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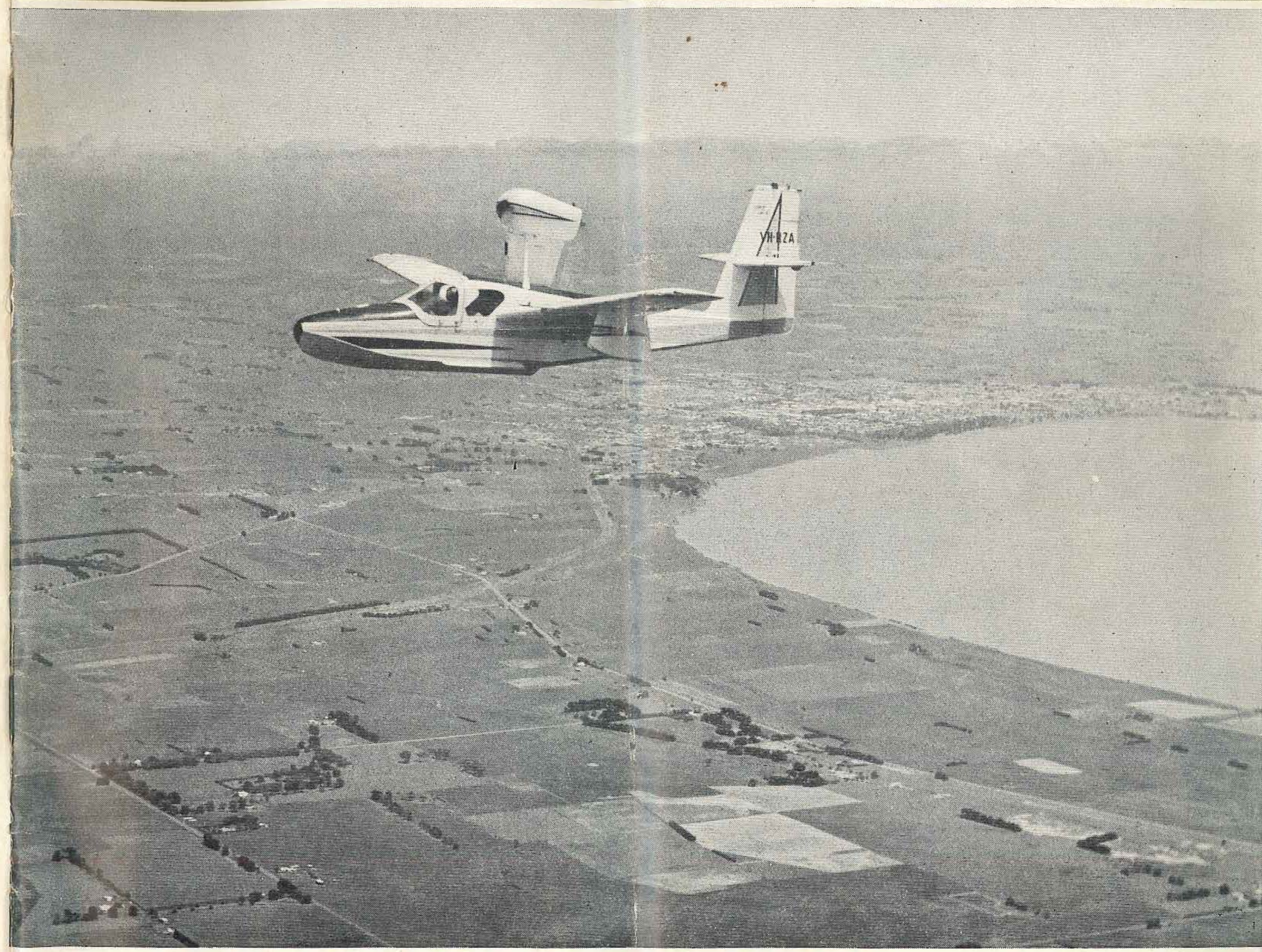
AVIATION SAFETY DIGEST

DEPARTMENT OF CIVIL AVIATION AUSTRALIA



No. 48 DECEMBER, 1966

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COVER:

Business aircraft with a difference. A Lake amphibian over Colac in the Western District of Victoria.

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Aircraft Collides with Parachutist

At Rabaul, New Britain, three members of a local parachute club had arranged to make descents from a Cessna 172.

The aircraft, with the three parachutists on board, one of whom was the club's parachute instructor, took off from Rabaul shortly after 1400 hours local time to fly to the approved dropping zone, a disused airstrip at Vunakanau, eight miles south of Rabaul. The aircraft belonged to a flying school based at Rabaul and was being flown by the school's chief flying instructor.

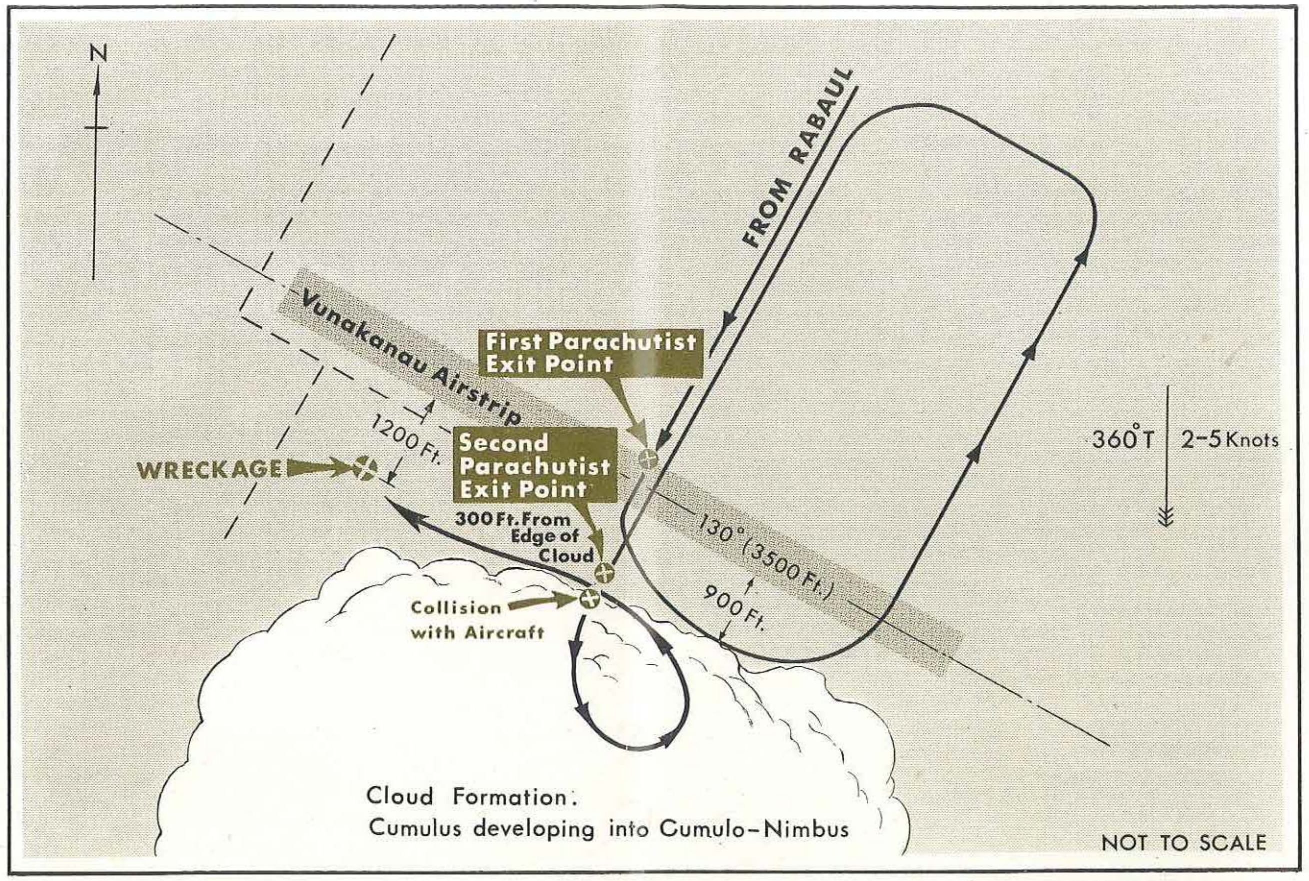
The day was fine and ideal for parachuting with only a very light breeze from the south, but as is usual in the afternoon in this area, large cumulus clouds were developing inland to the south of Rabaul. One cloud lay immediately to the south of the airstrip at Vunakanau, with a base of about 2,500 feet.

The brief flight from Rabaul to Vunakanau was uneventful and at the parachute instructor's suggestions during the flight, the pilot changed heading three times to assess the direction of the wind. This indicated the wind was negligible, confirming the meteorological information obtained by the instructor before taking off.

Approaching the airstrip, the aircraft made a dropping run at reduced airspeed toward the south-west. When the aircraft was over the northern edge of the strip at 2,700 feet, the first parachutist jumped, using a static line. The aircraft flew on, turned to port before reaching the cloud and made a wide circuit to bring it back on to a south-westerly heading for a second dropping run over the strip. On this run, however, the second person to jump, a young woman student parachutist, who was also using a static line, was not dropped until the aircraft was beyond the strip and only about 300 feet from the cloud. The student parachutist made a successful exit and her canopy deployed correctly, but almost immediately the aircraft entered the cumulus cloud which was lying to the south of the airstrip. From this point on, the events that followed are largely a matter for conjecture, but it seems probable that the pilot then began a steep turn to port to break out of the cloud as soon as possible. The aircraft remained in cloud for about half a minute, during which it continued turning through nearly 270 degrees and lost nearly 500 feet in height.

Just as the aircraft emerged from the cloud again, it collided with the woman student's parachute. The aircraft rolled on its back and entered an inverted spin. The parachute instructor jumped from the stricken aircraft, opened his canopy immediately and moments later the aircraft struck the ground. Although the instructor's parachute deployed

The wreckage lying where it fell in kunai grass. The tail assembly is separated from the fuselage and held only by the control cables.



only just before he reached the ground, he was not injured and he ran at once to the aircraft wreckage to render assistance. Both the pilot and the student parachutist sustained fatal injuries.

Examination of the aircraft wreckage indicated that the rear section of the fuselage had failed in flight. It is probable that the failure was initiated by the impact of the parachutist against the tailplane. There was no evidence of any malfunction in the aircraft which might have contributed to the accident. The engine was not running when the aircraft struck the ground, but as the parachute canopy and rigging lines were entangled around the propeller, it was considered that the engine would have stalled under the load imposed upon it.

The pilot held a commercial pilot licence with an "A" Class Flight Instructor Rating, and had accumulated over 3,000 hours aeronautical experience. He had carried out a good deal of instruction in instrument flying, but his own instrument flying experience was only 12 hours. His experience on parachute dropping operations was also limited, amounting to less than seven hours flying.

The parachute instructor, who was still in the aircraft when the collision occurred, said that there was a terrific crash just as they were coming out of the cloud and the aircraft went into a violent spin. He did not see what the pilot did as the crash occurred but was not aware of any sudden control movements. The instructor said he made several attempts to get out of the aircraft after the collision and succeeded on his third or fourth attempt. The wing struck him as he cleared the door and he opened his parachute immediately. It was hardly open before he reached the ground. The parachute instructor said that when the aircraft entered the cloud, he was standing at the door holding on to the safety strap with his left hand, and was reaching out with his right hand to pull in the static lines which were still trailing in the slip stream. The pilot had banked so sharply as the aircraft flew into the cloud, that he was swung off balance.

Why the aircraft lost so much height while turning in the cloud could not of course be definitely established. What is certain, is that the pilot continued his turn for nearly 270 degrees before the aircraft emerged from the cloud. There is no logical reason for him to have done this, for at the most, a turn of 180 degrees should have been sufficient to bring the aircraft out of the cloud with the least possible delay. Rather, the prolongation of the turn to almost 270 degrees suggests that the pilot did not have effective control of the aircraft after it had entered the cloud. It is possible the pilot, suddenly confronted with a transition from visual to instrument flight and not experienced in instrument flying, might have attempted to turn before he had fully adjusted himself to controlling the aircraft by reference to the instruments. Undoubtedly his intention in turning steeply was to regain visual flight as quickly as possible and probably also to avoid being caught in turbulence in the developing cumulus cloud.

From witnesses' evidence it was determined that the aircraft was in cloud for between 25 and 30 seconds, and as the second parachutist would have descended some 500 feet during this time, the rate at which the aircraft must have descended during its 270 degree turn, was of the order of 1000 feet per minute. In this type of light aircraft, such a rate of descent would not be abnormal either for an inadvertent loss of height as a result of the pilot's loss of effective control in cloud, or for an intentional descent made by the pilot during the turn, to try and break out of the base of the cloud.

Evidence obtained from a number of eye witnesses who saw the accident from the ground, clearly indicated that the collision occurred while the parachute was partly obscured by wisps of cloud. Although, at this stage, the aircraft had been visible to the witnesses for some seconds after reappearing from the main cloud bank, it was still flying through wisps of cloud which could have greatly reduced forward visibility from the aircraft. It is evident from witnesses' statements that both the aircraft and the parachute were partially obscured by cloud when the collision occurred, and it is almost certain that the pilot did not see the descending parachute until the moment of the collision.

