must have been nearly vertical.

The right wing and right lift struts were found with the fuselage. The left wing structure with the left front lift strut and a section of the fuselage still attached, the left aileron, right gasoline tank, pieces of wing fabric, and the left rear lift strut were found in a markedly localised area close to the main wreckage.

The propeller and engine were attached and deeply buried. There was no evidence of fire or explosion either before or after impact with the ground.

Examination of the wreckage yielded these significant facts:

1. There was no evidence of air collision with aircraft, bird, or any object. (A thorough check disclosed that no civil or military aircraft had reported a collision or a near collision that could be related to this accident.)
2. The power-plant exhibited nothing to suggest that it was not operating normally.
3. The aircraft's control system, although extensively damaged by bending, breaking, and

stretching, at time of impact and during salvage, appeared to have been normally operable at the time of structural failure.

4. Failure of the aircraft's primary structure was from downward acting airloads.
5. Damage to both wing panels, to their lift struts and to other associated components, was markedly bilateral.
6. There was no evidence of fatigue or of faulty or questionable construction.

Dover Air Park is a civil airport two miles south-west of the accident site. Persons there saw numerous military aircraft in the Kenton VOR area on the afternoon of the accident, but none saw the Piper. They stated that considerable and frequent turbulence near the Kenton VOR caused local pilots generally to avoid that area.

Dover Air Force Base, six miles south-west of the crash site, is headquarters for an Air Transport Group using C-130's and C-124's. Only C-124's were in use on the day of this accident. Proficiency flights on local flight plan from the Dover Base often use the Kenton VOR as a navigational and letdown aid. By agreement with the New York Air Route Traffic Control Centre, flights in this area departing or returning to Dover AFB, cross airways Green 5 and Victor 16, from the Hartley intersection to a point 20 miles north-east of the intersection, at 2,000 feet or below unless otherwise cleared. The Kenton VOR is on Victor 16, 11 miles from the Hartley intersection, and 7 miles from Dover AFB on a bearing of 346 degrees.

The number of total flights at Dover AFB for September 23 was not learned, although there were 45 local flights. Flight plans filed with the New York Air Route Traffic Control Centre did not indicate other aircraft in the vicinity of Dover, on the heading as reported by a witness, at the time of the accident. At 1400, runway 01 (010 degrees) was in use, but it was not possible to relate any particular aircraft, as reported by two witnesses, to the time and place of this accident.

The C-124 transport has four reciprocating engines and a wing span of 174 feet. Its empty gross weight is approximately 107,000 pounds; the maximum gross weight is 185,000 pounds. The rate of climb when light is approximately 1,100 feet per minute; at full gross it is approximately half that. Normal climb speed is 155 knots, normal cruise speed is 175 knots, and letdown speed is 145 knots with 10 degree flap.

A C-124 departing Dover AFB on runway 01 will cover the 7.6 miles to the Kenton VOR in about 2 minutes and 30 seconds. Loaded C-124's reach the Kenton VOR at altitudes ranging from 1,300 feet to 2,000 feet, depending on their gross weights. Their course will be approximately 90 degrees to Victor 16 and an aircraft on that airway could encounter their wake at approximately a right angle.

Practice and actual approaches to Dover AFB are made, using the Kenton VOR. An approach may be initiated at 1,500 feet, the minimum en route altitude for Victor 16, or at the cruising altitude of the aircraft, whichever is higher. This is an established procedure for military pilots and would be generally unknown to pilots of the type represented by the pilot of the Piper PA.22. Practice approaches can be initiated at 2,000 feet or less by military aircraft operating from Dover AFB by merely contacting the Dover Tower. The outbound heading is 20 degrees and the procedure turn is at 1,500 feet within 10 miles of the station. The inbound heading is 200 degrees with a descent to not less than 1,000 feet, with a turn over the station to a heading of 166 degrees. Vortex turbulence would be increased by any turn because of the increase in g loads in the turn. The missed-approach procedure calls for a climbing turn to the east, and a return to the Kenton omni at 1,500 feet.

As the Piper did not enter the Dover control zone, radio contact between pilot and the Dover tower was neither required nor made.

Official weather reports bracketing both the time and the place of the accident show that there should not have been any appreciable natural turbulence near Dover during the afternoon of September 23, 1958.

An autopsy disclosed nothing that might have impaired the pilot's flying ability.

ANALYSIS

On the basis of all available evidence the Board believes that the aircraft was airworthy and was being flown normally and competently in clear weather and smooth air when suddenly subjected to airloads greater than those it was designed to withstand. The overloads which caused structural failure were downward and not consistent with loads normally imposed by any acrobatic manoeuvre, including unduly abrupt recovery from a spin. Moreover, this aircraft was placarded against acrobatics. The pilot, who was known to fly conservatively, was transporting fragile and expensive phonograph equipment. These factors allow ruling out the possibility of intentional acrobatics. The possibility of collision may safely be dismissed as there is no evidence of it.

Thus, violent artificial turbulence produced by aircraft having high span loading is the only plausible explanation. First, the accident area was being traversed repeatedly by large military aircraft at the Piper's altitude. The wind was light, allowing longer life to the wakes of those aircraft. Second, the nature of the failure — its remarkable similarity on right and left sides — can only be explained by violent downloads to both wings applied simultaneously, causing simultaneous failures.

Turbulence lies in the wake of all aircraft and its severity and its persistence depend upon several factors. The dangers of wake or vortex turbulence are still unknown to many pilots. Engineering studies clearly indicate that vortex turbulence can be great enough to cause structural failure of light aircraft; however, vortices of such destructive magnitude are generally associated with aircraft of the larger civil transport or military types.

All tests and theory to date indicate that structural failure can be anticipated in light aircraft upon penetration of the vortices behind larger civil transports and military aircraft.

The variations and reversals of forces encountered when traversing a pair of vortices is of great scientific interest. The forces are both large and sudden.

When an airplane runs 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. airplane in less than two seconds. The initial abrupt and powerful up current might normally be met by down elevator. Then, within a fraction of a second a sharp reversal of load occurs, then again in the same brief interval, another reversal.

Pilot reaction during this short period can only be surmised. But if the elevator control were moved forward upon hitting the first up draught, as it might be, the following forces would be greatly intensified. This secondary shock, under these conditions, can be enough to destroy civil aircraft which are designed to accepted standards for normal category aircraft.

The Piper PA.22 is certificated under Part 3 of the Civil Air Regulations. It is designed to an ultimate manoeuvring load factor of 5.7g's and in conformance with Part 3 has a negative ultimate manoeuvring load factor of 2.28g's. This model aircraft has not been tested to destruction and the actual negative load limits of all components have not been determined.

Authoritative computations show that the loads that could be encountered in the wake of a large aircraft such as the C-124 are of a magnitude just approaching the limit manoeuvring load factors, positive and negative and, under certain conditions, may reach or exceed the negative ultimate manoeuvring load factors of normal category aircraft. These certain conditions include any appreciable attempt by a pilot to hold constant altitude upon encountering the vortex.

CONCLUSION

The Board concludes that the pilot was cruising on course at an altitude of 2,000 feet or less in the vicinity of the Kenton VOR; that a large aircraft, probably a C-124, was leaving or approaching Dover Air Force Base utilising the Kenton VOR; that the pilot of the PA.22 may or may not have seen the aircraft; that if he did, being unfamiliar with the potentially destructive forces of vortex turbulence, he may well have considered his crossing point to be safely behind it; that the pilots of the other aircraft did not see the Piper or saw it at apparently safe distance; that the Piper penetrated a wing tip vortex of the large aircraft and was destroyed.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was structural failure of a Piper PA.22 aircraft resulting from excessive airloads created by wing tip vortices behind a large aircraft.

A SAFETY MESSAGE FOR PILOTS

It is unfortunate that vortices are invisible. If they could be seen they would look like a pair of horizontal tornadoes stretching back from each wing tip. For miles astern these compact and fast-spinning air masses stay close together and parallel, sometimes undulating slightly, as a pair. They gradually weaken and die, but can remain dangerous until their birthplace is far out of sight. Because the real hazard can be many miles astern and since it is not thick or wide, the probability of running into this insidious danger by chance is extremely slim. However, the result is sure to be startling and may be lethal.

The intensity of the vortex is directly related to span loading and inversely related to airspeed; however, it is a safe and practical generalisation that the bigger the ship the more violent and long-lived will be the vortex disturbance. Technically, the faster the plane is moving the less energy it casts off. The more it weighs in relation to its span, the greater will be its trailing danger. Also, the blows (the airloads) felt on piercing a vortex depend on the speed of entry. At half the speed the shock would be only one-fourth as great.

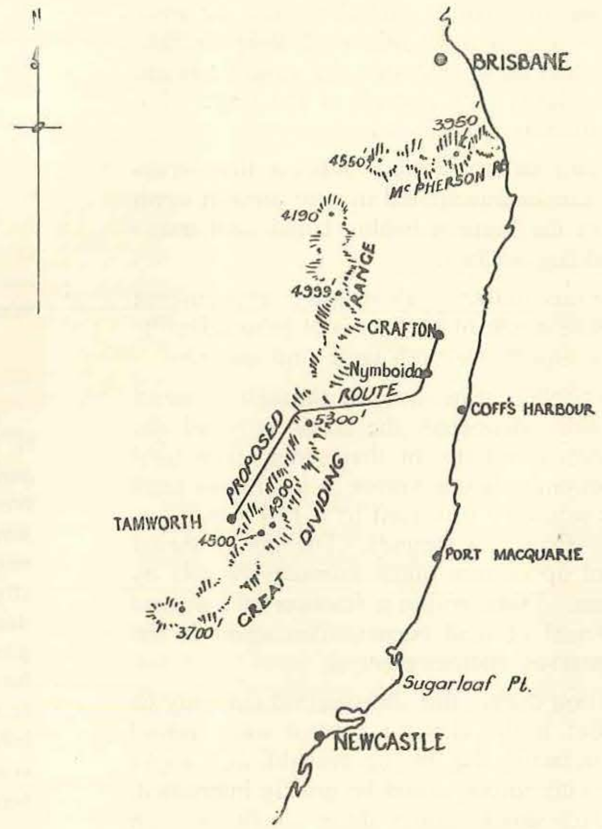
Don't pass close behind any other aircraft: the bigger it is the more time it should be given. Two minutes should suffice as a working rule. Avoid, when possible, places and altitudes frequented by large aircraft. Areas near high density airports, whether civil or military, should always be suspect. If you are to pass behind a crossing aircraft, change altitude so that you will be at least 100 feet higher or lower, preferably higher, and slow down. If you do get into a bad vortex, your best procedure is to ignore altitude changes and use no elevator control.

