No. 2

Aero O/Y, DC-3, OH-LCC, accident at Koivulahti, Finland, 3 January 1961. Summary report released by the Investigation Commission and the Commission for Investigation Control appointed by the Ministry for Communications and Public Works, Finland.

Circumstances

Flight AY 311 was scheduled to depart Kruununkyla for Vaasa at 0700 hours local time on 3 January, however, owing to a delay in pre-flight preparations the take-off did not take place until 0716 hours. The estimated duration for the Kruununkyla-Vaasa sector of the trip, a distance of about 100 km, was 30 minutes.

When approaching Vaasa the aircraft crashed in the woods in the village of Koivulahti at approximately 0740 hours, caught fire and was completely destroyed. The accident site is 10.5 km north of Vaasa Airport (direction 018°). All 22 passengers and 3 crew members aboard the aircraft were killed.

Investigation and Evidence

The Aircraft

Its last certificate of airworthiness issued 20 October 1960 was valid until 30 April 1961. Maintenance of the aircraft had been carried out as required.

On departure from Kruununkyla, OH-LCC's take-off weight of 11 252 kg was under the maximum permissible of 11 900 kg, and the aircraft's centre of gravity was within limits.

Crew Experience

The pilot-in-command of the aircraft had flown in that capacity on DC-3's with the company since July 1956. His airline transport pilot's licence was in order and valid until 9 June 1961. His total number of flying hours amounted to approximately 5 887.

The co-pilot held a valid commercial pilot's licence and had flown a total of 2 737 hours.

Weather

The preceding night a light snowfront was moving in the direction of Vaasa-Kruununkyla, followed by radiation fog on low-lying spots on the ground, such as fields and river valleys. The fog did not cover ridges and hills.

At the time of the accident (0740 hours) the weather conditions were:- visibility - 1 km in Vaasa; cloud 8/8, base 200 ft (60 m); temperature minus 2°C. The 0750 weather report transmitted to points including Helsinki and Tampere showed conditions which were similar to those existing at 0740 hours. There was also radiation fog in the river valley of Isokyrö, which lies near the place of the accident. The weather conditions were deteriorating. The temperature in Vaasa fell 7° within an hour, and the horizontal visibility at Vaasa Airport had deteriorated to 400 m by 0920 hours.

Activities of Flight Crew Prior to Final Flight - (Alcohol Discussion)

The pilot and co-pilot flew together on Friday, 30 December (1960) starting at 0805 hours on a scheduled flight Helsinki-Turku-Mariehamn-Stockholm. At 1535 hours on the same day they began the return flight Stockholm-Mariehamn-Turku-Pori. Owing to engine trouble an overnight stop at Pori was made, and the aircraft flew on to Helsinki at noon the next day (Saturday) without passengers. While at Pori the captain and co-pilot had liquor.

Both spent New Year's Eve and night in Helsinki at their homes and the following day, 1 January (Sunday), set out on a scheduled flight at 1850 hours for Turku-Mariehamn, returning Monday morning by the same route to Helsinki. No details are available as to how they spent their off-duty time in Mariehamn.

At 1805 hours on the Monday they commenced their joint working shift on a scheduled flight Helsinki-Pori-Vaasa-Kruununkyla. The landing at Kruununkyla was made at 2045 hours. On arrival at the town of Kokkola the captain and co-pilot went to the restaurant of the hotel where they were staying and had a meal with the local traffic officer, a representative of Aero O/Y , which included liquor (beer and gin).

After midnight the party had further liquor (cognac) for about half an hour in the pilots' hotel room. They then went to the traffic officer's residence for more drinks until about 0200 hours. Both crew members stayed there overnight.

Nex day the two flight crew did not arrive at the airline's office in Kokkola in time to catch the bus for the airport but went directly to the airport by taxi from the traffic officer's home.

On arrival at the airport, the pilot-in-command and the stewardess went straight to the aircraft whereas the co-pilot first reported to air traffic control.