The accident was the culmination of a set of circumstances that began with the decision by the parachute instructor to delay the student parachutist's jump until the aircraft was so close to cloud that its subsequent entry into the cloud was committed. In accepting this situation, the pilot contravened Air Navigation Regulation 149(2) by approaching closer than 2000 feet horizontally from cloud. No one can be sure of the precise actions or intentions of the pilot beyond that point, but the circumstances of an inexperienced instrument pilot being in cloud and undoubtedly wanting to get out as quickly as possible, and a parachutist descending in close proximity, had combined to set the stage for an accident.

CAUSE:

The probable cause of this accident was that, after entering cloud, the pilot, who was inexperienced in instrument flying, did not maintain effective control of the aircraft and the circumstantial flight path which resulted was such as to bring about a collision with the parachutist.

TREAT IT AS ALIVE!

At the completion of a 100 hourly inspection, the engine of a DH.82 was started, warmed up, then run to full throttle to check its performance. The test run was satisfactory and the engine was shut down and the fuel and ignition switches were turned off. With the throttle closed, the cylinder compressions were then checked by pulling the engine through one complete firing cycle. To finally check that the impulse coupling on the starboard magneto was not sticking, an engineer wound the propeller backwards a few pulls, then forward again. On the second compression, as the propeller passed through the vertical position, the engine fired and the engineer was struck heavily on the arm. The ulna of his right forearm was broken and the arm badly bruised.

Because the engine had just been run at full throttle, it is probable that carbon deposits in one or more of the combustion chambers were still incandescent and that this ignited the fuel/air mixture that would have been drawn into the cylinders while the compressions were being tested. "I didn't treat the 'hot prop' with the respect it deserved", was the engineer's comment later.

His remarks at the time of the accident, although not recorded, were probably rather less philosophical.

Fatal Tree Strike During Spraying Run

While engaged in crop spraying near Narrogin, Western Australia, a Cropmaster YA-I struck the tops of trees and crashed to the ground. The pilot was killed and the aircraft destroyed.

The aircraft was owned by an aerial agricultural company based at Jandakot, Western Australia, and had been working in the area for several days. Early on the day of the accident, a fine mild morning with clear skies and a light southerly breeze, the pilot flew the aircraft to a property at Highbury, a few miles south of Narrogin, to spray an area for web-worm infestation. On landing at the property, the aircraft was met by one of the firm's loader drivers, and filled with 100 gallons of DDT mixture. No fuel was added as the pilot said he had sufficient for the operation.

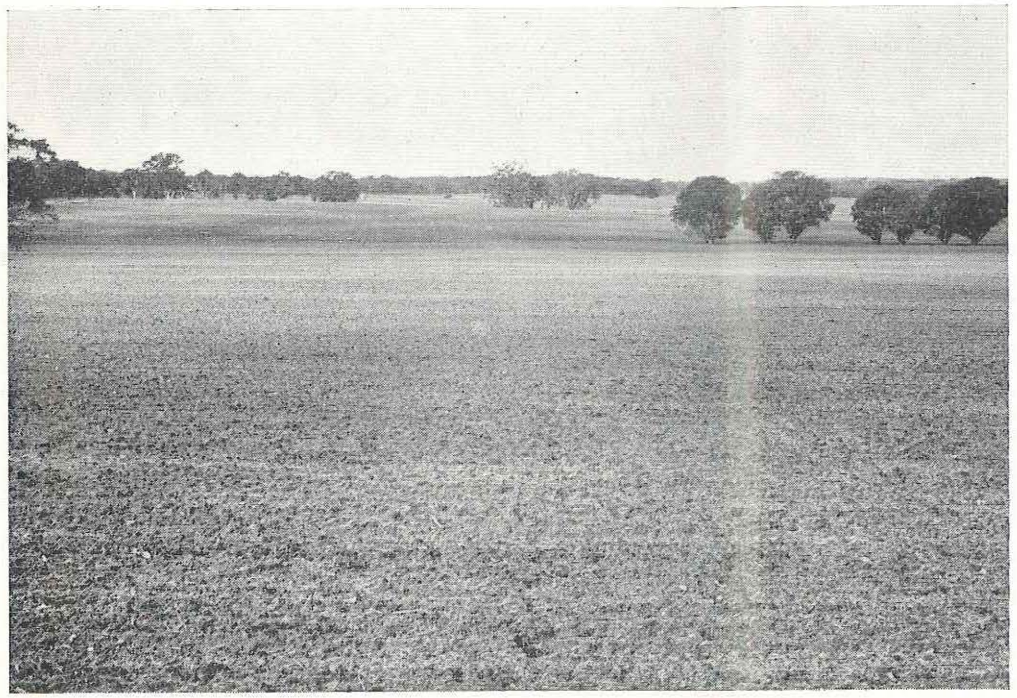
Soon after 0830 hours the aircraft took off and began a series of parallel spraying runs over the paddock to be treated, flying about four to six feet above the ground. The runs were being made east and west, which produced a cross-wind spraying pattern normal for the existing wind conditions.

On the western boundary of the paddock, a heavily timbered area of forest, with trees 60-70 feet in height, adjoins the property and is only separated from the boundary fence by a firebreak 40 yards wide. On completing each run into the west, the aircraft climbed sharply to clear the trees before carrying out a procedure turn for the run back in the opposite direction.

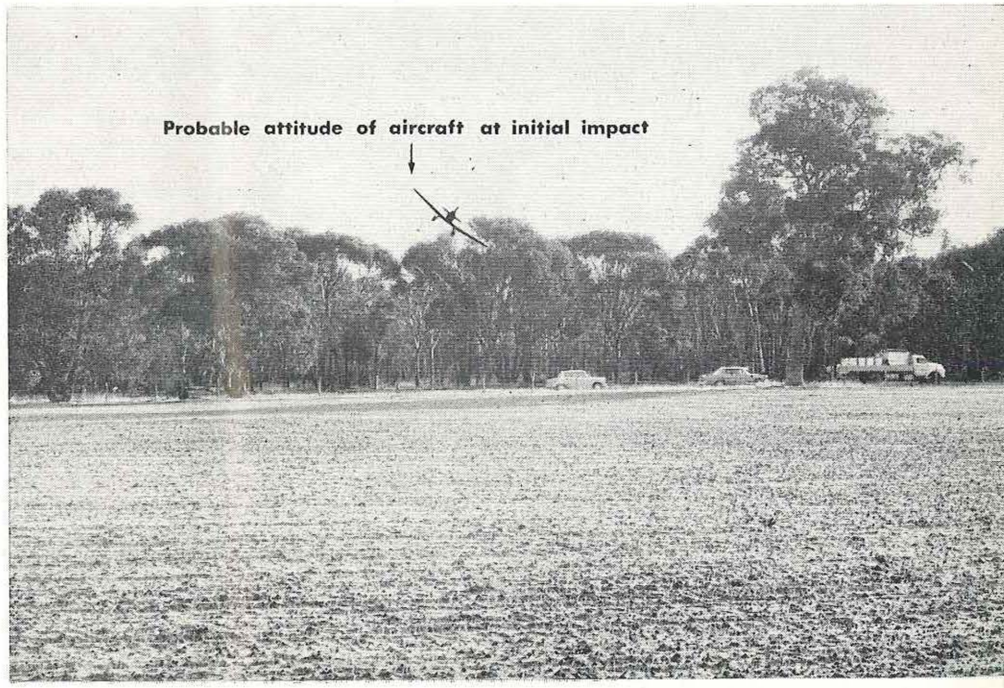
As it completed its sixth spraying run, flying into the west, the aircraft climbed off the crop, and as before, began making a turn to the right as the first part of a procedure turn calculated to bring the aircraft around on to a reciprocal heading. As the aircraft banked over the verge of the forest, the starboard wing struck the top of a tree 60 feet above the ground. The aircraft plunged into the forest, struck a second tree, and nose-dived into the ground, then slid for 30 feet before coming to rest upside down. The engine was torn out and the whole wing structure separated from the fuselage, but the fuel tanks remained intact and the aircraft did not catch fire.

Examination of the wreckage disclosed no evidence of any pre-impact structural or control system failure, or that any engine malfunction had occurred. Branches of trees cut by the propeller, and damage to the propeller itself indicated that the engine was delivering substantial power at impact. The aircraft was

The wreckage as it came to rest amongst the trees. The propeller lies half-buried at the point of initial impact with the ground.



Left: View back along path flown by aircraft on its final run, as seen from western boundary of paddock.



Below: View from paddock showing trees over which the pilot had attempted to climb, and point of first impact.

correctly loaded and had ample fuel in its tanks for the operation. The path of the aircraft after its initial impact with the tree on the fringe of the forest was plainly evident from tree damage and ground marks. It was clear that at this first impact, the aircraft was banked sharply to the right, an attitude consistent with the turning pattern the pilot had followed at the end of each of the previous runs.

The pilot was an American citizen who had been flying commercially in Australia for two years. He held an Australian Commercial Pilot Licence with a Class I Agricultural Rating and had accumulated almost 6,000 hours aeronautical experience. There was no evidence that he was other than fit and well on the morning of the accident.

There were no eye-witnesses to the initial impact, but the sound of breaking timber drew the attention of the two field markers in the paddock as the aircraft crashed through the trees. They ran at once to the wreckage and rendered what assistance they could. The marker who was near the western boundary of the paddock said that on each westerly run, the pilot had been spraying to within 20 to 30 yards of the fence before climbing steeply over the firebreak and the trees. The marker said that on the final run, the aircraft appeared to be lower than before, and it is possible that the pilot continued the run closer to the fence before commencing to climb.

Whether or not this was so, it was quite evident from the investigation that the pilot was "cutting it fine" in spraying as close as he could to the fence of the paddock before climbing off the crop to turn above the trees. In doing this, he was probably trying to minimize the number of "clean-up" runs he would have to make later, at right angles to his primary spraying pattern. In a situation like this however, where the aircraft has to fly directly towards trees, it is obviously prudent to err the other way—to end each spraying run a little earlier, rather than a little later, than would seem safe. Even if this does make an extra clean-up run necessary, the margin of safety achieved more than justifies the additional time and cost involved. One serious or fatal accident can completely negate all the operational economies that a pilot could ever hope to achieve!

CAUSE: The probable cause of this accident, was that the pilot whilst carrying out low level spraying operations, misjudged the point at which it was necessary to initiate a climb in order to clear obstructions.

COMPASS READING AFFECTED

En route from Lae to Mt. Hagen in poor visibility conditions, the pilot of a Piaggio began to have some doubts about his position. After checking track, against time intervals and headings flown, he suspected the compass was reading inaccurately. He moved a small electric fan which had recently been installed in the cockpit and found it immediately deflected the compass about 10 degrees. With further movement of the fan, the pilot found it was possible to deflect the compass reading as much as 40 degrees. Because it was impossible to obtain an accurate fix in the existing weather, the pilot climbed the aircraft to 14,000 feet and set course for Madang by radio compass. He landed there thirty minutes later without further incident.

It was found that the fan had been installed without an approved drawing and that no reference had been made to it in the normal inspection and survey sheets. A compass swing had been carried out after the fan was installed, but this did not show any additional deviation. A check made after the incident however confirmed that the compass reading was affected when the fan was rotated about its mounting spindle.

To Whom it may Concern

The following statements are taken from the reports of the investigations into four recent accidents to light aircraft in Australia:—

(1) **BEECH BARON**—"Inspection showed that the pivot bolt had seized in the trim tab horn bush. The bolt's retaining nut had previously been too firmly tightened down on the assembly. These conditions had caused a bending load to be imposed on the elevator trim tab actuating rod each time the tab was moved up or down from the neutral position. Over a period of time the load reversals had caused fatigue failure through the threaded section of the adjustable end of the rod."

(2) **CESSNA 185**—"Examination of the wreckage showed that the throttle control rod had separated from the throttle as a result of wear at the bolt hole in the throttle arm connection. This was caused by inadequate tightening of the bolt's retaining nut."

(3) **CESSNA 180**—"Investigation disclosed that the rudder cable clevis pin had pulled free of the attachment hole in the starboard rudder bellcrank. Elongation of the holes as a result of wear had progressed to the extent that the metal remaining between the hole and the outer edge of the bellcrank provided insufficient strength to withstand normal operational loads. Inspection of the port control attachment showed that the clevis pin hole in the port bellcrank had worn to twice its original diameter. A similar failure would certainly have occurred at this point within the next few hours of operation."

(4) **CESSNA 172**—"The starboard rudder cable had been installed incorrectly so that it passed on the wrong side of a guide pulley and was chafing heavily against a fuselage frame. The cable failed while the aircraft was taxi-ing out for take-off."

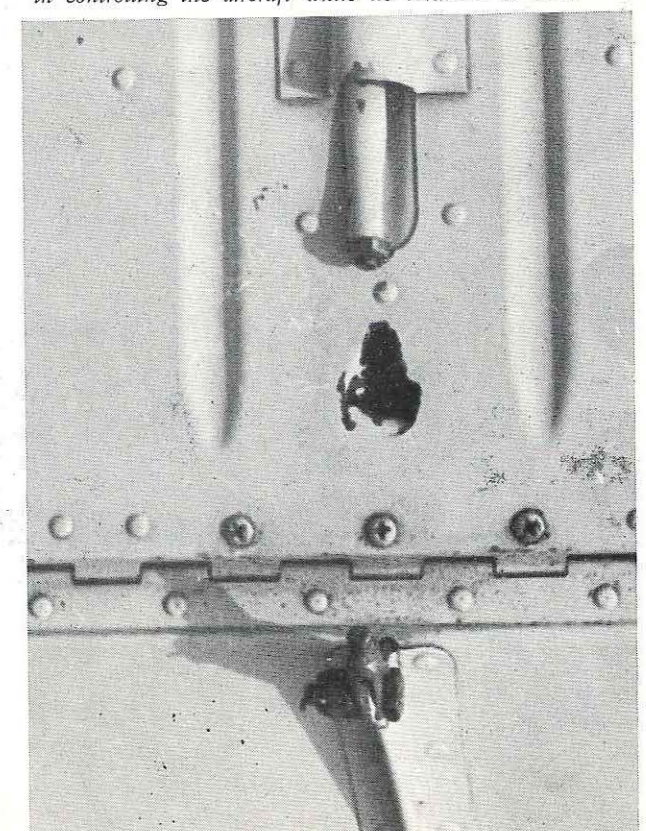
* * *

A study of these failures shows that faulty installation was involved in cases (1), (2) and (4) and in all four instances poor maintenance standards were a compounding factor. The discrepancies were all of a type which should have been found at 100 hourly inspections had this work been conscientiously performed.