Off Course? – What Course?

A very experienced commercial pilot departed Tamworth in a Cessna 180 on a V.F.R. flight to Grafton and subsequently landed at Brisbane Airport approximately one hour after last light.

The flight originated at Melbourne and the nominated destination was Grafton with stopping places at Albury and Tamworth. The flight was apparently uneventful to Tamworth, where flight details for the last leg of the flight were lodged. These showed an estimated time interval of 60 minutes, an endurance of 4½ hours and an L.T.R.A. of 2000 hours E.S.T.

The aircraft departed Tamworth at 1535 hours, giving an E.T.A. Grafton of 1635 hours. Tamworth and Grafton are situated in northern N.S.W.; Tamworth being on the western side of the Great Dividing Range, and Grafton, some 85 miles farther north, on the coastal plain. Brisbane is 135 miles north of Grafton (see sketch).



At the time of the flight, the weather west of the ranges was fine and on the coast there were 4/8ths cloud, base 2,500 feet, tops 7,000 feet, light showers and visibility 10 miles. This was consistent with the forecast weather given to the pilot for the flight.

The pilot reports that from Tamworth he flew on the western side of the ranges until abeam of some peaks which he thought were due west of Coffs Harbour (Coffs Harbour is about 40 miles south of Grafton). He crossed the ranges near these peaks and shortly afterwards sighted the coast. From this position he believed he was north of Grafton and so turned south. Sometime later he pin-pointed himself over what he thought was Sugar Loaf Point, 170 miles south of Grafton, whereupon he turned north, flying a few miles inland. Subsequently, he sighted a town which he took, at first, to be Nymboida (some 20 miles south-west of Grafton) but "when I sighted the railway line I knew I had come too far north so I headed for the coast in case I ran out of daylight before I found a place to land or get a definite fix. When I sighted the coast I was still uncertain of my exact position, so I flew south for 15 minutes. It was dark by now and difficult to recognise any of the towns as I was flying B.C.T.A. and close to high ground. I then turned north and continued on this heading until I recognised Brisbane, and requested permission to land."

The contact with Brisbane was made at 1816 hours, at which time the aircraft was approximately four miles south of Brisbane Airport and inside the control zone. The aircraft landed at Brisbane Airport at 1828 hours, one hour and 53 minutes after E.T.A. Grafton and 55 minutes after the end of daylight.

The pilot carried aeronautical maps for the area, but did not use them. He used a road map, but did not draw any tracks on it, and relied solely on map reading for his navigation. It has not been possible to reconstruct accurately the path taken by the aircraft and, bearing in mind the pilot's aeronautical experience and the nature of the terrain, it is astonishing that he was unable to locate Grafton, particularly as he had an hour's daylight after the E.T.A. at that place. On the evidence available this incident is attributed to totally inadequate flight preparation and gross inattention to en route navigation.

Do You Use REVERSE THRUST for TAXYING?

If so, remember the slipstream is also reversed.

The following is an account of what happened when a pilot either forgot or under estimated the effect of slipstream from reverse thrust.

Upon entering a DC.3 immediately prior to departure the pilot observed a Convair some 45 feet to the rear of the DC.3, the doors just being shut prior to start-up. Whilst completing the final actions of starting No. 2 engine of the DC.3 the control column was dislodged from its position where it was being held by knee pressure and the rudder and elevators moved rapidly to their extremes of travel. The controls were returned to the neutral position and held with some difficulty. It appears that after start-up the pilot of the Convair used reverse thrust to back out of the parking area and the forward slipstream caused the severe gust loading of the DC.3 controls.

The pilot of the DC.3 stopped his engines and made a visual inspection of the control surfaces. As nothing untoward was found and control movement appeared normal he decided to continue the flight. On arrival at the destination the aircraft was inspected by engineers and it was found that the rudder stop cables had been broken and the rudder support tube brackets were cracked. This is the damage normally associated with violent and unrestricted movement of the rudder.

Air Navigation Orders Section 105.1.0.2.5. Issue 2 states that where an aircraft is subject to wind exceeding 35 knots whilst on the ground when the gust locks are not engaged, and the control surfaces have not been effectively restrained by a person in the cockpit, the control system and control surface attachments **shall be inspected before further flight**. This Air Navigation Order is not one issued to pilots, who should get their reminder of this requirement through company operations manuals.

The stop cables are there for a purpose. If they are broken, take heed. In Aviation Safety Digest No. 9, March, 1957, there was an account of a jammed rudder in a DC.3 caused by the fork swage end of a broken stop cable jamming against the fuselage skin.

COMMENT

Broken rudder stop cables can be detected from the cockpit by movement of the rudder controls to their extreme positions. When a stop cable is broken the rudder control can be operated further forward than is usual and a different "feel" is evident at the extremity of rudder pedal movement. However, this is only one means of checking and it does not alter in any way the requirement for the control system and control surface attachments to be fully inspected.

Stall during Forced Landing

In carrying out a forced landing following complete power failure in a DH.82, the pilot allowed the aircraft to stall in a turn at 100 feet and the aircraft struck the ground in a steep nosedown attitude. The pilot was seriously injured and the aircraft extensively damaged, but the passenger escaped with only minor injuries.

During this local private flight the pilot carried out a steep turn and very soon after this the engine coughed, spluttered and then cut out completely. The pilot could see that the glide would not "stretch" to the aerodrome so he decided to make an emergency landing in a cleared flat field immediately below. He entered what was intended to be a 300-degree left turn but, after turning through some 180 degrees, the aircraft stalled at about 100 feet.

It was quickly established that the engine stopped because of fuel starvation, but there was still two gallons of fuel left in the tank and no satisfactory explanation was reached as to why it could not be utilised. Nevertheless, the investigation did reveal some safety considerations which are not new, but which are worth repeating.

An examination of the fuel tank led to the recovery of 20 pieces of rubber hose-lining of assorted sizes up to 2 inches by 1 inch together with a loose bolt. Quite obviously this indicates a lack of care, particularly in filtering during refuelling. Because there are 21 outlet holes of ⅛" diameter from the tank to the sump in this aircraft it is difficult to believe that these foreign bodies alone would completely cut off the fuel supply. Tests have confirmed this view.

The fact that only two gallons of fuel were found in the tank after a 15-minute flight indicates quite clearly that the flight was commenced with less than the minimum required, including reserves.

The Light Aircraft Handbook at Section RAC/3-1, paragraph 1.2, specified a minimum reserve of 45 minutes which, as applied to this flight, required a minimum of 6 gallons at take-off. Two gallons of fuel spread over the nearly flat bottom of a DH-82 tank provides very little coverage of the outlet even in level flight. It is quite probable that in sharp manoeuvres such as a steep turn the outlet would be uncovered and the fuel supply temporarily interrupted. Here again, however, it is difficult to believe that this would lead to a permanent cessation of fuel flow in a gravity feed system.

It is worth mentioning that in this accident the pilot was thrown forward on to the crash pad and instrument panel, receiving severe facial injuries, whilst the passenger suffered only slight concussion. Both wore "Q" type harnesses, but that of the pilot was only loosely fastened, allowing considerable movement of his body, whilst the passenger's harness was fastened firmly, thus affording the necessary restriction to prevent serious injury.

THE LESSON IS NOT ONLY OLD, IT IS OBVIOUS — BUT ALL TOO FREQUENTLY IGNORED.

In the forced landing the pilot elected to turn through 300 degrees left to approach into wind on a cleared area ½ mile long. This involved turning his back on the selected field and thus allowed little opportunity to compensate for miscalculations or variations in the descent rate or the effects of drift. It also ignored the fundamental principle of forced landing techniques to make all turns towards the selected field so as to keep it in sight. There was nothing wrong with the pilot's decision to land in this field, but his faulty planning of the forced landing approach path presented him with unnecessary difficulties, to say the least, and was undoubtedly the prime circumstance which led to the inadvertent stall.

KEROSENE . . . or GASOLENE?

(Extract from Business Pilots' Safety Bulletin 59-211)

Quite recently one tank of a piston-powered transport was accidentally fueled with jet kerosene. With more and more airports today servicing jet aircraft, the chances of kerosene being pumped into high-octane fuel tanks increase. Therefore, extra care and caution (spell C-A-U-T-I-O-N) is the order of the day (. . . or night). A flight engineer has suggested one check might be a sniff test. As a pilot checks the fuel quantity in each tank he also should check for any sign of kerosene odour. While a sniff test isn't a sure one, because individual tolerances to odours vary, it at least would be a preliminary check.

Another suggestion is evaporation off your hand. Gasolene evaporates rapidly, whereas kerosene almost has to be washed off.

OTTER Swings off Strip

In August of last year an Otter landplane departed Port Moresby for Tapini in Papua at about midday with two passengers and some 2,300 pounds of freight on board. The flight to Tapini occupied some 50 minutes and was uneventful. During the landing approach and just as the aircraft reached the airstrip threshold it sank rapidly and struck the ground heavily on the mainwheels close to and just inside the threshold. The aircraft bounced approximately 15 feet into the air and power was applied followed by forward stick to smooth out the second touchdown. However, the aircraft bounced again and, at a point some 410 feet beyond the threshold, the propeller struck the ground and the aircraft swung to the left off the strip where the undercarriage collapsed on very rough ground. A small fire broke out which was quickly extinguished by the pilot and the occupants of the aircraft escaped without injury.

