

REPORT

**Following the study
performed at the request of
The Minister in charge of the Department for Public Enterprise
on
the AER LINGUS VISCOUNT EI-AOM accident
occurred on March 24th, 1968
near TUSKAR ROCK
Ireland**

VOLUME I : STUDY REPORT



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EXECUTIVE SUMMARY

- The accident which occurred in 1968 to Aer Lingus Viscount EI-AOM was never fully explained and was the subject of continuing controversy.

In July 2000 the Irish Minister for Public Enterprise, Mrs Mary O'Rourke T.D., commissioned this independent study of the accident circumstances.

The study did not constitute a formal investigation nor a re-opening of the original investigation. The objective was to shed further light, if possible, on the cause or causes of the accident.

- Other than a limited amount of paperwork there was no longer any material evidence available.
- However the Team took advantage of a much longer in-service experience of the Viscount fleet than existed in 1968, and performed a deep analysis of several accidents considered as "relevant", since they presented similarities with the Tuskar Rock accident. This resulted in the identification of a field of possible causal factors.
- This field was narrowed taking into account the technical considerations, based :
 1. on the data reported in the annexes of the 1970 report
 2. on the conclusions of the year 2000 Review of the files by the AAIU
 3. on personal experience.
- An operational analysis of the various scenarios generated after the publication of the inconclusive 1970 Accident Report showed that, although a mid-air collision (or near collision) with a manned or unmanned aircraft was possible, this aircraft could not be the one sighted over Fethard after the assumed collision.

A call for witnesses, launched in September 2000, together with a careful examination of the witnesses' statements received in 1968 allowed for a flight reconstruction, different from the one presented in the 1970 report.

The Viscount had been heard and/or observed on the following track: take-off from Cork, flight as per the flight plan reaching approximately 10.000 feet over Old Parish, a loss of control and spinning down to very low altitude and then flying in more and more disabled conditions from Old Parish to Tramore, Brownstown Head, Tory Hill, Kennedy Arboretum, Ballykelly, Fethard, North Saltees and finally crashing into the sea at Tuskar Rock.

The flight reconstruction performed by the 1968 Investigation Commission was possibly misled by the transcript of the Shannon radio-communications.

- The study leads to the conclusion that :
 - An initial event , which cannot be clearly identified, disturbed the air flow around the horizontal tail surfaces and the pitch control of the aircraft. In the light of what was observed by non-skilled people there was a strong indication that structural fatigue , flutter, corrosion or bird strike could have been involved.
 - It is possible that the sensitivity of the engine fuel control units to negative accelerations imposed during the initial upset , had an adverse effect on the subsequent flight path of the aircraft.
 - The severe manoeuvres of the aircraft following the initial upset and the subsequent flight would have been outside the airworthiness certification envelope and may have resulted in some deformation of the structure.
 - A number of possible causes for an impairment of pitch control were examined and it is considered very possible that excessive spring tab free play resulted in the fatigue failure of a component in the tab operating mechanism thus inducing a tailplane-elevator tab free flutter condition.
 - The loads induced by the flutter condition would be of sufficient magnitude and frequency to cause a fatigue failure of the port tailplane within the timescale estimated for EI-AOM.
 - There was no involvement of any other aircraft or missile.
- The flight crew demonstrated a high level of proficiency, using all available techniques known from their experience to keep the aircraft airborne for more than half an hour with very high stickforces and a progressive loss of control. It is remarkable that they maintained a semblance of control as long as they did.
- As a conclusion, the light shed on the cause or causes of the accident can be summarized as follows:
 - The flight track reconstructed according to the statements of all witnesses can be considered with some confidence to be of a factual nature, since all the statements fit one to the others.
 - The initial event, and subsequent degradation process can be accounted for from technical and operational arguments, but is to be considered of conjectural nature, since no piece of material evidence is longer available.

STUDY REPORT

1. INTRODUCTION

1.1 Historical Recall

1.2 The International Team

1.3 The Task (s)Refer to :

Appendix 1a : Team members' experience

Appendix 1b : Data available

Appendix 1c : Glossaries

contained in Volume 2 : "Appendices and Annexes"

1.1 HISTORICAL RECALL

Aer Lingus Vickers Viscount 803 EI-AOM flying from Cork to London crashed into the Irish Sea near Tuskar Rock in County Wexford on 24 March 1968. All sixty-one persons on board were killed.

A report on the investigation into the accident was published by the Irish Department of Transport and Power in June 1970. The report concluded that there was not enough evidence available on which to reach a conclusion of reasonable probability as to the initial cause of the accident.

In view of the circumstances pertaining at the time and certain unsubstantiated hypotheses raised in the report, the cause of the accident remained controversial. Indeed at least one book, many newspaper articles and television programs continued to raise various scenarios, including conspiracy theories, thirty years after the accident.

As a result of continuing speculation, the Irish Minister for Public Enterprise

Mrs. Mary O'Rourke T.D., in cooperation with the UK Government, requested an official review of all relevant files to see if the cause of the accident could be determined. The report of this review was published in June 2000.

The comprehensive review report found errors and omissions in the maintenance of the Viscount type aircraft, by the operator, Aer Lingus and by the Airworthiness Surveillance Office of the Department .

No evidence of UK involvement in the occurrence of the accident was found ; nor was there any evidence that the UK as a State conspired against the investigating body in an attempt to conceal any facts.

The cause of the accident was still not established.

Consequently, the responsible Minister, Mrs. Mary O'Rourke T.D., commissioned an independent team of aeronautical experts with the objective "to shed further light on the cause (s) of the accident", by making a study of all available documentation, material and/or sources.

This report sums up that study.

1.2 REVIEW TEAM

The independent specialists selected by the Minister were as follows:

a) **Admiral Yves Lemerancier (Ret.)**

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A brief note on the experience of the team members will be found in Appendix

1a.

1.3 THE TASK

Mr. John Lumsden, Assistant Secretary General - Aviation, acting on behalf of the Minister Mrs. Mary O'Rourke T.D., set out the parameters of the study to be undertaken. These were as follows:

“The objective of the study is to shed further light, if possible, on the cause or causes of the accident. It is also important to indicate that the Minister has set no limits or restrictions on the nature or scope of this study or any subsequent inquiries which you may recommend or she may herself initiate. This study does not constitute a formal investigation, however, nor a reopening of the original investigation, the files of which have never been closed.

That said, you should in the first instance:

- a) examine the existing documentary evidence, including the 1970 Report and its Appendices and the June 2000 Review of Files and so much of the source material prepared or collected in connection with the Report and the Review as you deem appropriate;
- b) examine any new documentary material that may come to light in the course of your work;

- c) examine all available records in relation to investigations of incidents and accidents involving Vickers Viscount aircraft;
- d) be available to meet with representatives of the relatives of the victims of the accident, to hear their concerns, at an appropriate stage of your study.

You should aim to complete a report of your work by end November 2000 (if more time is needed, that will be afforded). Your report should make any conclusions, findings or recommendations which you see fit including any recommendations as regards further inquiries, tests or examinations which you feel should be undertaken either by yourselves or by others.”

2. METHODOLOGY_

2.1 1970 REPORT METHODOLOGY

2.2 2000 REVIEW METHODOLOGY

2.3 PRESENT STUDY METHODOLOGY

- **Similarities Study**
- **Technical Study**
- **Operational Study _**

2.1 1970 REPORT METHODOLOGY

2.1.1 The methodology applied

The methodology applied was the one recommended by the Annex 13 of the Convention on International Civil Aviation in its second edition (March 1966).

The analysis of the accident was performed under four main headlines :

- Study of similar accidents to Viscount
- Examination of wreckage
- Consideration of probabilities
- Discussion of witnesses' evidence on sightings and sounds

The conclusions included, as proposed in the Annex 13, the findings and the probable cause.

2.1.2 Assessment_

- The similar accidents studied did not include any comparison with an Aer Lingus Viscount EI-AOF, which crashed 9 months earlier.
- The wreckage examination and subsequent information was performed jointly by the Commission and the manufacturers.
- Their conclusions were exclusively based on the analysis of the recovered parts. As a consequence , no conclusions on what could have happened to the tail part were established.
- The same State organisation which was in charge of the investigation was also responsible for the regulation of airworthiness and operations.

- The considerations of probabilities eliminated without apparent substantiation all the causal factors with the exception of :
 - Collision with another aircraft
 - Upset due to evasive actions ,

although it was stated in the conclusions that there was no substantiating evidence of such possibilities.

- The findings did not identify any causal factor and what is stated as the probable cause is, in fact, a consequence.
- But the statement that “the conclusion that there was such another aircraft in the area is inescapable” did open a door to the imagination of everyone, in order not to leave the relatives of the victims ignoring everything about this accident.

After the publication of the 1970 report, several scenarios were generated, from simple “mid-air collision” theories to “conspiracy ” theories which include State (UK or Irish) misrepresentations.

This enlarged domain of imagination led the Irish Government to order a review which was performed from 1998 to 2000.

2.2 2000 REVIEW METHODOLOGY_

This review resulted from the common desire of the Irish Minister for Public Enterprise together with the UK Ambassador to resolve the speculation concerning British military involvement in the accident.

The task was to review all files held relating to the accident to see if the cause of the accident could be established.

2.2.1 Methodology of the Review

The team was facing a considerable volume of material accumulated : 54 files were examined.

The Irish and UK Officials agreed a structure based on the nature of the questions asked by the relatives:

- Initial upset and crash of the aircraft, immediate SAR efforts
- Search and salvage
- The possibility of the existence of another airborne mobile
- The aircraft, its airworthiness, its operation, its crew.

The conclusions of that common review by Irish and UK authorities stated, among others, that :

- While the maintenance history and Maintenance Operating Plan errors of EI-AOM contain many matters for concern, there is no evidence that any of these items had a bearing on the cause of the accident (conclusions Nr 34 – 39).
- But the structure of the aeronautical section of the Department posed a potential conflict of interest when the same Service had to approve the Aer Lingus Maintenance Plan (conclusion Nr 36) and to include in the Accident Report criticisms against this Maintenance Plan (conclusion 38 – 41) and the way it was applied by Aer Lingus (conclusion Nr 37). The same applies to Airworthiness responsibilities (conclusion Nr 40).
- With respect to the existence of another airborne mobile, they stated that :
 - The possibility that the other aircraft was an Irish Air Corps Dove a/c was eliminated (conclusion Nr 16).
 - The possibility of a cause other than a collision or near collision with another airborne object being the initial cause of the upset of the St. Phelim does not appear to have been adequately examined in the 1970 report (conclusion Nr 29).

2.2.2 Assessment

An exhaustive review of the existing files could not establish the cause of the accident.

Certain shortcomings of the 1970 report were identified, and, in addition, the hearing of some new witnesses demonstrated that, in this respect, the 1970 report ignored some aspects of what had been observed from the ground.

As a consequence of this review, the Minister of Public Enterprise decided to call an International Team, not to establish the cause of the accident, but “to shed further light, if possible, on the cause or causes of the accident”.

2.3 METHODOLOGY OF THE PRESENT STUDY

A methodology similar to the one proposed by the Annex 13 was not feasible: it was clearly stated in the mission letter that “the study did not constitute a formal investigation nor a re-opening of the original investigation”, due to the fact that the basic data was no longer available : no materials, the radio-comms recordings of Shannon control, on their original tapes, were lost ...

A methodology similar to the one used for the 2000 Review was not adapted as it was not intended to repeat the work already carried out.

The methodology selected by the Team was to use all information which could not be used in 1968 or which was only partially used; and to use this information for narrowing in the most logical process the large field of the possible causes of the accident down to a few probable causes and/or contributing factors.

It was mandatory in this “selection” process to include an assessment on the “missile theory” which was, at the present time, developed from the single “mid-air collision theory” to the various “conspiracy theories”.

2.3.1 “Similarities” Study

The first step is to present a “similarities” study, which identifies the similarities of the EI-AOM accident with other accidents/incidents, considered relevant when they presented a similar loss of control, and/or comparable flight attitudes in a disabled condition, and/or similar crash conditions.

This first step takes advantage of the lessons learned from all the accidents which occurred during the whole life of the Viscount (which was not feasible in 1968).

That study is concluded by the “Identification and ranking of several causal factors”.

2.3.2 Technical Study

The second step is to take advantage of the technical considerations, observed on the VISCOUNT fleet till the end of its life .

This “technical study” is concluded by two lists of causal factors ranked in terms of probability : extremely remote, improbable, possible or probable.

The first list refers to “Events”; the second list refers to “Aircraft components”.

As such, the field of the causal factors is narrowed to the events or components identified as “possible” and “probable”.

2.3.3 Operational Study

The third and last step is the operational analysis, where

- the various scenarios, as partially observed and partially built-up , are described;
- each scenario is assessed against the identified constraints resulting, from the operational characteristics and from the witnesses' observations, in order to check its internal consistency: track reconstruction, aircraft degradation process, etc...
- the different scenarios are assessed one against the other, in order to identify the most probable one.

That study concludes with the most probable scenario, as assessed by the International Team . This scenario includes the identification of the most probable causal factor (s), as much as feasible.

- 3. IDENTIFICATION OF SIMILARITIES WITH OTHER ACCIDENTS/INCIDENTS**
- 3.1 AVAILABLE DATA**
- 3.2 “SIMILARITIES” STUDY METHODOLOGY**
- 3.3 IDENTIFICATION OF SIMILARITIES**
- 3.4 CONCLUSIONS**

Refer to :

Appendix 3a : Birds migrations to/from South Ireland

Appendix 3b : Sample of ADs tail related

Appendix 3c : EI-AOF and EI-AOM detailed comparison
contained in Volume 2 : “Appendices and Annexes

3.1 AVAILABLE DATA

3.1.1 Viscount Occurrences (1976 – 1995)

The British CAA has communicated a list of accidents and incidents which occurred in the fleet of UK registered Viscounts.

From the survey of this list, the following have been identified :

- Number of occurrences : 1300
- Flight control anomalies : 34 occurrences, mainly due to icing, maintenance errors, corrosion, mechanical deformations, poor electrical continuity
- Corrosion/fatigue : 54 occurrences
- In-flight depressurisation : 7 occurrences
- Bird-Strike : 13 occurrences including one at Flight Level 200
- Skin and wind screen glass damage : 31 occurrences

3.1.2 ICAO Data

A significant volume of information with respect to accidents and occurrences on Viscount and other aircraft worldwide was made available by ICAO.

3.1.3 Accident Reports Examination

1. 135 Viscount accidents have been reviewed. They occurred from 1952 to 1994, half of them before the EI-AOM accident.

17 accident reports were fully analysed and considered relevant (14 on Viscount, 1 on Vanguard, 1 on Avro 748 and 1 on SO 30P).

Out of these 17, six were V700 types, eight V800 types plus one Vanguard 951. These 15 were all designed by the same manufacturer.