Neither the taxi-driver nor any other persons questioned by police who had been performing duties at the airport, reported having noticed that the two flight crew members were intoxicated. However, the foreman doing construction work at the airport, who had a brother among the aircraft's passengers, stated that he suspected such a possibility.

On the basis of blood tests taken at the post-mortem examination it was established at the Institute for Medical Jurisprudence of the University of Helsinki that the pilot-in-command's blood contained at least 2 o/oo and the co-pilot's 1.56 o/oo of alcohol. Approximately the same result was obtained by calculating the crew's assumed share of the total quantity of alcohol consumed by the party of three persons the foregoing evening (16 bottles of beer, 7 gingrogs and about 900 g of cognac).

Regulation regarding alcohol consumption

Paragraph 18, point 3, of the agreement between Aero O/Y and the Finnish Airline Pilots Association in force at the time of the accident contains a regulation forbidding the consumption of alcoholic drinks when on duty and during the 12 hours before a flight. However, 1/3 litre of beer or 20 centilitres of light wine was allowed in connexion with a regular meal comprising a warm dish, but not during the flight.

Reconstruction of the flight of 3 January

The flight crew and traffic officer arrived at the airport only five minutes before the scheduled departure of the flight. The start was delayed as the tickets and luggage of passengers from Pietarsaari had to be checked at the airport.

The co-pilot made out the flight plan and obtained the necessary weather information. The pilot-in-command examined the aileron of the aircraft to ascertain that there was no snow or ice on it but did not perform an outer inspection of the aircraft.

The weather report given by the meteorological station at Kruununkyla indicated that the existing conditions at Vaasa were fairly good -

0650 wind 220°/6 kt; visibility 10 km; clouds 8/8, cloud base 5 000 ft clouds 2/8, cloud base 1 400 ft.

The forecast was also good.

The flight (AY 311) was to continue on from Vaasa to Pori, and the co-pilot was informed by the air traffic controller

that the weather at Pori was not as good as at Vaasa. Pori is used as an alternate airport when flying from Kruununkyla to Vaasa.

Through ATC-Kruununkyla the co-pilot had requested permission from ACC Vaasa to fly at free altitude. This means that the aircraft is allowed to fly at or above the minimum altitude prescribed for the route in question. The lowest altitude allowed on the route Kruununkyla-Vaasa is 1 500 ft or 450 m. As there was no other traffic on the route, ACC Vaasa approved the request and the aircraft was informed, accordingly, before take-off.

The first part of the flight was normal except for the fact that it was carried out below the prescribed minimum altitude. The aircraft flew below the minimum the whole way, the last 30 - 40 km probably below 100 m.

At 0721, i.e. about 5 minutes after take-off, the aircraft was advised to change over to the radio frequency of Vaasa ATC. The radio communication between the aircraft and ATC Kruununkyla was normal and was probably done by the co-pilot. The air traffic controller (Vaasa) stated that the aircraft had thereafter called Vaasa ACC by radio several times, but it seemed that the answer from Vaasa could not be heard by the aircraft.

It was proved, during the reconstruction flights, that when flying at an altitude of 200 m, radio transmissions from Vaasa ACC could be heard aboard the aircraft beginning from a distance of about 50 km only, i.e. half the way from Kruununkyla to Vaasa. This also implies that the aircraft was flown at a low altitude.

Based on eye witnesses' statements and reconstruction flights it was concluded that the aircraft was flown within the prescribed airway, which is 18,5 km wide. Having maintained its initial climbing course as far as Ahtava, the aircraft turned somewhat to the right. At least from Oravainen to the accident site, a distance of about 30 km, it had apparently flown below 100 m. When passing Oravainen or thereabouts, about halfway, ATC Vaasa called the aircraft by radio at 0730 hours. The aircraft answered promptly and ATC Vaasa believed the co-pilot was operating the radio. The communication lasted about 4 minutes, and the Vaasa weather report was transmitted during this time. The report was the same as the one that the flight had received at Kruununkyla except that the weather had deteriorated and the clouds were now 8/8 600 ft. The aircraft was cleared for an approach to land on runway 16 for which an instrument approach must be carried out using the non-directional beacon "Seppa". The aircraft acknowledged the clearance. At the beginning of the communication the aircraft reported it was at 1 500 ft, above the clouds, and estimated it would be over Seppa at 0741 hours. The reported cruising level was obviously false. The aircraft was then about 20 km from the place of the accident and headed for the non-directional beacon at Seppa.