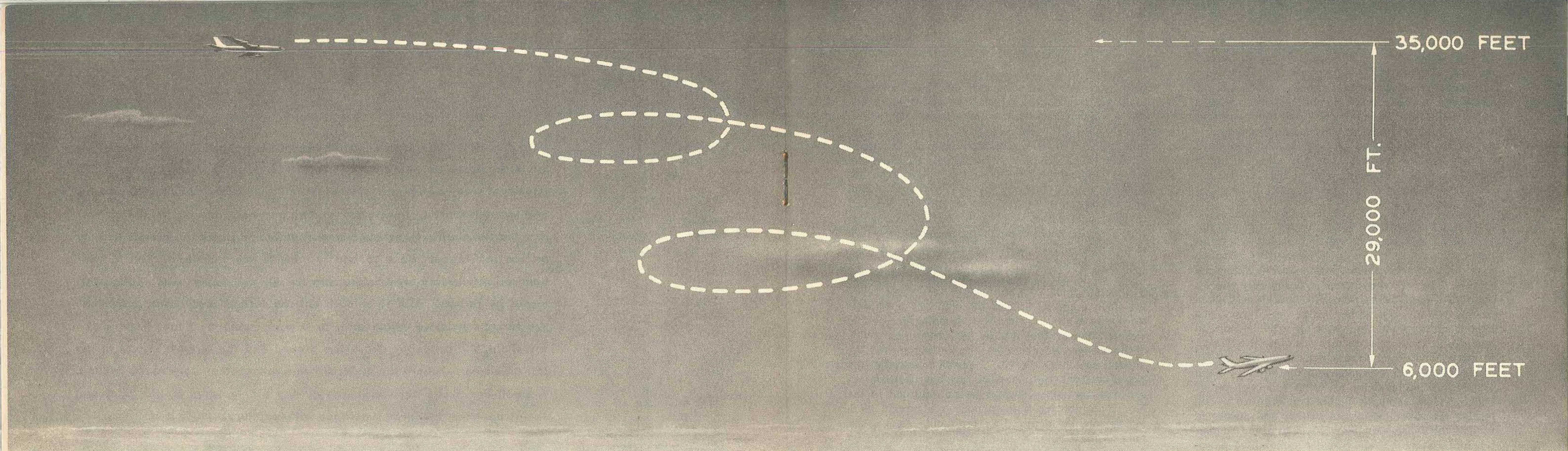
Tapini airstrip is situated in very rough terrain some 3,000 feet above sea level. Although the strip is 2,150 feet long it rises in steps and there is no missed approach path once the aircraft is more than 600 feet past the threshold. Without doubt it is one of the most formidable airstrips in the Territory and the approach has to be made "blind" up to a late stage. At the time of the day at which this landing was attempted the area is usually subject to severe turbulence and freak conditions of wind velocity.

Although the pilot had considerable aeronautical experience in Papua and New Guinea, most of this had been gained on flying boat and float plane types. Earlier on the day of the accident he had flown with the company check pilot from Port Moresby to Tapini where he saw a demonstration approach and landing and then himself carried out two take-offs and landings there. The aircraft was then returned to Port Moresby, where the passengers and freight for this particular flight were loaded. Although the pilot had 118 hours on Otter aircraft at this time, all but six hours of this experience had been gained on the amphibious float plane variant of the type. It is, perhaps, significant that the amphibious Otter has a mainwheel/nosewheel configuration whereas the aircraft involved in this accident was a conventional tailwheel type.

An examination of the aircraft did not reveal any defect which might have contributed to this accident, and although the local conditions at the time could not be described as ideal for aircraft operations, the turbulence was not severe enough, in the opinion of the pilot, to render the airstrip unusable at this time. The pilot had not operated in Tapini in any aircraft prior to the operations conducted under the eye of the check pilot earlier on the day of the accident.

It seems fairly obvious that a combination of limited familiarity with both aircraft type and the airstrip led to this accident. Tapini is recognised as being a tough proposition for any pilot, irrespective of his experience of the airstrip and even under ideal conditions. This landing was attempted relatively late in the day and at this time such approach difficulties as were encountered must be expected. The resulting heavy landing by no means made the accident inevitable, but it is probable that this pilot's experience with a different type of undercarriage on the amphibious aircraft led him into rather instinctive recovery techniques which were not suitable for the landplane type. The nature of the terrain meant that the alternative escape of a go-around was not available and eventually the aircraft assumed such a tail high position that the propeller struck the ground.

Perhaps the prime lesson in this accident is that extensive aeronautical experience will enable a pilot to cope with normal flight situations but, in dealing with the particular problems of a difficult airstrip in a particular type of aircraft, there is still a need for sufficient experience at the airstrip and on the type to cope with any problem which might be presented at short notice.



Uncontrolled Descent of Boeing 707 over Atlantic

(All times herein Greenwich Mean)

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

On February 3, 1959, at 2205 hours, a Boeing 707, Flight 115, en route from Paris to New York, made an uncontrolled descent of approximately 29,000 feet. Following recovery, the aircraft was flown to Gander, Newfoundland, where a safe landing was made. A few of the 119 passengers and 10 crew members on board sustained minor injuries and extensive structural damage to the aircraft resulted.

The aircraft was flying at an altitude of 35,000 feet in smooth air with the autopilot engaged when the captain left the cockpit and entered the main cabin. During his absence the autopilot disengaged and the aircraft smoothly and slowly entered a steep descending spiral. The co-pilot was not properly monitoring the aircraft's instruments or the progress of the flight and was unaware of the actions of the aircraft until considerable speed had been gained and altitude lost. During the rapid descent the co-pilot was unable to effect recovery. When the captain became aware of the unusual attitude of the aircraft he returned to the cockpit and, with the aid of the other crew members, was finally able to regain control of the aircraft. Recovery was made at an altitude of approximately 6,000 feet.

INVESTIGATION

Flight 115 was a scheduled flight between Paris and New York with intermediate stops at London and Gander, Newfoundland. The departure from Paris was routine and the trip to London was without incident.

At 1845 hours the aircraft departed London, the flight plan called for an I.F.R. flight to Gander of 4 hours 58 minutes at maximum thrust. The aircraft was to cruise at an altitude of 28,500 feet to the South Shannon intersection, 29,000 feet to 20 degrees west longitude, and 31,000 feet to Gander. A routine operation was conducted until near 30 degrees west longitude where a frontal condition accompanied by heavy thunderstorms was encountered. Because the flight, flying at its assigned altitude, was passing through the tops of these storms in moderate turbulence and encountering light icing, clearance was obtained from Shannon and Gander O.A.C. (Oceanic Area Control) to climb to and cruise at 35,000 feet. At this altitude the aircraft was on top with all stars visible.

At approximately 2150 hours, the captain went to the main cabin. The co-pilot remained in the cockpit, seated in the co-pilot's seat. The aircraft was in maximum cruise configuration flying at Mach 0.82 in smooth air; autopilot was engaged in the manual mode and the altitude hold was on; gross weight was between 190,000 pounds and 195,000 pounds; and outside air temperature was minus 55 degrees centigrade. The aircraft position was 52.5 degrees north latitude 40.5 degrees west longitude.

All other crew members were at their stations and a company despatcher from Idlewild on an indoctrination trip was seated in the observer's seat immediately behind the captain-in-command. The co-pilot said his belt was snug and the seat was so adjusted that he had easy access to the controls.

At approximately 2200 hours the navigator posted a change in heading requiring a left turn of about 20 degrees. The co-pilot complied, using the turn knob of the autopilot in so doing. He said that he observed the new heading on his R.M.I. (Radio Magnetic Indicator) for several seconds and that the autopilot was holding the heading in a normal manner. He then began to work on the "How Goes It" curve attached to a clipboard resting on his lap, which necessitated computations being made as to time, distance, cruising speed, and fuel consumption, some parts of which are computed by the navigator. During this time his headset was positioned on both ears as he was waiting to copy the 2205 Gander weather broadcast, and he said he did not observe the forward instrument panel during this time.

The first indications he had that the flight was not proceeding normally was when he felt the aircraft buffet. This was immediately followed by a feeling that positive acceleration forces were building up rapidly. The buffeting increased in intensity and his instrument panel lights went out. Quickly he looked at the captain's instrument panel which remained lighted and saw that the captain's artificial horizon had tumbled and consequently was of no use to him. He then glanced up and saw the stars moving rapidly counterclockwise, indicating that the aircraft was in a nosedown right spiral about to roll over on its back. At this point he grabbed the control wheel, pushed the autopilot release button, and attempted to stop the roll by applying left aileron and rudder, but by this time he was virtually immobilised physically by the pressures created during the manoeuvre. Various system-warning and fire-warning lights were being activated intermittently and the Mach warning bell was heard.

At this time the captain, with considerable difficulty, returned to his seat. As he passed the flight engineer he was reminded that the power was still at cruise thrust. The captain pulled the power levers to idle position and pulled himself into his seat, which had been moved fully rearward when he left it. His normal seat position when flying is full forward, rudder pedals in the full aft position. The captain asked the navigator, who was now immediately behind him, to hold him in his seat. Everyone in the cockpit was seriously affected by the G forces which made it difficult or impossible to move properly their heads, hands, or feet. The captain said that his head was bent over and his feet seemed pinned to the floor.

A quick glance at his instruments showed the airspeed needle in the vacant area to the right near the zero mark, and the altimeter passing through 17,000 feet with the needle turning at a terrific rate. He could not see the Mach meter because it was hidden by the control wheel and he could not lift his head. The artificial horizon was of no use to him because it had tumbled, and the turn and bank indicator was full to the right with the ball positioned slightly to the left of centre. He quickly glanced at the co-pilot and seeing him struggling with the controls shouted, "I have command." The stabiliser was in the full nosedown position and his electric trim button failed to function. Visual reference was impossible because they were in a cloud. The navigator somehow managed to fasten the captain's safety belt and while this was being done the captain rolled the wings level and the G forces were relieved. The flight engineer, now able to move, immediately pulled the circuit breaker which deactivated the stabiliser system and then straddled the console and began rolling both stabiliser wheels towards the up position by hand. As they passed through 8,000 feet the captain pulled the yoke back with a steady pull. At 6,000 feet there was a terrific violent pounding or buffeting which lasted a couple of seconds and then the aircraft ceased to descend and began a fairly steep climb. At 9,000 feet the wings were level and the aircraft was in a moderate climb. About this time the captain asked the flight engineer to roll the stabiliser a bit forward and with the aircraft responding reasonably well to control demands he realised he had once again regained positive control. He then moved the horizon switch to the No. 2 position, selecting the No. 2 vertical gyro, and his artificial horizon responded normally; however, when returned to the No. 1 position his horizon registered normal pitch movements, but depicted a steep bank. The captain noticed the stabiliser cutout switch was in the on position and that the Mach trim switch was in the off position. After determining their position the flight immediately advised Gander O.A.C. of the difficulty and a cruise altitude of 31,000 feet was obtained for the remainder of the trip.

During the climb some of the passengers felt the need for oxygen and it was administered by means of the portable bottles and the cabin's regular oxygen system. The cabin pressurisation system functioned in a normal manner throughout the entire event. When 31,000 feet was attained, a long-range cruise configuration was set up with a speed of Mach 0.79 and the aircraft was manually flown to Gander without further incident.

