No. 3

KLM Royal Dutch Airlines, Lockheed Super Constellation, crashed in the estuary of the River Shannon, Ireland, on 5 September 1954. Department of Industry and Commerce, Ireland, Accident Investigation Report, released 31 January 1955.

(This report was not included in Digest No. 6 /1954 accidents/ as ICAO was awaiting any comments on the Irish report that the Netherlands Government might wish to make. These have been added at the end of the report.)

Circumstances

The aircraft engaged on a scheduled flight from Amsterdam to New York took off from Shannon, after a scheduled stop, at 0230 hours with a crew of ten and forty-six passengers. The take-off from Runway 14/32 to the southeast appeared to be normal up to lift-off speed. Thirty-five to forty seconds later an inadvertent but almost perfect ditching was made in the River Shannon, 8 170 feet from the departure end of the runway used. Twenty-eight lives were lost and the aircraft eventually became a total loss through a combination of ditching, exposure and salvage operations.

Investigation and Evidence

The flight left Shannon Terminal Building at 0230 hours. It was properly loaded with fuel and load distribution was correct, placing the centre of gravity within acceptable limits. It was properly dispatched. The gross load was 131 930 pounds, well within the maximum allowable take-off weight.

The before take-off run-up was completed in take-off position on the active runway, No. 14, 5 643 feet long.

Take-off was made at 0238. V.1 speed was reached at 3 500 feet and lift-off at 125 knots was made just over the V.2 speed at approximately 4 000 feet from threshold. The flight then passed over the remaining 1 600 feet of runway in a shallow climb, retracting its landing gear; approached the 17 foot high embankment 850 feet further on and passed over it at a height variously estimated at 20/80 feet. Acceptable evidence tended to indicate that passage was very low, having in mind a heavily loaded aircraft in darkness. A somewhat steeper climb was initiated almost coincidentally with this passage. One ground witness whose evidence could not be shaken in any way was so concerned that he was instrumental in initiating a call to the Security Forces when he felt that the aircraft had "gone into the Shannon". This witness, a customs officer, with three and a half years' service at Shannon, was attracted, justifiably or otherwise, by what he considered unusual engine sound and exhaust flame as the aircraft gathered speed during take-off. He, therefore, particularly observed the take-off, initial shallow climb and passage over the embankment. The initiation of a somewhat steeper climb was followed almost immediately by a shallow descent (in his own words: "A gradual glide") to a point where the flight disappeared behind the Fire Station, which interrupted his line of sight.

Up to this point observation had been made from a vantage point just inside the Terminal Building. Such concern was felt that the witness went outside, accompanied by another customs officer, to see if the flight would reappear. It did not and it was then that the previously mentioned call was initiated. As no action of an emergency nature followed at the Fire Station (the Airport Rescue Headquarters) the witness assumed he had been mistaken.

The duration of the flight was about 31 seconds from the time it passed over the end of the runway until the aircraft first contacted the water in a tail-down slightly right-wing-low attitude. It then covered a certain distance to a point 7 350 feet from the runway, where it shed its Nos. 3 and 4 propellers, coming to rest on the Middle Ground, a shallow mudbank, losing Nos. 3 and 4 engines approximately 200 and 100 feet before doing so, at a total distance of 8 170 feet from the end of Runway 14. The aircraft was in complete darkness almost

immediately, as the flight engineer switched off the master electrical switch. The cockpit emergency lighting failed as the battery "drowned". The flight could not have exceeded at any stage a true height of 170 feet.

Total flight time has been variously estimated at 32-42 seconds. Thirty-nine seconds appear from reconstruction to be reasonable. In this 39 seconds a number of commands affecting changing flight configuration were given:

a) command gear up at 125 knots;

b) command first reduction (METO power) at 140 knots;

c) command flaps up at 150 knots;

d) command climb power at 160 knots.

Seconds after command climb power, first contact with the water, described as a "shiver" or a "shudder", and lasting 3-5 seconds, was made. This was followed by several heavy bumps, which appear to have been the first indication of trouble to all crew members except the captain, who had detected difficulty very shortly before the "shiver", apparently more from instinct than otherwise.

The captain's and first officer's evidence, relative to the various commands and speeds connected with this flight, coincide fairly well. Their statements on altitude, however, cannot be reconciled. The captain stated a last observed top altitude of 250 feet and climbing (acceptable only on the basis of a possible 100 foot altimeter error), prior to seeing, just before the crash, an altimeter reading of 100 feet and rate of climb indicator showing a descent passing through 1 000 feet per minute. The first officer stated normal flight climbing, at a last observed altitude of 600 feet. This was his last instrument reading prior to (he stated) placing the landing gear lever from "up" position to "neutral", and picking up his check list preparatory to calling the after take-off check. No reconstruction is possible with such a height (600 feet) between lift-off and touchdown. For this reason, considerable evidence was required in connection with flight instrument static and pressure "plumbing". It was impossible to reconcile the stated position of the landing gear lever. On first inspection of the wrecked aircraft it was found in the "up" position. It was generally agreed that owing to design features of this lever, it could not be moved by accident from the "neutral" position.

The initial investigation of the wrecked aircraft tended to indicate that the landing gear had been up and locked at the time of ditching and that although the left main wheel remained in its up-lock, the nose wheel and right wheel had, at some later time, come out of their up-lock condition. Close examination of the up-locks on the Super Constellation will show that once the up-locks are engaged, severe damage would occur to the up-lock mechanism if forcibly released. They could be released hydraulically, or through severe deceleration forces acting on the hydraulic piston of the up-lock. Owing to the type of system involved this appeared to have been impossible in this case. The up-locks for nose and right main wheels were, practically speaking, undamaged. It was concluded that the left wheel was up and locked and that for all practical purposes the nose and right main wheels were up but had not been locked when the hydraulic system failed to function as Nos. 3 and 4 engines tore loose from the right wing, at the time of ditching.