After the communication ended at 0734, ATC Vaasa received a message from the MET office stating that the cloud base was at 500 ft. This information was passed on to the aircraft immediately. The written 0735 weather report was then received, and according to it the Vaasa weather had deteriorated to such an extent that the horizontal visibility was only 1 km, clouds 8/8 200 ft and there was fog on the airport. The flight was again advised promptly, and it acknowledged receipt of the information. It was also told that conditions on the outskirts of the airport may even be worse. The aircraft then advised that it would be at the beacon in approximately two minutes time. This was the last radio communication with the aircraft, and it ended at 0739 hours. At this time the aircraft was about 3 - 6 km from the accident site. During this last communication the rpm of the engines was noticeably increased from 2350 - 2500 rpm. (This was established by comparing observations of persons who saw the actual flight with observations made by the same persons of reconstruction flights operated at different rpm's.) The increase indicates the

pilots had begun the check required before landing. The aircraft was about to arrive at NDB Seppa.

When the flight did not advise that it had reached NDB Seppa the air traffic controller attempted to contact it several times on all the frequencies used by Vaasa ACC, but without success.

At about 0755 the police of Koivulahti reported to Vaasa ACC that they had been informed that an aircraft had crashed in woods nearby.

Subsequent to the last radio communication the aircraft flew for about 1.5 minutes over the open fields of Koivulahti at about 50 m, perhaps less, and then made a steep left turn during which it lost so much speed that a stall resulted. An unsuccessful attempt to regain control was made giving full throttle at the last moment; however, the aircraft went into a spin.

From the manner in which trees and branches were broken in the vicinity of the crash it was concluded that the aircraft had struck the ground, left wing first and at an angle of about 70°. On crashing to the ground it turned at least 60°. The direction of the aircraft on the ground was approximately the same as its heading before the turn. It is probable that the landing light had been switched on.

The accident site is about 400 m south of the aircraft's route. The time of the accident was fixed at about 0740:30 hours (0540:30 GMT).

Discussion of possible causes of the accident

Icing - this factor as the probable cause was considered and eliminated. Weather conditions existing were such that the forming of ice in sufficient quantity to impair the flight characteristics of the aircraft was not possible. The deicing equipment aboard the aircraft had not been used, and ice accretion was not mentioned during any communications.

Collision with trees or other object - there was no evidence to support this as a possible cause of the accident. No traces were found on any of the aircraft's parts which indicated it had hit any obstacle prior to crashing to the ground.

Fire or explosion - eye witnesses, who had observed the aircraft prior to the accident, had observed nothing pointing to such a possibility. No objects had fallen from the aircraft away from the accident site. The fire extinguishing equipment had not been used.

Attempted forced landing - because in the last phase of flight the aircraft had turned back towards the open fields of Koivulahti, the possibility of an attempted forced landing was considered. No such intention was reported by radio. No other evidence was brought to light to support this theory.

Movement of passengers about the aircraft (centre of gravity) - the position of passengers in the cabin was studied following the accident. Most of the victims had been hurled forward and to the right. This resulted from the spin which the aircraft went into prior to hitting the ground. In order to change the centre of gravity through movements of passengers in the aircraft to such a degree that it would be sufficient to produce a noticeable change of the flight characteristics, it would be necessary for several to move from their places in the same direction at the same time. Having considered the location of the bodies and the contusions resulting from the accident, it was not believed that any general movement had occurred.