On arrival at Gander the aircraft was carefully examined and it was determined that although it had sustained extensive structural damage it could, with minor repairs, be flown safely to the Boeing plant at Seattle, Washington, for final repair.

The damage consisted mainly of buckles in the lower surface skin of the right and left horizontal stabilisers and buckles in the centre section web and upper surface doubler, and both wing panels were damaged, including shear wrinkles in the rear spar webs and damage to the outboard ailerons and aileron control rods. The wing-to-fuselage fairings were damaged and a three-foot section of the right fairing separated in-flight. Both wing panels suffered a small amount of permanent set. All four wing-to-strut fairing sections of the engine nacelle struts were buckled. Nos. 2 and 3 nacelle shear bolts partially failed in shear and the fitting holes of all front spar-to-wing bushings were elongated.

ANALYSIS

From all of the available evidence it appears that during the captain's absence from the cockpit the autopilot disengaged and the co-pilot did not detect that the aircraft had entered a steep nosedown right spiral. It is further evident that it entered this manoeuvre gradually without any abrupt movements. Also, since the accident was during the hours of darkness, the autopilot disengage warning light (a flashing red light) should have been observed by the crew unless it either failed or was almost completely shielded by the dimming cap. The latter appears probable as the cap was found in the full dim position at Gander.

The functional checks conducted on the autopilot system subsequent to the accident showed it to be operable in a normal manner with the following exceptions:—

1. In several instances the autopilot disengage warning light did not function properly after disengagement of the autopilot.
2. The pitch trim potentiometer did not recentre after autopilot disengagement. The mechanical centring of this potentiometer is necessary for the autopilot upon re-engagement to have available full nose-up and nose-down trim.

These must be evaluated as to what effect, if any, they would have on the behaviour of the aircraft under the conditions prevailing at the time of the accident.

According to crew testimony, the aircraft was cruising at an altitude of 35,000 feet on Mach 0.82, in straight and level flight; the autopilot was engaged and operating in the manual mode; altitude hold was "on" and the comparison unit was in operation. Under these conditions the pitch trim potentiometer irregularity would remain unnoticed and it would have no tendency to cause the aircraft to depart from the established cruise condition.

The rate switch of the vertical gyro transmitter was inoperative. Specifically, the rate gyro motor was found to have an open winding. The rate switch was, therefore, unable to respond to turns and would have permitted the erection system to remain on at all times. Normally, the rate switch deactivates the erection system during turns to prevent erection of the vertical gyro to a false (dynamic) vertical. However, during the slight turn and subsequent continuation of the straight flight path, this malfunction would not have manifested itself.

Tests of the comparison unit disclosed some irregularities in the pitch-up attitude condition. One involved intermittent disengagement at a 10-degree nose-up attitude; however, this attitude is not pertinent to the level attitude of the aircraft in this instance. It was also slightly out of tolerance in response to a step change in pitch-up attitude; however, this would have made it less sensitive and therefore less likely to disengage the autopilot in response to a pitch-up of the aircraft.

These were the only discrepancies involving components capable through malfunctioning of causing the autopilot to alter the established flight condition or cause autopilot disengagement.

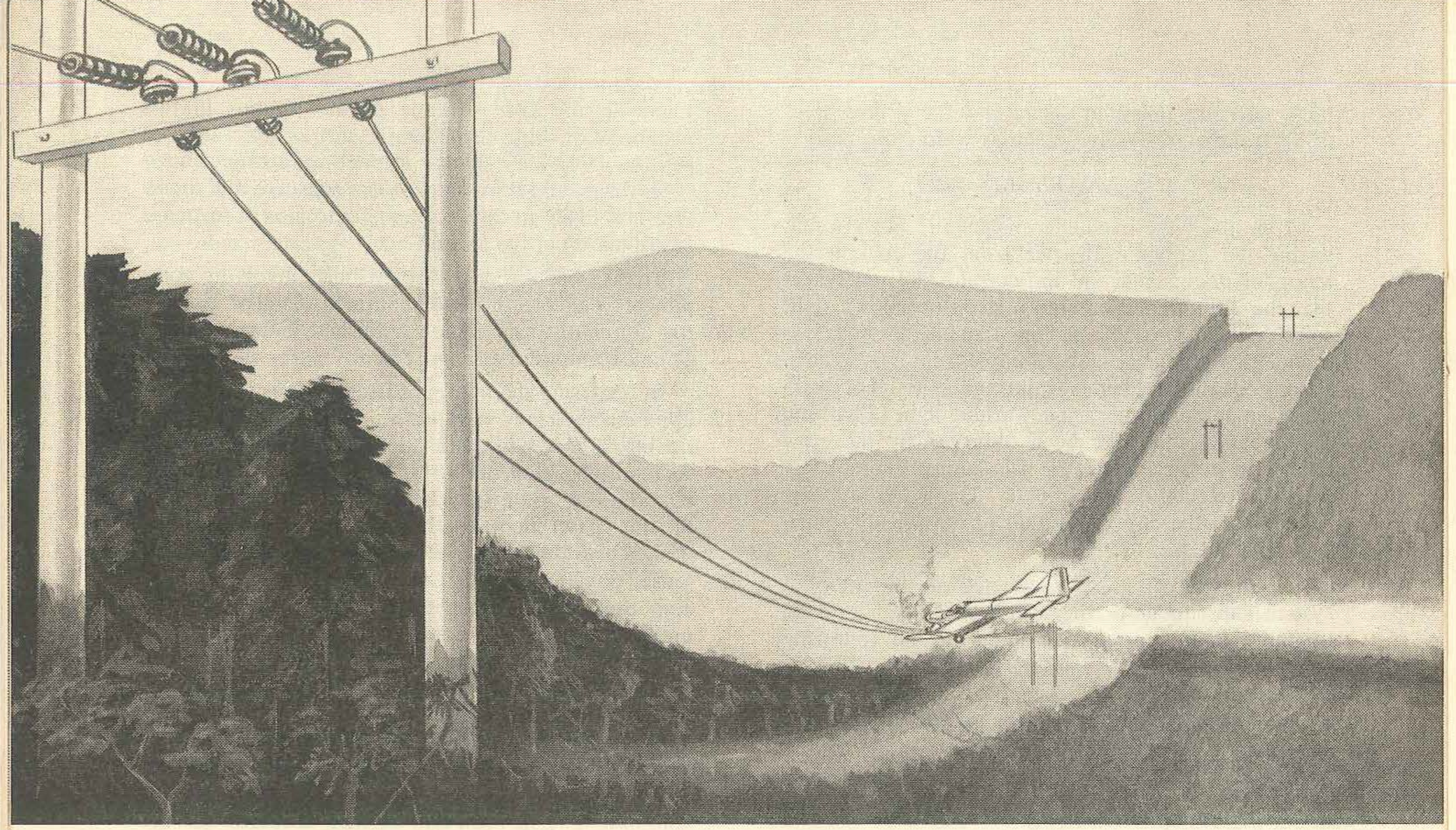
In analysing the autopilot irregularities found, it is apparent that they were both minor in character and unable to have caused this disengagement. Although such disengagements are by no means common occurrences, some may be expected of an autopilot of this type incorporating a comparison monitor designed to disengage the autopilot quickly should it sense any number of undesirable behaviours or responses. In achieving the desired sensitivity of the monitor system it is conceivable that nuisance disengagements can occur as the result of transitory spurious signals. In this instance, the disengagement also could have been the result of either the accidental operation by the co-pilot of the stabiliser trim switch or the autopilot disconnect button, both of which are on the control wheel; or by operating the autopilot engage (on-off) switch located on the pedestal.

Functional tests performed on the Mach trim system disclosed that it was capable of normal operation. It must be concluded that it had not been turned on by the crew, otherwise it would have provided increasingly more nose-up stabiliser trim action with increase in Mach number.

The crew reported a change in stabiliser trim to full nose-down. This did not result from a malfunction of the Mach trim system but could have resulted from inadvertent pressure upon the electric stabiliser trim switch located on the control wheel. Although the co-pilot testified that he is quite certain his hand did not touch the switch, it remains, after careful consideration, the only logical explanation for the trim system behaviour. It is not definitely known what caused the captain's electric stabiliser switch to not function when he attempted to use it after returning to his seat. It may have been caused by clutch slippage induced by high aerodynamic loads. In any event, it functioned in a normal manner when tested later.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the inattention of the co-pilot to the progress of the flight, during the absence of the captain from the cockpit, following the involuntary disengagement of the autopilot. Contributing factors were the autopilot disengage warning light in the dim position and the Mach trim switch in the "off" position.



FLETCHER FU24
Tangles with Overhead Wires

NEW ZEALAND

(Summary based on the report of the Air Department, Wellington, N.Z.)

On September 12, 1959, whilst engaged on a top dressing operation, a Fletcher FU.24 collided with triple 110,000 volt overhead wires while proceeding from the strip to the top dressing area. The pilot was killed instantly and the aircraft was destroyed.

THE FLIGHT

At approximately 0730 hours on the morning of the accident, the pilot arrived at the Tait property strip with the object of fulfilling a top dressing contract on the Hamilton property, which is situated approximately 1½ miles north of the strip. He had operated from this strip on numerous occasions and was thoroughly familiar with the area and with the location of the local power wires, a triple 110,000 volt line which bisects the top dressing area from north-east to south-west, being exceptionally well defined by an associated firebreak through the pine plantation.

Before flying commenced, the farmer referred to the power wires and suggested to the pilot that he "keep well up." The position of the sun at the time was such that the pilot was forced to take-off and land directly into the sun. He remarked upon the excessive glare but, in accordance with his usual practice, he was not wearing sun-glasses.

Having completed the dressing of a block of land some distance to the north of the wires, the pilot took-off on the tenth and last flight between 0815 and 0830 hours to lay a swath parallel and close to the wires in the firebreak. The swath was to be on a north-easterly heading, commencing at pole 90 and would entail a 90-degree turn above the wires between poles 89 and 90.

The take-off was normal. The aircraft was next seen by a witness who had observed all the previous flights. He testified that the aircraft flew along the valley on a northerly heading, tracking along the railway line. This approach was at right angles to the wires, poles No. 89 and No. 90 being to port and starboard respectively. This witness saw the aircraft start a medium turn to the right, at which point his vision was obscured by a tree. Immediately afterwards he heard the sound of collision. He was firmly of the opinion that the engine noise was maintained until after the collision with the wires had occurred and that there was no flash.