Note.- The landing gear and flaps operated from the secondary hydraulic system supplied by hydraulic pumps driven from Nos. 3 and 4 engines.

The wing flaps were up at time of ditching. The landing gear should be up and locked prior to initiation of flap retraction. The fact that the aircraft was not found in this configuration called for explanation and considerable investigation as follows:

a) Was the take-off made with flaps up rather than in the take-off position? It has been established from flight test data that the time for landing gear retraction varies from a minimum of 9 to a maximum of 25 seconds. It is apparent that on a flight totalling 32 to 42 seconds there was ample time for the landing gear alone to be retracted if the flaps had not been in take-off position. This confirms crew evidence that flaps were in the proper take-off configuration.

b) Were the flaps selected to "up" by mistake at command "gear up"? If this mistake was made and landing gear selected "up" shortly after the error was noted, the aircraft, having been lifted off the ground at 125 knots would have passed the embankment low and accelerating and lost lift approximately 10 seconds after lift-off, as the flaps were in the final stages of retraction. It would then have touched down in a nose-up attitude as the landing gear was finally retracting, quite beyond the control ability of the captain.

The Court, aware that this type of mishandling has occurred on other type aircraft in the past, considered the possibility should not go unquestioned. The crew evidence denying such mishandling was accepted.

c) Were the flaps selected "up" inadvertently prior to completion of landing gear retraction? The red light which indicates that the landing gear is unlocked and/or in a transient condition was removed from the aircraft, tested and found burned out. Although not wholly satisfied with the method of removal and checking of the bulb in question, the Court accepts that it had burned out during landing gear retraction giving a false indication of landing gear "up".

Under such a condition during take-off, and while the landing gear was retracting, acceleration to flap-up speed would have been made and the "flaps up" order given.

It was found from test flight data that when flaps are selected while the landing gear is in the retracting stage the flaps will first retract delaying the landing gear and, in some cases, allow re-extension. The joint operation - flaps up, landing gear up - takes 34-38 seconds. It is quite possible that this did occur, thereby causing unexpected drag, creating a condition wholly unexpected by the captain. Performance of the Super Constellation, loaded to full gross weight, is such, that this situation could reasonably have been handled with adequate safety. Consequently the Court can only consider the condition referred to as contributing to but not the cause of the accident.

Reconstruction of the most probable flight path of the aircraft, based on facts and submissions accepted and inferences drawn by the Court, with accompanying comments and consideration is as follows.

Point of unstick; speed of unstick; point of contact with the water; speeds at various commands have been taken as stated ante.

The wreckage was found about 650 feet to the left of a projection of the centreline of Runway 14/32. The aircraft, after take-off, probably followed a slightly more easterly course than the centreline of the runway and the bank, referred to earlier, was originated only a short time before the ditching.

The direction of the fuselage was at an angle of about 60° east of the course of the aircraft.

While it is clear that the aircraft must have hit the water, with some starboard bank, in a southeasterly course, the Court rejects the opinion that it made a 270 degree turn before coming to rest, as such a turn would have affected passengers and crew much more than they were in fact affected. It has been taken, therefore, that the aircraft came to rest in a more or less southerly direction, partially resting on the mud and partially floating, and that the tide movement at the time of the disaster caused the aircraft to turn through about 90 degrees to its final position. A rough calculation shows that, assuming the aircraft made first contact with the water at an airspeed of 170 knots (ground speed of about 158 knots), approximately at the point some 300 feet before the propellers were found, the time elapsed between this point and reaching the final position of the wreck would have been about 9 seconds. This is justified by the time observations made by several witnesses on the sequence of shudder, bumps and so-called impact and final coming to rest. The average deceleration must then have been .9g.

The Court considered that the aircraft followed a flight path somewhat as reconstructed in Fig. 1. This is based on the calculations (these are set out in the original Report as Appendix V) taken from the appropriate evidence accepted by the Court and taking into account the following factors.

Instrument Errors: As rough calculations showed the impossibility of the aircraft having ever reached the height of 250 feet (as observed by the captain) the possible error of this instrument was examined. Several errors - all aggregable - were found. They were as follows:

a) According to check sheets submitted by KLM an altimeter check was made at Schiphol on 4 September, when the aircraft was prepared for the flight. The captain's altimeter then showed a setting of 1013.8 mb at a barometric pressure of 1014.8 mb. This instrument error could thus account for a possible reading of 1 mb (28 feet) too high.

b) The captain's altimeter before the take-off at Shannon appeared to be set at 1010.3 mb whilst the official setting (QNH) passed to PH-LKY before take-off was 1009.6 and the actual barometric pressure eight minutes before take-off (0230 hours) appeared to have been 1009.3 mb.

This difference between actual barometric pressure and the captain's altimeter setting could have accounted for a possible reading of 1 mb (28 feet) too high.

c) According to Document 193* measurements made by the National Aeronautical Research Institute, Amsterdam, on the so-called "position errors" of the static system of L. 1049 aircraft show that at speeds from about 120 knots to 150 knots, flaps in take-off position (irrespective of landing gear position) and at speeds of about 160 knots, flaps "up", a position error of about 30 to 50 feet, altimeter reading too high, can be expected. This is different from the previously existing data which showed that in this range of speeds, errors of about 10 feet only might be expected. However, taking into account that the tests in Amsterdam have been made carefully, it was accepted that an error of 30 to 50 feet (altimeter too high) due to position error might be possible.

The errors mentioned under a), b) and c) above, which all have to be added, result in a possible total error of about 90 to 100 feet in the captain's altimeter, reading too high, during the take-off. Thus it is considered that about 160 feet was the greatest true altitude actually reached.