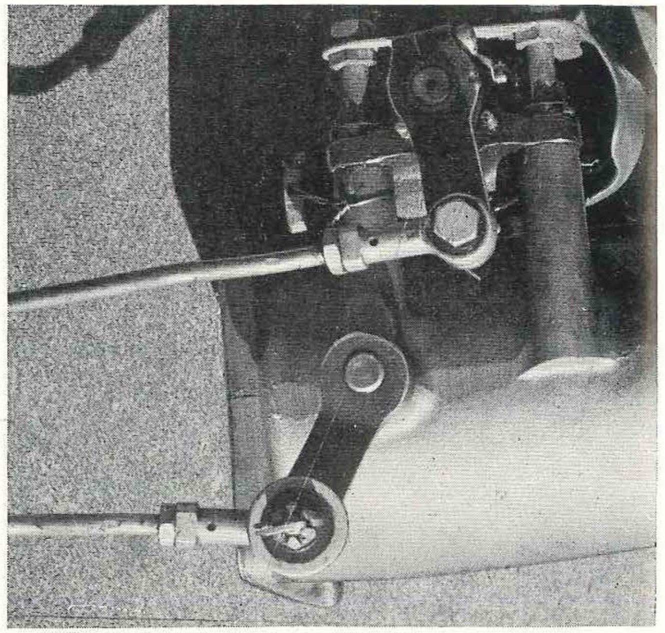
Each case provides valuable lessons that could help to avoid repetition of these faults, and all maintenance personnel should consider them most carefully.

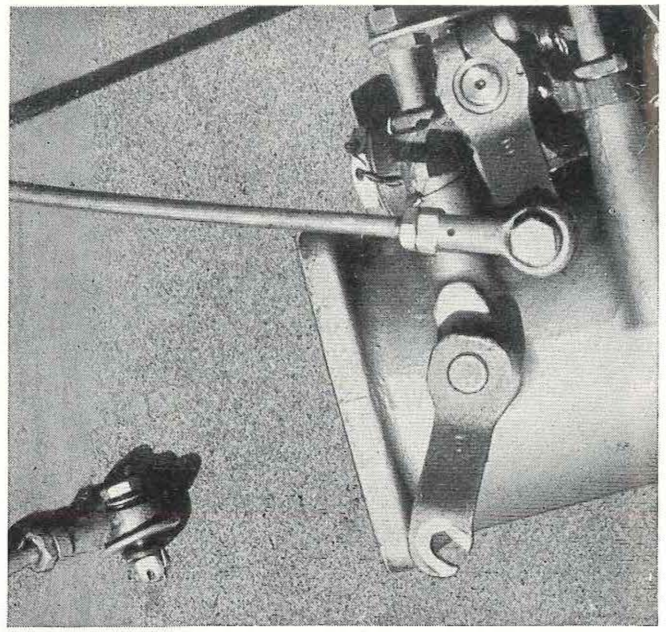
CASE 1—The end of the trim tab actuating rod on the Beech Baron is adjustable for length and incorporates a fork which fits over the trim tab horn.

This photograph shows a broken elevator tab actuating rod on a Beech Baron. Flapping of the tab after the rod failed, forced the broken end through the skin of the elevator. The failure occurred soon after the aircraft had taken off and induced severe buffeting. The pilot experienced difficulty in controlling the aircraft while he returned to land.



The fork pivots on a bolt carried in the trim tab horn bush, and the assembly is secured by a castellated nut and split pin. During assembly, the pivot bolt had been clamped tightly on to the fork and horn. This was evident from the shape of the fork and the amount of galling on the sides of the horn. Because the pivot bolt is a clearance fit in both the horn and the fork end, it should have been obvious that, for the fork to remain free to pivot, the retaining nut must be tightened only sufficiently to be firm against the fork, without causing distortion. By using a little grease on the bolt during assembly and at subsequent inspections, the corrosion that had occurred could also have been considerably reduced.





The throttle control failure illustrated in these two pictures was responsible for a Cessna 185 making a forced landing in timbered country. The aircraft was very severely damaged.

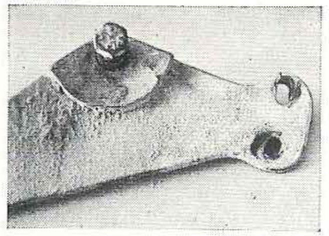
CASE 2 — The assembly that failed on the Cessna 185, consists of a solid arm attached to the throttle butterfly spindle, and a self-aligning ball race, on the end of the throttle control rod, held together with a bolt and a split-pinned castellated nut. All relative movement between the arm and the rod is taken up by the ball race, and the bolt's only function is to secure the two components together. If the bolt is not tightened properly it will tend to rock back and forth until it becomes loose in the arm, and once this point is reached, the chatter caused by vibration will cause accelerated wear until the hole in arm is elongated to the point of failure. Another fault often found in these assemblies is that the threaded portion of the bolt, instead of the shank, is used as the bearing surface in the arm. This is incorrect and should be avoided whenever possible. Good maintenance consists of checking the bolt for tightness by placing a spanner on the BOLT HEAD and testing to see whether or not the bolt can be rotated. If it can, then obviously the nut needs adjustment. This looseness will become apparent a long time before the damage reaches failure point. Such a check had obviously not been made during recent maintenance of the engine.

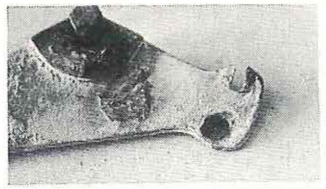
CASE 3 — The fault which led to the Cessna 180 accident should need no explanation as it is obvious that the assembly had not been properly inspected for many hundreds of hours previously. Again a flat plate and a fork end were involved, but in this case the pivot was a clevis pin. Under normal conditions the pin is a free fit in both the fork end and the plate. In aircraft which are being used in agricultural operations, the assembly has to work in very dusty conditions, and this causes a high rate of wear. The hole in the plate is of course covered by the fork end and if inspections are skimped, there is a strong probability of the pin becoming reduced in section undetected, or as happened in this case, the plate wearing away until there is insufficient material left to carry normal operating loads. It is a simple matter to check such easily accessible assemblies, and the fact that this

Because the rudder controls failed during take-off this Cessna 180 ran off an agricultural strip, ground-looped and was badly damaged.

Below right: The cause of the loss of control. The clevis pin hole in the rudder bell-crank on the starboard side, had become elongated to the point of failure.

Below left: The rubber bell-crank on the port side, though still intact, was also found to be badly worn.





accident occurred can only be attributed to ignorance or sheer laziness.

The aircraft's records show that it had been in operation for some 2,000 hours and there was no evidence to indicate that the components had been changed or even dismantled during the whole of that time.

As a result of this accident a special mandatory inspection and recording at each 100 hours (A.N.O. DCA/Cessna/22) was introduced.

CASE 4 — The rudder cable in this installation passes over a pulley and then through a lightening hole in a frame in the rear fuselage section of the aircraft. In the case under discussion it had been installed so that it passed under the pulley, and was consequently so far out of alignment with the lightening hole that it rubbed heavily on the edge of the hole until the cable failed. The report indicates that it had not been disturbed since the aircraft was imported. During its 700 odd hours of operation in this country, the aircraft had been through seven 100 hourly inspections and at least two Certificate of Airworthiness renewals. Each of these inspections contained a certification that the control systems had been inspected. Whether the certifying engineers had not performed the inspections properly themselves or had failed to exercise proper supervision over others for whose work they took responsibility, is immaterial. The fact remains that a control installation, with an elementary fault which should have been apparent on visual inspection, passed through an organization's maintenance release inspection system at least nine times without being detected.

SUMMARY

Our purpose in presenting the above discussion is to highlight two factors; firstly, that there are dangers in allowing unqualified, and in some cases inadequately trained, persons to perform what are apparently simple functions, without giving them proper direction and supervision; secondly, that even the simplest of mechanisms can, and will, fail unless they are properly maintained by competent staff. In the first three cases major accidents were caused, and resulted in expense far outweighing the cost of any time saved by skimpy inspections; in two of them, no less than ten people narrowly escaped serious injury.

Conscientious implementation and adequate supervision of aircraft inspection and certification procedures, by the industry, is an intrinsical part of the Department's system of ensuring the airworthiness of aircraft operating in Australia. Generally speaking, the Department has ample justification for its confidence in this system, but the incidence of failures, such as those reviewed in this discussion, shows there is still room for improvement.

S.T.O.L. aeroplane stalls on take-off

Taking off from Terapo, Papua, a Pilatus Porter climbed rapidly immediately it became airborne, assuming an increasing nose-up attitude, until it stalled and dived to the ground. The aircraft was almost completely destroyed by impact, the pilot was seriously injured and the only other occupant sustained minor injuries.

The aircraft, which had only recently been acquired by a Port Moresby airline, was engaged on a charter flight to drop cargo to a mission station near Kaintiba, almost on the Papua/New Guinea border. It was the airline's first commercial operation with the new aeroplane, which was being flown by the company pilot who had ferried it to Port Moresby from Melbourne. Arrangements had also been made for a company first officer, acting as cargo handler, to accompany the pilot on the charter trip, to gain some flight familiarization on the aircraft type.

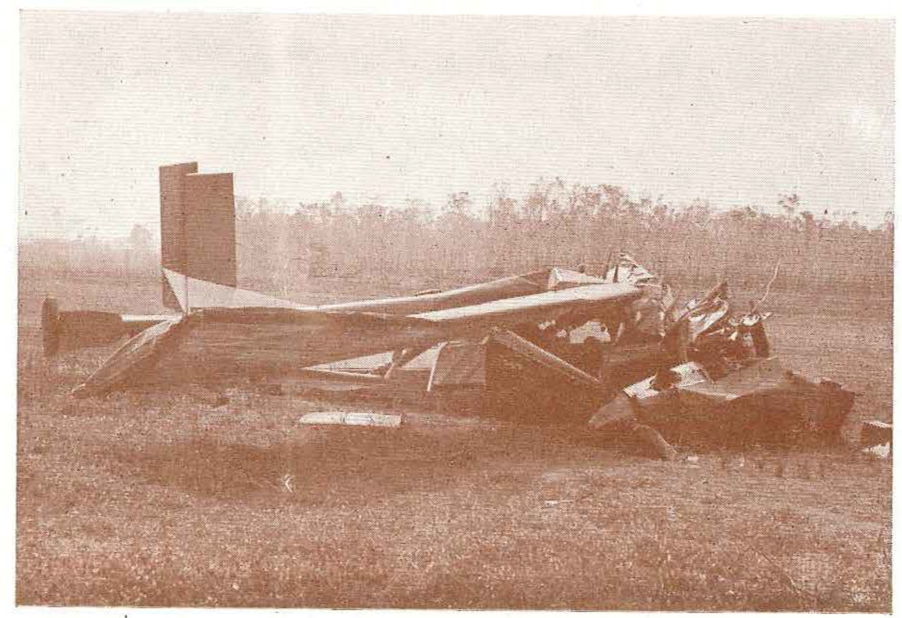
At 0730 hours local time, the Porter departed from Port Moresby and flew to Terapo, a mission station on the south coast of Papua, 94 miles northwest of Port Moresby and the supply point for the mission at Kaintiba. On its arrival at Terapo, the aircraft was loaded and the first air drop to the Kaintiba mission was carried out. The aircraft returned to Terapo, was loaded again, and the second air drop was successfully completed. After returning and landing for the third time at Terapo, the crew stopped for lunch, then at about 1230 hours the aircraft was refuelled and loaded for the next trip. Shortly before it was ready for departure, however, the first officer complained that he was feeling ill and asked if he might remain at Terapo for a while and lie down. A priest on the staff of the Terapo Mission then offered to act as cargo handler in his place. The pilot-in-command agreed, and spent some minutes instructing the priest in operating the cargo dropping doors in the cabin floor.

The pilot and the acting cargo handler then boarded the aircraft and soon afterwards, at about 1305 hours, the aircraft commenced its take-off run. After running along the ground in a three-point attitude for about 650 feet, the aircraft left the ground suddenly and immediately began to climb at an increasingly steep angle. At about 80 feet above the airstrip, in a very nose-high attitude, it stalled. The port wing dropped and the aircraft stall-turned to the left and dived to the ground in a near-vertical attitude.