INVESTIGATION

Fragments of the inner-outer wing joint leading edge of the starboard mainplane were resting on the ground beneath the overhead wires. These fragments carried imprint marks of the conductors, which indicated an angle of bank of 45 degrees when the damage was inflicted.

A deep indentation appeared on the ground 320 feet north of the wires at which point the aircraft had struck the ground violently in the inverted position.

The collision involved the wires suspended across a valley between poles No. 89 to the south-west and No. 90 to the north-east. These poles are 903 feet apart and the collision occurred 300 feet along the wire from pole 90, at which point the wires are 166 feet above ground level. The site of pole No. 89 is 95 feet higher than that of pole 90, thus the wires slope upwards to the south-west. Because of this upward slope the wires do not at any point sag below the level of the attachment to pole 90 and, in fact, at the point of collision, the altitude of the wires is 10 feet higher than the top of pole 90. For a pilot approaching from the south at wire level, pole 89 and about 100 feet of wire would be obscured from view by tall trees.

The pilot took-off on the last flight secure in the knowledge that it would only require visual clues from the air to avoid the wires. There is testimony that the track of the aircraft was exactly similar to that of previous flights, which means that the wires were approached at right angles on a northerly heading. In regard to the altitude during the approach, from the dimensions of the aircraft and the 45-degree angle of bank at contact, it can be calculated that the aircraft was 9 feet above the wires when right bank was applied.

The visual clues presented to the pilot under these approach conditions would consist of a view of the triple wires running parallel and very close together, pole 90 to starboard, plus a clearly defined impression of the track of the firebreak. Pole 89, on the port side, together with about 100 feet of wire, would not be visible due to tall pines on the port slope.

As the pilot had considerable experience and was considered to have a keen sense of responsibility he would be fully aware of the erroneous impression of height and distance that is derived from a wire suspended in space. It would be quite natural and in accord with usual top dressing practice to use the pole line to obtain perspective. As the pole to port was obscured and the projected turn was to be to the right, it is logical to assume that the pilot was judging his height from pole 90, which was clearly visible on the starboard side.

The obscuring from view of pole 89, which was situated at a higher level on the port side, deprived him of the essential clue which would indicate that the wires sloped upwards. While there was a normal sag of about 20 feet across the span, at no point did the wires sag below the top of pole 90. Had the suspension poles been at equal level, this height, plus the bonus from the natural sag in the wire, would have provided adequate safety clearance.

The circumstances surrounding the accident would suggest that the pilot was working on the generally accepted principle that, if the aircraft is above pole height, collision with the wires is impossible. This principle is sound if the aircraft passes almost immediately over the pole. If, however, the wires are crossed some distance from a pole it is essential that the aircraft be flown at a height above both poles, to avoid the danger of being deceived by sloping wires.

Another possible error in judging height in relation to overhead wires became apparent during the investigation. If multiple wires are suspended horizontally level and an aircraft makes a right-angle approach at exactly the same height as the wires, only one conductor will be visible. If, however, the aircraft approaches at a slightly higher or lower level than the wires, all the conductors will be visible. The significance of this is that the same visual clues are presented to the pilot if the aircraft is slightly above or below the wires and, in an emergency, this could lead to confusion.

CONCLUSION

It was concluded that the pilot judged his crossing of the wire by reference to the lower pole and, in consequence, collided with the upward sloping wire.

Norseman Trapped by Weather

A Norseman aircraft set out from Minj in the Wahgi Valley of New Guinea for a 40-minute flight through the rugged terrain of the Central Highlands to Mendi. The aircraft, which was in the hands of an experienced pilot, was heard circling above cloud in the Mendi Valley some 25 minutes after it was due at its destination. Soon afterwards a patrol officer heard the engine noise increase and then saw the aircraft "come through the cloud dropping in a vertical clockwise spin." The aircraft struck the ground at a point some six miles north of Mendi, and was completely wrecked. The pilot was killed in the impact.

The purpose of the flight was to transport cement and sundry stores to the New Guinea Administration post at Mendi, some 5,500 feet above sea level. The terrain on this route is particularly rugged, even by New Guinea standards, and it is subject frequently to poor weather conditions for flying. However, the post is completely dependent on air services for its supplies and the strip surface is such that it is rarely usable by other than light aircraft because of the heavy local rainfall.

This aircraft was radio-equipped and departed Minj at 1630 hours E.S.T. with an E.T.A. Mendi of 1710 hours and a fuel endurance of 186 minutes. At 1648 hours the pilot reported his position abeam of Mount Hagen at 10,000 feet estimating Mendi at 1708 hours (i.e., two minutes earlier than planned). At 1713 hours the pilot reported "at the northern end of the Mendi Valley — having a lot of trouble with weather — don't think will be able to get to Mendi — will try a little longer, then give it away." Eight minutes later he was asked to advise his position and intentions and the reply was "still in the Mendi Valley trying to get out to return to Minj — will advise." Despite many attempts no further radio contact was made with the aircraft, but some ten minutes after the last contact several European and native witnesses heard the aircraft circling in the Mendi Valley but out of sight and presumably in or above the cloud base which was estimated to be 8/8ths at 2,000 feet above the valley floor. Two European witnesses then heard the engine note increase very considerably and one of these persons saw the aircraft emerge from the cloud in a "spin" towards the ground.

The wrecked aircraft was found in soft ground alongside the Mendi River, some six miles north of the aerodrome. Considering the way the aircraft had buried itself into the ground and had passed almost vertically through a clump of trees, it was obvious that the pilot had not been able to regain control after emerging from the cloud base. A careful examination of the wreckage did not reveal any evidence of defect in the aircraft, its engine or flight control systems, and it seems most probable that control was lost due to the pilot losing visual reference for a substantial period of time. This is supported by his radio contacts, which indicate quite clearly that the aircraft had been trapped by a combination of weather and terrain. On several occasions other pilots have been similarly trapped on this route but, fortunately, the results have not been so drastic.

This particular pilot had almost 1,000 hours of aeronautical experience, including some 300 hours on the Norseman type, and a total of 550 hours in New Guinea. His instrument flying experience, however, amounted to only 34 hours, the last of which was done 12 months prior to this accident. He had flown over this route and into Mendi on 89 occasions, so that he was quite familiar with the local terrain and weather characteristics. There is no real evidence that this pilot unnecessarily flew in cloud or even that he ventured too far in the face of deteriorating weather. The fact remains, however, the weather did close in around him, and in this area this can occur despite the greatest care. The life-saving point to be remembered is that no matter how great is a pilot's other experience, he will not survive long under instrument conditions unless he has been fully trained and is in current practice in instrument flying technique.

NITROGEN CARTS

(Extract from Aviation Mechanics' Bulletin, September-October, 1959)

"Someone installed an argon bottle on a nitrogen cart. This cart is used to service aircraft landing gear struts. We do not know how many airplanes had been serviced with argon. When the error was discovered, Engineering was questioned as to effect of the use of this gas in struts. We were advised that argon is an inert gas and there is no problem involved.

"But if we can inadventently (or unconsciously) install the wrong type bottle on the nitrogen cart, we have every reason to believe that it might have been a bottle containing a gas which could be highly destructive and hazardous, not only to the aircraft but to the people in the immediate vicinity of the servicing operation."

DEFINITELY ASCERTAIN WHICH MATERIALS SHOULD BE USED FOR A GIVEN JOB. SOME MATERIALS DO NOT PERMIT A SECOND GUESS.

RADIOACTIVE CARGOES

The carriage by air of radioactive substances is becoming more frequent, and the practice will probably continue to grow with their increasing use in medicine and industry.

Radioactive substances essentially contain elements of isotopes which are unstable, and during breakdown emit radiations in the form of alpha, beta, or gamma rays and neutrons. The alpha and beta rays are relatively low energy charged particles which have low penetrating power. Gamma rays are analagous to short wave length high energy X-rays. Airline personnel are primarily concerned with protection from these rays and neutrons. None of them can be felt or seen and they can only be detected by means of instruments. Their radiations can have very damaging physiological effects, and the maximum permissible dose for the whole body should not exceed 0.3 roentgen per week. Where only part of the body is involved, e.g., hands, feet or head, a dose of 1.5 roentgen per week may be tolerated.

The allowable radiation under I.A.T.A. packaging requirements is 10 milliroentgen per hour at 1 metre from the radioactive source, i.e., a person would have to remain within 1 metre of the package for 30 hours per week to receive the maximum permissible dose. The intensity of the radiation decreases in proportion to the square of the distance from the source, i.e., at two metres the radiation intensity is 1/4 of the intensity at 1 metre and the time necessary to receive a tolerance dose is increased four times; at 3 metres it is increased nine times and so on. It is, therefore, foolish to stand or work unnecessarily close to radioactive cargo when a few extra feet of separation can provide almost complete protection.

Lead is the most commonly used protective material for packaging radioactive substances and the thickness necessary to provide adequate protection depends upon the strength of the source of the radiation. A lead box suitable for one source may be inadequate for another, and carriers would be well advised to ask for certification by a recognised authority that the radiation limits prescribed by I.A.T.A. are not exceeded.

In the event of damage to a package containing radioactive material, the best precaution is to evacuate the area and obtain the assistance of a radiologist. On no account should unqualified staff attempt to investigate or repair damaged containers. Should a container become damaged in flight, personnel should remain as remote as possible from it and the package unloaded at the earliest opportunity. A radiation check of the aircraft should be made to ensure that dangerous contamination has not occurred.

If it is suspected that personnel may have been exposed to excessive radiation, a blood count should be arranged with the appropriate Health Authority as soon as possible. However, if consignments are packed in well-designed containers, leakage or breakage is virtually impossible and no hazard exists in handling or transporting such radioactive cargoes.

Thorough investigation has shown that radioactive material has no effect on the operation of the radio equipment, even under the most adverse conditions.

Wires are Where You Find Them

In August, 1958, two experienced pilots flew to Goulburn in a Beaver with the intention of inspecting a local field to assess its suitability for the operation of a Bristol 170 on agricultural operations.

During a preliminary air survey of the area, power lines were noted at an estimated 300 yards to one side of the field at a height of 30 feet. A simulated approach was commenced in which the pilot aimed to fly over the wires with a minimum of safe clearance because of their height and position in relation to the field. As the aircraft was about to pass over them with an apparent clearance of 25 feet it struck two earth wires which ran parallel to the power lines and 25 feet above them.