Performance Characteristics: Assuming that the gear might not in fact have been in the "up" position when flap retraction was ordered, it followed that the aircraft would have had a slowly retracting landing gear. A possibility existed that the performance of the aircraft, climbing at METO power, was not fully up to L. 1049 standard. Therefore, in making calculations for the flight path, slightly lower performance has been allowed for.

The Climb: It was considered that the evidence can fairly be interpreted by an estimate of an average rate of initial climb of 150 ft./min., a height of 36 feet passing the embankment, and a speed of 140 knots at 12-13 seconds after unstick. During that initial climb, say three seconds after unstick, landing gear retraction would have been ordered. At about the time of crossing the embankment a much steeper climb was set up and METO power was ordered. Assuming that around 3-4 seconds later METO power was set and the speed increased to 144 knots 15-16 seconds after unstick, a more or less steady climb would probably then have taken place, which is estimated at 530 ft./min. and this is reasonably justified by the evidence of a rate of between 500 and 600 feet per minute. The true indicated speed of 149 knots (which according to Lockheed data could have been shown on the airspeed indicator as 150 knots) would have been reached at a true height of 140 feet conforming to a probable altimeter reading, as it appeared to the captain, of around 230 feet. From then on some more climb (say about 30 feet) would have been performed but this would have been coupled with a flap retraction and is dealt with later.

The Transition between Ascent and Descent and the Flap Retraction; The Descent: There was a gradually curved path between climb and descent (no sudden vertical accelerations or other irregularities were noticed by any crew member between airspeeds of 150 to 160 knots). During this period flap retraction was initiated.

On the basis of a re-extension of the landing gear, as described earlier, having occurred, the results of the tests submitted in Doc. 227** were used to estimate the flight path between ascent and descent.

From a point, where during climb a speed of 150 knots was reached, it was assumed that a flight path, according to the tests of Doc. 227, was followed, which path then gradually proceeded to the descending flight path. Flap retraction would then, according to the tests mentioned, have been initiated about two seconds before the true indicated airspeed of 150 knots, i.e., at a speed of 149 knots (which could, however, as stated earlier, have been shown on the captain's airspeed indicator as 150 knots).

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* Report on Lockheed L. 1049 C Super Constellation. Pitot-Static Pressure Deviations in Take-off and Initial Climb by F.E. Douwes Dekker - Report V. 1749, National Aeronautical Research Institute, Amsterdam.

** Observations on the Influence of Flap Retraction on Gear Retraction Time - KLM Research Department. ILS/MVM/Dec. 16, 1954.

The rate of descent of an average of 1 200 ft./min., conforms with the captain's evidence of an indicated rate, passing through 1 000 ft./min. (which with the known appreciable lag in the rate of climb indicator, denoted a higher true rate of descent). The airspeed of 160-165 knots likewise agrees with the evidence of indicated airspeeds.

A surface headwind of 12 knots reported at time of take-off was allowed for. The usual variation of wind with height, as well as momentary deviations from the reported value of the surface headwind could well account for a shortening of this flight path by some hundreds of feet. The final part of the flight path, therefore, could well have been somewhat more flattened out, thus allowing for a point of first contact some hundreds of feet before the point actually shown in Fig. 1.

In regard to the descent, the Court considered the possibility of a lift disturbing action during this part of the flight. No evidence, however, could be found to support such a disturbance. Examination of the wreck did not reveal any condition which could have caused it. Nor was there any evidence of the vibrations or buffeting which would be expected at an earlier stage of the flight from such a condition.

If a re-extension of the landing gear took place, after flap selection, the landing gear must normally have had a retraction time of around 25 seconds, which is fairly long but not inconsistent with evidence on retraction times of other aircraft of the same type (Doc. 231*) showing cases of 23 and 25 seconds. Furthermore, flap retraction time must have been around 12 seconds which is fairly short but again not inconsistent with data given in the same document, showing some cases of 12 and 13 seconds flap retraction time. Moreover, the conclusion that in this case flap retraction was fairly quick is corroborated by evidence from the co-pilot.

From the data of this flight path, the approximate instrument indications, available to the captain, from flap retraction onwards, were computed.

It was observed that the airspeed indicator indicated a gradual increase in speed, which, in general, is not uncommon during flap retraction. The rate at which speed was increasing, as far as it can be judged from the airspeed indicator, would certainly not have shown anything abnormal to the captain for about the first 10 seconds after flap retraction.

The altimeter would have shown him for about the first 9 seconds from flap retraction an indication nearly at, or slightly above, 250 feet "several times" and after that a gradual decrease of altitude.

The rate of climb indicator should have been indicating for about the first 9 seconds a rate of climb, at first staying around 500 feet per minute and later on decreasing gradually, until about the eleventh second after "flap up" selection, when it should have shown about level flight and from then on a descent at an ever increasing rate. To the captain, who was not aware that a descent of considerable rate had already begun and thus had no reason to suspect an increasing degree of lag in the rate of climb indication, this instrument, in the first 9 seconds after flap retraction, could have conveyed the erroneous impression of a gradually flattening flight path, to be followed by a more or less horizontal flight at the end of flap retraction.

The artificial horizon should have shown him at the initiation of flap retraction a certain nose-up attitude conforming with the climb he had been performing before flap retraction started. A nose-up attitude change from this moment on for about 4 seconds should have been apparent in conformity with the action taken by the captain to correct the aircraft's attitude for flap retraction.

However, at about 6 seconds after flap retraction started the horizon indication should have begun to show an aircraft attitude lower than the nose-up position during the climb preceding the flap selection.

* Report on Retraction Times of Gear and Flaps on KLM Super Constellations departed from Schiphol during the period from Dec. 25, 1954 until Jan. 3, 1955 - F.H. van Weydom Claterbos. Schiphol. Jan. 3, 1955.