2. When these accidents occurred, most of the aircraft were in service for 12 years maximum and had flown less than 25.000 hours.
3. In addition, a number of accidents on other aircraft types were reviewed when circumstances indicated some possible relevance.

3.2 “SIMILARITIES STUDY” METHODOLOGY

Based on this available data, the study identifying which probable cause(s) produced the most “similar” accident(s) to that of EI-AOM follows the here-under described sequence :

1st step : Among all accidents in the whole life of the Viscount, identify those presenting the following characteristics :

- sudden loss of control
- continuing in a disabled flight
- ending in a crash.

17 accidents were selected, most of them with an identified “probable cause”.

These “probable causes” are :

- A- Icing
- B- Stall
- C- Bird Strike
- D- Structural fatigue failure of the tailplane
- E- Elevator Tab Circuit (Spigot) failure
- F- Rear pressure bulkhead failure
- F- Alternative Power Supply Disruption
- G- Propeller Control Unit contaminated
- H- Propellers entering ground fine pitch in flight
- I- Door strike
- J- Door flapping

2nd step : Each selected accident is then described in elementary sequences, to enable comparison with the same sequences of the EI-AOM accident.

The EI-AOM accident is described here-under :

- Initial loss of Control
 - a) The initial event happens suddenly without any precursor announcement to the crew.
 - b) The loss of control initiation shows abrupt pitch-down or sudden lurch in yaw.

(Abrupt pitch-down results from large decrease of the (negative) lift of the tail plane. Sudden lurch in yaw results either from decrease of thrust or increase of drag.)
 - c) The loss of control phase shows the following typical attitudes and movements of the aircraft:
 - A quickly accentuated nose-down attitude with the air speed increasing rather slowly (because of propeller drag.)
 - Flutter can appear in the flight-controls where loads are transmitted to the yoke which is violently shaken in the cockpit. Forces of extreme magnitude must then be exerted by the crew.
 - Abnormal attitudes in pitch, sudden changes in angle of attack and slide slip. Slipping and sliding generate violent accelerations, normal and transverse (+3g - 1,7 g) that can overstress the structure, and put components out of their certified domain.
- Recovery from the “initial out of control phase”
 - d) Recovery can be gained only if:
 - Flow circulation is reinitiated through
 - Aerodynamic and engines’ controls
 - Appropriate pilot’s actions.
 - Natural horizon seems to be an initial essential condition.
 - e) The flight after recovery is in reduced stability condition. The aircraft is at low or very low altitude; the aircraft is unsteady, shaken by fast angular movements and shows rapid changes in

engine and propeller regimes, commanded or not commanded. Noises of engine compressor surge, explosive relight and emission of black smokes are characteristic.

- Ultimate phase

- f) The ultimate phase is a non recoverable loss of control. The aircraft's mechanical qualities are degraded by overstressing and possible separation of flight control elements. The altitude margin is no longer available. Usually the aircraft pitches down and impacts the ground close to the vertical at high vertical speed. Crew actions are ineffective.
- g) The wreckage examination shows that the integrity of the aircraft has been impaired prior to the crash: some parts of the aircraft may have separated in flight. Typical deformations or ruptures can be apparent on key structural items.

3rd step : Then each of the 17 selected accidents is compared, elementary sequence by elementary sequence, to the EI-AOM accident.

Each elementary sequence is qualified Similar (S), Different (D) or Not Applicable (NA).

4th step : As a conclusion, a ranking can be made :

- on a global aspect, the number of similar elementary sequences is a good indicator
- on more qualitative approach, the identification of similar groupings of elementary sequences is of interest

This ranking is then to be assessed against the technical analysis and the operational analysis.

3.3 IDENTIFICATION OF SIMILARITIES BETWEEN EI-AOM ACCIDENT AND THE “RELEVANT” ONES

Note : the following is valid as long as the technical data provided by the 1970 report is not contested .

3.3.1 Similarities between EI-AOM Accident and Accidents caused by ICING

Three accidents, occurring in 1960, 1977 and 1994, are studied.

3.3.1.1 Description of the Accidents

- 1) - Identification - VISCOUNT - Type 700 – MSN 217 – reg : N. 7462
 - TSN : 9247 hours
 - January 18 – 1960 – Charles City – Virginia – U.S.A.
- Description
 - descending from 8000 f to FAF altitude for ILS approach – 22h19 e.s.t Night
 - weather conditions : average to bad
 - freezing condition between 5 to 9000 ft
 - heavy showers, fog, light drizzle on ground
 - ac configuration : clean
- Occurrence
- triggering factor
 - flame out of the four engines ; consequently propellers auto-feathered
- ultimate flight phase
 - attitudes : the ac dived in an effort to attain sufficient air speed to drive the props out of the feathered positions, by wind-milling
 - low-flying ac in a left pattern within 2 M area of the crash site, at increasingly lower altitudes
 - no emergency was declared
 - crash attitude : Nose Up 8 deg.
 - No forward velocity
 - wings approx. level
- wreckage
 - most of the blades of each prop were bent in various directions or missing from the hub

- Probable cause(s)	- delayed arming of the engine anti-ice protection systems while flying in icing conditions, resulting in the loss of engine power and consequently propellers auto-feathered, and attendant electrical energy required to un-feather propellers and to relight sufficient engines to maintain flight.
2) - Identification	- VISCOUNT – Type 838 – MSN 372 – reg : SE.FO8 - TSN : 12 208 hours - January 15 – 1977 – 08.05 GMT – Day-light
- Description	- during the ILS approach to Bromma airport, from an altitude of approx. 1150 ft at a distance of about 5 kms from the runway, the ac suddenly pitched down and went into a vertical dive, and crashed. - weather was hazy – cloud base was irregular at approx. 700 ft, visibility about 5 kms – 90% humidity +, wind SE 10, risk of icing – severe icing had been reported by other ac
- Occurrence	- triggering factor - accumulation of ice on the leading edge of the stabiliser. The anti-ice system was in the “off” position at impact.
- ultimate flight phase	- the ac was in approach configuration. With flaps set at 32°, unusual pitch oscillations were perceived. When setting the flaps to 40°, the ac becoming uncontrollable started to dive. - speed build up from 137 to 200-210 knots in 6 seconds.
- wreckage	- the wreckage was confined to a very small area (30x20) m. There were no indications that any part had fallen off the ac before impact. - the ac hit the ground with the left wing before

the right one. The ac pitched over on its back after it hit the ground.

- Probable cause(s) - the accident was caused by ice on the leading edge of the stabiliser. This disturbed the air flow and resulted in stabiliser stall when the flap setting was increased to 40°.- the aircraft then became uncontrollable, went into a steep dive and crashed with an impact angle of 110°.

Then, a fire started.

- 3) - Identification - VISCOUNT – Type 803 – MSN : 3494 –
reg : G. OHOT.
- TSN : 50.995 hours – manufactured 1958 –
fitted with Epsilon F.D.A.S. and CVR
- February 25 – 1994 – Uttoxeter – Staffordshire
- 19h40 – Night-light
- Description - during the descent, still in cloud and
approaching FL 150, the N° 2 engine failed
(flamed out) and the prop-auto-feathered. Less
than a minute later, the N° 3 engine started to
run down and the crew requested an immediate
descent. As unsuccessful attempts had been
made to re-start N° 2 et N° 3 engines, the crew
declared an emergency.
- N° 2 engine was restarted successfully but,
during this process,
- N° 4 engine failed. Despite further attempts to
restart N° 3 and N° 4 engines, the remainder of
the flight was conducted on the two left-hand
engines alone.

- Occurrence
 - triggering factor
 - two consecutive engine failures (flame out) N° 2 and 3 deprived the ac of any air frame de-icing .
 - ultimate flight phase
 - the flight being conducted on the two left-hand engines alone, the crew were unable to control the ac in yaw.
 - wreckage
 - the ac struck the ground and an intense fire consumed the cabin section.
- Probable cause (s)
 - multiple engine failures occurred as a result of flight in extreme icing conditions.
 - incomplete performance of the emergency drills by the crew, as a result of not refining to the Emergency CL, prejudiced the chances of successful engine-restarts.
 - crew actions for securing and re-starting the failed engines, which were not in accordance with the operator's procedures, limited the .available power.
 - poor crew resource management.

3.3.1.2 Comparison with EI-AOM Accident

- Aa) EI-AOM and accidents whose probable cause is Icing are similar since upsets happen suddenly without any precursor announcement. However, theoretically, ice build up may generate some vibration following initial air-flow separation. **S**
- Ab) The loss of control in icing in the cases reviewed shows abrupt pitch down whereas according to a single witness statement the loss of control in EI-AOM shows a turn-right and a pitch-down.
Abrupt pitch-down in accidents due to icing results from air flow separation at the level of the elevator due to ice accretion on the horizontal stabilizer. No spinning is observed since ice accretion is quite symmetrical on both tail planes.
In the case of EI-AOM using the above hypothesis, spinning resulted from an asymmetry. **D**
- Ac) In both cases, nose-down attitude is quickly accentuated. Yaw and roll movements appear to be disconnected in EI-AOM case, whereas they are not when Icing is the Probable cause. **D**
- Ad) Partial recovery was apparently gained for EI-AOM, possibly due to height and natural horizon whereas in the case of icing, recovery was not successful in the Swedish (SE-FOZ) accident due to uncontrollable pitching moment in Flaps 40 configuration. **D**
- Ae) After partial recovery, flights are quite similar (duration, stability conditions, propellers' and engines' soundings) for EI-AOM and all other accidents caused by Icing. **S**
- Af) Ultimate loss of control is similar. **S**
- Ag) Wreckage examination shows that mechanical integrity is observed after a crash due to Icing, whereas it is not in the case of EI-AOM. **D**

3.3.1.3 Conclusion

The level of similarity between accidents caused by ICING and EI-AOM is quantified by : 3 **S** – 4 **D**.

3.3.2 Similarities between EI-AOM Accident and an Accident originated in a STALL

3.3.2.1 Description of EI-AOF Accident (1967)

- Identification
 - VISCOUNT 803 – MSN : – reg : EI-AOF
 - TSN : 17.447 hours – manufactured 1955
 - June 22 – 1967 – Ashbourne – IRL -
at 07.35 GTM = 08.35 IST – Day-light
- Description
 - during training flight for demonstration of recovery from the approach to the stall, and taking appropriate recovery action, something happened which caused the ac to descend, without requesting ATC clearance, to an altitude very much lower than that for which it was cleared or at which, during the training exercises scheduled, the ac would normally operate.
 - low cloud-base and restricted visibility in the area.
 - ac configuration variable : landing gear Down/Up/Down – Flaps –
- Occurrence
 - triggering factor
 - for reasons which cannot be determined, the ac lost much more altitude than usual for a stall recovery demonstration. After a period of low altitude disabled flight, the ac entered an unintentional stall and probable spin at a low altitude from which recovery was not possible.
 - ultimate flight phase
 - no communication was received from the flight crew by any ground station.
 - from several witnesses statements:
 - the ac went along a bumpy trajectory, in and out of clouds, during 25 minutes, flying erratically, “fluttering” and gushing black smoke as the engines “revved up” ;
 - the ac “zig zagging” appeared to drop vertically in an “incipient spin”.

- wreckage
 - confined in a rectangular area (400x150) ft
 - ac in an inverted position , consistent with a nearly vertical spin.
 - fire destroyed the nose, centre section and flight deck. The tail unit and extreme rear part of the fuselage were comparatively unaffected.
 - sludge was found in the Nr 1, 2, 3 engines' oil filters.
- probable cause(s)
 - the immediate probable cause of impact with the ground was an unintentional stall and incipient spin at a low altitude from which recovery was not possible.
 - there is not enough evidence to determine the circumstance leading to the initial loss of altitude and to the disabled flight.

3.3.2.2 Comparison with EI-AOM Accident

- | | | |
|-----|---|----------|
| Ba) | Since the “stall warning” is serviceable, the sudden stall is announced. | D |
| Bb) | Initiation of loss of control is different since abrupt pitch down starts in a high angle of attack | D |
| Bc) | Similar. | S |
| Bd) | Similar. | S |
| Be) | Similar in attitudes and duration. | S |
| Bf) | Ultimate phase is different since it is a stall (in full flaps configuration) compared to EI-AOM. | D |
| Bg) | Different since EI-AOF did not show any part separated prior to the crash | D |

3.3.2.3 Conclusion

The level of similarity between an aircraft suffering a STALL and EI-AOM is characterized by : **3 S – 4 D.**

Note : However, in the case of AOF, the stall identified as the probable cause is the last one before crash.

The initial stall, performed for demonstration purpose is the initial factor which could have initiated another failure : in this case, this failure could become the probable cause of the accident.

Refer to appendix 3c for a much more detailed comparison of the total process of the accidents of AOF and AOM.

As a result, some conclusions of the accident report of AOF may be questioned, and lessons learned from one accident may be applicable to the other.

3.3.3 Similarities between EI-AOM Accident and an Accident caused by BIRD STRIKE

3.3.3.1 Description of N 7430 Accident (1962)

- Identification
 - VISCOUNT – Type 700 – Model 745 D –
TSN : 128 – reg : N.7430
 - TNS : 18,809 hours – manufactured 1956 –
equipped FDR L 109 C
 - November 23 – 1964 – Ellicott city – Maryland
 - U.S.A. – approx. 12.24 E.S.T – Day light .
- Description
 - the flight was cleared to descend from 10 to 6000 ft
 - advisory was issued “numerous reports of considerable amount of ducks and geese around this area”, that was acknowledged
 - routed by radar vectors to FAF for landing
 - radio and radar contact was lost at 12.24
 - weather conditions were good
 - several witnesses observed the ultimate flight phase
 - a partial bird carcass (skin + feathers) was found 10 feet from the separated section of the left horizontal stabiliser
- Occurrence
 - triggering factor
 - bird strike (2 birds) on the leading edge of the left hand stabiliser
 - ultimate flight phase
 - the ac went along an irregular path, at very low altitude, turning to the left ; the ac abruptly rolled inverted and disappeared through the trees in a near vertical attitude.
 - some shiny objects, later identified as parts of the ac, were observed falling in the immediate area of the crash.

- the attention of some witnesses was attracted to the ac initially by an unusual noise, the origin of which has not been determined.
- wreckage
 - the wreckage examination showed that the bird penetrated the leading edge and passed through the leading edge member. Continuing, the bird fractured the spar web, partially separating it from the top and bottom caps.
 - the left horizontal stabiliser and elevator failed along a chord plan.
 - in addition to this failure, the right stab and elevator separated downward.
 - subsequently the weakened in board portion of this horizontal stabiliser also failed.
- Probable cause(s)
 - the NTSB determined that the probable cause of this accident was a loss of control following separation of the left horizontal stabiliser which had been weakened by a collision with a swan.