Argument between passenger and crew member - the theory that one of the passengers had gone forward to the cockpit to find out why the flight was being carried out at an abnormally low altitude and that an argument had arisen between him and the pilot was considered.

However, if this type of incident had occurred it cannot be assumed that the person in question would have been able to interfere with the piloting of the aircraft without the intervention of the co-pilot.

Other possibilities - The aircraft had entered into an unintentional spin. Two other possibilities were considered:

1) something had happened that had made the pilot incapable of action; or

2) an erroneous manoeuvre had been made.

1) Insanity, death, or a sudden case of illness were considered. The captain's medical record showed no mental diseases which would have pointed towards a possible sudden fit of insanity.

If the pilot had been suddenly taken ill the co-pilot was there to take over. It was not considered very likely that the pilot, who had his seatbelt fastened, could have collapsed in his seat and thereby have made it impossible for the co-pilot to use the right side controls.

Suicide was also considered and eliminated.

2) On the basis of the aforesaid, the remaining and most probable cause of the accident was thought to be an erroneous manoeuvre in the last phase of the flight. The captain had either begun turning the aircraft too sharply or endeavoured to increase the flying altitude too abruptly, whereby the aircraft crashed to the ground as a result of the decreased speed.

Reconstruction flights established that it is not possible to pilot the aircraft into a turn of such a small radius as the aircraft in question made without first considerably reducing the engine power. Witnesses did report that the engine noise had faded for a while. If the aircraft had stalled as a result of the decreased speed, the big increase in engine noise heard by observers could be explained as an attempt at the last moment to prevent the aircraft from crashing by increasing the engine power. A possible reason for the pilot's having made a steep turn to the left might have been that he had the erroneous impression that the aircraft had already come so near the Seppa NDB that he had begun to turn in the landing direction, which was almost at a right angle to the flight direction. As mentioned previously, the rpm and power of tne engines had already been adjusted to what they should be when preparing to land. The aircraft at that time was about 6 - 7 km from where the turn was begun. The erroneous conception of the aircraft's position may have been caused by a wrong estimation of its arrival time over the Seppa NDB by the similarity between the terrain outside Vaasa and that of Koivulahti, by the deceiving impression that the lights of Koivulahti village were the lights of the settled area near Vaasa (visibility was hampered by radiating fog on low-lying spots of the terrain), or by the directions of the radio compasses having been wrongly read.

One of the radio compasses was tuned to the frequents of the Seppa NDB and the other to the frequency of the locator serving as approach aid for runway 16. The estimation of the distance between the aircraft and the NDB is based amongst other things on the angle between the needles of these compasses. It was established, subsequently, that the Pori NDB*, which has the same frequency, is disturbing the above-mentioned locator and thus the position of the compass needles to each other may partly have misled the pilot. If such an error or some other erroneous reading of the radio compasses had occurred, the steepness of the turn could be explained by the fact that there is a radio mast with a height of about 114 m close to the approach from the Seppa NDB to the runway, which the aircraft would have had to be cautious of when flying at a low altitude.

A too sudden increase of the flying altitude may have caused the accident. If

* This new beacon was put into operation for tests only on 20 December 1960.

the aircraft was banked to the left at that moment it may have come into such an incorrect turning movement that it was no longer possible for the pilot to straighten it up. The momentary decrease of the engine noise, as heard by observers, could also have been due merely to the fact that the aircraft had drawn further away. The sudden increase of the engine noise may have been caused by a last minute attempt to regain control by applying more power. The eyewitness, who had followed the last phase of flight, did not report having noticed any increase in the flying altitude, at least no sudden increase, but exact observations were made difficult by the darkness, fog and the fact that he had not seen the aircraft from the side. His statement that the right wing was lower than the left and the green blinking light was visible may have been the attitude of the aircraft in its dive, when the green light on the right wing was already visible on account of the turning of the aircraft.