This nose-down movement of the indication should have continued for about 3 more seconds until it more or less settled to a condition conforming to about 4 degrees of attitude lower than the attitude in the climb preceding flap selection. (This attitude corresponds with a still slightly nose-up or about level position of the fuselage reference line, certainly not with a marked nose-down attitude.)

It may have been about the eleventh second after flap selection that Climb Power was ordered. The altimeter may then have shown about 200 feet and the rate of climb indicator may have been moving through about zero. In the next one or two seconds, however, the rate of climb indicator ought to have been showing an appreciable rate of descent whilst the altimeter should have continued to show the downward movement at an ever increasing rate. The true descent was then about fully developed and it must have been at this moment that the captain, according to his statement, realized that there was something entirely wrong. He then took decisive recovery action pulling the control column very firmly, which gave him probably the impression of a pronounced "stiffening up" of the elevator control. It is quite clear that apart from a nose-up movement on his horizon, none of the normal flight instruments could have given him, in the few seconds that remained before the contact with the water, any indication of a response of the aircraft to his control movement.

The Report then considered what explanation could be given for the above described events and for the actions of the captain.

In this respect, in the first place, attention was drawn to the fact that the events which had an immediate and direct bearing on the final disaster began to develop at the moment of flap retraction, that is only about 15 seconds before the moment of contact with the water.

The first indication of the necessity for corrective action on his part should have been given by his horizon displaying a definite lowering of the nose, though not indicating a nose-down attitude.

The occurrence of this attitude change, notwithstanding a positive nose-up correcting action for flap retraction taken by him several seconds earlier, must very probably have been promoted by the fact that the landing gear was in the course of re-extension, which, as was brought forward in evidence, is likely to cause the aircraft to have a tendency to lower the nose, and possibly by the fact that the captain did not retrim the aircraft for flap retraction.

Even if the change of attitude to a more or less level position had not been noticed immediately by the captain, the first indications of a descent could have been noticed about 3 seconds later on the altimeter. The fact that at that moment a scan of his instruments had not yet revealed to him an undesirable flight condition must be attributed to one or both of the following causes:

a) After the first 5 or 6 seconds of climb, when he is accustomed to scan his instruments less continuously, the captain's observations of the horizon and (particularly after 250 feet indicated) the altimeter movements were inadequate; he placed too much reliance on the rate of climb indicator.

b) He did not, to the full extent, appreciate the anticipating character of the horizon indication, in that a change of the horizon bar position indicates a change of flight conditions which will not become apparent from the other instruments until some seconds later. The fact that some pilots, in this respect, fail to gain the fullest profit of the observation of the horizon was brought forward in evidence.

The captain ordered climb power at a speed of 160 knots and immediately afterwards felt that there was something entirely wrong. He was later convinced the descent had already begun, before he gave this order. This conveyed to the Court that he did not observe his altimeter for some seconds before ordering climb power.

When he detected the fatal flying condition he took decisive action immediately but nothing then could have prevented the accident. The action taken was fortunately just in time to prevent a heavier impact.

Other factors contributed to the accident. In the first place a proper setting of the captain's altimeter before take-off would have reduced the error of his instrument by about 20 feet. Secondly, the climb performance of this aircraft was not utilized by the captain to the extent possible.

If the captain had concentrated less on building up speed and more on gaining height in take-off, he would have had a better opportunity for coping with unexpected incidents. He was at a further disadvantage in dealing with unexpected hazards, in his stated assumption that 250 feet indicated altitude placed him in a position of sufficient safety against all known take-off risks.

There is no question of individual or collective experience. Evidence during the investigation, and the very nature of the accident, focused attention on a number of items and actions which a) appeared at variance with the Manufacturer's and Company's instructions and b) appeared to be at variance with basic requirements of an operator of Scheduled International Air Services.

1) The captain agreed that the flight engineer could abandon take-off, up to V.1 speed, on his own initiative.

2) The chief flight engineer stated that it was normal practice to switch in generators individually, as each engine was started.

3) The flight engineer stated that it was his practice to switch off automatic feathering, immediately after reduction to METO power, (i.e. at very low altitude on initial climb).

4) The captain's altimeter, as found, was not set at the official barometric pressure, current at take-off.

5) The landing lights were found "off" but in the "extended" position. Neither pilot could state if they were used during take-off. (Evidence indicated no definite practice.)

6) Though not necessarily at variance with Company policy, the Court was impressed with the captain's emphasis on the desire for speed rather than climb, particularly in the early stages after take-off. This technique, coupled with a stated concern in connection with the use of take-off power, "with these highly strung engines", could have an adverse effect on the course of events during the take-off of heavily loaded aircraft.

7) The second pilot had initial difficulty opening the forward entrance door until the third pilot remembered that it was necessary to press a device to unlock the handle. One of the survivors (a passenger who gave evidence) stated that the cabin crew had difficulty with the rear main entrance door. In his own words: "The stewardess said to us that we should keep quiet and everything is all right, and then they were hammering on the door to open it; they were pushing with their shoulder against the door and that is the last I heard." (It is significant that on Super Constellation aircraft this door opens inwards.)

8) The flight radio operator's last emergency ditching drill was 31 March 1954. He had not had any type of "dry run" ditching, or emergency drill in Super Constellations. Written instructions only had been available.

9) The instrument rating renewal of KLM pilots is accomplished within Netherlands regulations by a combination of

a) An instrument check which is accomplished in a Link Trainer;

b) Conducting a periodic proficiency check which is acccomplished on a regular en route flight;

c) Indicating to the licensing authority that the applicant for rating renewal is currently in fact exercising the rights of his licence (i.e. doing sufficient actual flying).

10) The captain, on 31 July 1953, completed a conversion course on Lockheed Super Constellation aircraft, consisting of six hours flying and certain technical ground school subjects. Between that date and 5 September 1954 a periodic proficiency check was conducted on 25 January 1954 by a check pilot while en route Amsterdam/New York. An instrument check (in the Link Trainer) was completed on 25 March 1954.