3.3.3.2 Comparison with EI-AOM Accident

Ca)	Bird strike is a sudden event without any precursor announcement to the crew.	S
Cb)	The loss of control shows abrupt pitch-down and descent.	S
Cc)	The loss of control phase is characterized in the case of the N. 7430 bird strike by a large change in heading whereas it is a typical spin reported in the case of EI-AOM.	D
Cd)	No recovery was gained in the case of the bird strike whereas a “partial recovery” was reported for EI-AOM.	D
Ce)	Not applicable to bird strike.	NA
Cf)	Ultimate loss of control is similar	S
Cg)	In both cases, parts separated prior to crash.	S

3.3.3.3 Conclusion

The level similarity between an aircraft suffering a bird strike and EI-AOM is characterized by :

4 **S** – 2 **D** - 1 **NA**.

3.3.4 Similarities between EI-AOM Accident and two Accidents caused by a structural Failure

The two selected accidents are those of SP-LVA and HK 1058.

3.3.4.1 Description of the Accidents

- 1) - Identification - VISCOUNT – Model 804 – MSN : 249 –
reg : SP-LVA – Polish air lines – LOT

- TNS : 14.087 hours – manufactured 1957

- August 20 – 1965 - Belgium
- Circumstances - a frontal meteo zone is over the area (OLNO,
GATTA)

- Cbs 6/8 are forecast – iso ø is at 3500 m –

severe icing can be expected

- the flight reported at 12.54 passing FL 120 and
levelling at 130, then reported as last
communication :” estimating GATTA 12.59
and GTA OLNO 13.10 “–

- the ac impacted the ground by 13.08
- Occurrence

- triggering factor - not established. The hypotheses of an upset due
to flying in a CB barrier has been mentioned.
Other ac having reported stormy activities in this
area.
- ultimate flight phase - not observed – no distress signal emitted.

- the ac sank. Both external wings broke, then
the tail planes broke. One engine (4) separated
from the wing. The Nr 4 propeller blades were
pitched at 24°, the Nr 1,2,3 propeller blades
pitched at 50-52°
- wreckage examination - the wreck was spread over a 1000m x 600 m
area..
- Finding - the ac went in a dive and reached 300 kts

- the ac disintegrated at a height 2000/3000 ft

		- the wings and tail planes broke due to loads exceeding the ultimate loads. - no corrosion or metal fatigue was found.
	- Probable cause(s)	- loss of control due to turbulence in CBs - manoeuvre to resume control could have submitted the ac to aero loads exceeding the extreme admitted loads at speed close to 300 kts.
2)	- Identification	- VISCOUNT – Model 785 – reg : HK 1058 - TNS : unknown – CVR fitted - June 8 – 1974 – 22h30 – approx. 14H30 loc. time Daylight – San Cayetano (Norte de Santander) – COLUMBIA
	- Description	Note : this ac had previously suffered one accident and two incidents. For the accident damages repairs and for refitting to the maintenance standard, works on this ac were carried out by Field Aircraft Service Ltd in London in 1971. - the flight was cleared for descent to 7 000 ft in VMC at 22.27 - ETA to destination being 22.35 - radio contact was lost at 22.27 - weather conditions were good at destination air field and all around. Turbulence could be expected in one particular area that was known by the crews - the ac was assumed to descend at max authorized velocity (gear down).
	- Occurrence	
	- triggering factor	- flight control anomaly
	- ultimate flight phase	- the ac impacted the mountain : Cerro el Retiro - with an angle of 90 deg. to the ground and with an angle of 60 deg. with the horizon.
	- wreckage	- the wreckage was confined in a limited area.

- a piece of the tail unit was found at 1 500 m from the impact point ; that was identified as the liaison between the stab and the elevator L.H. side).Fatigue cracks and instantaneous break marks were observed on this part.
- the spar (viga) of the L. stabiliser has been sent to VICKERS for laboratory tests at their request.
- it was not certain that all the components of the ac were located in the crash site.
- Probable cause(s)
 - factor : structure of the ac – empennage.
 - resulting in an in-flight break-down of the horizontal stab.
 - this resulted in the separation of the L stab and elevator assy, and consequently in the loss of control of the ac.

3.3.4.2 Comparison with EI-AOM Accident

Da)	Since no distress message was emitted in both cases (SP LVA and HK 1058), the event can be assumed to be sudden, without precursor announcement. However, it is to be noted that in both cases, the report insist on the presence of CBs clouds and associated turbulences , which could have hidden the announcement of technical nature in the cases of structure failures.	D
Db)	Similar	S
Dc)	However in the case of SP LVA , neither a witness nor technical conclusion could sustain that there was no spin, the case of HK 1058, which was observed during the largest part of the disabled trajectory tends to assess for “different”.	D
Dd)	Since in both cases, there was no recovery, the assessment result is “different”	D
De)	N.A.	NA
Df)	Similar	S
Dg)	Similar	S

3.3.4.3 Conclusion

The level of similarity between an aircraft suffering a structure failure and EI-AOM is characterized by : **3 S – 3 D – 1 NA.**

3.3.5 Similarities between EI-AOM Accident and an Accident caused by an ELEVATOR TAB CIRCUIT FAILURE

3.3.5.1 Description of the PK-IVS Accident (1980)

- Identification
 - VISCOUNT – Type 812 – MSN : 353 W –
reg : PK-IVS
 - TNS : 20.659 hours - 17.947 ldgs –
manufactured 1958
 - August 26 – 1980 – Day light – Near. Djakarta -
INDONESIA
- Description
 - at 05.51, PK-IVS contacted ATC : no difficulties were reported.
06.04 - “May Day” call, IVS reporting “shuddered”.
 - ATC vectored an F28 ac to intercept PK-IVS.
 - 06.28 – the F28 crew reported “something is happening to IVS, at the elevator – IVS is falling to the left.”
 - 06.27–28 – PK-IVS reported vibrating harder and harder, cannot see outside.
 - 06.29 – F28 crew reported : IVS crew cannot control this ac ; it’s falling to the left.
 - IVS impacted the ground, inverted about 25° nose down relative to the ground and with its port wing low.
- Occurrence
 - triggering factor
 - the F28 crew reported separation of the right elevator, the port tail plane and elevator were still intact.
 - ultimate flight phase
 - next, the port tail plane and elevator separated in flight. This resulted in a loss of control of the ac.
 - the F28 crew saw the ac pitching up and rolling to the Left about 90 deg. and from there entering a vertical descent, rolling as it descended.

- the ac impacted in inverted attitude about 25° nose down relative to the ground and with it's port wing low.
- wreckage
 - the wreckage plot shows, with some exceptions, all parts of the ac in a triangular area of approx.
(3 800 x 2 800 x 2 700) ft. Some empennage parts were not recovered.
 - no fire.
- duration of disabled flight - 25 mn
- Probable cause(s)
 - the cause of this accident was the in-flight fracture of the spigot in the elevator tab circuit.
 - this part had exceeded the 12 000 flight hours retirement life by 21 000 hrs resulting in a life of 33.000 hrs.
 - the right elevator separated in flight. Then the port tail plane and elevator separated. This resulted in a L.O.C. of the ac.

3.3.5.2 Comparison with EI-AOM Accident

Ea)	Precursor announcement (shuddering) was perceived about 25 minutes before the final loss of control. It is interpreted as a failure which did not result from an initial loss of control. This accident did not show initial LOC.	D
Eb)	Not applicable.	NA
Ec)	Not applicable.	NA
Ed)	The flight of PK-IVS is to be compared to the “disabled flight” of AI-AOM.	S
Ee)	The degradation process of the two aircrafts is similar.	S
Ef)	Ultimate phase shows sequential separation of Port tail plane and elevator and anti balance tab, then starboard elevator and trim tab, then fin and rudder, then starboard tail plane and part of tail cone. Aircraft impacts the ground inverted close to the vertical, whereas EI-AOM aircraft impacted the sea right-way up at an angle lower or equal to 45 degrees. In the case of EI-AOM the process was similar but the duration of the dive appears to have been too short.	S
Eg)	In both cases, mechanical integrity of the empennage was impaired approximately 10 to 25 minutes after the triggering event. Different : the life limit of the spigot of EI-AOM is assumed as having been respected. However, in normal circumstances the limit is not significant.	S

3.3.5.3 Conclusion

The level of similarity between an aircraft suffering a spigot rupture and EI-AOM is characterized by : **4 S – 1 D – 2 NA.**

3.3.6 Similarities between EI-AOM Accident and an Accident caused by a REAR PRESSURE BULK HEAD FAILURE

3.3.6.1 Description of Vanguard G.APEC (1971) Accident

- Identification
 - VANGUARD – 951 – MSN 706 –
 - reg : G.APEC
 - TNS : 21.683 hours – equipped FDR –
 - manufactured 1959
 - October 2 – 1971 – 10h10 GMT = Day light –
 - Aarsele – BELGIUM
- Description
 - in bright sun light conditions
 - whilst in level flight at normal cruising speed at FL.190, G.APEC suffered a major rupture in the rear pressure bulkhead.
 - this failure caused the tail planes to become pressurized. The empennage skin was blown out.
 - the resultant loss of the major portion of both horizontal tail surfaces caused the ac to enter a steep dive.
- Occurrence
 - triggering factor
 - at 10.04, G.APEC reported passing WU.VOR at FL 190 – OPS Normal - at 10.09, with no prior warning, G.APEC transmitted “we are going down... May Day... out of control”
 - ultimate flight phase
 - the G. APEC went in a dive, descending from FL 190 to the ground within 1 minute.
 - wreckage
 - the reduction in the aerodynamic down loads on the horizontal tail planes caused the ac to enter a steep dive from which it was not possible to recover.
 - At impact, the longitudinal attitude was between 20 and 30 deg. over the vertical.

- Probable cause(s)

- the accident was caused by the rupture of the rear pressure bulkhead, which led to the separation of both tail planes in flight and caused the ac to dive into the ground.

3.3.6.2 Comparison with EI-AOM Accident

- | | | |
|-----|---|-----------|
| Fa) | Both events happened suddenly without precursor announcement. | S |
| Fb) | Loss of control initiation shows abrupt pitch down whereas the EI-AOM according to one witness shows first a rapid right turn before entering a spin. | D |
| Fc) | Loss of control phase similar in both cases. | S |
| Fd) | Recovery was not gained by the Vanguard | D |
| Fe) | Not applicable to Vanguard. | NA |
| Ff) | Ultimate is in line with the initial loss of control (Vanguard); the aircraft impacted the ground inverted in a steep diving attitude. | D |
| Fg) | In the case of Vanguard, separation of both tail planes occurred in flight whereas one is suspected for EI-AOM. | S |

3.3.6.3 Conclusion

The level of similarity between an aircraft suffering a failure of the rear pressure bulkhead and EI-AOM is characterized by **3 S – 3 D – 1 NA**.

3.3.7 Similarities between EI-AOM Accident and an Accident caused by an ALTERNATIVE POWER SUPPLY DISRUPTION

3.3.7.1 Description of G.ATFN Accident (1968)

- Identification
 - VISCOUNT – Type 739A – MSN : 394 –
reg : G. ATFN
 - TNS : 18.658 hours – equipped SADAS recorder
 - August 9 – 1968 – Flight London to Innsbruck
- Description
 - cleared to descend to FL 120 by Munich radar ; no answer was received , the radio transmitter having failed as a result of the fall in electrical power supply.
 - weather conditions were bad : clouds top 15 000 ft base 800 ft
 - no distress call was emitted
 - the crew probably decided to descend at a moment when they could still make an approximate estimation of their position.
 - the two outer wings broke off.
- Occurrence
 - triggering factor
 - the vital instruments for indicating the flight attitude showed increasingly incorrect readings.
 - ultimate flight phase
 - conducted in I.M.C. (instruments meteo conditions) with unreliable instruments, the crew lost control of the ac.
 - the attitudes of the ac were not observed but were presumably abnormal as the ac was subjected to severe loadings that broke off the outer wings.
- wreckage
 - the wreckage examination showed that the stress fractures which took place in flight were the consequence of the overloading occurring during the uncontrolled flight at air speed in excess of 310 kts.

Probable cause(s)

- the aircraft electrical power supply failed in cruising flight (probably DC generator controller).
- the vital instruments for indicating the flight attitude showed increasingly incorrect readings and failed completely after the gyros stopped rotating.
- the ac got into uncontrolled attitudes in which it was subjected to severe loadings exceeding the ultimate load, leading to structural failure.

3.3.7.2 Comparison with EI-AOM Accident

- | | | |
|-----|---|-----------|
| Ga) | Although in both cases, the crew were not warned, the cases are not comparable since for EI-AOM, the loss of control happened suddenly whereas for G-ATFN the loss of control was the consequence of incorrect presentation of the aircraft's attitude. | D |
| Gb) | The initiation of the loss of control is not comparable in both accidents since for G-ATFN, it resulted from the wrong indicated aircraft attitude due to the impaired flight instruments in IMC. | D |
| Gc) | The loss of control phase for EI-AOM shows typical attitude (spinning or spiralling) when the loss of control phase of G-ATFN shows erratic abnormal attitudes of the aircraft. | D |
| Gd) | No recovery of the out-of-control phase of G-ATFN | D |
| Ge) | Not applicable. | NA |
| Gf) | Ultimate phase resulted from loads exceeding ultimate loads which resulted in failure of the outer wings and elevators. | S |
| Gg) | Examination of the wreckage in G-ATFN case shows that the mechanical integrity of the aircraft has been impaired prior to the impact. | S |

3.3.7.3 Conclusion

The level of similarity between an aircraft suffering an alternative power supply disruption and EI-AOM is characterized by : 2 **S** – 4 **D** – 1 **NA**

3.3.9 Similarities between EI-AOM Accident and an Accident caused by UNCOMMANDED GROUND FINE PITCH IN FLIGHT

3.3.9.1 Description of N 7404 Accident

- | | |
|-------------------------|---|
| - Identification | - VISCOUNT – Model 744 |
| | - N 7404 |
| - Description | on final descent at 50 ft, sudden loss of speed and increased vertical speed. |
| - Occurrence | |
| - triggering factor | - the propellers' blades had come to ground fine pitch. |
| - ultimate flight phase | - the ac touched short off the runway and stopped on its belly 1 625 ft short. |
| - Probable cause(s) | - micro switch guarding the props blades in the flight pitch failed, allowing uncommanded pitch change. |
| | - no specific inspection procedure was issued. |

3.3.9.2 Comparison with EI-AOM Accident

- | | | |
|-----|--|-----------|
| Ia) | Both events were sudden. | S |
| Ib) | Initiation of the loss of control is similar. However pilots' actions on the power level are presumably different. | S |
| Ic) | In both cases, the loss of control phase shows a typical attitude. | S |
| Id) | Different. | D |
| Ie) | Not applicable. | NA |
| If) | Different. | D |
| Ig) | The event was not long enough to impair the structural integrity prior to the crash. | D |

3.3.9.3 Conclusion

The level of similarity between an aircraft suffering from an uncommanded ground fine pitch in flight and EI-AOM is characterized by : 3 **S** – 3 **D** – 1 **NA**.