The aircraft sustained very heavy damage. It had hit the ground first with the nose and port wing, and had then fallen into an upright position and slid tail-first for 40 feet before coming to rest. The engine, and propeller, with the engine mountings, fire wall and instrument panel still attached, were torn bodily from the front of the fuselage. The cockpit section of the fuselage was almost destroyed, only the cabin floor and a small section of the starboard side of the fuselage remaining. The floor itself was badly damaged by compression and the undercarriage legs had collapsed and sheared off. Further to the rear, the fuselage remained generally intact, though buckled and distorted in a number of places. Both wings, though still attached to the fuselage, were twisted and distorted as a result of severe compression loadings. The fuel tanks ruptured in the impact, spilling their contents, but no fire broke out.

Examination of the wreckage showed that the flaps were in the retracted position and that the tailplane trim was set four degrees nose-up. The engine had been running when the aircraft struck the ground and there was nothing to suggest that any malfunction or failure in the engine or airframe had contributed to the accident. The loaded weight of the aircraft was well within the maximum permissible figure and the centre of gravity was within the specified loading envelope, though well towards the aft limit.

The pilot had a great deal of flying experience, having been a senior captain on large four-engined jet aircraft with an international airline until the middle of 1962, but his experience on light single-engined aircraft was very limited. The company purchased the Pilatus Porter in September, 1965, and sent the pilot to Switzerland to undergo conversion training on the type. The pilot returned to Australia in November 1965, and in Melbourne, carried out the required performance tests on the aircraft before ferrying it



General view of wreckage from the starboard side. The engine has been torn bodily from the fuselage.

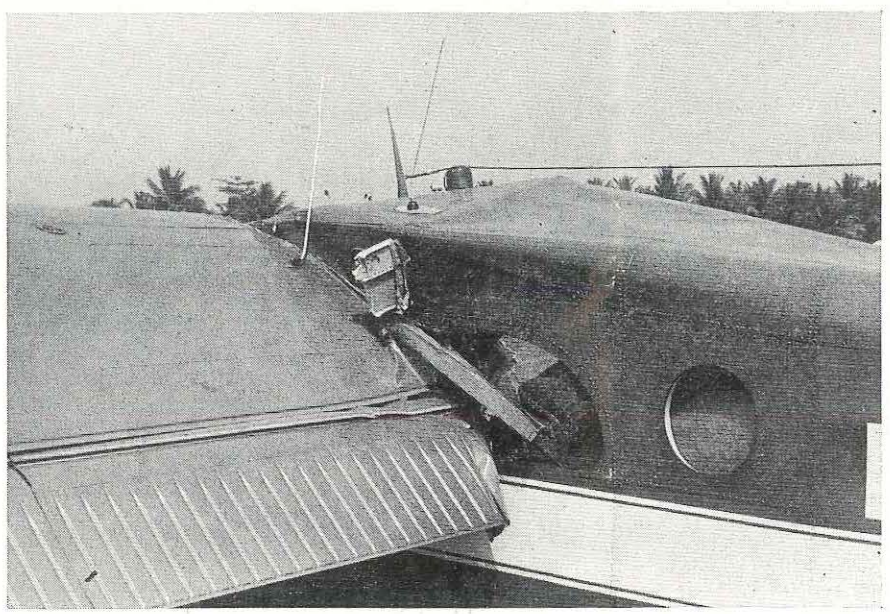
to Port Moresby. Apart from one very brief flight after returning to Port Moresby late in November, the pilot did not fly the aircraft again until the day of the accident, about three weeks later. At the time of the accident, the pilot's total experience on the type amounted to 33½ hours.

When interviewed after the accident, the pilot said that when the aircraft had been loaded at Terapo for the third time to the same take-off weight as used on the first two air drops, he completed his cockpit checks and then commenced to take-off. The pilot said that with this type of aircraft, the take-off technique he employed involved holding the tail wheel on the ground to help counter the aircraft's tendency to swing and then, when flying speed had been gained, lifting the tail wheel off the ground with forward stick and allowing the aircraft to fly away normally. On this occasion, however, the aircraft left the ground before he could ease the control column forward, and he was then unable to overcome the heavy rearward column forces that had developed. The pilot believed that in the Pilatus Porter, it was not possible to alter the setting of the tailplane trim while a substantial force was being applied to the control column. He stated that he had therefore attempted to lower the nose by retracting the flaps from their take-off setting, but the change in attitude was insufficient to avert a stall.

The pilot's belief that the tailplane trim control is immovable while control column forces are applied, was supported by the evidence of the first officer who had been undergoing flight familiarisation on the aircraft. The first officer said that this characteristic had been demonstrated to him during climb, cruise and descent, at speeds in excess of 90 knots. He did not know what the trim reaction would be at lower speeds, and admitted that during the demonstration he had only applied normal pressure to the trim control. He could not say whether the trim could be moved in these circumstances if greater pressure were applied to the trim control.

In the Pilatus Porter aircraft, the flaps and tailplane trim movements are controlled by coaxial hand cranks located centrally on the roof of the cockpit above the pilots' seats. Trim changes are effected by the shorter of the two cranks, which actuates a screw jack attached to the tailplane via a chain and cable linkage and varies the incidence of the tailplane. The trim setting is shown on a horizontal slide indicator in the cockpit. The recommended setting for take-off with the aircraft centre of gravity at the aft limit is three degrees nose-down, and with the centre of gravity at the forward limit, two degrees nose-up. The Pilatus Porter Manual states that, without applying high control forces, it is not possible to operate the elevators throughout their full range of movement with elevator control alone, and for this reason the use of the tailplane trim to assist elevator movement is recommended.

The question of whether the tailplane trim control was movable in the configuration in which the aircraft crashed was referred to the manufacturer of the Pilatus Porter. The manufacturer advised that control column forces would be high, but that there should be no difficulty in adjusting the tailplane trim setting either way. Following this advice, the wrecked aircraft's tailplane trimming mechanism was again carefully checked for freedom of operation and was found to have been fully serviceable. The mechanism had been properly lubricated and moved freely and there was no evidence of binding in the cables and pulleys. The settings of fixed tabs on the elevator were also checked and were found to be as specified by the manufacturer.



The port wing almost severed from the fuselage. Note the extensive fuselage buckling of the top of the cabin.

A series of flight tests were carried out in New Guinea on another aircraft of the same type. With the aircraft load, trim setting and airspeed adjusted to simulate the conditions at the time of the accident, it was found that there was no restriction in trim movement and that the aircraft was completely controllable with elevator alone. Above 91 knots, however, with full nose-up trim and climbing power applied, the tailplane trim control could not be moved, but became movable again when the speed was reduced to 86 knots. A test was also made to determine what the trim setting would have been in the landing configuration on the aircraft's return to Terapo immediately before the flight on which the accident happened. With the test aircraft loaded to simulate these conditions, a four degrees nose-up setting was required to trim it to an approach speed of 60 knots.

Because the tailplane trim was found set in a four degrees nose-up position after the accident, it seems very likely that the pilot had failed to re-set it after landing from the previous flight. This meant that, on the take-off on which the accident occurred, the aircraft was mistrimmed nearly seven degrees, the difference between the recommended three degrees nose-down setting and the actual setting of four degrees nose-up. The fact that the aircraft was loaded with the centre of gravity near the aft limit was significant to the cause of accident only in that the aircraft was seriously mistrimmed, the rearward centre of gravity position thus aggravating the situation. Had the trim been correctly set before the take-off run commenced, no difficulties would have developed. With the trim in the four degrees nose-up position, however, the aircraft left the ground much sooner than the pilot expected and quickly assumed a steep nose-up attitude. The take-off technique which the pilot was using, involved holding the control column hard back until the aircraft had gained flying speed, then easing the column forward sufficiently to allow the aircraft to fly away normally. In this case, however, the aircraft became airborne while the pilot still had the control column hard back. With the flying controls held in this position, the nose-up trim effect would have been accentuated and a situation was produced where it was not possible for the pilot to adequately control the aircraft once the take-off run had commenced. Possibly, if the pilot had attempted to raise the tail earlier in the take-off run, he would have recognised the out-of-trim condition and abandoned the take-off. As it was, the stage was set for an accident once the aircraft had left the ground and rotated so quickly into a steep nose-up attitude at what was obviously a very low airspeed.

The pilot said he was unable to correct the attitude of the aircraft because of heavy rearward forces on the control column. The flight tests conducted on a similar aircraft, however, established that, at initial climbing speed, the aircraft was completely controllable with elevator alone. It seems likely, therefore, that the rapidity with which the aircraft rotated into a near vertical attitude once it left the ground, coupled with the comparatively high rearward force acting on the control column, may have given the pilot the impression that he was unable to overcome the control column force to correct the nose-high attitude of the aircraft.

CAUSE:

The cause of the accident was that the pilot neglected to set the tailplane trim to a position appropriate for the take-off and thereafter did not maintain control of the aircraft in the pitching plane by the means which were available to him.

AIRMANSHIP

— *and the other fellow*

The Department has received a number of incident reports in recent months from aircraft captains complaining about non-standard procedures adopted by other pilots in the vicinity of country aerodromes where there are no Flight Information Units, and of the presence of other aircraft in areas where they had been advised that there was "no known traffic".

Many of these complaints have been made about general aviation aircraft by the captains of regular public transport aircraft, but there are incidents on record where the boot was on the other foot! Possibly there would be more in this category, were it not for the well-known reluctance of some general aviation pilots to become "involved" in incident reports, despite the potential benefits of the system to themselves and the industry as a whole!

Taken as a whole, the incidents indicate that there is, among all classes of pilots, an overall lack of appreciation of the problems and points of view of their fellow airspace users. The errors and breaches of procedure that have been reported might, for the most part, seem minor ones, but this does not blunt the fact that many of them could have led to a serious situation or even a fatal accident. All of us, when approaching an apparently deserted country aerodrome, are perhaps inclined to think that we have the sky to ourselves and that it is rather overdoing things to be expected to follow the same procedures that would be required of us at a controlled aerodrome! Perhaps this attitude might have been acceptable from a safety point of view even a few short years ago, but the tremendous expansion in flying that has taken place in Australia, particularly in the field of general aviation, has produced a situation where it is no longer valid. Light aircraft today are literally everywhere, and this increasing traffic is imposing greater responsibilities under the "see and be seen" concept of VFR flight.

It is hardly surprising that pilots of heavy regular public transport aircraft have been outspoken in voicing their complaints—it is they who are often at a great disadvantage in the sort of situations that have come under criticism. Pilots of regular public transport aircraft are responsible for a large number of passengers, they are at the controls of an aeroplane that, by its very size and weight, is far less readily manoeuverable than its much lighter and smaller counterparts, and the field of view from the cockpit is usually more restricted than that enjoyed by the pilots of most light aeroplanes. Small wonder then that regular public transport pilots are usually sensitive about the importance of observing correct air traffic procedures!

Reporting

One of the causes of much of this anxiety and worry, is the fact that pilots, as a whole, are not making the best use of the traffic information procedures set out in the AIP on pages RAC/OPS 1.19 and 20, and in the Visual Flight Guide on pages 108 and 125. These procedures require pilots operating outside controlled airspace to report their movements by radio, when taxi-ing at, departing from, or flying within, a ten-mile radius of a Flight Information Unit. This then enables the Flight Information Unit to provide a directed traffic information service to all radio-equipped aircraft operating in that vicinity. Obviously however, the service that the Flight Information Unit can give is only as good as the traffic information it receives, and, in this sense, the unit is entirely in the hands of the pilots flying in the area it serves. Where aircraft are operating from, or close to, an unmanned aerodrome which is more than ten miles from a Flight Information Unit, pilots are encouraged to broadcast details of their movements, altitudes and changes of level, on the route VHF frequency. This procedure then enables the pilots of other radio-equipped aircraft who may be flying in the area, to form their own assessment of the local traffic situation in the vicinity of that aerodrome and to report their intentions accordingly. Pilots of agricultural aircraft working in the vicinity of an aerodrome can assist this scheme considerably by advising details of their operations to other aircraft that have broadcast their intention of operating into or out of that aerodrome.

Benefits

All pilots of radio-equipped aircraft, whether regular public transport or general aviation, should make use of their radio to the best possible advantage. In doing so, everyone will benefit, and pilots will be helping themselves to get the best from the Department's traffic information system. At more remote country aerodromes, where regular public transport aircraft would normally transmit their ground reports (e.g., taxi-ing at ...., landed at ....) on HF, it is obviously desirable that they should also transmit this information on the VHF route frequency for the benefit of any aircraft in the area that are maintaining a listening watch on VHF only. This gives general aviation pilots the opportunity of knowing the movements of regular public transport aircraft in their particular area, so that they may regulate their own aircraft movements accordingly. General aviation pilots who are uncertain of the VHF route frequency applicable to a particular aerodrome, can obtain this information from the nearest Flight Information Unit.

The provision of traffic information in these situations is very much a two-sided affair—the responsibility for making it available lies equally with both regular public transport and general aviation pilots, who should each be interested in the other's movements. When necessary or desirable for traffic separation, aircraft may also communicate directly with each other on VHF, but care should be taken to avoid causing congestion on the frequency in use.