11) The first officer completed co-pilot conversion training on Super Constellation aircraft on 14 July 1953 consisting of 1 hour 30 minutes flying and certain technical ground school subjects. Previous to this, on 27 June 1950, co-pilot conversion training had been completed on the smaller Constellation, Model L 749, consisting of 7 hours 03 minutes flying. There is no record of any recurring flight training or checking between these dates. An instrument check (in a Link Trainer) was completed on 12 February 1954 for licensing purposes. A captain's transition training course on Convair 240 and Convair 340 type aircraft was completed on 27 May 1954 consisting of 4 hours 25 minutes flying.

The first officer, however, is a captain in his own right and had apparently, from 18 September 1949, been flying DC-3 aircraft in that capacity. He had not had any periodic proficiency checks in this period.

During the three months previous to this accident the first officer had flown either as captain and/or first officer on five different types of aircraft.

In connection with any consideration of crew competency, respecting a Scheduled Air Carrier, it is considered relevant to quote from ICAO Anne · 6:

"The present edition of Annex 6 contains Standards and Recommended Practices adopted by the International Civil Aviation Organization as the minimum Standards applicable to the operation of aircraft in scheduled international air services, etc."

"4.2.7.2.S. An operator shall ensure that piloting technique and the ability to execute emergency procedures is checked in such a way as to demonstrate the competence of his pilots. Such checks shall be performed twice within any period of one year. Any two such checks which are similar and which occur within a period of four consecutive months shall not alone satisfy this requirement.

"4.2.7.5 An operator shall ensure that all crew members are instructed and periodically examined in the use of the emergency and life-saving equipment required to be carried and that they are drilled in emergency evacuation of the aircraft used."

Pilots: The Court is of the opinion that the amount of checking done, though formally complying with the Operators' Licensing Authority's requirements, for instrument rating renewal:

a) Does not fully satisfy the intention of the applicable portions of Annex 6 of the ICAO.

b) Does not represent the amount of recurring training and/or checking required, for the many and varied procedures that pilots of modern transport aircraft are involved with.

Flight Engineers: There is apparently no formal requirement to ensure maintenance of flight engineer competency. The applicable crew station on modern aircraft is important and involves complex procedures. It was the Court's opinion that there is a necessity for periodic inflight checking of a supervisory nature in order to maintain competency. (This recommendation is not intended to imply that the flight engineer on this flight had any responsibility for the accident).

Crew (General): Making due allowances for the effects of "after-casting", the evidence nevertheless suggested insufficiency of drill "in emergency evacuation of the aircraft used."

Probable Cause

The probable cause of the accident was as follows:

1) Failure of the captain to correlate and interpret his instrument indications properly during flap retraction, resulting in necessary action not being taken in sufficient time.

This failure was partially accounted for by the effect on instrument indications of inadvertent and unexpected landing gear re-extension.

2) Loss of aircraft performance due to inadvertent landing gear re-extension.

3) The captain failed to maintain sufficient climb to give him an opportunity of meeting unexpected occurrences.

RECOMMENDATIONS

It is recommended:

1) That warning or signal lights, indicating an unlocked or transient condition of the landing gear, as on the Lockheed 1049 Super Constellation, be duplicated.

2) That self-sufficient emergency lighting be provided in passenger accommodation of transport category aircraft.

3) Respectfully that regulations be adopted at the earliest date specifying "Standards for ensuring that holders of the instrument rating maintain their competency". (See: Note to ICAO, 3rd Edition, April 1953, Annex 1, Para. 2.11.1.3).

4) That flashlights for use of flight crew personnel be so designed that they may be functional while leaving the hands free.

5) That flight personnel be made aware of the danger that a power-on ditching may remove power plants from the wings, in turn causing damage to the wings and possible loss of dinghies stowed therein.

6) That flight personnel and all other services concerned, be made aware of the extreme danger of fumes in a confined space, such as the cabin of an aircraft, resulting from ingress (or in-flow) of petrol.

7) That portable oxygen equipment for emergency use by more than one crew member be available on transport category aircraft.

Search and Rescue

The Court was satisfied that after the aircraft had become airborne at 0238 hours and had passed out over the embankment, the Air Traffic Control Service were under the impression that the aircraft was still flying but had developed a complete radio failure, an impression strengthened by the erroneous report of identification by the GCA Director. Their main task, therefore, became one of trying to re-establish radio communication for Control purposes. But for unawareness of the report that a witness had suspected that the aircraft was in danger after take-off, and the later erroneous report from the GCA Director, the control officer in the tower undoubtedly would have investigated the possibility of the aircraft being down. On the other hand, the Section Leader of the Security Force was satisfied that nothing was amiss, when, upon receipt of the telephone report, he looked out over the river and saw or heard nothing to arouse his suspicions. In the result - the air traffic control officer was unaware of the message received by the Security Force concerning the aircraft's take-off, while the Section Leader was unaware that the aircraft was out of radio communication with the control tower. If the information received by the Security Force had been immediately available to the nerve centre of the airport, (i.e., the control tower) no doubt the suspicion that a disaster might have occurred in the vicinity of the airport would have set in motion the Rescue Services before the GCA report had been received and would probably also have influenced the GCA Director to be more guarded in his identification of a "blip" which showed for a very short time on his radar screen.

Rescue operations were delayed because no one at the airport realized, or even suspected, the need for rescue. A crash was not associated with the lack of radio communication wholly or to a less extent by reason of the cumulative effect and misleading influence of the circumstances next mentioned and commented on:

a) Any fears entertained by the Security Force from the alarm given by the Customs officials were allayed by the absence of fire, or any other indication of danger and the Customs officials' own fears were set at rest by their seeing no unusual activity at the Fire Station.

b) The non-observance by the officer on duty in the air traffic control tower of the aircraft after it ceased to climb.