3.3.10 Similarities between EI-AOM Accident and an Accident caused by an In-Flight Door Separation resulting in a DOOR STRIKE

3.3.10.1 Description of the HS-748 G.ASPL Accident

- Description

- En route the pilot transmitted a distress call indicating that the ac had suffered a violent decompression, possibly due to the loss of a rear cabin door and that they had severe control problems. Having just passed 80 ft, the wings and the left tail plane and elevator became detached.

The fuselage with the fin, rudder, right tail plane and elevator still in position struck the ground, 11 mi from East Midlands airport.

- Occurrence

- ultimate flight phase - FDR and CVR were recovered and good quality read-outs have been obtained. No evidence of any explosive device detonation has been found. The right rear cabin service door became detached and struck the right tail plane leading to a loss of control and subsequent overstressing of the ac.

Probable cause(s)

- The baggage door opened, separated and became attached to the right tail plane, this altered the tail's aerodynamic characteristics so much that the ac became uncontrollable. During pitch instability both the wings and tail became overstressed and detached. The door locking mechanism was misrigged and the door was not fully locked at the time of take-off.

Recommendations were made to improve the door unsafe warning arrangements and to provide better maintenance instructions. It was also recommended that ways be found to improve defect and occurrence data acquisition and means for identifying recurring defects.

3.3.10.2 Comparison with EI-AOM Accident

Ja)	In both cases the event is sudden	S
Jb)	Initiation of the loss of control is similar.	S
Jc)	Loss of control phase shows erratic attitudes of the HS-748.	S
Jd)	Similar.	S
Jf)	The ultimate phase is different, since in the case of door strike, the final effect could be quite random, making the loss of control not irreversible.	D
Jg)	Mechanical integrity has been impaired prior to the crash.	S

3.3.10.3 Conclusion

The level of similarity between an aircraft suffering from a door strike and EI-AOM is characterized by : **5 S – 1 D.**

3.3.11 Similarities between EI-AOM Accident and an Incident caused by a DOOR FLAPPING In Flight

3.3.11.1 Description of the FNF S030 P Incident

- Identification
 - SO30 P
 - FNF – 325 – NR6
 - November 25 – 1959 – 09.00 AM – Day Light
- Description
 - during pre-start checks, the red warning “door unlocked” kept alight. Visual checks lead to state :
micro-switches misadjustment.
 - After having completed a 1 hr 45 mn flight at level 80, the flight was just beginning descent to destination, and as the ac crossed the altitude of 5 000 ft, suddenly it banked left violently up to 90 deg.. Full rudder and ailerons deflections were applied. The ac banked right violently up to 90 deg. Rudder and ailerons deflection triggered a left vertical bank.
- Occurrence
 - triggering factor
 - the cargo door had flown away. But the crew could not understand why and how the absence of the door could make the ac banking so violently.
 - ultimate flight phase
 - A distress call was radioed. A crash was decided on a flat ground right ahead. As the ac height was 100 to 200 feet, the magnitude of the banks was reduced to 30-45 degrees. By chance, a runway could be seen right ahead. In landing conditions (ac configuration and speed), the ac recovered some stability. The crew landed the ac without other damage to the ac.
- wreckage
 - The controller having seen some part falling down off the ac, out of the air-field, in line with the axis, the door could be recovered. This door was (1,20 x 1,30) m with an horizontal up hinge.

It was creased, cross-shaped, having been stuck to the rudder and horizontal tail plane junction.

- Probable cause(s)
 - The investigation established that the lock was worn.
 - The door had been flown away from starboard to port, and then stuck by the air-flow to the empennage.
 - this created an important air flow disturbance which impaired the ac stability.
 - some stability was regained when the air speed was lowered for crash or landing, and because the low altitude (200-100 feet) could have generated ground effect.
 - normal stability was definitely regained when the separated door was liberated off the empennage.

3.3.11.2 Comparison with EI-AOM Accident

Ka)	Similar.	S
Kb)	Similar.	S
Kc)	Similar.	S
Kd)	Not applicable.	NA
Ke)	Not applicable.	NA
Kf)	Not applicable.	NA
Kg)	Not applicable.	NA

3.3.11.3 Conclusion

The level of similarity between an aircraft suffering a disabled flight caused by a door flapping in flight is characterized by : 3 **S** and 4 **NA** (since there was no crash).

3.3.12 Similarities between EI-AOM Accident and an UNEXPLAINED LOSS OF CONTROL

3.3.12.1 Description of the VT-DIO Accident (1963)

- Identification
 - VISCOUNT
 - VT-DIO
 - Indian AL
 - September 11 – 1963 – 04.00 AM – I.S.T. –
Night-time – calm weather – no icing
- Description
 - the crew reported operation normal
but the radio signal was so low that the message
could not be received by the ground radio
station.
Repeated calls were negative.
- Occurrence
 - triggering factor
 - undetermined
 - ultimate flight phase
 - several witnesses observed the ac and its sudden descent, coming down in a steep dive emitting some kind of fire or bright light, and then at a low altitude. After a 6 M. trajectory, the ac impacted the ground. There is evidence of partial control up to the last.
The ac must have been operating with a forward speed between 252-330 kts.
- wreckage
 - the ac struck the ground while diving in an attitude slightly over the vertical.
An immediate explosion at impact and fire lead to an extreme disintegration of the ac.
- Probable cause(s)
 - no probable cause but a list of 15 possible causes and a list of 9 findings were established. 8 recommendations among those : Deficiency list for the VISCOUNT ac duly approved by the Department of civil aviation should be issued without any further delay.

3.3.12.2 Comparison with EI-AOM Accident

L a)	Not observed.	NA
L b)	Similar.	S
L c)	Similar.	S
L d)	Different.	D
L e)	Not applicable.	NA
L f)	Similar.	S
L g)	Similar.	S

3.3.12.3 Conclusion

The level of similarity between this unexplained accident and EI-AOM is characterized by :

4 S – 1 D – 1 NA

3.4 CONCLUSIONS

It may be considered that the number of NA is an indicator of the level of relevance of each accident.

It may be considered that $[nb(S)] / [7 - nb(NA)]$ is a global indicator of the level of similarity.

	S	D	NA	$\frac{S}{7 - NA}$	Rank of similarity
Icing	3	4	0	0.4	9
Stall	3	4	0	0.4	9
Bird strike	4	2	1	0.7	4
Structure failure	3	3	1	0.5	5
Spigot rupture	4	1	2	0.8	3
Bulkhead failure	3	3	1	0.5	5
Alternative power supply disruption	2	4	1	0.3	11
PCU contamination	3	3	1	0.5	5
Uncommanded GFP in flight	3	3	1	0.5	5
Door strike	5	1	0	0.9	2
Door flapping	3	0	4	1.0	1

Note : 7 is the number of considered factors of the accident.

Comments

The “door opening” similarity level shows that this part of the flight which was relevant (the disabled flight) is quite similar to the disabled flight of EI-AOM.

The strikes on the tail, whatever the cause (door, bird) produce the same effect. The main factor with respect to the consequences is the level of the initial damage on the tail : it will lead to a direct crash in the most serious case or a period of disabled flight as long as the aircraft degradation process is developing up to crash ; or in the best cases, just a damage on the tail allowing for a safe landing.

The different types of structure failures show the susceptibility of the tail section.

Conclusions

What appears characteristic, in term of similarity, is the degradation process of the aircraft capacity, and a good indicator is the duration of this process.

This process may be initiated by an external event (bird strike, door strike), but also a direct structure failure (spigot) or by an aircraft manoeuvre (stall recovery).

This initial event initiates a structure failure which will develop during 20 to 30 mn, before parts break, eventually separate from the aircraft and finally leads the ac to a crash.

The ranking of possible initial events is as follows :

- door strike
- bird strike
- spigot rupture
- structure failure
- severe in flight manoeuvres.

The accidents of VT-DIO (Indian – 1963), EI-AOF (AER Lingus – 1967), EI-AOM (AER Lingus – 1968), HK 1058 (Columbia – 1974) and PK-IVS (Bouraq – 1980) appear to be a “family” of accidents.

Inside this family, AOM and AOF present a particular level of similarity, as it appears in Appendix 3c.

- 4. TECHNICAL ANALYSIS**
- 4.1 INTRODUCTION**
- 4.2 ENGINES AND PROPELLERS**
- 4.3 FLIGHT CONTROLS**
- 4.4 SYSTEMS**
- 4.5 DOOR STRIKE**
- 4.6 BIRD STRIKE**
- 4.7 FUSELAGE FAILURE**
- 4.8 METAL FATIGUE**
- 4.9 FLUTTER**
- 4.10 MAINTENANCE**
- 4.11 REGULATORY ACTIONS**
- 4.12 CONCLUSIONS**

Refer to :

Appendix 4a : The Viscount Aircraft

Appendix 4b : Flight controls

Appendix 4c : Metal fatigue

Appendix 4d : Flutter

contained in Volume 2 : « Appendices and Annexes »

4.1 INTRODUCTION

From the outset, it became clear that Appendix 4 to the 1970 report, which was not published at the time, details an excellent expert examination of what was recovered of the airframe engines, propellers, equipment and systems of the accident aircraft.

The original accident report published in 1970 examined seven other Viscount accidents but concluded that the circumstances were either not relevant or any connection was extremely remote. In considering probabilities, the report states that failure of the basic airframe structure is contra-indicated and bird strike is improbable.

In Conclusion 11, the 1970 report states “The aircraft was substantially intact when it entered the sea, except for the probable loss of all or part of the elevator spring tab”.

In fact, it would appear that both left and right tailplanes (with the exception of the starboard tab) together with the tailplane centre-section spar were not lying in the sea bed with the main wreckage.

The year 2000 Review Report states (conclusion Nr 29) that the 1970 report did not adequately examine the possibility of a cause other than a collision or near collision although it does quote a Conclusion from Appendix 4. “The evidence available does not eliminate the possibility of a defect or failure on the elevator and/or tailplanes having contributed to the accident”.

With the passage of time and with the lack of any significant newly discovered wreckage or data, the main avenue open for this current review was to examine the initial report and annexes in the light of other occurrences and accidents and to evaluate possible scenarios which may be at least consistent with the accident circumstances. Accordingly the following areas are considered.

A broad description of the Viscount Aircraft type is at Appendix 4a.

Complementary information is in :

- Appendix 4a.1: General View.
- Appendix 4a.2 : General Arrangement.
- Appendix 4a.3: Leading Particulars.
- Appendix 4a.4.1 : Tail structure : Fin Leading Edge to Fuselage.
- Appendix 4a.4.2 : Tail structure : Tail Center Section Spar to Fuselage.
- Appendix 4a.4.3 : Elevator Torque Tube to Gimbles.
- Appendix 4a.4.4 : Spring Servo Mechanism Levers to Elevators.

contained in Volume II : “Appendices and Annexes”

4.2 ENGINES AND PROPELLERS

All four propellers and three of the four engines were recovered and examined by the manufacturers (Rolls Royce and Dowty Rotol) in association with Irish Government personnel. The fourth engine (No. 4) was not recovered but was sighted in the main wreckage location.

The original investigating team, reporting in 1970, considered that all four engines were firmly attached to the aircraft at impact and providing low power with all propellers on or about the flight-fine pitch stop.

Although the fuel control units were not found, the fact that all four propellers were in fine pitch at impact and none were feathered, indicates that major engine failure did not occur.

Experience with a limited number of single engine Dart powered military aircraft (subject to much more rigorous flight envelopes) revealed some issues relating to fuel flow and excessive smoke following maladjustment or the application of unusual acceleration forces. Examination of the history of the multitude of civil Dart powered multi-engined airliners reveals that there is little evidence to suggest that similar problems were factors in this accident.

However, the study of relevant accidents reveals a number of cases of a problem where misadjustments and unusual acceleration forces provided abnormal fuel flow and recorded cases of visual smoke emissions. Such reports may explain witness reports of puffs of smoke following an upset.

The original investigation concluded that all four engines were alight, with the throttles closed, and with an airspeed at impact less than 130 kts.

Witness statements indicate the possibility of one (Number 3) or more propellers being feathered at some stage in flight.

There was no sign of any pre-impact failure or fire.

Complementary information is in :

Appendix 4a.5.1: DART Engine: Left Hand View

Appendix 4a.5.2 : DART Engine : Right Hand View.

Appendix 4a.5.3 : DART Engine : “General Arrangement “ View

4.3 FLIGHT CONTROLS

Although a number of parts were not found , there was nothing to suggest that any defect was present in the ailerons or their control runs prior to impact.

The upper two-thirds of the fin and rudder was complete and recovered in one piece. It was concluded that the fin, rudder and tab were on the aircraft at impact and no evidence was uncovered to suggest the presence of any damage or defect in these or the rudder controls, which would prevent normal operation.

A review of the above investigation, in the light of the subsequent service history of the aircraft type, has produced no evidence to vary the findings made at the time with respect to the aileron and rudder controls.

However, it was not possible to eliminate the possibility of a defect or failure in the elevator and/or tailplanes having contributed to the accident as both elevators, both tailplanes, the tailplane centre-section, the tailcone and the rear pressure bulkhead were not found.

The elevators on the Viscount are fitted with three types of tab ; a trim tab, a spring servo tab and an anti-balance tab. In view of the consideration given to the elevator controls in this report, a brief outline of the tab functions may be useful and is presented at Appendix 4b.

A section of the starboard elevator trim tab was found in the main wreckage area and a section of the port elevator spring tab was found seven miles away some six months after the accident. The anti-balance tab, also from the port elevator, was not recovered.

Complementary information is in :

Appendix 4b 1 : Flying Controls

Appendix 4b 2 : Viscount Tail Pictures (3)

Appendix 4b 3 : Elevator Structure

Appendix 4b 4 : Elevator Control Relationship

Appendix 4b 5 : Elevator and Rudder Trim Tab Control

Appendix 4b 6 : Controls Aft of Pressure Bulkhead

Appendix 4b 7 : Elevator Torque Tube

contained in Volume II : “Appendices and Annexes”

4.4 SYSTEMS

The air conditioning and pressurisation system is of interest from the point of view of crew incapacity as a result of lack of pressurisation, sudden decompression or fire. However pathological evidence is that there was no sudden decompression (the Institute of Aviation Medicine of the RAF and its Irish equivalent performed all pathological work). Many items were damaged or not recovered but on the limited evidence available nothing unusual was discovered.

Some significant parts of the thermal de-icing system were recovered and did not reveal anything to indicate abnormal operating conditions. There is evidence that at least part of the system was turned on.

The electrical system was very carefully examined during the original investigation. In August 1968, a British registered 700 Series Viscount with 48 people on board was lost over Germany following a complete electrical failure. In that case, the crew did not notice the failure and eventually drained the batteries. The aircraft was in IMC and in descending through cloud without reliable instruments, control was lost and the aircraft broke up.