Although both the earth wires were broken by the impact they dragged the aircraft to the ground directly below. Both occupants were injured and the aircraft was damaged beyond economical repair.

There was nothing unusual in the array of wires, the earth wires being suspended between individual pylons mounted on top of the main structures. The pylons were quite prominent and, on seeing them, the pilot should have suspected that they were there for some purpose and could have wires strung between them. Had a survey been made from the ground beforehand they most certainly would have been seen and the accident avoided.

Admittedly, it is easy to have hindsight, but it does seem that for those whose business it is to fly close to obstructions, and hope to continue to do so, it would be wise for them to have a thorough knowledge of their exact nature so that they can be successfully avoided.

DC.3 Emergency Landing

COLORADO, U.S.A.

Shortly after noon on August 23, 1958, a DC.3 experienced an emergency gear-up landing two miles north-west of Pueblo Airport whilst engaged on a scheduled service from Denver to Grand Junction, Colorado, with intermediate stops including Pueblo. Several of the 19 passengers and crew of three received minor bruises, but there were no serious injuries. The aircraft was substantially damaged.

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

THE FLIGHT

A normal take-off was made from Pueblo Airport by the first officer in the left-hand pilot seat. Immediately after the aircraft became airborne and gear retraction had started, the captain, in the right pilot seat, observed the cockpit fire warning for the left engine come on. In accordance with operations manual instructions, he immediately tested the fire warning system, but the warning light remained on; the captain then feathered the left propeller. Pueblo control tower was advised that the flight was returning to the airport and the captain took over control. Because of higher terrain ahead, a shallow left turn was made at an altitude of 50 to 75 feet and at an indicated airspeed of 95 knots. This altitude and airspeed could not be maintained and, after passing under a 34-feet high power line with the airspeed dropping to 75 knots, the power was cut on the right engine. Ground contact occurred almost immediately and, after a ground slide of nearly 1,000 feet, the aircraft came to rest on the underside of the fuselage.

INVESTIGATION

The aircraft departed Pueblo with 19 passengers and the same crew at 1204 hours on a V.F.R. (visual flight rules) flight plan from runway 30. According to company load computation the aircraft was loaded to 24,420 pounds, which is below the allowable take-off weight of 24,900 pounds under the prevailing conditions; the weight was properly distributed with respect to the centre of gravity.

Examination of the aircraft revealed no evidence of failure or malfunction of the airframe or powerplants prior to ground impact. This was substantiated by the pilots, who stated that there was no roughness or indicated engine malfunction during the take-off, that the warning light went out after the feathering and no CO_2 was discharged intentionally either in flight or on the ground.

Because of the circumstances related by the flight crew, immediate attention was directed to the fire-warning system. A review of pilot flight reports disclosed that the aircraft had experienced five false engine fire warnings between July 9, 1958, and August 19, 1958. In each instance the left engine was involved and in no case was there a fire. The crew in this accident was not aware of the false fire-warning reports.

According to the statements of the flight crew, the left propeller was feathered because of the left engine fire warning light appearing as gear retraction was started. A minute examination of the left powerplant failed to disclose any evidence of fire or of a hot spot that could have actuated the fire-warning signal.

Subsequent to the accident, the relays and cockpit test switch were removed from the aircraft for examination. Each unit, plus the left engine thermocouples, were subjected to bench tests designed to test their integrity. These tests proved that all units were operating normally in accordance with specifications and that the units, in themselves, were incapable of actuating a false fire warning.

Since there was actually no fire during flight, the circuits of the aircraft were carefully tested for continuity as well as possible leakage and/or short circuits between wires. All circuits in the fuselage, wing, nose and associated junction boxes and instrument panels were found to be without electrical faults. Extending from the firewall junction box to the inboard nacelle junction box is a flexible conduit, approximately 40 inches long and three-fourths of an inch inside diameter, containing 15 tightly bundled wires. These wires included the sensitive thermocouple circuit wires as well as 28-volt circuits. By moving one of the thermocouple wires in this conduit a variable resistance was present. Removal of the wires from the conduit disclosed a substance consisting of damp oxidised aluminium, oil, and dirt in the area of the conduit ferrule which connects to the junction box where bending and movement occurs. Two wires of the bundle were unnecessarily long and were found criss-crossing other wires. This condition was found to exist in the area where the electrical fault was found. Examination failed to disclose further indication of circuit faults.

The five previous false warnings occurred at different stations away from Denver and in various aircraft configurations. The pilot write-ups and their dispositions were as follows: (1) Found loose cannon plug at firewall. Tightened plug, checks OK; (2) Checked system, no repairs recorded; (3) Repaired loose connection, system on left engine checks OK; (4) Checked system and found nothing wrong; (5) Changed fire-warning relay box complete. Pilot report copies were forwarded to the Denver base in each case, but the base records do not indicate that corrective action was taken at the Denver base to eliminate the recurring false warnings.

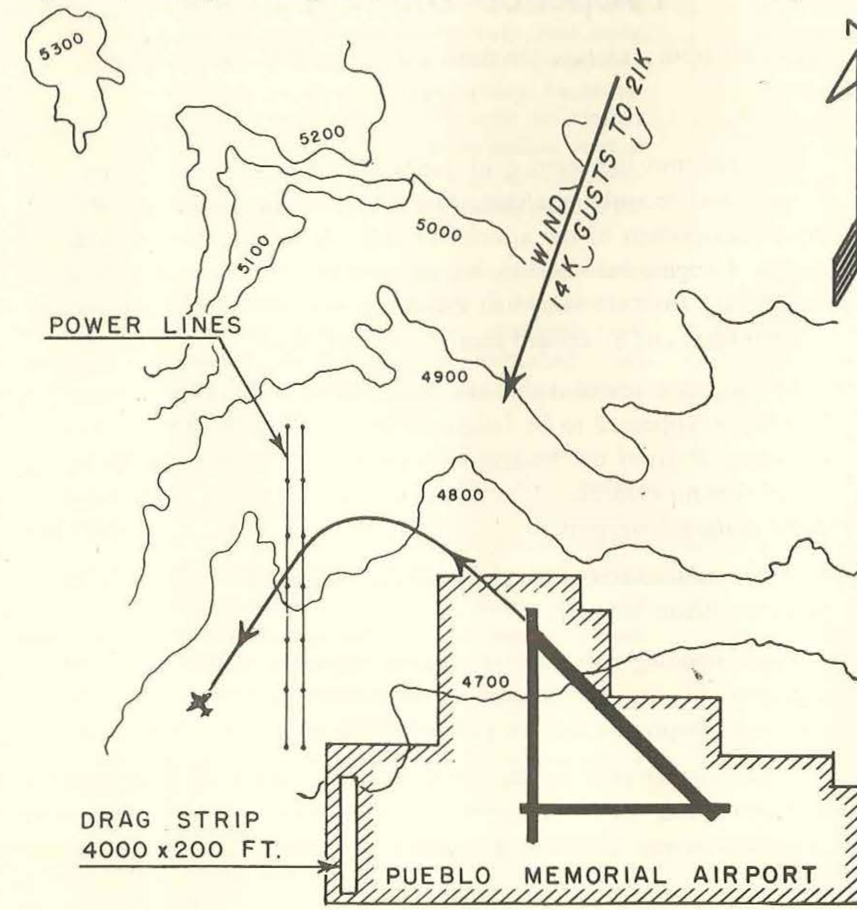
ANALYSIS

Reference to the company weight versus indicated airspeed chart for flight reveals that for a gross weight of 24,420 pounds the airspeed for best single-engine climb and manoeuvring is 92 knots. The company manual minimum airspeed for single-engine is 84 knots. With an indicated 95 knots following take-off and the feathering of the left propeller, the captain had three knots above the best single-engine speed for straight climb or manoeuvring flight. According to competent witnesses, altitude was being gained very slowly as the aircraft left the airport boundary. The aircraft was then going towards higher terrain ahead and to its right. Testimony was received regarding the effect of air-temperature upon rate of climb. It was shown that with the gross weight of 24,420 pounds and the temperature of 75 degrees F., the aircraft should have been capable of a rate of climb of 282 feet per minute on one engine. Even if it were possible to obtain this performance, the aircraft could not have cleared the high terrain lying ahead. Consequently, there was no alternative for the left turn away from the higher land. This turn, in conjunction with the loss of performance resulting from gustiness and turbulence caused by the high ground to windward, was a factor in the aircraft losing airspeed and altitude.

A glance back from the cockpit towards the left engine would have disclosed no evidence of fire and the action could have delayed the feathering of the propeller and averted the accident. However, the captain carried out emergency instructions as outlined in the company operations manual at that time. These instructions are currently being revised to give the captain an opportunity to use his own judgment regarding immediate feathering in the case of engine fire warnings.

Referring to maintenance practices it appears, in this instance, there was a definite failure to comply with the prescribed procedures in that the log office did not discover the recurring false fire warnings when they reviewed the pilot reports.

A study of the available evidence makes is obvious that, regardless of the other circumstances of the accident, a false warning due to faulty wiring and/or the presence of foreign matter would not have occurred and triggered the events that followed had the maintenance department properly corrected the recent and recurring difficulties reflected in pilot write-ups of false fire warnings on this same engine and aircraft. A few circuit tests would have revealed the electrical leakage and pointed out the need for replacement of the wires. The Board, therefore, concludes that the log sheets of the aircraft were not properly monitored; that corrective action taken by the maintenance personnel was not adequate; that there was a laxity on the part of the maintenance supervisory personnel in not detecting this inadequacy; and that the maintenance department was remiss in not progressing prompt and adequate corrective action as a result of the continued write-ups concerning the fire-warning system.



PROBABLE CAUSE

The Board determines that the probable cause of the accident was a false fire warning during climb-out towards rising terrain, followed by the immediate feathering of a propeller. The resulting aircraft performance under the existing conditions necessitated an off-airport landing. The false fire warning was due to inadequate maintenance.

Loss of Control in a Lockheed Hudson

The Digest of March, 1959, contained an article describing a fatal accident at Horn Island involving a Hudson which crashed out of control when overshooting following a misjudged asymmetric approach. Twelve months later another Hudson crashed in circumstances which, it will be seen, were similar.