This officer was alone on duty in the tower. While it was unfortunate that he failed to observe the aircraft longer, when he might have noticed its descent, he cannot be blamed for ceasing to watch it when he did.

c) The security officer on duty in the Fire Station Watch Room kept the flight under observation only until it passed over the embankment and did not further see it.

It is not clear from paragraph 1.1 of the Shannon Airport Crash Orders whether the stand-to period ends when the departing aircraft can be no longer seen or heard by the Duty Crew, or when it can no longer be seen or heard by the Look-out. This should be clarified.

The Court accepted the explanation given by the officer who was in the Watch Room, that reflections of airport lights on the windows of the Watch Room could prevent his picking out again the aircraft's lights when he resumed his watch after making his log entry.

d) No distress signal emitted from the aircraft.

The crew of the aircraft had no time to send out a radio distress signal before ditching and they were unable to use the radio after the accident owing to the lack of electric power and the immersion of the aerials. Petrol on the water and in the vicinity of the aircraft and dinghies precluded the lighting of distress flares near the scene of the accident and no Verey pistol equipment was carried in the aircraft.

e) The Security Force did not pass on to the control tower the observations of the Customs officers.

Although there are no written instructions regarding the passing of suspected flight incident reports by the Security Force to the air traffic control, it should be the normal practice for all such reports to be passed to the control tower so that any necessary coordination of action can be undertaken by a central body on the airport. The recognition of the air traffic control tower as the nerve centre of the airport, through its knowledge of minute to minute aircraft movements, should be impressed on all airport personnel.

f) The GCA Director passed to area control and tower a radar identification of the KLM Constellation in flight, outward bound.

The Court considers that a grave error of judgment was committed by the GCA Director in positively identifying the aircraft "blip" as the KLM Constellation without qualifying the report that the path of the aircraft had not been followed from the vicinity of the airport and had, in fact, only been on the screen for some ten seconds' duration.

g) Failure of Launch - Tower Intercommunication.

The unfortunate failure in obtaining HF/RT communication between the rescue launch and the control tower when the launch first set out, caused by the tower receiver being off tune, resulted in a delay of some 35/40 minutes before the launch arrived at the scene of the disaster It was not considered necessary for the Court to investigate fully the reason for the receiver being off tune but the Court considered that, apart from the high noise level in the control tower, the type of radio installation in use for this important means of communication, open as it is to the possibility of the receiver becoming off tune, calls for criticism.

No blame was attached to either the launch crew or the air traffic control officer in the tower.

Note: The Court was unaware of any vehicles superior to those presently in use at Shannon for negotiating the mudflats, but understood that this question is constantly under review by the airport authorities.

RECOMMENDATIONS

It is recommended:

1) That an assistant to the air traffic control officer in the tower at Shannon Airport be provided at all times.

2) That the stand-to period of the Security Force at the Fire Station be more clearly defined in the Shannon Airport Crash Orders.

3) That instructions be issued to all sections and services employed at the airport to communicate suspected flight abnormalities to the air traffic control tower and that the importance of this requirement be stressed.

4) That GCA crews be instructed not to report identifications of aircraft to other agencies without giving appropriate identifying facts.

5) That the noise level in the control tower be reduced to a minimum, while at the same time adequately monitoring required radio frequencies.

6) That radio communication installations fitted to the rescue launches, or any other airport service equipment be such that effective instantaneous inter-communication is ensured at all times.

Note: The Court was gratified to learn of the work in progress (prior to 5 September 1954) for construction of a Rescue Launch Station at the airport. When this work is completed, a launch will be more readily available for emergency.

Subject to this, the rescue facilities and services at Shannon Airport were considered adequate and no recommendation was made in this regard.

Comments of the Netherlands Government on the Irish Report

"Aeronautical Council
The Hague - The Netherlands.

DECISION

The Commission formed from the "Aeronautical Council" referred to in Article 6 of the "Act, regulating the Investigation of Accidents to Civil Aircraft;"

Considering the documents relating to the preliminary investigation made by the Preliminary Inquirer into the causes of an accident which occurred to the aircraft PH-LKY (Triton) on September 5, 1954, in the vicinity of Shannon airport. Ireland;

Considering the recommendation made by the Preliminary Inquirer on October 10, 1955, No. BVO-3/8, to the effect that no further investigation will be made by the Aeronautical Council;

Taking into account that the Commission from the documents pertaining to the preliminary investigation found the following:

a) Progress of the flight.

Although the aircraft was heavily loaded, the take-off weight was approximately 500 kgs below the maximum take-off weight. The aircraft was airworthy. With the exception of a few parts to which reference will be made below, the inspection of the wreck showed no evidence of technical deficiencies. The engines functioned normally

The Commission is in agreement with a reconstruction of the take-off path prepared by the Irish Court of Inquiry.

During the first 25 seconds after leaving the ground the climb was normal. During this period take-off power was reduced to METO power (maximum except take-off power) after approximately 15 to 20 seconds. At the end of this period a height was reached of approximately 40 metres. At that moment the captain considered the undercarriage to be fully retracted, and he gave the order to retract the wing flaps which at the time were in the take-off position. During this manoeuvre the take-off condition began to develop unfavourably. After the aircraft had reached a height of 50 metres (according to the indication of the altimeter 80 metres), the flight path gradually changed from a climb into a descent. The descent continued during the later part of the flight, for a period of approximately 10 seconds.

The descent could have been apparent to the captain from the indications of various instruments, in particular from the indications of the artificial horizon and the altimeter. A few moments later this descent would also have been apparent from the indication of the vertical speed indicator which reacts with a certain delay. However, the captain paid insufficient attention to these instruments since he was of the opinion

that with a normally functioning aircraft no special alertness in respect of the continuation of the take-off was required after reaching a height of approximately 75 metres.