With respect to EI-AOM, sufficient material was recovered to establish that there was both A.C. and D.C. power on the aircraft at impact. This finding, together with the good visual weather conditions, make any electrical system causal factor extremely improbable.

A defect in the Auto-pilot, which had been present when Aer Lingus purchased the aircraft from KLM, was the subject of much analytical, ground and flight test investigation following the accident. The 1970 report concluded that the defects found could not be the initiating cause of the accident.

During this current study, one oral submission was received claiming that the auto-pilot defect could indeed have initiated the accident and that the original investigation was wrong. Although the comments were received from a well qualified person they could not be substantiated in the face of the extensive investigation carried out at the time.

The Team believe that a qualified crew could have overridden any auto-pilot abnormal behaviour easily, particularly as the flight was in visual conditions.

4.5 A DOOR STRIKE

The Viscount, like a number of other aircraft types, has had a number of door defects and separations. A study of occurrence reports supplied by the UK Civil Aviation Authority which unfortunately only covers the last ten years of the aircraft service, shows 20 reports of door problems, all non-serious. One of the reasons for the lack of reports may be the fact that, following early Viscount door separations, requirements were introduced for micro-switch contacts and indicator flags on each door latch pin. Historically therefore a cabin door separation in flight cannot be entirely discounted.

Although not commented upon in the 1970 accident report, Appendix 4 (a) to the report provides a comprehensive cover of the door situation. There are three entrance doors above the floor line; two cargo hold doors below the floor line and one freight door above the floor. Sufficient evidence was available to show that four of the doors were closed at impact. However, the starboard rear cargo door and the starboard rear freight door were both missing with no evidence to show whether or not they were in place at impact.

In the absence of aerodynamic airflow data, it is not possible to state with any certainty whether either door could have struck the tailplane. The cargo door looks as if it would likely slide under the wing and be carried by downwash below the tail whilst the freight door looks a little too close to do other than slide under the tail plane. Nevertheless it must remain a possibility that a starboard side tailplane strike could occur.

On the question of consequences of such a strike, there is little useful data. However, there was one significant fatal accident which occurred in June 1981 to a British registered Avro 748 Rolls Royce Dart powered airliner. In that case, the rear baggage door opened, separated and became attached to the starboard tail plane. This altered the aerodynamic characteristics of the aircraft to the extent that it became uncontrollable. As a consequence of the instability in pitch, both wings and the tail unit were overstressed and separated from the aircraft.

Another reported incident concerned a Turkish operated Viscount in March 1968 which lost a forward cabin door in flight. This resulted in damage to both propellers on one side and, reportedly, autofeathering. However, the sudden power loss on one side did not result in loss of control.

One difficulty with the proposition that one of the doors from the starboard side struck the tail is that the spring tab from the port elevator was found remote from the main wreckage whilst a portion of the trim tab from the starboard elevator was recovered from the main wreckage area. This is indicative of a port side tailplane or elevator failure but the possibility cannot be discounted of a partial failure on one side subsequently affecting the other side.

On the limited evidence available, this scenario must remain a possibility.

4.6 A BIRD STRIKE

As mentioned in the 1970 report, one Viscount was lost in the United States as a result of a whistling swan striking the port tailplane. There are some interesting features of this accident which may have some relevance to the accident to EI-AOM.

The circumstances were that the aircraft, a Viscount 754D, on November 23, 1962, encountered a flock of whistling swans at an altitude of 6000 feet. One swan struck and penetrated the port tail plane 49 inches from the root causing separation of the outboard 11 feet. This weakened the structure of the remaining inboard section which subsequently also separated. Displacement of the elevator during this failure sequence imposed severe down loads on the starboard tail plane which then failed in downwards bending. The wings did not separate from the fuselage despite the loss of both tail planes.

One theory against the loss of all or a substantial part of the tail planes had been that although it would clearly result in loss of control and the entry into a spin or uncontrolled dive, it would also probably result in failure of the wings in downward bending. This actually happened in the loss of a Convair 580 near the Danish coast in September 1989 with the loss of 55 lives. The tail separated from the aircraft as a result of a fatigue failure followed by flutter. It was interesting therefore to note that wing failure did not occur in the Viscount bird strike accident which to that extent at least was consistent with EI-AOM.

The International Civil Aviation Organization (ICAO), has a statistical unit specialising in bird strike occurrences on a global basis, (the IBIS system). The data is far from comprehensive but it does list 25 cases of bird strikes on aircraft flying between 10000 and 25000 feet. Some of these caused serious damage to the aircraft concerned. In addition, CAA occurrence reports show that one British Viscount 814 had a serious bird strike at 19000 ft over the Irish Sea in the month of July 1981. The windscreen was crazed.

In looking at available evidence, it is considered that the possibility of a bird striking one tailplane resulting in partial failure may well be a triggering factor (ref appendix 3 a).

4.7 FUSELAGE FAILURE

There have been two prominent fatal accidents resulting from the failure of rear pressure bulkheads. One concerned a twelve-year old Vickers Vanguard aircraft with 21685 hours time in service which crashed in Belgium in October 1971 with the loss of 63 lives. The aircraft was in steady cruise at 19000 ft when catastrophic structural failure occurred.

At a cabin differential pressure of about 5.75 lb/sq in, the rear pressure bulkhead ruptured releasing air under pressure into the tailcone and the interior of both tailplanes. The pressure was sufficient to cause structural failure and in-flight separation of the outer two thirds of both tailplanes.

A short message was received from the pilot before the aircraft impacted the ground in a vertical dive about one minute after the bulkhead failure.

Metallurgical examination of the wreckage showed that the bulkhead failed as a result of extensive intergranular corrosion along the lower edge under a redux bonded doubler. It appears the aircraft had a blocked drain hole which allowed fluids such as toilet spills and hydraulic oil to accumulate in the area. The inspections carried out were clearly inadequate.

The other accident involved a Boeing 747 which crashed in Japan in August 1985 following the fatigue failure of the rear pressure bulkhead. Five hundred and twenty lives were lost in this, the biggest loss of life ever in any single aircraft accident. Fatigue cracking initiated at an improperly carried out repair and resulted in the complete rupture of the bulkhead. The release of pressurised air from the cabin resulted in partial failure of the vertical fin and the severing of primary hydraulic lines and consequential loss of the flight controls.

The Boeing 747 accident was a unique event with few parallels to other types. However, the bulkhead failure on the Vanguard, at first sight, appeared to have some similarities with the circumstances of the accident to Viscount EI-AOM.

However, a close examination shows the Viscount to be a rather different case. Although some corrosion had been reported, there is no evidence in defect, occurrence or accident reports of any major problems. The cabin diameter and pressure differential are less and the detail design less complex as it is without the corresponding bonded doubler. It is also more inspectable.

EI-AOM had been inspected by Scottish Aviation in February 1967 prior to the delivery to Aer Lingus and two corroded rear belly skin panels were replaced and others treated.

It is difficult to imagine that the very extensive corrosion required to fail a bulkhead would have remained undetected at this time or would have occurred in the thirteen months the aircraft was in service with Aer Lingus.

A further consideration is that pressurisation of the tailplanes in the event of a bulkhead failure is not possible as the area behind the bulkhead is sealed with limited air entry to the interior of the tailplanes. The elevator control rods pass through the bulkhead and it is conceivable that control could be lost or interfered with in the event of a failure or partial failure of the bulkhead. However, there is no history of any such problem and nothing to suggest such a scenario.

It is difficult to connect a possible bulkhead failure with the loss of EI-AOM although this part of the structure was not recovered or seen in the field of the wreckage.

4.8 METAL FATIGUE

A brief explanation of fatigue criteria, the establishment of tailplane retirement lives and some service experience are presented at Appendix 4c.

The examination of the wreckage evidence by the original investigation team showed the wing primary structure to be intact at the time of impact. As a result, the issue to be examined is whether there is any possibility of a fatigue failure of a tail plane spar, an attachment fitting or an elevator or tab linkage.

It was not found possible to obtain the specific Aer Lingus retirement schedule for EI-AOM but figures were obtained from the Vickers Viscount 800 Series Aircraft Manual held in the UK CAA library. Although of a 1972 issue, the figures give some indication of the mandatory lives. They are:

Tail plane spar including root end attachment fitting	20,000 landings
Tail plane centre section top boom	17,500 landings

Various modifications are listed in order to extend lives.

A life of 12000 hours was introduced in 1971 following an investigation into the failure of an elevator spring tab spigot on an Austrian aircraft. Prior to that investigation, the spigot and associated torque tube did not have a retirement life limit but were subject to overhaul and inspection at 12.000 flying hours intervals. This overhaul inspection interval would have applied to EI-AOM.

In the case of the Australian Viscount referred to in Annex B 3 which suffered the wing failure, the tail plane spars were removed and the inboard 50 inches examined. All holes were broken open and the surfaces examined under a microscope. No fatigue cracks were found.

Of more interest is an accident in Colombia on 8 June 1974 when a Viscount 785D crashed with the loss of 44 lives. The accident resulted from the fatigue failure of the port tailplane spar upper boom at the attachment to the steel root fitting. The tailplane had reached 28095 flights in service and the failure initiated in the outboard holes in both the vertical and horizontal flanges of the aluminum alloy spar boom.

In February 1968, a large (0.65 in) fatigue crack was discovered during an inspection in one inboard hole in the upper flange of the port side upper steel attachment fitting. This was in a British registered Viscount 700 series which had achieved a total of 19324 flights.

It is possible that other cracks were found during inspections and the records show that two cracks were found in the corroded upper boom of a British Viscount mentioned earlier.

Four Viscounts are known to have been lost in fatal accidents involving metal fatigue.

With respect to EI-AOM; if the tail plane time in service is the same as the aircraft, at 16923 landings (this was not always the case as some airlines are known to have rotated tailplanes between aircraft), then the following factors alone or in combination would be required for a fatigue failure to occur:

- ◇ An unconservative life estimation
- ◇ An ‘extreme probability’ failure as accepted as part of the safe life philosophy
- ◇ An aircraft defect such as a badly drilled hole, a scratch or corrosion
- ◇ Some additional external loading

Complementary information is in :

Appendix 4c 1 : Example of Fatigue Crack on Tailplane Spar Joint Fitting

Appendix 4c 2 : Typical Position of a Crack on Tailplane Spar Joint Fitting

(2 views)

Appendix 4c 3 : Areas of Concern Corrosion Related in 1969

Contained in Volume II : “Appendices and Annexes”

4.9 FLUTTER

One very well documented accident which occurred in 1980 resulted from failure of the elevator spring servo tab circuit and consequential tail separation and loss of control of the aircraft.

The aircraft was a Viscount 812 operated in Indonesia. The accident was witnessed by the crew of another aircraft and the wreckage was available.

The aircraft was in cruise at 14000 feet altitude when it transmitted a Mayday call that the “aircraft shuddered”. Subsequently, the starboard elevator, then the port tailplane were observed separating from the aircraft and pilot control was lost.

The final chain of events started with the fatigue failure of a spigot in the elevator spring tab operating mechanism. This failure allowed a symmetrical “spring tab free” flutter mode involving the tab, elevator and tailplane, to develop. The resultant repetitive loads were of sufficient magnitude and frequency to cause a fatigue failure of the port tailplane spar upper boom end fitting. As a result the tail plane complete with its elevator separated from the aircraft.

The aircraft total time in service was 20659 hours and 17947 landings but interestingly it was discovered that the spigot concerned had previously been fitted to another aircraft and had reached a total time of over 33000 hours. A mandatory retirement life of 12000 hours had been introduced in 1971 following a fatigue failure in another aircraft. With respect to EI-AOM, in 1968, there was no requirement for an individual track of the spigot. So it is possible that the EI-AOM spigot had more hours than the aircraft.

It was discovered that in spite of the high hours of the spigot, higher than normal loads were still required to induce failure. The Aircraft Manual maximum allowable free play at the spring tab is reported to be 0.10 inches for 700 and 800 Series aircraft and 0.05 inches for the 810 Series..

Note that the tab free play is obtained by measuring the free deflection at the trailing edge. The spigot fitting is a steel 1/4 inch spindle mounting which serves as a pivot point in the drive mechanisms.

In summary, it appears that exceeding the manufacturer’s tab free play limits would be sufficient to eventually induce failure of the tailplane.

It is noted that Conclusion 7 of the 1970 report states “A portion of the elevator spring tab from the port elevator probably became detached while the aircraft was airborne” and that § 2121 states that seaweed was not prevalent at the accident site and tidal currents are not such as to wash the tab ashore the necessary 7 miles.

It is not known when the tab free play was last checked by Aer Lingus but the Vickers recommended interval was 900 hours.

A tab free play inspection was unlikely to have been included in the Aer Lingus 2.04 maintenance inspection, the records of which are missing.

Following the 1980 Indonesian accident, the manufacturer issued a Campaign Wire stressing the importance of backlash checks. In the UK alone six aircraft were reported to have been discovered with twice the allowable spring tab backlash limit. This indicates that it was not uncommon for excessive backlash to be present at a level which would cause additional cyclic fatigue loading to be imposed on the tailplane.

In summary, a critical chain of events arises if the elevator spring servo tab free play or backlash exceeds allowable limits. In such a case, additional cyclic loading is induced into the spigot in the tab operating mechanism which may eventually cause it to fail in fatigue. In the event of complete failure of the spigot in flight, the oscillation of the elevator spring tab mechanism at normal cruise speeds could develop into tab/elevator/tailplane flutter, the severity of which could lead to fatigue failure of the tailplane root end attachment.

Although only two spigot failures have been reported it should be borne in mind that for most of the time Viscounts were in service there was no mandatory reporting system and from 1971 a 12000 hour retirement life was imposed. However, it should be noted that the manufacturer has advised that a check of service history and defect investigation files failed to reveal further incidents of spigot failure.

A brief explanation of the phenomenon of flutter is given at Appendix 4d.

Complementary information is in :

Appendix 4d 1 : Characteristics of Separation Sequence vs Air Speed

(extract of aeroloading note Nr 627 – December 6, 1965).

Appendix 4d 2 : Example of Separation Process

(extract of Bouraq accident report of PK IVS –

August 26, 1980)

4d2 – 1 : Fragmentation of Empennage : Port Rear View

4d2 – 2 : Fragmentation of Empennage : Starboard Rear View

4d2 – 3 to 6: Separation Sequence

contained in Volume II : “Appendices and Annexes”

4.10 MAINTENANCE

The Year 2000 Review report in pages 33-40 presents a thorough coverage of the maintenance file history and, in particular, it provides an analysis of the missing paperwork related to the 2.04 inspection work package.

Inspection package 2.04 was last carried out on 18 December 1967 and is basically a 350 hour check. It was not found possible to identify individual Aer Lingus work card numbers but an examination of the Viscount 800 Aircraft Manuals was made at the UK CAA offices at Gatwick and BAE Systems at Manchester. These manuals were produced by Vickers and provided a basis for operators to devise their own schedules under an approval system agreed with the relevant regulatory authority.