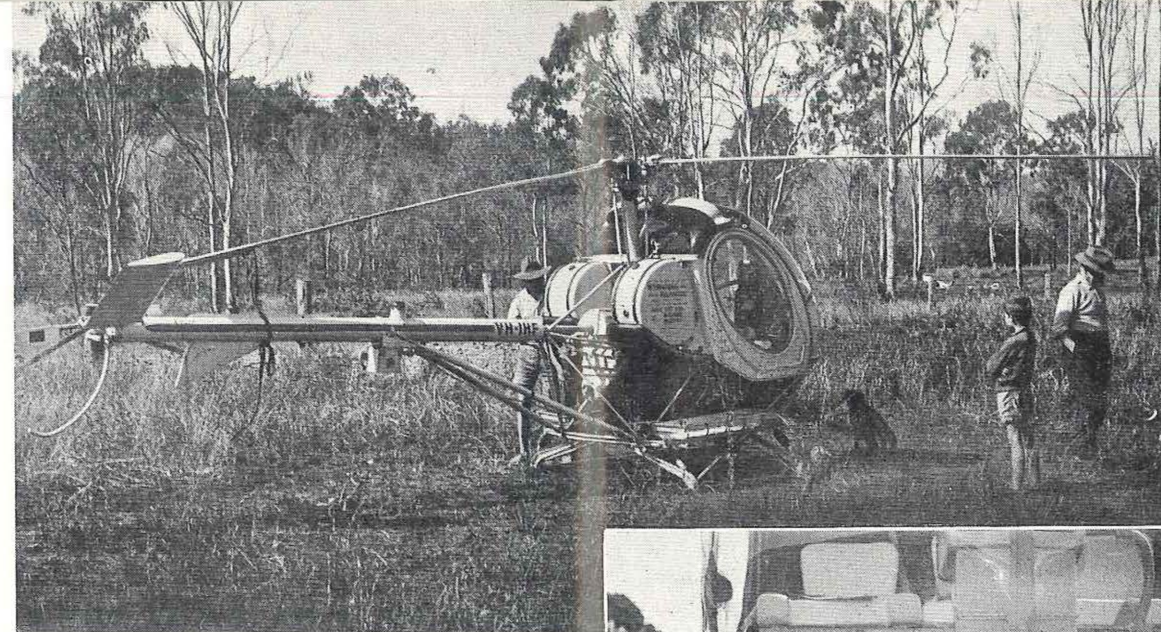
Non-Radio Aircraft

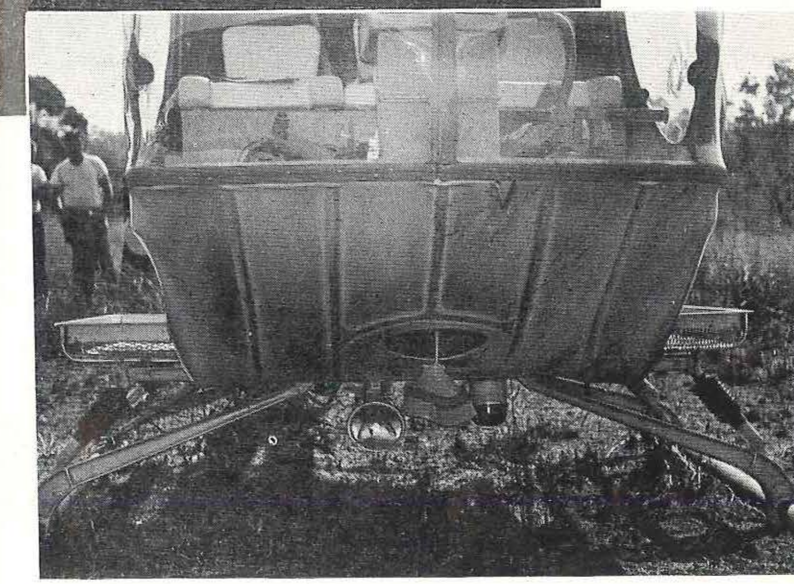
It must always be remembered that, even if every pilot of every radio-equipped aircraft flying were always to provide the fullest possible information on its movements, there would still be some unreported aircraft movements taking place outside controlled airspace. These are the "non-radio" aircraft, often encountered in country areas away from major centres. It is important therefore, that pilots accept this fact and be prepared at all times to encounter unnotified air traffic when operating outside controlled airspace. In these situations, as in all others, the philosophy of "see and be seen" is an essential element of traffic information.

The Visual Flight Rules and procedures have been devised so that this "see and be seen" concept of air traffic separation can function with acceptable standards of air safety. They do this by defining standards of visibility and of vertical and horizontal separation from cloud for Visual Meteorological Conditions which, in normal circumstances, provide sufficient airspace for avoiding action to be taken. If these standards are compromised in any way, a conflicting traffic situation could arise where the separation between two aircraft is insufficient for their pilots to take avoiding action. For this reason, the Visual Meteorological Conditions should always be regarded as a minimum acceptable standard and one which requires a continuous and vigilant watch to be kept for other aircraft.

Pilot Co-operation

The whole problem of traffic confliction is essentially one of airmanship, and, like others in this category, its solution lies almost entirely in the hands of pilots themselves. A more positive, responsible, generous and considerate spirit of co-operation from pilots in all sections of the aviation industry, will go a long way towards reducing the amount of heat at present being generated on flight decks and in cockpits. More importantly, it will make a significant contribution to air safety.





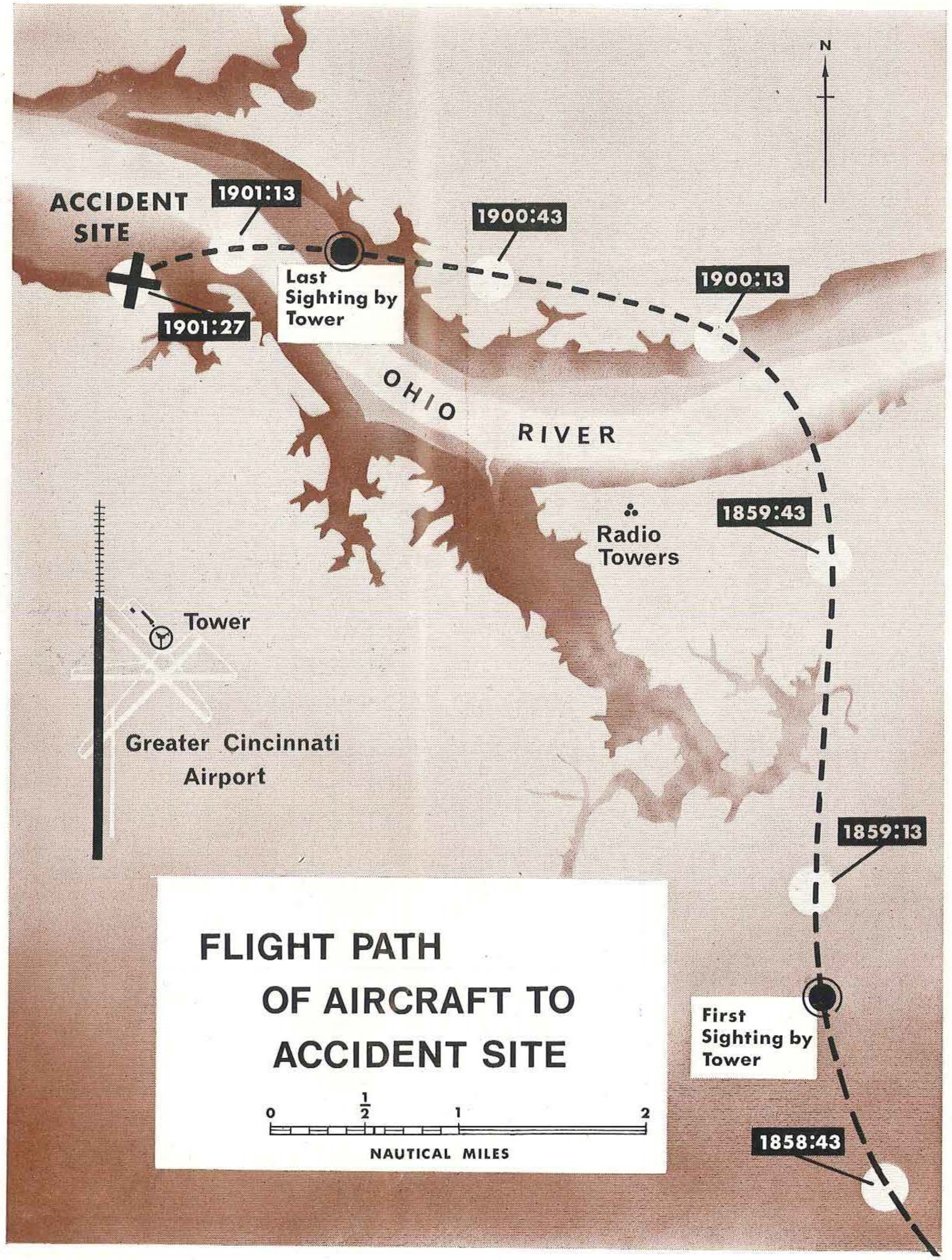
HELICOPTER PILOTS—

Beware of Landing in Long Dry Grass

These photographs show what happened to two helicopters when they landed in dry grass in the Northern Territory and in Queensland. In both instances the engine exhausts set fire to the surrounding grass. In the case of the Hughes (above and inset) the pilot climbed out to find the grass on fire beneath his aircraft. He immediately scrambled back into the cockpit to fly the helicopter to safety, but although he was unable to start the engine, probably because of the heat generated, the fire burnt itself out without spreading to the aircraft's fuel system. Damage was confined to the cockpit bubble, engine wiring and other plastic components such as the air cleaner and the engine fan shroud.

The pilot of the Bell (below) wasn't so fortunate. After landing in a clearing in the course of a gravity survey flight, the engine stopped before the pilot had time to shut it down. He climbed out to investigate and found that the long grass under the engine area was burning and had set the aircraft on fire behind the fire wall. Almost immediately afterwards, and before he could take any preventative action, flames engulfed the aircraft and it was completely burnt out.

Boeing Flown into Ground During Approach



During a visual approach to land at Greater Cincinnati Airport, Kentucky, U.S.A., after a night flight from New York, a Boeing 727 crashed and burnt on the wooded slopes of the nearby Ohio River. Fifty-eight of the sixty-two occupants were killed and the aircraft was totally destroyed.

THE FLIGHT

The aircraft had departed from LaGuardia Airport, New York, at 1738 hours local time, on a regular public transport flight to Cincinatti, carrying 56 passengers and a crew of six. The flight proceeded normally at 35,000 feet I.F.R., and at 1845 hours, the aircraft reported its E.T.A. Cincinatti, as 1905, and was advised that the QNH was 30.01 inches and that the airport barometric pressure setting (QFE) was 815 feet "above". At 1855, when the aircraft was 27 miles south-east of the airport, it was transferred to Cincinatti Approach Control. The weather at the time was clear to the east and north-east of the airport but there was cloud and lightning to the north-west.

Descent clearances were issued to the aircraft and on leaving five thousand feet the aircraft requested a VFR approach as the airport was in sight. The Approach Controller cleared the aircraft for a VFR approach to runway 18, and advised the crew that rain was falling just to the west of the airport boundary, and moving to the south. The crew acknowledged the clearance and they were then cleared to descend to 2,000 feet. When the aircraft was six miles south-east of the airport, it was transferred to the Cincinatti Tower and given the landing instruction "Runway 18, Wind 230 degrees, five knots, Altimeter 30."

Controllers in the tower first sighted the aircraft about four miles to the east-south-east, flying a northerly down-wind leg. Its navigation lights were clearly visible and it appeared to be at the normal traffic pattern altitude. The Tower called the aircraft again advising they had it in sight, and cleared it to land on runway 18.

Asked by the aircraft how far to the west was the line of precipitation, the tower replied that it appeared to be almost over the airport. The aircraft passed about a mile to the east of a group of radio towers located three miles east-north-east of the Tower, then began a left turn on to base leg and commenced a gradual descent. As it continued west on base leg, however, it disappeared from view two or three miles north-east of the airport. The controller watching thought it had flown into weather and called the aircraft to see if the crew still had the runway in sight. The aircraft replied "barely" but said they would "pick up the ILS." The Tower then advised the aircraft that the airport approach lights, flashers, and runway lights were all set to high intensity and received the reply "Okay". This acknowledgment was the last transmission from the aircraft.

Five seconds later the aircraft flew into timbered slopes on the west bank of the Ohio River valley, two miles north of the approach end of the runway. The point of impact was 665 feet above mean sea level but 225 feet below the level of the airport. The aircraft cut a swathe through foliage and scrub for 340 feet, before colliding violently with a group of large trees. It exploded a few seconds afterwards and burnt to destruction. A stewardess, a company pilot travelling in the forward section of the passenger cabin, and two passengers were the only occupants to survive.

INVESTIGATION

Examination of the wreckage at the scene of the crash showed that the first impact occurred when the starboard wing struck a tree, while the aircraft was in a level attitude on a heading of 235 degrees. The terrain at the point of impact has an upward slope of about ten degrees.

The airframe structure and all flight control surfaces were found in the wreckage area and there was no evidence of any inflight separation of the aircraft structure or components. The tailplane trim setting was found to be in the normal range, and the undercarriage was found locked in the retracted position. The trailing edge flaps were extended 25 degrees and all leading edge devices were fully extended. All spoilers were retracted.

All three engines were recovered from the wreckage. The engines had all ingested timber, mud and twigs during the impact, and the debris was distributed from the air inlet sections through to the turbine sections of each engine. A complete examination of the flying controls, the hydraulic and electrical systems and the three engines, revealed no evidence of any failure or malfunction before the crash but no reliable information could be gained concerning the power settings at the time of the accident. All flight and engine instruments in the cockpit were either severely damaged or destroyed and none were capable of being functionally tested. The remains of the Kollsman altimeters installed in the aircraft were recovered from the wreckage and were examined by the manufacturers. The captain's altimeter (No. 1) was found at a barometric setting of 29.06 inches, with the index marker set on 800 feet. The "thousands of feet" drum position (see illustration) could not be determined because of damage. The co-pilot's altimeter (No. 2) was found set to 29.03 inches with the index marker positioned at 815 feet. Portions only of the centre instrument panel altimeter (No. 3), were recovered and no information could be obtained from it.