As soon as the flaps were fully retracted he gave the order to reduce the power of the engines to climb power without first reading the altimeter. This must have taken place approximately four seconds before the aircraft came into contact with the water. A few seconds later the captain realized that the aircraft was descending. He took action with the elevator control. Due to the small distance between the aircraft and the water the only favourable result of this action was that upon contact with the water a heavy impact was avoided.

b) After considering this course of events the Commission agrees with the conclusions of the Irish Court that, in the first place, the accident must be attributed to the captain failing to pay sufficient attention to the indications of the instruments, in particular those of the artificial horizon and the altimeter.

Some attending circumstances, which contributed to the accident were:

1. Prior to take-off the captain failed to adjust the altimeter according to the latest barometric pressure communicated to him; as a result the altimeter overread by six metres.

2. In addition, instrument errors of the altimeter and the change of barometric pressure, which occurred after the last weather report communicated to the aircraft, resulted in an overreading of 20 to 25 metres.

3. In all probability the warning light, which should be on when the undercarriage is not retracted and locked, was unserviceable. This may have led the captain to the conclusion that the undercarriage was retracted and locked while this was actually not the case. Investigation of the wreck revealed that the nose wheel and the starboard main gear could not have been locked up. If the undercarriage is not locked in the "up" position, retraction of the wing flaps may result in the landing gear moving down again. The resulting increase in drag considerably affects the climb performance of the aircraft. When METO power is applied, such need not necessarily result in a descent. However, when insufficient attention is paid to the indications of the instruments the flight path may easily change from a climb into a descent. This possibility is further enhanced by an apparent tendency to pay more attention to the increase in speed than to the maintaining of a sufficient rate of climb (shallow take-off).

Consequently, as a result of the unserviceability of the warning light the captain did not realize that the condition of the aircraft had become such that the climb performance was unfavourably affected. This again resulted in the fact that the actions which the captain normally took during take-off did not lead to a normal continuation of the climb.

The consideration which prompted the Commission to view the above factor as only a secondary cause of the accident is that during a night take-off the captain should pay considerable attention to the indication of the instruments. If the captain had paid this attention, he would have been able to take the necessary action in time.

4. That a dangerous situation should arise is also to be attributed to the tempo in which the various actions followed each other, such as the retraction of the undercarriage, power reduction to METO power, flap retraction, and power reduction to climb power. As a result the captain did not fully utilize the favourable performance possibilities of the aircraft, and thereby it happened that, as explained under 3, the flap retracting system started to operate before the undercarriage was locked.

Take-off power had only been applied for approximately 50 seconds, whereas 2 minutes' continuous take-off power is allowed without affecting the proper functioning of the engines.

METO power had only been applied during approximately 25 seconds, whereas there is no restriction as to the duration of this power setting. With wing flaps retracted the climb performance of the aircraft exceeds the climb performance with flaps in the take-off position only by a very small margin. Therefore, early retraction of the flaps is not at all necessary.

This fast tempo of successive actions, together with the apparent tendency to pay more attention to the increase of speed than to the maintenance of a sufficient rate of climb, contributed to the beginning of the descent.

In the case under review the take-off procedure is incompatible with the requirements of safe air traffic. In this connection it may be observed that the crew was under the erroneous impression that it would be beneficial to the reliability of the engines if the time during which take-off power is applied were to be reduced to a minimum.

c) Lessons to be derived from the accident.

1. When flying with reduced or zero visibility, or in darkness close to the ground, much attention has to be paid to instruments which give information on the vertical movements of the aircraft.

2. A fast tempo in which during take-off the various actions in relation to engine-, undercarriage- and flap handling are carried out, together with the application of a shallow take-off, reduce the safety margin which is essential in view of unforeseen circumstances. The relative KLM instructions permitted application of a take-off procedure, the safety aspects of which left room for improvement. KLM has derived from this accident, as well as from an accident which happened a short time previously, the lesson that the take-off procedure for its aircraft had to be described in more detail. Revised instructions have been issued to its flying personnel.

3. One of the recommendations made by the Irish Court of Inquiry was to duplicate the undercarriage warning lights. Follow-up action has been taken.

d) Consideration of the need of a further inquiry.

The Preliminary Inquirer proposed not to hold a further inquiry. A very accurate and competent investigation was made by the Irish Court of Inquiry, the result of which, together with all relevant documentation, was kindly put at the disposal of the Department of Civil Aviation and the Aeronautical Council. The Preliminary Inquirer concurs with the viewpoints and the resulting verdict, which is also entirely acceptable to the above mentioned Commission. Under the circumstances taking of disciplinary action against the captain is not urgently required, and it is the task of the Commission to declare that a further investigation need not be held.

According to the Irish Court, it is evident that, by neglecting the indications of the instruments, the captain failed to exercise caution. However, taking into consideration the distress which the accident has caused to the captain and also taking into consideration the fact that this accident brought the very long and distinguished career of the captain to an end, the Commission considers it justifiable that, in this case, the Council does not exercise its authority to take the disciplinary action referred to in article 37 of the Act regulating the investigation of Accidents to Civil Aircraft.