Accordingly, whilst there will be local variations, the basic inspection coverage would be expected to have met the intent of the manufacturers' recommendations.

A check of all the material available provided no evidence or even a suggestion that any omission or error in carrying out the 2.04 inspections could have contributed in any way to the accident to EI-AOM.

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However, with respect to maintenance in general carried out by Aer Lingus, the many serious errors discovered in the maintenance plan of the aircraft do not inspire confidence in the maintenance culture of the airline at that time. Whilst, for example, no maintenance mistakes or omissions were evident relating to the pitch control system of the aircraft we cannot be even reasonably sure that they did not exist.

4.11 REGULATORY ACTION

The regulatory control of Viscounts with respect to problems manifesting themselves in service was primarily done by the issuance of Preliminary Technical Leaflets (PTLs) or Service Bulletins (SBs) by the manufacturer and classified as mandatory in the United Kingdom.

Until the mid 1970s airworthiness control was the responsibility of the UK Air Registration Board (ARB) which had certificated the Viscount to design requirements effective in 1951. The ARB did not issue Airworthiness Directives (ADs) on UK aircraft but achieved the same effect by classifying manufacturers Service Documents mandatory as appropriate.

There was little practical change when the UK Civil Aviation Authority (CAA) was formed in the mid 1970s as, in effect, the ARB just became the Airworthiness Division of the CAA. The same policies applied for many years but eventually an AD system was introduced.

The change of regime from the ARB to the CAA had no discernible effect on the regulatory control of the Viscount, although the CAA have actually underwritten the series 800 Life Extension report LER VIS/800 conducted in 1988 which extended the aircraft's life to 75000 Full Stop Landings or 45 years with additional inspections, modification embodiments and reduced fuselage pressures.

Service Documents classified Mandatory by the UK only had effect for aircraft on the UK Register unless countries with Viscounts on their Register specifically mandated them. This was almost invariably the case and was the system employed in Ireland.

In addition, some countries, notably Australia, issued Airworthiness Directives (ADs) independently based upon their own experience with the aircraft.

As an example, the Australian Department of Civil Aviation in 1969 required the immediate and unprecedented removal of all 700 Series Viscounts from the Register and restricted future operations of the 800 Series. This followed the fourth Viscount accident in Australia – one which resulted from a wing fatigue failure.

Hundreds of PTLs and ADs and other documents were sighted during the study and they told a story of continual effort over more than forty years to maintain the airworthiness integrity of the aircraft. This should not surprise or alarm people as it is typical of aircraft of its day and indeed a similar situation still exists with current modern airline aircraft.

A significant number of PTLs and ADs on the Viscount do however relate to serious structural problems, particularly ones relating to metal fatigue. The wings, fuselage and tailplanes were all affected in spite of the fact that these components were certificated with mandatory retirement lives.

Significant inspection, retirement, modification and other action was taken with respect to the Tailplane spar cap and attachment fittings and the elevator spring tab control linkage.

Other problems related to door separations, corrosion, control interference and maintenance.

It is impossible to be precise about any cause and there are always a great many possibilities in an accident such as this one. However, to the extent possible, the various regulatory actions have been taken into account in this study.

4.12 CONCLUSIONS

From a technical evaluation of the circumstances surrounding the accident to EI-AOM, it is possible to summarize the probability of events or aircraft components being causal factors. These are presented in terms of Extremely Remote; Improbable; Possible and Probable.

EVENT	PROBABILITY
▪ Weather – general ▪ Weather – icing ▪ Internal pressure of tailplane ▪ Fire	Extremely remote
▪ Door Strike ▪ Bird strike ▪ Metal corrosion ▪ Maintenance	Possible
▪ Metal fatigue ▪ Flutter	Probable

AIRCRAFT COMPONENT INVOLVEMENT AS INITIAL CAUSE	PROBABILITY
▪ Engines ▪ Propellers ▪ Systems : · Electrical · Hydraulics · Anti-icing ▪ Systems : · Flight controls (excluding pitch control) ▪ Wing ▪ Fin-rudder	Extremely Remote
▪ Fuselage	Improbable
▪ Tailplane ▪ Elevator, including tabs ▪ Systems : pitch control	Probable

Accordingly it is concluded :

- **A structural failure of the port tailplane is consistent with the evidence relating to the loss of EI-AOM.**

There are a number of possibilities which could explain the separation of whole or part of the tailplane but an analysis of the service history of the type suggests that this may have resulted from a fatigue failure of the main spar upper boom or attachment fitting initiated or exacerbated by excessive spring servo tab free play.

- 5. OPERATIONAL ANALYSIS**
- 5.1 INCONCLUSIVE 1970 REPORT**
- 5.2 “MID-AIR COLLISION” SCENARIOS**
- 5.3 “NO RECOVERY” SCENARIO**
- 5.4 “AS PER WITNESSES” SCENARIO**
- 5.5 SHANNON R/T TRANSCRIPT CRITICAL ANALYSIS**
- 5.6 CONCLUSIONS OF THE OPERATIONAL ANALYSIS**

Refer to :

Appendix 5.1a

Appendices 5.2a to 5.2i

Appendices 5.4a to 5.4e

contained in Volume II: “Appendices and Annexes”

5.1 INCONCLUSIVE 1970 REPORT

5.1.1 1968 Flight Reconstruction

5.1.2 Unsolved Inconsistencies

5.1.3 Inconclusive 1970 Report

5.1.4 Consequences of this inconclusive Report

5.1.5 Operational Analysis Methodology

Refer to

Appendix 5.1a : 1968 Track Reconstruction

contained in Volume II : “Appendices and Annexes”

5.1 INCONCLUSIVE 1970 REPORT

5.1.1 1968 Flight Reconstruction

5.1.1.1 Data Available

The flight reconstruction performed in the 1970 accident report was based on :

- The radio-comms transcripts
- The time of the spin
- The position of the wreckage
- The statements of those witnesses who appeared to be “very reliable” (§ 2.1.3.3 and § 2.1.3.8) or “quite reliable” (§ 2.1.3.8).

5.1.1.2 Positioning and Timing (GMT)

From 10 hr 32 min to 10.51.48, EI-AOM climbed regularly up to FL 170, reporting “by Youghal” at 10.40, and “by Bannow” at 10.57.07.

Since the flight was authorized direct to Strumble at 10.40, authorization acknowledged by the crew, and since the wreckage was discovered near Tuskar Rock, there is an ambiguity on the Viscount positioning at 10.58, when the crew reported “spinning”. However an “uncertainty zone” may be defined, which, under the considered data, surely contains the position of the spin (refer Map 5a1).

After 10.58, there were no further radio-comms.

- The nearest points of the area of uncertainty from the position of the wreckage are not more than 5 nautical miles away, in direct line.
- This opens a possibility for the crash to occur from 11.00 if there is no recovery; up to an undetermined time if there is a recovery, and if the Viscount can have been flown in a disabled condition over the sea, out of the sight of any witness.

It can be noted that, even if the spin occurred at the farthest point of the area of uncertainty, a crash between 11.10 and 11.15 remains possible.

The time of the crash, as determined from the observations of two witnesses, considered by the Investigation Team as very reliable, could be between 11.10 and 11.14.

If this observation is “reasonably reliable” then the Viscount cannot : spin at 10.58 at the nearest point of the uncertainty zone, fly in a disabled condition from this point to Fethard area, be observed from Saltnills (North Fethard) coming from a North West direction, and crash at Tuskar between 11.10 and 11.15.

This led the Investigation Team to state that (§ 2.1.4.10) “the conclusion that there was such another aircraft in the area is inescapable”.

5.1.2 Unsolved Inconsistencies

Such a flight reconstruction, with the presence of a second air-mobile in the area, yet left some unsolved inconsistencies.

- The first one referred to the impossibility to loose 12000 feet in 7 sec : this was the first interpretation of the last two messages emitted by EI-AOM :
- 10.58 : EI-AOM with you
- 10.58.⁰⁷ : 5000 feet , descending spinning at rapidly.

After a considerable interpretation work performed in the “International Institute for Research Industrial and Standards” of Dublin, and in US laboratories of acoustics, 5000 feet were read instead of 12000 feet , and it was considered that the first message “EI-AOM with you” was emitted when the aircraft was already spinning.

- There was no possibility to identify the second air-mobile : no manned aircraft was signalled missing, the UK test centres of the Welsh coast were closed, no dangerous military activities had been NOTAM warned, no Irish Air Corps activity was in the air before the flights for SAR taking off in the early afternoon

In conclusion, no positive evidence : this was stated in the report (§ 2.21 line 12).

- Several statements had to be rejected, in particular those given by witnesses located West of Waterford and by those eye witnesses having positively identified an AER LINGUS Viscount, flying (in an abnormal attitude) over Old Parish, or Ballykally.

The statement of one witness was considered reliable for what he observed at Hook Head, and not reliable for what he observed at Ballykally.

5.1.3 Inconclusive 1970 Report

Under the headline “Conclusions”, the Report states in the “Findings” (§ 2.2.1) :

- For a reason that cannot be determinedthe aircraft went into a spin ...
- The aircraft flew in a disabled condition over the sea (no witness) for a period of at least 10 mn (based on two independent witnesses) during which no radio signals were received from it (no evidence that it was flying)
- There is evidence which could be construed as indicative (evidence or indicative ?) of the possible presence of another aircraft or airborne object in the vicinityThere is no substantiating evidence of such a possibility.....

and in the “Probable cause “ (§ 2.2.2)

- There is not enough evidence available on which to reach a conclusion

The probable cause of the final impactwas impairment of the controllability of the aircraft(The probable cause of the final impact is the consequence of the unidentified probable cause of the accident !).

5.1.4 Consequences of this inconclusive Report

5.1.4.1 Since there was no probable cause identified, nor causal factors, the responsibility of the aircraft manufacturer, his subcontractors, and of the operating airline could not be a matter for claims.

5.1.4.2 Since there was nothing clearly explained about the accident process, together with very few bodies recovered, the relatives of the victims were deeply frustrated, asking for further explanations about a fully consistent accident process.

5.1.4.3 As a consequence, several attempts were made to generate consistent scenarios; but in order to be consistent, they had to deliberately ignore those parameters which should have made this scenario inconsistent.

Thus opening the door to pure imagination, imagination going up to the most sophisticated “Conspiracy theories”.

5.1.4.4 The foregoing factors led to much speculation. It is the aim of this study to clarify the facts surrounding the accident.

5.1.5 Operational Analysis Methodology

5.1.5.1 The scenario including the existence of a second air-mobile in the vicinity of the Viscount and a mid-air collision between both, as “suggested” in the 1970 report, is based on the following :

- If EI-AOM was, at 10.58, at a position near to the one conforming to the flight plan, in accordance with the radio-comms transcripts
- If EI-AOM crashed at Tuskar Rock between 11.10 and 11.15, as stated by two witnesses considered as reliable
- Then, the air-mobile which was sighted over Fethard, coming from a North West direction at low altitude could not be the Viscount.
- As a consequence, it had to be another one which could have collided with EI-AOM before it was sighted over Fethard.

It is of interest to observe that “the conclusion that there was such another aircraft in the area is inescapable”, is valid if, and only if :

- This aircraft collided with the Viscount at 17.000 ft
- **And** was sighted over Fethard at low level after the collision.

5.1.5.2 This scenario calls for the following observations:

- The existence of the second air-mobile does not result from a positive evidence, but from a deduction in the conclusions.

Consequently, the first check is to state if, and under which conditions, a mid-air collision is feasible in the environmental conditions existing in 1968.

Several scenarios of mid-air collision are proposed today. An assessment of each of those against the realistic constraints existing in 1968 will conclude if these scenarios are plausible, and which one is the most plausible.

- The existence of the second air-mobile is the consequence of a reasoning based

on :

- The position of the spin
- The time of the crash
- The sighting of an air-mobile, considered “non identified”, over Fethard, around noon.

If one of these three considerations is demonstrated not valid, then there is no need for the existence of a second air-mobile.

- The questioning of the time of the crash was the basis of a scenario generated by a retired British Airways Captain.
- The position of the spin, and the “non-identification” of the low altitude air-mobile may also be matter of questioning.
- An assessment between a “realistic mid-air collision” scenario, and those scenarios resulting from the questioning of the basis of this scenario could allow to determine the most probable scenario fitting with the most probable technical cause (s) of the initial upset and subsequent degradation process of the aircraft.

5.1.5.3 The resulting Methodology of the operational Analysis is :

1st step :

Description of the different “mid-air collision scenarios”, assessment of each of them against the constraints existing in 1968 , and conclusion with respect to their probability of occurrence.

2nd step :

Description of the different scenarios generated by the questioning of one or several considerations on which was based the reasoning of the 1968 Investigation Commission.

Assessment of their internal consistency. Identification of those scenarios externally consistent.

3rd step :

Identification of the most probable scenario.

5.2 “MID-AIR COLLISION” SCENARIOS

5.2.1 Basic Observations

5.2.2 Military Observations

5.2.3 “Mid-Air Collision” Scenarios

5.2.4 Conclusion

Refer to :

- Appendix 5.2a : Location of UK ranges (1968) on the Welsh Coast
- Appendix 5.2b : Dangerous areas (1968) on the Saint-Georges Channel
- Appendix 5.2c : Dangerous areas (1968) related to ranges activities
- Appendix 5.2d : Drones characteristics (1968)
- Appendix 5.2e : Missiles characteristics (1968)
- Appendix 5.2f : Extracts of “Air Targets at the RAE Aberporth ranges”,
safety related
- Appendix 5.2g : I.A.C. aircraft types in service (1968)
- Appendix 5.2h : Provost TM 51 characteristics
- Appendix 5.2i : Extract of Baldonnell “Daily Movements Log”

contained in Volume II : “Appendices and Annexes”

5.2 “MID-AIR COLLISION” SCENARIOS OPERATIONAL ANALYSIS

5.2.1 Basic Observations

5.2.1.1 Military Activities in the St. George Channel

- UK activities

The Irish Sea and St. Georges Channel are parts of the Western approaches of England; in addition, it is a kind of “interior” sea between England and Ireland, well adapted for training and testing activities.

As a consequence, the Royal Navy, the Royal Air Force and the Army have installed several bases on the Welsh Coast, from where they perform daily activities, in particular for training and testing (refer map in appendix 5.2a). The Royal Navy may be considered having permanently some ships sailing in that area.

- Irish activities

Although at a much lower level of activities, the Irish Forces operate also in that area. The Irish Forces have no test ranges on the East coast, South of Dublin or on the South coast, East of Cork harbour.

- Bi-lateral activities

In 1968, several bi-lateral agreements existed between the UK and, in particular, European nations, like France, Germany, ...allowing these nations to use the UK facilities for training their personnel or testing their weapon systems.