The Kollsman drum-pointer type of altimeter installed in the aircraft has a range of from plus 50,000 feet to minus 1,500 feet. Hundreds of feet are indicated by a radial pointer; thousands of feet are indicated on a rotating drum. To increase the conspicuity of the thousands of feet readings, a cross-hatched marking is printed on the drum adjacent to the figures. A conventional barometric scale calibrated in inches of mercury is provided for setting the altimeter, and the adjusting knob also positions an index on the periphery of the instrument face which is used for setting the QFE. The company's altimeter procedures require that approaches to land be flown with the captain's and co-pilot's altimeters (Nos. 1 and 2) set to the local QFE, and with the third altimeter set to the QNH.

The aircraft, a Boeing 727-23, had been properly maintained in accordance with the airline's procedures and Federal Aviation Agency directives. Both the weight (120,980 pounds) and centre of gravity were well within the prescribed landing limits. The aircraft had carried a total of 38,000 pounds of kerosene jet fuel on departure from LaGuardia airport.

The flight was under the command of a company check captain, who was supervising the final stages of the other pilot's training to act as pilot-in-command of Boeing 727 aircraft. The check captain had accumulated over 16,000 hours flying time, 225 hours of it in 727 aircraft. The pilot who was flying the aircraft under supervision had been a captain with the airline for eight years and had logged 14,000 hours. His total time on 727 aircraft was 35 hours. Since being granted a type rating on the 727 three weeks before the accident, he had flown 9½ hours acting as pilot-in-command under supervision. The same check captain had flown with him on all the seven flights he had undertaken, one of which had been into Cincinatti four days before the accident.

Greater Cincinatti Airport is 890 feet above sea level. Its runway 18 is 8,600 feet long and 150 feet wide and is equipped with high intensity runway lights and a standard type "A" approach lighting system with sequenced flashing. All lights were on their highest intensity setting at the time of the accident. The ILS serving runway 18, the Cincinatti VOR, and the facility radar, were all operating satisfactorily.

It was established that the captain of the aircraft had obtained an adequate weather briefing before departing from LaGuardia. The weather at Cincinatti at the time of the aircraft's arrival was very much as forecast. The actual weather at the time of the aircraft's approach was:

"Ceiling 1,500 feet broken, 2,500 feet overcast, visibility 2 miles, moderate rain showers, wind 260 degrees 8 knots, altimeter setting 30.01 inches, thunderstorm north-west moving south-east, occasional lightning in cloud and cloud to cloud."

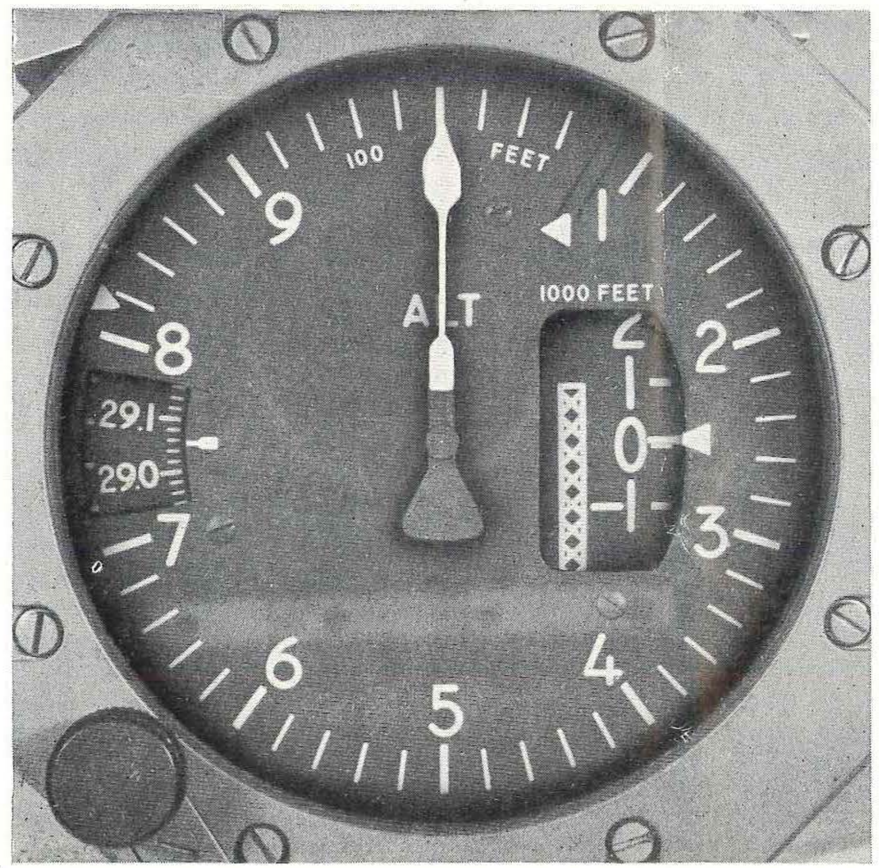
The Cincinatti arrivals radar controller stated that precipitation areas were visible on his radar scope as the Boeing was approaching. The heaviest area was to the west of the airport, moving southwards, with areas of lighter precipitation to the north and north-east. When the aircraft was last observed on radar two miles north-east of the airport, it appeared to be at the leading edge of the lighter area of precipitation.

The aircraft was seen by a number of ground witnesses during its approach. It flew down-wind about four miles east of the airport, crossed the Ohio River at low altitude, and turned west on to base leg. Its landing lights were on, the noise of its engines was loud and it appeared to be either flying level or making a gradual descent. The aircraft started to turn towards the airport two and a half miles from the end of runway 18. Light rain was falling at the time and heavy rain began to fall shortly after the aircraft passed. One witness located half a mile west of the crash site watched the aircraft's last 10 seconds of flight. He said he first saw four bright landing lights coming towards his position from the east. He then observed the aircraft bank rapidly to the left, crash into the hillside and burst into flames. He saw nothing unusual about the aircraft except that it was flying too low to clear the terrain.

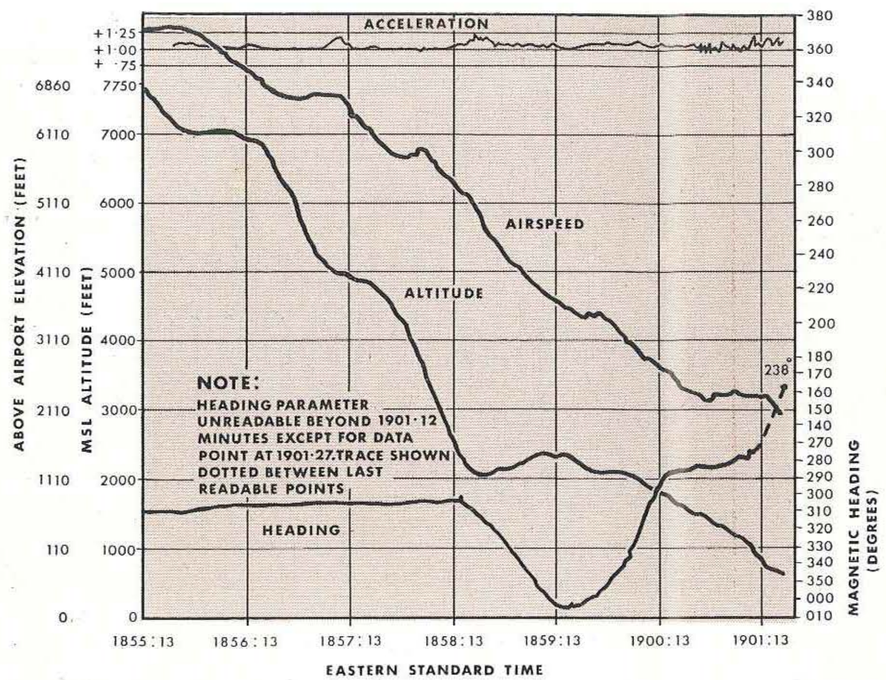
The pilot of a light aircraft, also inbound to Cincinatti at the time of the accident, said that when he was approximately five miles north-east of the airport, he observed a streak of light which he later assumed were the landing lights of the aircraft, progressing from left to right. The lights appeared to diminish in length during this period of three to five seconds, then went out. A few seconds later, he saw flames erupt from the ground. He stated that the weather was generally VFR to the north of the field, with thunderstorms located to the west and north-west. There was a line of light precipitation over the Ohio River extending from west of the airport, east to between the airport and the radio towers, with low scud in the same general area. He also noticed an area of heavy precipitation just starting in the immediate vicinity of the accident site. There was little or no turbulence.

Of the four occupants who survived the accident, only one, the company pilot who was travelling in the passenger cabin, could recall any details of the final stages of the flight and the crash itself. This survivor was occupying the forwardmost window seat on the starboard side of the first class cabin. He said that the flight en route from LaGuardia was normal. The initial descent into the Cincinatti area seemed rapid and the lights of Cincinatti were visible to the north after the aircraft levelled out. The next time he looked out the window, "It seemed like we were very low . . . I sat there unconcerned, and it seemed like we were on approach . . . and yet it seemed we had started another left turn and we were in a 10 to 15 degree bank" He heard what he thought were hydraulic flap motors towards the rear of the aircraft, and immediately afterwards the aircraft struck the ground. He was thrown to the floor of the cabin on impact and a great deal of debris piled on top of him. Although momentarily stunned, he saw flames coming from the rear of the cabin, and after extricating himself made his way forward and stepped out the front of the aircraft where the nose had been demolished. A few moments later the aircraft exploded and began to burn intensely. He said that during the final portion of the approach he had seen strobe light reflections from scud clouds below the aircraft. It was not raining when he first left the aircraft but a heavy downpour began about half a minute later.

Kollsman altimeter as fitted to Boeing 727's.



The aircraft's flight recorder was recovered from the wreckage and examination of the tape covering the portion of the flight from LaGuardia to the initial descent into Cincinatti revealed nothing unusual. A detailed read-out of the flight recorder traces for the final six minutes of the flight produced a ground track and profile which corresponded in all essentials with the evidence of air traffic controllers and witnesses on the ground. It showed a continuous descent from 7,000 to 2,000 feet on a heading of 305 degrees, during which the airspeed was reduced from 350 knots with a descent rate of about 3,000 feet per minute. The aircraft levelled off at 2,000 feet (1,110 feet above airport level)



Read-out obtained from Flight Recorder Traces.

and remained at this altitude for 1 minute 20 seconds while the airspeed decreased to 190 knots. While still maintaining this altitude the aircraft turned to a northerly down-wind leg and subsequently began a left turn on to base leg. At 1859:57 (1859 hours, 57 seconds) the aircraft began descending again, and a relatively steady descent of about 800 feet per minute was maintained for 70 seconds and the airspeed was reduced to 160 knots. At this point the aircraft was still holding a west-north-westerly heading on base leg. At 1900:53 another left turn was initiated on to final approach and at 1901:07, 20 seconds before impact, at an altitude of 1,100 feet or 210 feet above airport level, the descent rate increased to approximately 2,100 feet per minute, for 10 seconds. During this time, the aircraft descended into the valley, formed by the Ohio River, below the elevation of the airport. In the final 10 seconds of flight before impact, the descent rate decreased to approximately 625 feet per minute and the airspeed to 147 knots. There was no significant turbulence except in the last 50 seconds of flight when the recorder indicated some light turbulence.

The airline's normal VFR training pattern for Boeing 727 aircraft provides for the downwind leg to be flown at a distance of 1½ miles from the runway. Evidence obtained from the Cincinatti air traffic controllers and eye witness on the ground nevertheless indicated that the down-wind leg on this flight was flown some 4½ miles from runway 18, and this aspect of the approach was examined in detail. Evidence from the airline indicated that although the VFR training pattern taught to pilots serves as the standard or desired VFR approach many variations in distances, airspeeds, descent rates, flap and undercarriage extensions, are utilized in actual operations. Regardless of these deviations from the basic pattern however, it is always recommended that the aircraft should be stabilized on final approach, so that only small adjustments to the glide path, approach speed, and trim need be performed at this stage. It is also recommended that on VFR approaches pilots should utilize ILS glide slopes or visual approach slope indicators where available, as an aid to establishing and maintaining the proper approach path.