Carrying one pilot, a navigator and a photographer, the aircraft departed Lae on a photographic survey flight over the Wewak area, but conditions proved unfavourable for photography and it was decided to return to Lae. Lae tower was called five minutes before arrival and landing instructions were passed, in which it was advised that Runway 32 was to be used, the wind velocity being 300 degrees at 15 knots with gusts to 20 knots.

Just before turning on to base leg the aircraft was cleared to do a practice asymmetric landing, but was warned to expect turbulence on the final approach. This was acknowledged by the aircraft. Witnesses agree that the aircraft was very low at the time of entering the final approach from a right-hand base leg with the left-hand propeller feathered. They also agreed that, following what sounded to be a marked increase in the power setting when 300 yards from the end of the strip, the aircraft rolled to the left and dived into the water in a partly inverted attitude. All three occupants perished.

Due to the depth of water at the point where the aircraft sank, salvage operations were not practicable. It is not known, therefore, whether there may have been any defects present which could have contributed to the accident. The relevant documents indicated the aircraft to have been airworthy before the flight commenced and that it had been loaded within permissible limits.

The pilot was fully qualified for the type of operation in which he was engaged and had a total aeronautical experience of 2,814 hours, of which 932 hours had been flown in Hudsons. His log book indicated only one dual training flight to have been done since being first converted to the aircraft type 2½ years previously. Since none of the company's aircraft were equipped for dual flying, however, it was probably his custom to practise the various emergency procedures in the course of his normal flying duties.

Although this may have been so, it seems highly likely that some undetected or persistent flaw in his technique rendered him incapable of safely executing a practice asymmetric approach in the conditions encountered on this occasion. Whether or not the landing was correctly planned is unknown, but it is apparent that either the pilot did not appreciate the trend of the approach or his reactions were too slow, and, for some of these reasons, the aircraft was allowed to get into a situation of height and airspeed from which, in the asymmetric condition, a loss of control could not be avoided.

Propeller Blade Fails

(Extract from Aviation Mechanics' Bulletin, September-October, 1959)

The extreme importance of reporting propeller blade impact damage was recently emphasised by a blade failure which resulted in the destruction of the aircraft by fire. In this incident a blade on No. 4 engine failed during the take-off run. The engine caught fire and fell from the wing and loss of the aircraft followed. It was a cargo flight and all aboard escaped without injury.

Investigation revealed that the blade failed at the 29.1″ station. The break appeared to be fatigue in nature. The focal point was located 2.7″ from the leading edge on the flat side of the blade. There was no evidence of corrosion or material defect at the focal point of the fatigue pattern.

The manufacturer indicated that the failure was the result of previous blade bending.

Blade bending is not always readily apparent. This makes the reporting of *any* blade impact imperative, to ensure that the necessary inspection will be performed before the next departure.

Blade impact may be described as impact resulting from bird strikes, contact with snow banks, taxy or runway lights, baggage carts, service vehicles, etc. Any blade impact requires an immediate report.

OXYGEN CYLINDERS

HANDLING AND INSTALLATION PRECAUTIONS

(Extract from Aviation Mechanics' Bulletin, September-October, 1959)

During a recent replacement of an oxygen cylinder on an airline aircraft, a flash fire occurred which injured two mechanics and extensively damaged the aircraft. The exact cause is unknown at this time, but there is reason to believe that one or more of the following basic oxygen safety rules was violated:

1. **Always open and close oxygen cylinder and line valves slowly to avoid heat-generating pressure surges.**
2. **Do not tighten or loosen oxygen tubing fittings until line pressure has been bled off.**
3. **Never use a mixture containing oil, grease, or other hydrocarbons on any connection, packing, gauge, or other oxygen equipment. Use thread lubricant SPARINGLY and on the first two male threads only.**
   CAUTION! Use only thread lubricant that your company has approved specifically for oxygen equipment. (Note: If your company has not issued a list of approved materials you may ask the Maintenance and Equipment Division of the Flight Safety Foundation for guidance.) Thread lubricant should be used from collapsible metal tubes, as the possibility of contamination becomes too great with can type containers.
4. **Close all disconnected lines immediately; use only lint free caps or clean plastic bags to exclude all foreign matter from entering the lines. Masking tape, sealpeel, rags, etc., are not suitable.**
5. **Hands, clothing, and tools must be free of oil, grease, and dirt when working with oxygen equipment. Oil or grease in the presence of compressed oxygen may ignite violently.**
6. **Newly fabricated lines, contaminated components, fittings, valves, gauges and other components shall be cleaned before installation or use in any oxygen system.**

FOLLOW THE RULES AND BE SAFE!

Note: Further information on the use of oxygen system recharging equipment is contained in Oxygen Explosion, Aviation Safety Digest, No. 12.

BELL 47-G crashes in Severe Turbulence

During November, 1958, a Bell 47-G helicopter was on charter to the Hydro Electric Commission of Tasmania for the transport of surveying staff and equipment in the rugged north-central area of Tasmania, generally known as the Great Western Tiers. During an alighting approach to a small plateau at Clumner Bluff the helicopter encountered severe turbulence and was damaged when forced on to the plateau short of the alighting area. Fortunately, there was no serious injury to the pilot or the two passengers, but the aircraft was badly damaged.

The helicopter set out from the base camp near Mole Creek at 0745 hours E.S.T. to fly the five miles to Clumner Bluff. This also involved a climb of 3,360 feet to the landing area which is 4,700 feet above sea level. Although there was little wind in the protected area of the base camp, there was a 40-knot northerly wind over the area on this day and, as might be expected, the turbulence around the peaks and valleys of this very rugged terrain was quite severe. Clumner Bluff was reached after fifteen minutes' flying and the pilot circled the alighting area several times assessing the prospects of a safe landing. Despite the fact that twice during this period full power was necessary to counteract the effects of downdraughts, the pilot decided to attempt a landing, approaching from the north-east. When the aircraft was 150 feet horizontally and 35 feet vertically from the alighting area it commenced to descend rapidly and struck the ground short of the alighting area, although full power was applied. The aircraft bounced some 45 feet and, in colliding with rocks and overturning, the cabin structure, main rotor blades and various other components were extensively damaged.

The pilot involved in this accident is a most experienced and capable helicopter pilot with considerable experience of flying in mountainous areas. In view of his experience and the fact that on at least two occasions he had to use full power to maintain height, it seems that he must surely have attempted a landing against his better judgment. The investigation has not been able to establish the reasons for the pilot's decision to press on under extremely adverse conditions but, whatever they were, it is believed they could not justify the risk to life and limb involved in the accident.

Crossed Controls in a Glider
CANADA

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

At 1245 hours on May 3, 1959, a Schweizer SGU-1-19 glider took-off from a field at Belwood, Ontario, with a winch tow. Immediately after take-off, the glider began banking to the left. As the bank was continued it rolled on to its back and crashed to the ground. The aircraft was destroyed and the pilot seriously injured.

Witnesses stated that shortly after take-off, at a height of approximately 10 feet, the left wing started to drop. The glider continued to roll to the left and climbed to a height of about 40 feet. At this point, while in the inverted position, the winch cable was released. The glider crashed to the ground nose first, still in the inverted position.

Investigation of the wreckage revealed the upper fuselage "bell-crank" to which the aileron push-pull control rod attaches had been installed incorrectly, which resulted in reversing the control column movements when using the ailerons.

CONCLUSION

Due to the reverse installation of the "bell-crank," to which the aileron control rod is connected, the aileron controls were crossed.

COMMENT

This is a story as old as aviation itself, but it should be noted well that the seriousness of the consequences has not lessened with the passing of time.

SPIN ACCIDENT — Holz der Teufel Glider

In June last year a member of a newly formed gliding club was seriously injured when a Holz der Teufel glider spun into a field near Greta in New South Wales.

A small group of gliding enthusiasts formed the new gliding club in November of 1958 and they obtained the partly constructed glider from another gliding club in New South Wales. Construction was completed in May, 1959, and several flights were conducted prior to this accident, commencing with short hops and progressing to local circuits. On this day a club member was launched in the glider by means of an auto tow and released at a height of about 500 feet. He was then observed to make a gentle turn to the right downwind, but during the turn on to base leg the right wing was seen to drop and the glider entered a spin or spiral to the right at a height of some 150 feet. The glider completed three turns before contacting the ground on its nose and then turned over on to its back. The glider was badly damaged and the pilot sustained a broken leg and facial abrasions.

Construction of this particular glider had taken place sporadically over some twenty years. The design originated in Germany prior to 1930 for the purpose of hill soaring and it can best be described as a single-seat primary glider of relatively low performance. The aircraft was inspected by qualified personnel prior to its first flight and an examination subsequent to the accident did not reveal any condition or defect which might have contributed to this accident.

The pilot's experience of gliding at the time of this accident consisted of 10 short hops in this particular aircraft and, in addition, he had some 100 hours of experience on light powered aircraft but this flying had ceased some four years prior to this accident.

Apart from the fact that the performance of this glider was poor by comparison with other types now in common use in Australia, the use of a single-seat primary glider for training purposes is regarded by the Gliding Federation of Australia and by the Department with some concern. The Gliding Federation had no official knowledge of the flights being conducted in this glider and it is fair to say that they would have discouraged its use if the full facts had been known. Nevertheless, the flights were conducted and, as could be expected, it was not long before an accident occurred.

The probable cause of this accident was that the pilot lost control when the aircraft stalled during a poorly co-ordinated turn and this can be attributed to his limited gliding experience and lack of proper instruction. The performance of this type of glider is usually such that a high rate of descent occurs in a spin or spiral and more than the usual amount of airspace is needed for recovery. In the hands of a pilot of limited experience it is extremely doubtful whether 150 feet would be enough airspace to permit recognition of the loss of control and to take effective recovery action. This was a common type of accident in the days when single-seat primary gliders were used for training, but in this day and age of dual control training gliders we believe there is no justification for the risks inherent in this type of operation.

GRAVITY is Still With Us

During February of this year a DH.82 aircraft was engaged in superphosphate spreading in particularly hilly country in Western Australia. The strip from which operations were being conducted was situated in a narrow valley, and its location necessitated a 180-degree turn after take-off in order to climb out of the valley in the direction of the spreading area. Four take-offs were made with the aircraft climbing over rising terrain and, during the climb following the fifth take-off, the aircraft stalled and struck the ground, causing extensive damage. The pilot escaped without injury.