- NATO activities

That zone is a part of the Western approaches of the UK. It is also included in the Western approaches of Europe. As such NATO generated naval or air activities in that area, which may involve the military means of the 3 major Commanders in Chief in the NATO military organization, at this time .

It is to be noted that these NATO exercises were usually performed by highly trained personnel, at the level of the forces and not at the one of the single units; the risk of human errors was much lower than during initial training of a military unit.

- Soviet activities

The “Cold War” was fully effective in 1968. Some Soviet air (long range surveillance aircraft) or naval (trawlers specially equipped) units were deployed on several occasions, in particular for the observation of the testing activities of the newly developed occidental weapon systems.

It is to be noted that, usually, these Soviet ships or aircraft remained in international zone, in order not to be intercepted.

However the UK Forces reported every day on those Soviet units which were carefully tracked.

As a conclusion, it can be stated that there was an important daily military activity in that area; this resulted in the existence of some level of risk. The Irish fishermen were used to recovering in their nets some wreckage of missiles, drones, aircraft ; some of them concentrated in well identified zones, as a result of tidal currents.

Since this risk was well known, in particular with respect to civilian air transport, the coordination and the control of the military and civil air activities was subject of intense efforts of organisation and equipment.

5.2.1.2 Control and Coordination of Air Activities

In order to avoid air collision, strict rules were elaborated, on both the civil and the military sides.

These rules were based on the following basic principles :

- When a positive control of the position (including altitude of the air-mobiles) is possible, the Authority having the best information is in charge of avoiding collisions.
- When a positive control of the position of the air-mobiles is not feasible, the Authority is in charge to keep the air-mobiles separated.
- The OTCs (having the authority on different mobiles flying in the same air volume) have to coordinate themselves. This coordination may allow to use , for the benefit of all , some control equipments (like radar,...) belonging to one of them.

In application of those principles :

- The civil air transport aircraft fly in airways, from one airport to the other .

However, when the Air Traffic Control Centre knows that there is no risk out of the airways, it may authorize the civil aircraft for a shorter route, out of the airway.

- The crews are warned when a non regular air activity is planned in a zone by the means of NOTAMs. These NOTAMs may apply to the activation or deactivation of some permanent dangerous or ruled air zones; or to the implementation of some transitory ruled zone (Refer to the appendix 5.2b: map of the dangerous zones above the St. Georges Channel).
- The military units can fire their weapons, either for combat, or for training, or for testing, only when they have positive control of the firing zone, thanks to radar, complemented, if needed, by secondary radar.

On the military side, when operating a weapon launch, strict procedures have to be followed:

As an example, in the Navy, when an exercise is operated with the authorization to launch a weapon, all involved units are aware of the level of threat and subsequent authorization since :

“Birds tight” situation implies “no firing authorized”

“Birds free “ situation implies ‘firing authorized”.

- An air target being detected, it is observed for a while to evaluate its intentions.
- Tracking for some seconds to calculate its flight parameters
- Classification “hostile” if the target does not transpond “friend” (IFF – Identification Friend or Foe).
- Authority in charge (LAAWC) to decide for firing
- Target designation to the firing body
- Authority in charge to fire the weapon when all firing parameters are adequate.

This procedure implies :

- Positive radar control of the target
- Identification “Foe”
- Four decisions from the level “Authority in charge”
- The commanding officer of the ship can always overpass the decisions of the level of authority “in charge”.

Similar type of procedure is established by the Air Force, the Army or DERA for the test ranges.

5.2.1.3 Air Collision Risks

Despite the organisation, the operating procedures, the surveillance equipments and the safety devices on all flying mobiles, some dysfonctionnings may occur.

A situation of possible collision may be caused by :

- A defect in the diffusion of the NOTAMs.
- A mistake made by an air controller authorizing an aircraft to enter an activated dangerous zone.
- A crew navigation error resulting in the aircraft entering a dangerous zone.
- A loss of control of a drone or a missile, for that part of the trajectory flown before the destruction devices be operated.

- A failure in the destruction or the auto-destruction system (if fitted with) of a drone or of a missile .
- The fragments of the air mobiles falling to the ground after the collision or the explosion.
- The level of occurrence of such events is very low but not nil.

It can be observed that some military activities may be considered as being covered by Defence Secrecy, which allows for the servants either to refuse to answer, or not to tell the truth. So, the statements given by official servants may be rightly questioned, and their answers assessed one against the others.

Taking into account the many questions asked by the Irish side during the 2000 Review, and those questions asked since 2000 by the Celtic League, the International Team have asked a series of questions to the Royal Navy, the Royal Air Force, the Army Historical Service. DERA also was questioned, in particular with regards to Aberporth and Llandbedr ranges.

In order to be exhaustive, since the 30 years period occurred in 1998, the Public Record Office was also questioned. Annex B includes the questions and the official answers provided by each questioned service.

5.2.2 Military Observations

The military assets which can collide with a large civil transport aircraft, flying at FL170, by day and good visibility, are the following :

- Another manned aircraft
- An air-to-air missile fired from a manned aircraft
- A surface or ground-to-air missile fired from a ship or from the ground
- A drone.

5.2.2.1 Characteristics of the Weapon Systems existing in the UK in 1968

Refer to appendix 5.2d and 5.2e for the characteristics of :

- The surface/ship-to-air missiles
- The air-to-air missiles
- The drones.

(The Army anti-air missiles are all too short range.)

The following characteristics are of interest for the military analysis :

Prior to the collision :

- The range and the ceiling of the air mobile
- The guidance system.

After the collision, or near collision, if no explosion :

- The flight characteristics.

- Provided the ceiling of the missile is higher than 17000', the range is of interest since :
 - It determines if the missile or the drone can fly over Tuskar if it is launched from the ground
 - It determines an area inside which is to be located the launcher ship
 - With regards to the air-to-air missiles, short range implies, by good visibility, visual identification of the target, so no risk of errors on the nature of the target, when this is not true for medium or long range missiles.

- The guidance system is of interest since :
 - When the final track is based on launcher radar information, remote control from the launcher site is feasible up to the end, provided there is no technical failure in the guidance system.
 - When the missile is (or becomes) “fire and forget”, then the launcher has no means to control the missile.

- The flight characteristics after the collision, or the near collision if the missile missed its target.
 - If the missile is destroyed, its debris may be dangerous for an aircraft flying lower.
 - If the missile misses its target, everything is operative on board, and it continues its normal flight and guidance, up to engine starvation or self-destruction .

If it is “fire and forget”, it can croach another target .

 - If the missile is not fitted with an explosive warhead , or in case of a drone colliding with an aircraft, they can fly in a disabled condition. But since there is no pilot on board, since the drone may be out of line of sight, and/or since the guidance system may be damaged, the flight will result only from aerodynamic forces, without any logical human inputs. As an example, if the missile (or the drone) has a descending trajectory, there is no chance that it stabilizes at a low level horizontal flight when approaching the ground.

5.2.2.2 Conditions for a Mid-Air Collision to occur

In this “military” context, a collision between a civil transport aircraft and a military asset may result from :

- The deliberate will of the launcher
- A human error of the operating personnel

A technical failure of the weapon system, in particular in the remote guidance system or in the self destruction system.

- The deliberate will of the launcher should be envisaged as an example in the following situation :

A high ranked terrorist is among the passengers and “for the highest interest of the Nation”, an order is given to kill the man, even at the price of the lives of all other passengers on board.

The examination of the list of the passengers of the St. Phelim makes such a situation non relevant.

- A human error of the operating personnel may cause a collision in several situations.
 - The pilots of each aircraft may not see each other aircraft or are not aware of each other's presence in the same airspace, and collides with the Viscount in error.
 - When launching from a military aircraft a missile which does not require visual identification of the target, the missile may strike another aircraft which was not the intended target. However, the UK forces were not equipped with such missiles in 1968.

When firing a short range missile (2 to 3 nautical miles) on such a large aircraft, an error in the target identification is hard to comprehend.

- A ship may fire a medium or long range (15 to 25 nautical miles) surface-to-air missile following a wrong identification of the target.

This seems not feasible with short range (2 to 4 nautical miles) surface-to-air missiles.

- It seems also difficult to imagine that a human error made in operating a drone in the air volume allocated to one of the test centres of the Welsh coast should cause a collision 50 nautical miles away. Such an error is to be complemented by a technical failure.

- A technical failure may cause a collision in such situations :

- A missile can be fired on an aircraft used as a target, but in this case the guidance system includes safety devices which prevent the missile from colliding with the target. If such safety devices in the guidance system fail, a collision is possible.
- A drone, remote controlled, can escape to the controller.

If, in addition, the remote-controlled destruction device fails, and the self-destruction device fails, the drone continues its flight without any possible human intervention till the starvation. A collision then can occur.

- As a conclusion, a mid-air collision may result from :

- A human error of the pilot of an aircraft flying near the Viscount :

During a military exercise at sea,

- A wrong identification of the target by the operations officers on board the ship
- Technical failure of the guidance system of a long/medium range missile

- During a weapon system flight testing including the use of a drone, 2 technical failures in the remote-controlled destruction and in the self-destruction systems of the drone (if fitted).

Several “mid-air collision” scenarios were suggested or created, based on one or the other of such occurrences :

They have now to be described more precisely, and assessed against the military parameters and the witnesses’ statements, if those are considered reliable.

5.2.3 “MID-Air Collision Scenarios

5.2.3.1 Collision with an unmanned Aircraft

5.2.3.1.1 Description

5.2.3.1.2 Assessment

5.2.3.1.3 Conclusion

5.2.3.2 Collision with a manned Aircraft

5.2.3.2.1 Description (s)

5.2.3.2.2 Assessment

5.2.3.2.3 Conclusion

5.2.3 “Mid-air collision” Scenarios

Several “mid-air collision” scenarios have been suggested or created:

- The first one was suggested by the Investigation Team’s Final Report, when concluding that the presence of a second aircraft in the vicinity was inescapable.

It can be considered that the “Tragedy at Tuskar Rock”, by Dermot Walsh, complements this scenario , since the author often states that this book was written with the support of Mr O’Sullivan, then retired, so not further linked by the “Reserve Duty”.

- The second one is proposed by a retired RAF Captain, who supports also some victims’ relatives.

5.2.3.1 Scenario suggested by the 1970 report : Collision with an unmanned Aircraft .

5.2.3.1.1 Description : (§ 2.2.1-12)

§ 2.2.1-12 :”another aircraft or airborne object in the vicinity” of the Viscount.....

- By reason of collision, or by its proximity causing an evasive manoeuvre, or by its wake turbulence
- Might have been the initiating cause of an upsetting manoeuvre resulting in the Viscount entering a spin or a spiral dive.

§ 2.1.4.10 :an unmanned aircraft had fallen in the sea, and remained afloat for some hours.

This may be described :

- A drone collided (or near-collided) with the Viscount just before 10.58 (GMT).
- The Viscount flew in a disabled condition for about 15 mn
- The drone flew in a disabled condition over Fethard and crashed between Hook Head and the Saltee’s around noon and remained afloat for some hours.

Basis on which this scenario is built

- This scenario is based on a logical reasoning :

If the St. Phelim was at the estimated position of the track reconstructed at 10.58, if the time of the crash is between 11.10 and 11.15, then the air-mobile which was sighted over Fethard around noon could not be the Viscount.

So the mobile which was sighted over Fethard was a second mobile.

- The statements of the witnesses at Fethard indicated that they had seen for several tenth of seconds an air mobile coming from the North West, at low altitude, making steep turns on the right.

Outer wings were red, a cloud of smoky colour revolving around and travelling away.

Some other witnesses observed between 1.30 and 3.30 (local time) a metallic object, of silver colour, looking like the wing of an aircraft.

5.2.3.1.2 Assessment

- This scenario is valid if :
 - The Viscount was roughly “By Bannow” at 10.57 (GMT).
 - The time for the crash is between 11.10 and 11.15.

For the time being, there is no reason to question these points : the radio-comms transcripts confirm the EI-AOM position, and the two witnesses of the crash are considered reliable.

- What was the second mobile ?

The report had a preference for a drone , but did not eliminate the missile.

A drone

- > Consideration of distance .

Tuskar Rock is roughly 90 nautical miles from Llandbedr, from where the drones are launched.

The maximum range of JINDIVIK is over 400 nautical miles, and the one of a METEOR around 100 nautical miles (refer Appendix 5.2e).

Both drones can be present at Tuskar Rock. Both have a ceiling over 17000', in all conditions.

Both drones can collide with the Viscount.

The STILETTO is not taken into consideration since its first flight, in an early prototype configuration, took place in July 1968 (refer Annex B.b Item 2.3).

- > Consideration of guidance and flight .

The scenario suggests the possibility of a “near collision” at 17.000 ft. The drone is not damaged, but by reason of evasive manoeuvre or wake turbulence, the Viscount goes in spin.

The drone, being out of the line of sight from Llandbedr, where its (ground) pilots are located, cannot be guided.

It flies steadily, at the same heading (South West) and at the same altitude until fuel starvation and subsequent crash.

Therefore it is impossible for a drone as described above to be seen over Fethard at low altitude.

There is no possibility that the air mobile seen over Fethard could have been a drone which nearly collided with the Viscount.

The scenario also suggests a collision .

In this case, the drone also is damaged. Its trajectory cannot be predicted, it depends on the type of damage. But, since there is no pilot on board, and since the (ground) pilots in Llandbedr cannot be efficient (too far), there is no possibility that the drone, when arriving near the ground, levels its flight for at least some tenths of seconds.

There is no possibility that the air mobile seen over Fethard can be a drone which collided with the Viscount.

A missile

The previous chapter (§ 5.2.2.2) showed that the only possible missiles for a mid-air collision were the medium and long range surface-to-air missiles, launched from a ship, (or from landbased RAF missile (Bloodhound) in case EI-AOM should be quite near to Strumble).

- In 1968, the SEA DART was still under development (2 launches were executed in Aberporth during the first quarter of 1968).

The SEA SLUG (range 15 nautical miles) equipped the HMS Devonshire, Hampshire, Kent, London, Glanmorgan and Five.

None of these ships were on March 24, at noon, in the Irish Sea/St. George channel area. (Refer Annex B the document giving the position of the ships).

The ships which were appointed for the SAR activities were not fitted with surface-to-air missiles.

- Even if that information provided by the UK officials is questionable, the following technical considerations are not :

The SEA SLUG is not equipped with altitude holding devices.

- > If the missile “near collided” with the Viscount, it should have continued its flight under beam riding of the ship radar type 901 (if no technical failure had occurred) or without any guidance (if a technical failure occurred).

Since this mobile was reported at low altitude over Fethard, its trajectory after the near collision would have normally been descending.

Since there was no missile equipped warship within 16 nautical miles of Carnsore Point, the only possible position of the ship launcher should have been in the sector South of Tuskar.

If the missile on northerly heading almost collides with the Viscount , it is impossible for this missile to be observed approaching Fethard from the North-West.