The aircraft was flying low over the open fields of Kouvulahti. The reason for the increase in altitude may have been the appearance ahead of a dark forest, probably free from fog, from the edge of which the terrain begins rising to more than 10 m for a distance of a few hundred metres and in which some trees are more than 20 m high. There may have been other reasons for increasing the flight's altitude. A sudden icing of the outside of the windshield may have occurred necessitating a change from night VFR to IFR. The change to IFR may also have been caused by the aircraft's entering cloud, the base of which was at an altitude of about 200 ft (60 m) in Vaasa and may have been at the same altitude at Koivulahti. The rapid deterioration of weather conditions at Vaasa Airport, which the pilot was aware of, may have made the pilot realize that the flight would not be continued VFR all the way to the airport and he, therefore, decided to climb higher. The sky had apparently been nearly free from clouds as far as Koivulahti and the flight was carried out during full moon in such a direction that the low-lying moon glared from straight ahead. This may have made the change to IFR more difficult and calls for rapid reading by the pilot of the indications of several instruments. If the increase of the aircraft's altitude had been too sudden and it was banked to the left, the apparent result was a series of movements which led to the crash.

Conclusions

Based on an examination of the wreckage and eye witnesses observations it was concluded that technical difficulty during the flight did not cause the accident.

The reason for low flying may at first have been that the cloud base was said to be 1 300 ft in the weather report and that flying in the clouds might have occasioned slight icing. That the flight was continued at a still lower altitude could not have been for any pertinent reason, which is evidenced by the fact that a false flying altitude was reported by the aircraft. The time lost by the delayed departure of the aircraft or reluctance to climb to a higher altitude because of the shortness of the route is no explanation for such low flying. It is, therefore, evident that during the flight in question regulations were wilfully and without reason violated by flying at too low an altitude. The navigation of the aircraft was, on the other hand, properly conducted.

The aircraft was piloted, at least in the last phase of the flight by the captain. The position of the bodies of the crew showed that the pilot had been sitting in his own seat on the left-hand side and that he had his seat belt fastened, whereas the seatbelt of the co-pilot was not fastened. According to the company's operations manual, one of the pilots must be at the controls with his seat belt fastened during the entire flight. According to the air traffic controller it was the co-pilot who had been in charge of the radio communications, which would also indicate that he was not piloting the aircraft.

According to the regulations the pilot-in-command is responsible during the flight for the operation and handling of the aircraft

as well as for its safety and for the safety of all persons on board. The co-pilot is under the command of the responsible pilot. The regulations concerning the use of alcoholics before a flight, however, concerned both of them.

The physical and mental conditions of the pilots were not normal because of a lack of sleep the night before the final flight and because of alcoholic drinks which had been consumed contrary to regulations.

The air traffic controller at Kruununkyla, whose responsibility it was to supervise the safety of the flight, had not had the opportunity of verifying the captain's condition, since the latter did not come to air traffic control. As for the co-pilot, only one of the persons who had seen him in the morning in question reported that his conduct gave reason to suspect that he had taken alcoholic drinks.

The duties of the company's traffic officer at Kokkola were to take care of the passengers and to check that the aircraft was properly loaded, therefore, his position did not involve any obligation to interfere with the course of events in this case.

Regarding the operations of the Vaasa meteorological office, it was established that the written reports passed to Vaasa ATC concerning the local weather conditions for the morning in question were incomplete and erroneous. It was on the basis of these reports that weather information was provided to OH-LCC.

Probable Cause

The probable cause of the accident was the wrong execution of a left turn at low altitude at night, as a result of which the aircraft stalled, lost its manoeuvrability and went into a spin.

Contributing factor

As a consequence of having had alcoholic drinks and insufficient sleep the night before, the pilot was not considered to be in a satisfactory mental and physical condition to undertake the flight. For the same reason, the co-pilot should not have been allowed to start on the flight in question.

- - - - - - - - - - - - - - -

ICAO Ref: AR/694