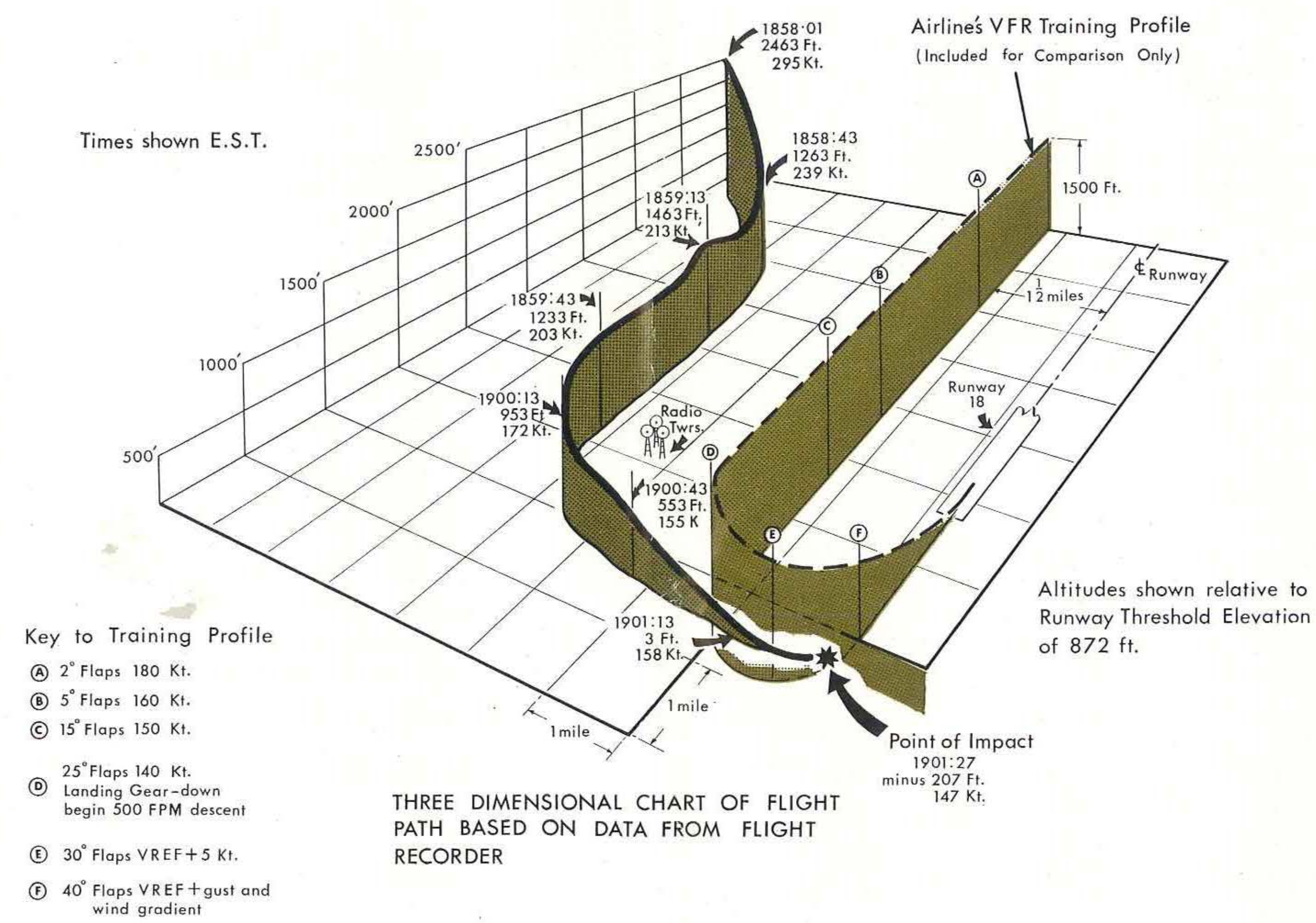
During the investigation, the flight characteristics and low speed performance of the aircraft type were reviewed. The study was made in the light of another generally similar Boeing 727 accident to determine if there was any inherent design characteristic in the aircraft that might in some way be related to the cause of the accidents. The study was later expanded to include a third Boeing 727 accident. The entire study disclosed no evidence of any design or performance deficiency and substantiated that the Federal Aviation

Agency and the Boeing Company had conducted extensive tests and research to ensure that the Boeing 727 complied with all applicable Federal Aviation regulations.

It was determined, however, that the lift/drag ratio obtained in the 727 with full flaps extended, requires a higher percentage of thrust than other types of large jet aircraft, to maintain desired landing speeds and rates of descent. At idle thrust and 40 degrees of flap, the Boeing 727's descent angle at the minimum approach speed was about two degrees steeper than the average descent paths of other models in the full flap configuration. The Boeing 727's speed is lower than those of other large jets with full flap and idle power, and in this configuration a steeper descent path was only to be expected. It was also found that the 727, with its hydraulically powered flight control system, has lighter control forces and is more responsive than other large jets.

Generally, pilots operating the 727 were pleased with its flight characteristics and had experienced no major difficulties in the operation of the aircraft. The Airline Pilots' Association believed that the aircraft constituted a major advance in aircraft design but noted that the aircraft's high descent rate with the flaps in the 40-degree position required the use of a greater percentage of thrust to maintain desired speeds. It therefore recommended against the use of steep approaches with high rates of descent.

Research being conducted by the National Aeronautics and Space Agency indicated that high descent rates close to the ground and non-stabilized close-in approaches occurred more often in Boeing 727 operations than with other large jet aircraft. The frequency of these occurrences varied from airline to airline. It was found that the pilot training programmes of airlines operating the Boeing 727, included no specific manoeuvres for demonstrating high rates of descent close to the ground, but all the training and operations manuals reviewed stressed



THREE DIMENSIONAL CHART OF FLIGHT PATH BASED ON DATA FROM FLIGHT RECORDER that high sink rates should be avoided in this phase of flight.

An exhaustive study of all the evidence indicated that the cause of the accident was directly related to the way in which the crew had conducted the approach, and indirectly related to specific factors which may have influenced them during the approach. The final radio transmission from the aircraft five seconds before impact, showed that the crew did not know they had descended below the level of the airport.

ANALYSIS

Analysis of the flight recorder data relating to the aircraft's flight path and configuration during its approach, in conjunction with a study of the airline's recommended approach procedures, indicates that the aircraft entered the airport traffic pattern at 210 knots with spoilers retracted and two degrees of flap extended. The airspeed diminished as the aircraft began its turn on to base leg and the flaps were extended to five degrees at 170 knots. Midway along base leg, 15 degrees of flap was selected at 160 knots, and as the aircraft turned on to final approach 20 seconds before impact, the flaps were extended to 25 degrees. The study indicated that the flap extensions, although conforming to the company's extension speeds, were concentrated or "bunched-up" on the base leg because of the comparatively high airspeeds maintained by the aircraft throughout the approach. It was also evident that except for the brief period of level flight at 2,000 feet m.s.l. at the beginning of the base leg, the entire descent was probably conducted at or near idle thrust. The only logical explanation for an approach at such low engine power settings was that the pilot had attempted to expedite the reduction in airspeed to the stipulated approach flap extension speeds. It can be seen, however, that if the down-wind leg altitude had been maintained, or if a considerably lower descent rate had been used while the flaps were being lowered, the airspeed would have been reduced more rapidly and the successive flap extensions could have been accomplished further back on base leg. Thus, with the aircraft slowed and approach flap extended, it would have been possible to use higher, more desirable thrust settings earlier in the approach. As it was, a number of aircraft configuration changes and landing checklist items still remained to be completed when the aircraft was turning on to final.

It is difficult to understand how two experienced captains could spend almost two minutes descending from 1,200 feet above the airport elevation at night and under adverse weather conditions, without properly monitoring altitude. Even if both pilots were primarily concerned with maintaining visual contact with the airport, it would be expected that one of them would make an occasional cross-check of the instruments. It can only be assumed that the crew, preoccupied with continuing the approach into deteriorating weather, did not give proper attention to their altimeters. It would be unreasonable, however, to attribute their failure to do so to one or two factors alone and the answer lies more probably in a number of complex and closely related circumstances which developed during the approach. The more significant of these will be examined separately but the influence of each must be gauged in the light of the total effect on the crew.

One of these factors which undoubtedly influenced the conduct of the flight was the weather situation in the Cincinatti area. Before the aircraft turned on to base leg, better than VFR conditions existed along the flightpath, but after making the turn, the aircraft encountered light rain and scud which rapidly reduced visibility. To maintain VFR conditions it might have been necessary to descend from the down-wind leg altitude. As the aircraft continued on base leg, rain became heavier and in-flight visibility dropped to two miles or less. The sequenced "flashers" of the approach lighting system would probably have been the only airport lights visible to the crew and it is likely that the pilots were mainly occupied at this time in maintaining visual contact with the airport.

Terrain Features

The Ohio River basin directly to the left of the flightpath is 400 feet lower than the terrain south of the river in the direction of the airport, where unlighted, wooded slopes rise steeply from the river to the approximate elevation of the airport. At night under poor visibility conditions, it is quite conceivable that the lights of houses on the river bank could be associated with the terrain elevation in the vicinity of the airport.

At all times after turning on to base leg, the airport was well to the left of the aircraft, so that to keep the airport in sight, the pilots would have had to look out the left side of the cockpit. The only other lights visible in this direction would have been the lights of the houses along the river bank which could have given the pilots an illusion of adequate altitude and terrain clearance.

Misinterpretation of Altimeter Presentations

The drum type of altimeter, fitted to the aircraft, has been in operation for many years and is considered by the industry to be an accurate, highly reliable instrument. Nevertheless, improper monitoring could possibly lead to misinterpretations. To read this type of altimeter, the pilot must first look at the number below the index on the "drum" for the thousand-feet level, and then at the radial pointer for the hundreds of feet indication. At constant altitudes, or at low rates of climb and descent where the drum is virtually stationary, the pilot must be certain to associate the correct thousands of feet indication with the hundreds of feet reading. For example, an altimeter presentation of 900 feet would show "1", slightly above the drum index and the "zero" below the index. The radial pointer would be pointing to the nine on the outside dial. A misinterpretation could occur if a pilot mistakenly associated the radial pointer reading with the "1" slightly above the index rather than the "zero" below the index for the thousands of feet indication. The result would be a reading of 1,900 feet rather than the 900 feet actually indicated, an error of 1,000 feet. In descending to a "below zero" elevation, the radial pointer, rotating anti-clockwise, does not point to the actual hundreds of feet below zero. For instance, a reading of 100 feet below zero elevation would be portrayed with the radial pointer on the outside dial nine and with the zero on the drum slightly above the index. This requires the pilot to interpret the nine hundred feet indication as actually meaning 100 feet below zero. Additionally, with negative values, the number *above* the drum index rather than the number *below* the index gives the correct thousands of feet reading. In other words, the drum presentation reverses at below-zero altitudes.

A pilot familiar with the altimeter should have no problem whatsoever in quickly determining the correct altitude reading, but it is possible under conditions of infrequent, or distracted monitoring, a misinterpretation could occur.

Cockpit Workload

Because higher than normal airspeeds were maintained by the aircraft throughout most of the approach, all the flap extensions occurred on the base leg, and as late as the turn on to final, two and a half miles from the runway, only 25 degrees of flap had been extended. According to the airline's operating procedures, the aircraft should have been in the landing configuration at the completion of this turn with the airspeed and rate of descent stabilized. But even in the latter stages of the turn, the undercarriage had not been lowered, and the landing checklist had obviously not been completed. There can be little doubt that the crew would have been extremely busy at this time.

Consideration must also be given to the fact that the two captains had flown together on seven previous flights, knew each other well, and most probably had established a high degree of reliance on one another's operational capabilities. It is possible that the check captain, confident in the other pilot's ability to operate the aircraft safely, might have assumed that the instruments were being monitored and that he could concentrate on maintaining visual contact with the airport. It is also possible that the captain under supervision might have felt secure in the knowledge that a well qualified check captain was in the right hand seat, and that he could concentrate on keeping the airport in sight, with the assurance that the check captain was monitoring the instruments.

The airline's operational procedures require the pilot not making the landing to call airspeed, altitude, and rate of descent when the aircraft has reached 500 feet above airport level. The rate of descent is called again if at any time it exceeds 700 feet per minute, once the aircraft has descended below 500 feet. The flight recorder shows that the aircraft descended through 500 feet on base leg at 1900:45, 42 seconds before impact, but that the rate of descent remained in excess of 700 feet per minute throughout the remainder of the approach. It is evident that either the altimeter monitoring procedures were not being followed, or that a misinterprtation of the altimeter had occurred. If the pilot not making the landing, in this case the check captain, was concentrating on maintaining visual contact with the airport, the limits of his line of vision would have been between 80 and 45 degrees left of straight ahead. With his heavy workload of extending the flaps, performing the landing checklist, making all radio transmissions and trying to keep the airport in sight, he would have had little time to swing his gaze back to his own instrument panel on the right hand side of the cockpit. With the captain's altimeter on the left hand side almost in his line of vision with the airport and set to the same QFE as his own, it is probable that the check captain would have used this instrument for reference. The probability of error is enhanced when an instrument is read from a side angle, which in this case, would have been about 55 degrees. It is doubtful that the centre altimeter (No. 3) set to the QNH, would have been used during the approach. It is also reasonable to assume that the flight engineer, occupied in completing the landing checklist, would not have been monitoring the flight instruments at this stage of the descent.

From other evidence gained during the investigation it appears that the entire flight was conducted so as to expedite the aircraft's arrival at Cincinatti Airport. En route clearance changes were obtained which provided direct and shorter routings to Cincinatti, the aircraft's average ground speed within the terminal area (between 30 miles and 6 miles of the airport) was in excess of 325 knots, a contravention of a Federal Air Regulation which restricts terminal area speeds to 250 knots IAS within 30 miles of the destination below 10,000 feet, and, despite adverse weather, the crew elected to make a visual rather than an instrument approach.

These aspects of the flight do not suggest any hazardous operational practices, but they do indicate operational decisions aimed at arriving at Cincinatti Airport in the shortest possible time.