Based on the above considerations, the Commission has decided that no further inquiry will be held by the Aeronautical Council into the causes of the accident."

dated 9 January 1956

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KLM Lockheed Super Constellation crash - River Shannon, Ireland - 5 September 1954

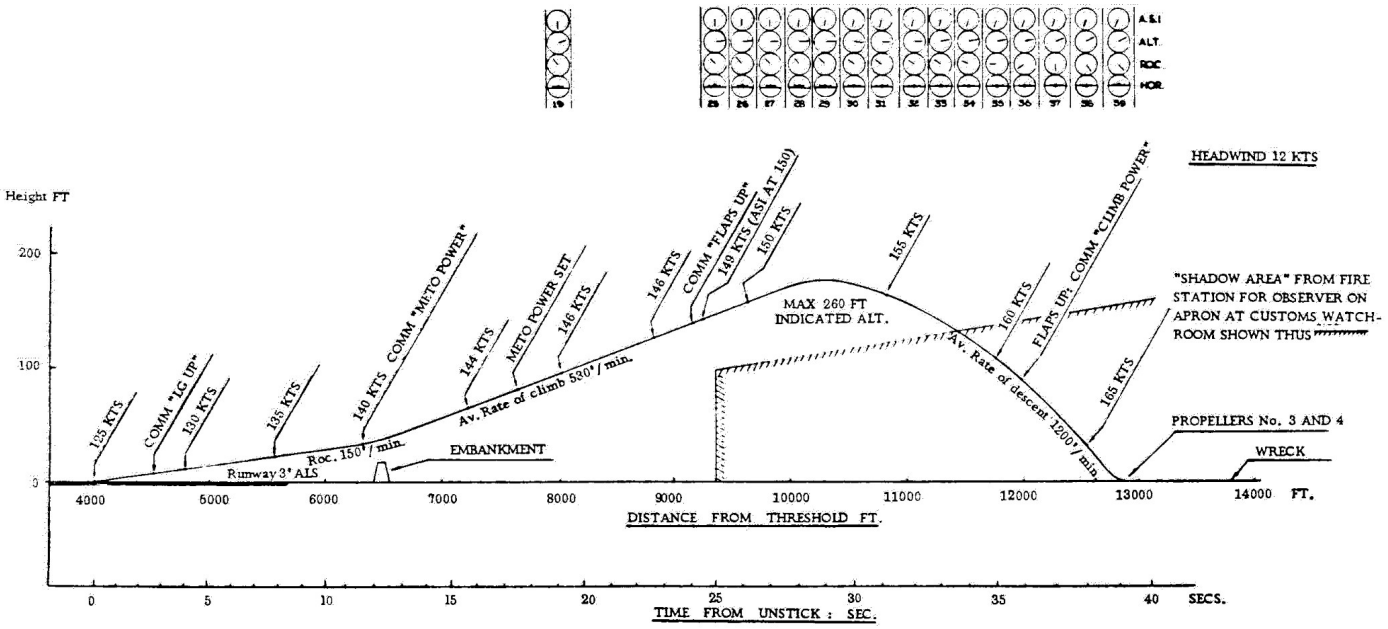

FIGURE 1
FLIGHT PATH AND
RELATED INSTRUMENT
INDICATIONS

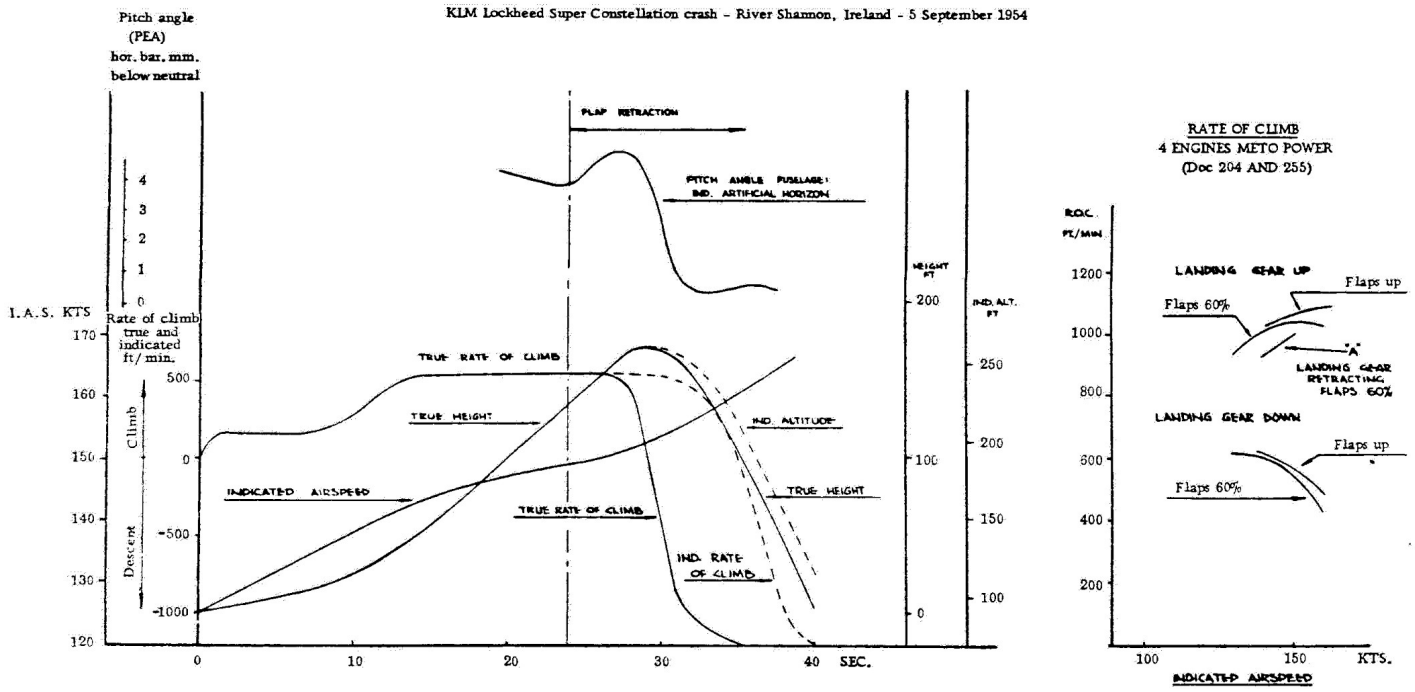

FIGURE 2
TIME HISTORY
AND
INSTRUMENT INDICATIONS