The operator of this aircraft took every precaution to ensure that the work could be conducted safely. The aircraft was correctly and safely loaded in accordance with the relevant performance chart; wind velocity was indicated by flags in three different positions and the pilot was carefully briefed to follow the line of the valley after take-off and before turning in order that sufficient height could be gained to clear the rising terrain safely en route to spreading area. The pilot, however, chose to follow a different flight path involving a right-hand turn soon after take-off and a climb across open rising terrain until the ridge forming the southern side of the valley was reached. Substantially the same flight paths were followed on each occasion, but on the fifth attempt the aircraft found its task too great, with the inevitable result. The stall was apparently so unexpected that the pilot did not even attempt to dump the load of superphosphate.

There is no evidence of any defect in the aircraft which might have contributed to this accident and, although wind conditions and turbulence in this type of country would need careful watching, there is no reason why the operations could not have been conducted with complete safety.

The pilot's total flying experience was some 315 hours, of which 194 hours had been gained on the DH.82 type and 105 hours in agricultural operations.

There is no doubt that the operator's briefing to the pilot was adequate and essential, having regard to the terrain conditions in the area of operations. The pilot gives no explanation as to why this briefing was ignored but, in all probability, he chose the shorter path and the greater risk in an endeavour to accelerate his spreading rate. It is most likely that the flight path followed during the four previous sorties, which were carried out without incident, was dangerously close to the rising terrain; thus it only required some small variation in wind velocity, aircraft performance, pilot judgment, or actual flight path to tax the aircraft beyond its capacity.

It is difficult to believe that the final situation developed so quickly that the pilot did not have time to recognise it and dump the load. It seems more likely that, for reasons known only to himself, he was loathe to dump the load until the very last seconds, but probably didn't appreciate fully the stall characteristics of the aircraft under the particular flight circumstances.

The lesson is obvious in this accident — know your aircraft thoroughly and fly safely within its capacity. This involves a careful assessment of all flight conditions and a continual alertness for variations which might adversely affect the aircraft's performance.

Unfortunately, although this lesson and that of all stall accidents has been plain for all to see almost since man first took to the air, there are some pilots who make no effort to study them. We will tell you of their miserable failings from time to time.

GLIDER AIRWORTHINESS CERTIFICATES

There have been a number of glider accidents recently in which the glider concerned did not have a certificate of airworthiness. Although the actual airworthiness was not suspect in most cases, the absence of the certificate of airworthiness was a disturbing feature.

Accordingly, the Department now requires that all gliders have a Certificate of Airworthiness by April 1, 1960, and every assistance is being given to the Gliding Federation to enable them to meet this requirement. Every person who flies or operates a glider has a primary basic responsibility to ensure that his machine is currently airworthy. The first requisite is to have a current certificate of airworthiness, and the second is to be satisfied that the glider is cleared as safe and serviceable for the proposed flying.

"Horse Sense"

(Extract from Aviation Mechanics' Bulletin, September-October, 1959)

Trouble shooting of any component or system is the systematic examination of the component or system to find the cause of the malfunction. For any malfunction or trouble there are usually several possible causes. To change all possible faulty components is not only wasteful, but time consuming. Every minute spent on changing a component operating properly is time wasted. To stop this waste, experienced maintenance personnel "trouble shoot" or examine the malfunction before beginning maintenance.

In order to trouble shoot any component or system, the man performing the maintenance must first thoroughly understand the design, function and operation of the system or component he is responsible for maintaining.

The first step in maintenance, then, is to analyse these known facts and attempt to find some key, or to find a similarity with another malfunction with a known cause. For this reason, the experience of the trouble shooter greatly increases his worth. Knowledge of the proper operation of the system is a necessity, and familiarity with abnormal system operation is helpful. If the mechanic recognises the cause of the malfunction, he can proceed immediately with corrective action. If, however, he does not recognise the cause, he must carefully and systematically eliminate every possible cause until he has found the faulty component.

This systematic elimination is the measure of the trouble shooter. To change every component in the system may solve the problem, but it has taken much time, drawn heavily from supply and has not helped if the same malfunction appears again. Sooner or later, the needless and wasteful replacement of serviceable parts will become old and it will be necessary to find the cause, so why not start trouble shooting properly the first time.

As the trouble shooter goes through the system, he uses every technical manual and report available which may contain a clue concerning this cause. He also consults other maintenance personnel to see if they have experienced a similar malfunction. Remember, two heads are better than one.

After a thorough investigation and analysis, the trouble shooter makes his decision. He now changes the faulty component or, if he finds that linkage was the cause, he adjusts the linkage. Now he repeats the ground operational checkout. If, after a complete checkout, the malfunction has not recurred, the aircraft is ready for any further necessary flight testing.

The ROT Sets in

On arrival at Geraldton, the trailing edge of the port lower mainplane of an agricultural DH.82 was found to be loose and unstable. On inspection it was found that the inboard end of the rear spar, the trailing edge member and trailing edge ribs were rotted, due to contamination by moisture and superphosphate. The rear section of the wing was packed tight with superphosphate, seeds, and what appeared to be the residue of spray chemicals.

Although the aircraft had flown only 110 hours since overhaul, a build-up of superphosphate, etc., in the trailing edge had completely blocked the drain holes.

Operators of agricultural aircraft are advised to periodically check the drain vents which can become choked, with the result that rotting of the fabric and timber leads to a weakening of the mainplane structure in a short time.

AEROSOL STOWAGE

(Extract from Accident Prevention Bulletin 58-5)

The pressurised packaging (aerosol) of certain products, i.e., shaving cream, insecticides, liquid cleansers, etc., may make such products easier to handle and use, but certainly not easier to store, particularly in aircraft. A recent case proves the point.

A pilot and passenger were en route cross-country in a private plane. They were at an altitude of 3,000 feet, airspeed 140, and just passing over a small community when a loud explosion in the rear of the cabin was heard. Immediately thereafter, the pilot and his passenger detected what they thought was gasoline fumes. Believing the gasoline heater under the rear seat had blown up, the pilot quickly searched out an emergency landing area and came in without damage to the aircraft. Subsequent examination disclosed that a pressure-packed can of ice repellent liquid, some of which had been used earlier on the propeller, had exploded, due to the warmth of the cockpit.

With aerosol-type packing so susceptible to heat, extra care is required in stowing such products aboard aircraft.

DESIGN NOTES

MECHANICAL EQUIPMENT — Deflection Interferences

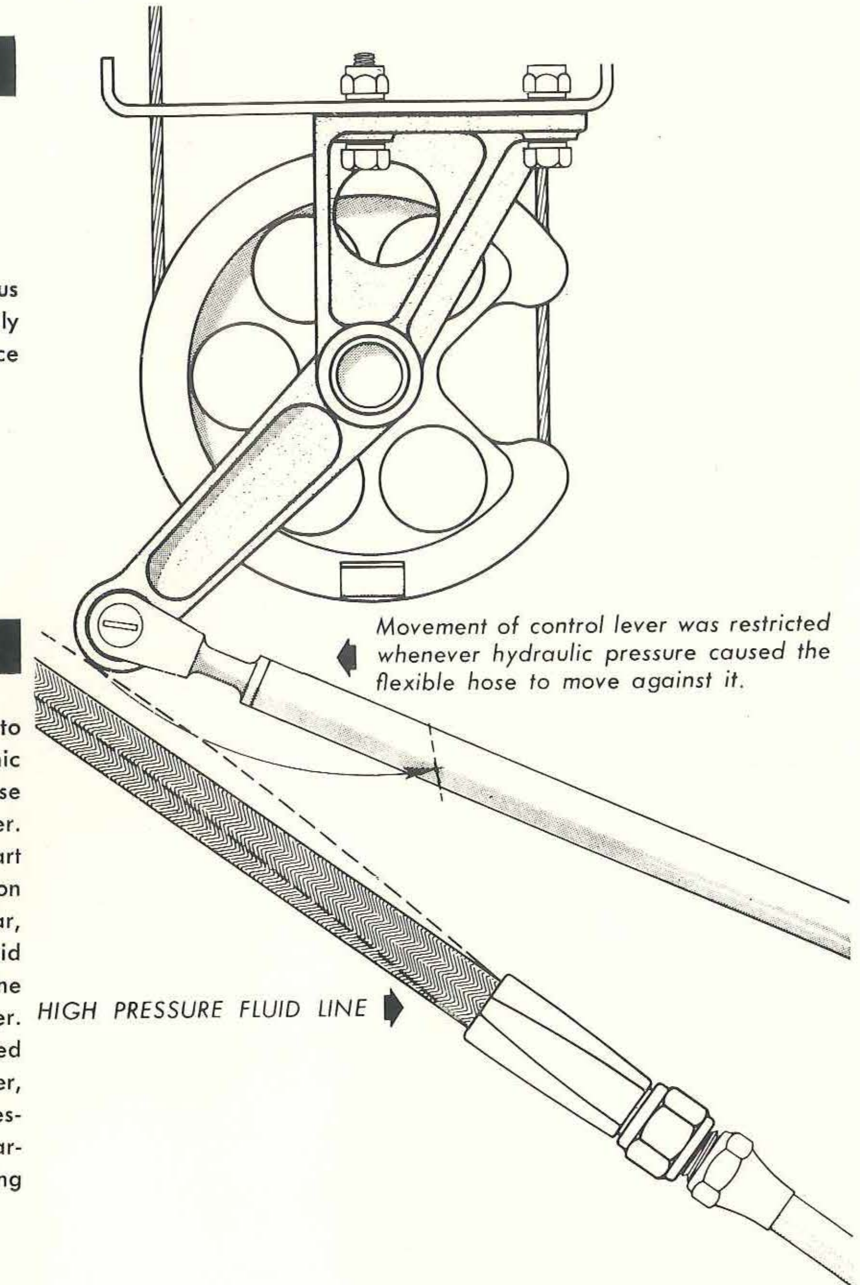
Reduced Clearance Caused Intermittent Interference

The SITUATION

A control system jammed in flight at various times but happened to operate satisfactorily whenever tests were made to find the source of trouble.

The HAZARD

Following several unsuccessful attempts to uncover the difficulty, an alert mechanic noticed a worn spot on a flexible hose which was close to a control system lever. The hose was a high pressure line, a part of the hydraulic landing gear retraction system. When actuating the landing gear, the internal pressure of the hydraulic fluid caused the flexible hose to move out of line and into the path of the control lever. Whenever the landing gear was actuated simultaneously with movement of the lever, jamming occurred. Normally, without pressure applied within the hose, ample clearance existed between it and the actuating lever.



(By courtesy Flight Safety Foundation, Inc.)