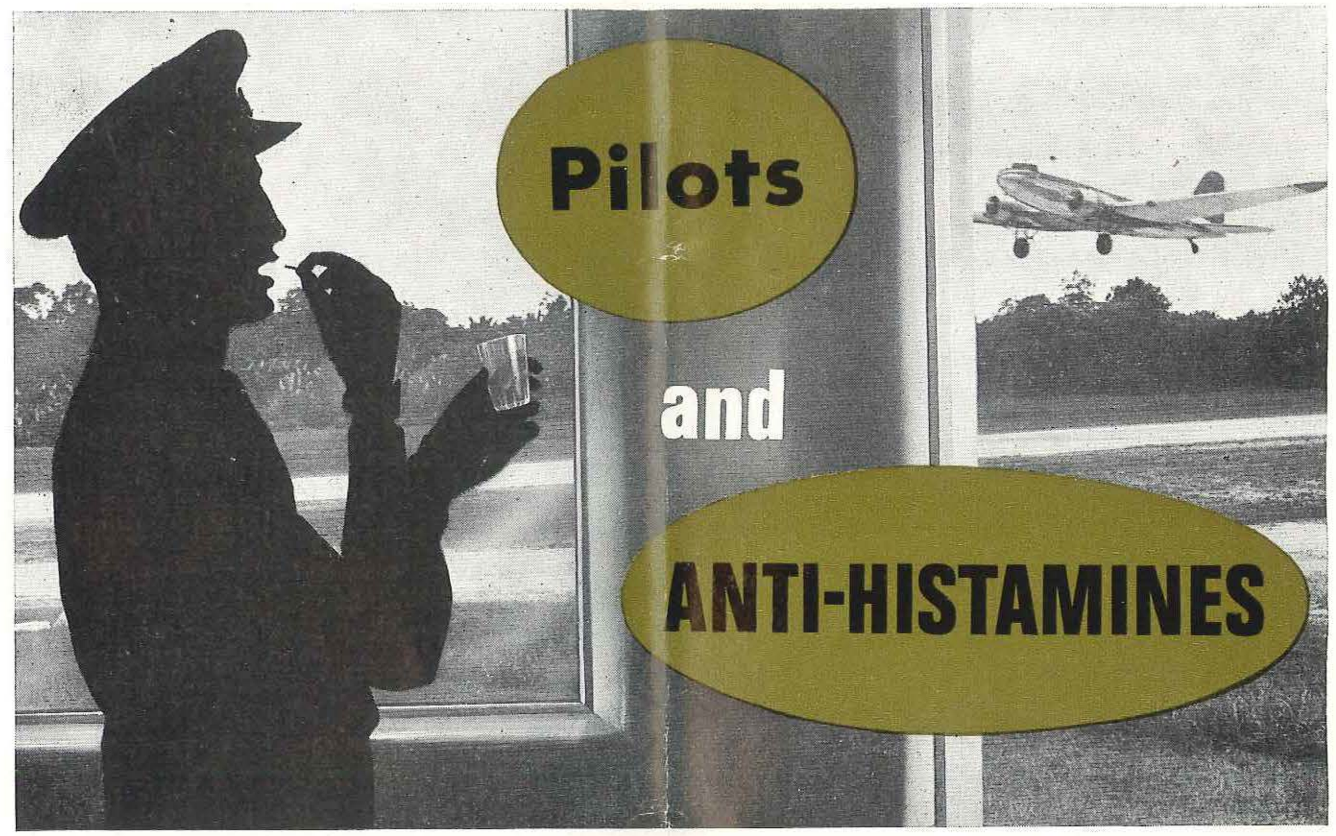
This situation alone, however, should not have precluded proper monitoring of the aircraft's altitude, and can only be considered as a factor which may have contributed to the crew's apparent inattention to the flight instruments.

It cannot be determined to what extent the lightning flashes associated with the storm might have affected cockpit visibility or distracted the crew, but these, with other indeterminable factors, must be considered in the final evaluation. It is clear, however, that the rapidly deteriorating visibility and the increasingly heavy cockpit workload, compounded with these other influencing conditions, could have distracted the crew from proper monitoring of the aircraft's altitude. The last point at which this accident could have been averted was approximately 13 seconds before impact. At this time the aircraft was descending below the level of the airport and any visual contact with the airport or approach lights would have been immediately lost. At that point a missed approach could have been accomplished within the operating capabilities of the aircraft. However, as already stated, the accumulation of many factors either delayed or precluded proper recognition of the situation.

Although it was clearly established that the flight characteristics of the aircraft were not a factor in the accident, the investigation uncovered operating practices that require attention. Close-in, high rate of descent, unstabilized approaches, are being flown more often in the 727 than in any of the other large jet aircraft studied. Why this is so is not immediately evident, but as the aircraft has been used principally for short or medium haul operations as compared to the longer range operations of the older and larger jet transports, it is possible that the very nature of these short range operations is engendering deviations from standard jet operating practices. Consideration must also be given to the fact that the 727's favourable flight characteristics may be misleading to pilots, giving the impressions that greater liberties may be taken with the aircraft, especially during the approach and landing. It is not known which of the above factors is responsible for results indicated, or if some combination of them is involved, but the Civil Aeronautics Board believes the matter is of sufficient importance to warrant a thorough review by the industry to resolve the question.

The circumstances of this accident are greatly different from those involved in another Boeing 727 accident which occurred at Salt Lake City, Utah, for which the Civil Aeronautics Board has already issued a report, but there are elements of crew judgment common to both. For this reason the Civil Aeronautics Board re-emphasizes that the responsibility and authority committed to an airline captain requires the exercise of sound judgment and strict adherence to prescribed practices and procedures. Any deviation can only result in a compromise of aviation safety. Airline management too, has a heavy responsibility for devising and implementing methods that ensure their pilots constantly exercise a conservative and prudent approach to their daily work.

Probable Cause: The Board determined that the probable cause of this accident was the failure of the crew to properly monitor the altimeters during a visual approach into deteriorating visibility conditions.



Pilots and ANTI-HISTAMINES

From time to time, whether they know it or not, most pilots take some form of anti-histamine drug, especially if they are among those unfortunates who suffer seasonally from hay fever. But there are probably many pilots who don't know that anti-histamines can produce side effects which could affect safety in flight.

Anti-histamines are so named because they were developed to combat the effects of histamine in the human body. Histamine is normally present in the human body and is thought to play an important part in the processes of producing the state of shock, as well as various allergic conditions. Anti-histamine drugs were first introduced in 1937 and today there are many varieties available under proprietary names. Antistine, Ancoline, Meclozine, Avil, Benadryl, Fabahistin, Histryl, Nilergix, Periactin, Phenergan, Piriton, Polaramine, Thephorin and Marzine are some well-known examples.

The effectiveness of anti-histamines has been proved beyond doubt in the treatment of hay fever, urticaria (nettle rash), hives and other allergic conditions. Their value in treating common colds and similar infections, vomiting and asthma, is debatable, but they are, nevertheless, widely used for these purposes. Certainly they give considerable relief by drying up secretions in the nose, mouth and lung passages. Some anti-histamines, for example Benadryl, Dramamine, Phenergan, Avomine, Meclozin and Marzine, are also undoubtedly effective as a treatment for motion sickness and are often used for this purpose.

Anti-histamine drugs are usually prescribed and administered in the form of a brightly coloured tablet or pill. A doctor's prescription is not always required for their purchase—the law varies from state to state in this regard—and they may frequently be found in drug mixtures being marketed as remedies such as "cold cures".

Nearly all types of drugs have undesirable side effects in one form or another, and in the case of anti-histamines the most common one is drowsiness. This is a particularly insidious side effect because it may not be recognized and may recur after a period of seeming alertness. Inability to concentrate, dizziness, lack of co-ordination in body movements, depression and even fainting are other possible side effects. All these symptoms may be aggravated if the subject has also taken alcohol. All in all, it is not difficult to appreciate that a pilot's flying capabilities can deteriorate under the effects of anti-histamine drugs.

Last year in the United States, a Cessna 172 was making a flight to drop two parachutists. Although the pilot was highly experienced and mature, he lowered full flap during the take-off and, as a result, the aircraft barely cleared a power line beyond the end of the strip. The pilot continued the climb, however, and at 3,000 feet the first parachutist jumped as arranged. The second jumped after the aircraft had climbed further, but soon after this parachutist had opened his canopy, he and other witnesses saw the aircraft in a steep, power-off dive. A witness watching from the ground said that the speed in the dive became so high that she expected the aircraft to break up in flight. With little or no change in the angle of descent, however, the aircraft continued to dive and plunged into the ground with tremendous force.

Post-mortem examination of the pilot's remains showed a level of anti-histamine in excess of the normal amount that a doctor would prescribe. The side effects produced by this particular anti-histamine drug include dizziness, nausea, high fever and drowsiness. Pilots taking the drug are advised not to fly for 24 hours after a normal adult dose or for at least 12 hours after taking half the smallest adult dose.

With all types of drugs, the response of different individuals varies enormously, whether the dose is large or small, and, for this reason, it is not possible to predict what side effects will manifest themselves when any one person takes an anti-histamine drug. As the side effects are so clearly detrimental to flying safety, however, precautions must be taken when pilots find it necessary to take anti-histamines, as many no doubt do, in the "hay fever season". Quite obviously, therefore, a pilot must wait a reasonable period for the effects to wear off before he flies again. The time interval which should be allowed will, of course, vary with the condition being treated, the particular drug taken, and the response of the individual pilot.

Because of this potential for such wide variation in response, advice in broad general terms such as might be offered in an article of this sort, could very well be misleading. It is most necessary, therefore, that individual pilots seek the advice of their own doctor if they feel in need of treatment for any of the conditions mentioned. It hardly needs to be said that it is dangerous to attempt to treat oneself with anti-histamines.

In such circumstances, because a doctor may not know that his patient is a pilot, and because the doctor may prescribe an anti-histamine drug without the pilot realizing what it is, pilots should always inform their doctor of the nature of their flying activities. Indeed, THEY SHOULD DO SO WHENEVER THEY CONSULT A DOCTOR—many other drugs also have side effects which are undesirable for flying and it is possible that a doctor, unaware that his patient is a pilot, may prescribe treatment which should preclude flying altogether.

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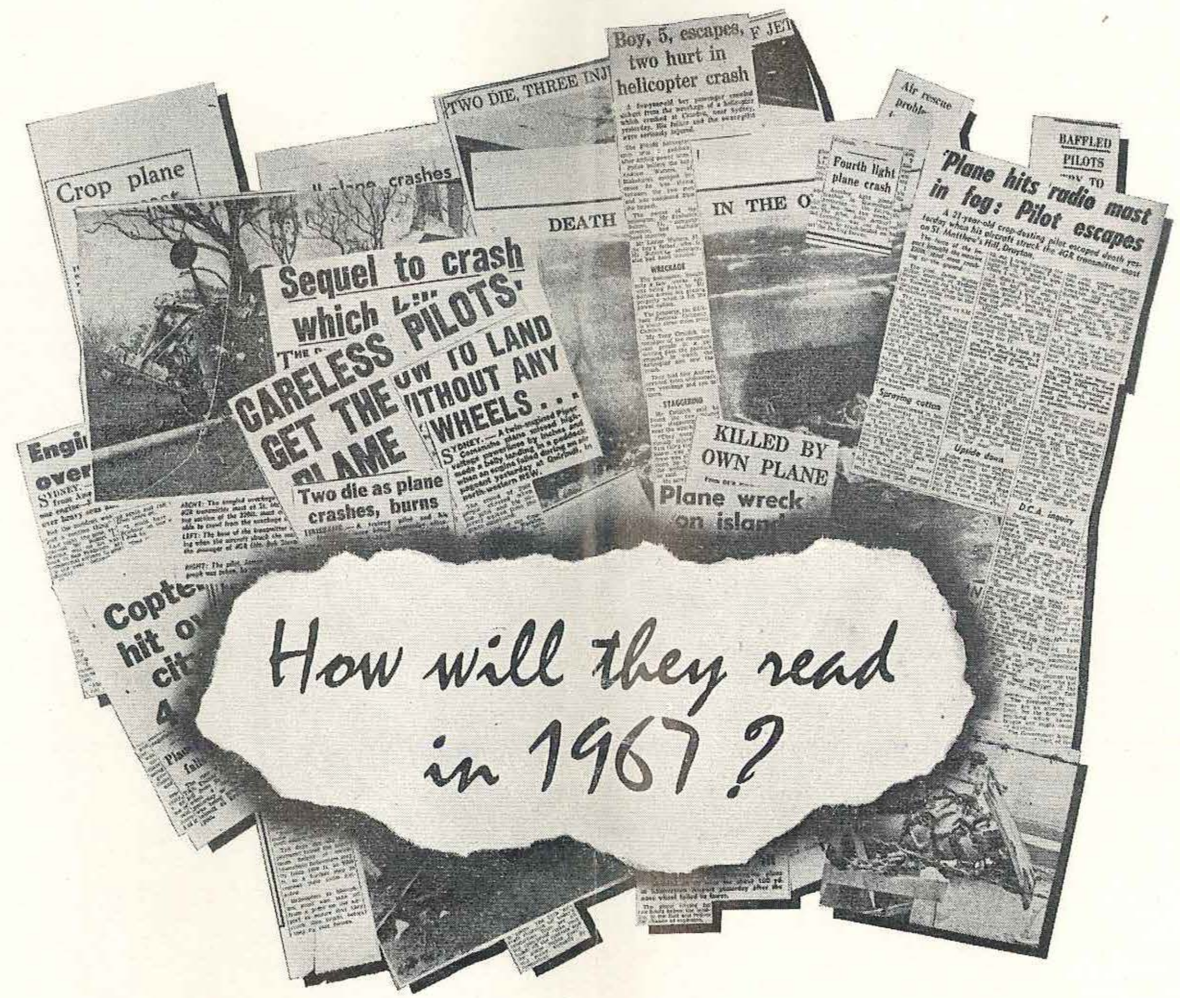

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