- > If the missile was to collide with the Viscount, it is impossible to reconcile such a possible collision with the witnesses’ observations.

There is no possibility that the air mobile seen over Fethard was a missile.

5.2.3.1.3 Conclusions

Taking into account the characteristics of the UK weapons systems in tests or in operations in 1968, a “collision” or a “near collision” near Tuskar with a drone or a missile is possible.

But in no case the colliding drone or missile can be observed over Fethard in such conditions where an air mobile was observed.

As a conclusion, it can be stated as in the 1968 report, that :

- > If the location of the initial spin is that one reconstructed from the radio-comms transcripts
- > If the time of the crash as observed by two independent witnesses is the good one
- > Then the air mobile which was sighted over Fethard is not the Viscount
- > Consequently there is a second air mobile in the vicinity

Today the conclusion is that :

- > **This second air mobile cannot be a missile or a drone having “collided” or “near collided” with the Viscount.**

5.2.3.2 Alternative Scenario : Collision with a manned Aircraft .

When listing the conditions for a mid-air collision to occur (refer conclusions of

§ 5.2.2.2), besides human errors or technical failures when operating drones and missiles, there were human errors of the pilots.

Facing the negative conclusions of the previous scenario, a normal attitude was to generate a “mid-air collision scenario” based on a collision between the Viscount and another aircraft.

Which other aircraft ?

A collision could be envisaged between a fighter aircraft, and another aircraft used as a target (the Viscount in that case should have been a target of opportunity).

Since, in 1968, the UK fighters were fitted only with short range weapons, the fighter had to approach near his target, at high speed.

An inexperienced pilot could be surprised, and collided with the target.

But this day, the visibility was excellent, so suppressing this type of risk.

There is no limit to the creative imagination, in particular, when elaborating on partial observations : some details may provide the flash of a “rumour”, which does not care if several other details make it non consistent with what was really observed.

As examples, during the interviews, the team was reported on the following :

- > According to some conversations held at the bar, at an hour when nobody had drunk enough beer to be out of his mind, on that Sunday March 24th, 1968, some secret training session could have taken place above the St. Georges Channel, with the participation of some German fighters (presumably F 104 G).

The generation of the scenario stops there. The possibility of the presence of fighters ac in the area where the Viscount was flying is enough to introduce the possibility, and consequently the existence of any catastrophic event.

The existence of this catastrophic event cannot be denied since referring to a bilateral military activity, which is covered by the “Defence secrecy.”

In this case, the basis of the “rumour” is a phone call given by a RAF operations officer to one of his Irish fellows(ac operations officer) to keep the Irish ac on the ground, i.e. not to fly on the St. Georges Channel on that Sunday.

It is to be noted that a collision may always be envisaged, in particular when training pilots are involved. But, on that Sunday morning, the visibility was excellent, hence decreasing the risk.

The Team has asked the RAF and the Luftwaffe commands if some air activities had taken place on that Sunday in the whole approach of Irish Coasts. Both denied any air activity.

The probability of setting bilateral activities in an area touching the IRL-UK FIR boundary, without NOTAMs activating the “D” areas is extremely remote.

- > Another “rumour” referred to the air activities preliminary to signing a contract related to the procurement of a US made drone (AQM 37A) which became, after modifications, manufactured by Shorts Belfast, the supersonic target “Stiletto”.

In the process of the negotiation, the US Industry and Navy could have made, this Sunday, off the South of the Irish coast a demonstration flight including three assets : a target drone, another aircraft controlling the drone, which, in the same time, carried the English observers. The launcher aircraft should have been an English Canberra, having possibly taken off from Boscombe Down RAE.

The basis of this rumour was the presence of a Canberra flying in the search area on the Sunday afternoon; moreover, an airmiss was emitted on the Monday afternoon, relative to the presence of a “DC6 type aircraft”, South of the Irish

Coast. This aircraft was considered being an US Navy P3 Orion, which should have been tasked to find “something” damaged and crashed at sea during the target demonstration flight.

Once again, the scenario is not precise, and the imagination is fed by the simple possibility of a presence of a military asset in the vicinity.

Although such a rumour is very vague, it contains some points which make it unrealistic: besides the fact that it cannot be envisaged that such a flight test air demonstration cannot take place without any emission of NOTAMs, without positive control by an authority having the capability to assure the air surveillance and safety in the zone, it is to be noted that the definition and the implementation of a modification making an aircraft capable of carrying and launching a missile or a drone is a lengthy and expensive process, which cannot be envisaged as long as the contract is not signed.

In this case, the aircraft launcher should have been a US one, so could not be a Canberra, so the basis of the rumour disappears.

- > With respect to all these rumours limited to the possible presence of a military asset in the vicinity of Tuskar, it is to be noted that the scenario has to provide an acceptable explanation of the collision at FL 170 **and** of the presence over Fethard, of the colliding air mobiles, coming from the North-West at low altitude.

It is hard to comprehend how a German aircraft, or an English one, or a US one, colliding with the Viscount, could have been enough damaged to lose 17.000 feet and to fly low altitude over a foreign country, then would have flown normally to safely return and land on its home base.

And it is also rather unrealistic to consider that a damaged aircraft can land on a base where hundreds of people are working without any one of those being tempted to chat about this event around him, his family and up to the local press media.

Some scenarios may be generated upon a better basis.

As an example, a scenario was generated by an experienced pilot, ex-RAF squadron leader.

5.2.3.2.1 Description

- > Whilst climbing out from Cork, the Captain sees a red light appear on the undercarriage indicator (or any other external mobile device). In order to avoid perturbing the passengers, and since he spent some years in the Irish Air Corps, he calls on a military frequency for some fellow in flight to help him in inspecting his undercarriage in flight.
- > Some Irish Air Corps pilot, flying in the Cork-to-Waterford area, on an aircraft, hears him, and rallies .
- > The Air Corps pilot, when approaching for inspection, informs the Viscount “EI-AOM with you”, meaning in military usage : “I am now flying very close to you, so do not change your flight parameters without warning.”
- > In order not to disturb London AWYS, both pilots decide to switch on frequency 132,475 Mhz (the one which was tuned on the second radio set in the wreckage), whilst the Viscount first officer should assure the comms with London;
- > When changing manually the frequency, and entering in the downwash of the two port propellers of the Viscount, the military pilot (not enough trained) collides with the port tail of the Viscount, at the level of the spring tab.
- > The Viscount enters a spin, and the co-pilot emits : “5000’, descending spinning, rapidly”; 8 seconds later : “EI-AOM with you”. “5000” was really emitted (and not 12000’), but in the panic of the moment the co-pilot read 5000’ instead of 15000’, since he did not see the tiny 10000’ needle on his altimeter. (The Viscount dived at 250’/sec or 15000’/mn).
- > The other aircraft turned left away from the Viscount and back towards the mainland, with fuel siphoning out of the ruptured tanks in the starboard wing and, probably, on fire.
- > Off shore Saltmills, the 2 crewmembers ejected.
- > The pilotless aircraft , aimed out to sea by the crew to minimize the danger to personnel and property ,crashed out at sea, East of Fethard, after some time of unsteady flight.
- > The Viscount also crashed near Tuskar.

Basis on which is built this scenario

This scenario is based on :

- > A different interpretation of “EI-AOM with you”, which should have been emitted by a different voice from the next message.
- > The setting of the second radio set, on 132,475 Mhz, in the wreckage.

- > The position where the spring tab was discovered.
- > A different interpretation of the message giving the altitude of the Viscount, which gives a rate of descent more realistic (however still very high).
- > A different interpretation of the statements of the witnesses at Fethard:
 - o Fuel siphoning, and in fire.
 - o 2 pilots ejected.
 - o Crash between Fethard and the Saltees.
 - o Some wreckage observed during the afternoon.
 - o An Irish Provost was reported scrapped in June 1968, following an accident, without precise date. This was interpreted as a regularisation for the crashed aircraft in March 1968.
- > The Dove, when flying its SAR mission , flew exactly over that part of the land, East Waterford, where the crew was supposed to have ejected;
- > The alleged statement of a crewman of the Dove, who said that the cause of the Viscount crash was “closer to home”.
- > In addition, this scenario may be the result of a logical reasoning :
 - o The air mobile which was sighted over Fethard could not be the Viscount.
 - o It could not be a missile, nor a drone
 - o So, it was another aircraft
 - o This scenario is a valuable attempt to describe a situation where this mobile over Fethard could be a second aircraft; in this case, an Irish jet engine aircraft (Vampire) of the Irish Air Corps .

5.2.3.2.2 Assessment

- The flight history presents a quite realistic sequence of events and crew reactions.
 - > An alarm on an external mobile device of the aircraft
 - > The call to a fellow for in-flight inspection
 - > The answer
 - > The collision
 - > The disabled flight of the Viscount

- > The disabled flight of the military aircraft
- > The crew ejection
- > The crash of the pilotless military aircraft.
- However the internal consistency of the flight description presents some weaknesses :
 - > If it is considered that the IAC aircraft is the Piston Provost which was reported scrapped in June 1968, the relative performances of the Viscount and of the Piston Provost have to be compared for identifying the condition under which the rallying and the formation flight are possible.

The max speed of the Piston Provost TIK 51 is 195 mph, and the climb rate allows for a climb to 10.000 feet in 7 mn and to 17.000 feet in 20 mn. Service ceiling is at 22.500 feet.

This means that, if the Provost was in flight at a normal altitude for a navigation training session, say below 10.000 feet for an aircraft not equipped with oxygen circuit, it needed for joining the Viscount in the vicinity of Tuskar at FL 170 at least 13 to 15 mn.

If the Viscount Captain requested some help a few minutes after take-off, say at 10.35, the Provost had 20 mn for rallying, so had to fly at 10.35 inside a circle centred on Tuskar, of 40 to 50 nautical miles radius, in a sector over the South-East zone of Ireland, limited by a circle crossing Dungarvan, Kilkenny and Arklow.

So, for a Piston Provost to rally the Viscount after a call emitted at 10.35 (GMT), it was mandatory for it to be in flight over the South-East sector of Ireland, to be equipped with an individual oxygen set, and to know that the Viscount flight proceeded via Tuskar Rock.

In addition, the formation flight between a Provost and a Viscount is very difficult to maintain, since the large difference between the operating speeds, which would have obliged the pilot of the Viscount to take the responsibility of the formation.

These constraints make impossible a rallying manoeuvre and a formation flight without a preliminary briefing, and an accurate common preparation of each phase of the manoeuvre.

Such preparation implies that both pilots, the Viscount Captain and the Provost pilot, were friends, both experienced.

Captain O'Beirne was 38 years old, and had left the IAC since 10 years.

The pilot of the damaged Piston Provost was a young trainee !

If the Provost pilot was not the trainee who was reported piloting the damaged Provost, and could have been a friend of O'Beirne, he would have been about the same age, and, at that age, the fighter pilots have terminated their in flight career.

- > The consequence of the here-above mentioned observations is that the Piston Provost could not be the colliding aircraft.

A collision, in the same conditions, should have been possible with a Vampire. But no Irish Vampire disappeared or was damaged in 1968.

- > Some other details may also be matter of questions.
- > Why the 2 pilots tuned manually their radio-set, when they were already on the "military frequency".
- > Why should the military pilot have emitted "EI-AOM with you" on London AWYS, when the previous messages were on that military frequency ?
- > Why switching manually the radio-set when so near from the Viscount, in particular if not well trained ?
- > Why flying so close to the Viscount, in the downwash, when the inspection is not even begun, since other manipulations are still operated in the cockpit ?
- > According to the Irish Air Corps (IAC), no air activity was recorded on that Sunday morning (refer Appendix 5.2i).

It is noted that is an operational statement, and so, questionable.

But there is evidence that the colliding IAC aircraft was not the piston Provost, single-seat, damaged at take-off, with a trainee pilot on board, which was reported scrapped in June 1968.

- > Finally, a detailed reconstruction of the IAC aircraft after the collision, at Tory Hill and Fethard, does not fit with the described sequence : ejection over Saltmills, at heading South-East, and flying pilotless over Fethard, before crashing East of Fethard.

It is to be noted that Piston Provost was not equipped with ejection seats.

- > The Dove flew heading South- East of Waterford and West of Fethard, which was not the place where the wreckage was sighted.

- Of interest also is the interpretation given to the statements of some witnesses, given by an experienced pilot : fuel siphoning out of the wing, fire out of the wings, ...
- Some “side” considerations which tend to enlarge the basis on which is elaborated the scenario.
 - > Automatic MAYDAY calls reported by a coastguard.
 - > Wreckage sighted by 51°57' N-6° 10' N.
 - > Irish search aircraft moved away from the search area by the British.
 - > Wreckage taken to UK port.
 - > The alleged statement of an Irish Air Corps member that the solution should be “closer to home”.

In the first instance , it can be stated that :

- > The origin of the automatic MAYDAY is not identified.
- > It is difficult to understand that the military aircraft, pilotless since Saltmills, flew over Fethard, crashed South-East of Fethard in such way that some wreckage (wing-shaped) be seen from 12.30 to 14.30 pm (GMT), and some other (fuselage and undercarriage) be seen at 12.35 at 30 nautical miles far away.
- > The Dove’s Captain declared that , after having performed a search from Tuskar to Strumble , he was requested to stay West of Tuskar Rock, out of the search area operated by the British.
- > The documentation archived in the AAIU includes reports stating that all the wreckage transited through Irish ports.
- > The IAC member who is of the opinion that the solution should be “closer to home” is not yet identified , despite the interview of the Dove ’s pilot.

5.2.3.2.3 Conclusion

- This scenario takes place in a logical reasoning aimed at the identification of the second air mobile over Fethard.
- This scenario is internally consistent, and expresses a deep air military experience.
- Some interpretations of the individual witnesses' statements are of interest, but it was not possible to reconcile the track of the scenario together with the witnesses' statements.
- The duration of the pilotless flight seems too long, for a disabled aircraft.
- The sequencing of the crash is difficult to understand.
- The key factor is that there is no IAC aircraft which could have disappeared that day.

Although this scenario is internally consistent, it lacks of substantiation :

- > No aircraft missing in IAC
- > The flight of the disabled IAC aircraft after the collision is difficult to reconstruct, in particular in the Tory Hill area, and in the Fethard area when pilotless.

5.2.4 Conclusion of the Operational Analysis of the “Mid-Air Collision” Scenarios

- On the 24th March 1968, at noon, and taking into account or not the UK official statements on the closure of their ranges or on the position of their ships, a collision or a “near collision” with a missile or a drone is possible, but in no case, this missile or this drone could be observed over Fethard as stated by some witnesses.
- A collision with an Irish Air Corps aircraft looks like “a murder without corpse”.

The proposed track reconstruction is very difficult to reconcile with the witnesses’ statements.

As a consequence, there is an extremely remote possibility of a “mid-air collision or near collision”.

So the logical attitude is to question the assumptions which made inescapable the presence of a second aircraft in the vicinity.

5.3 “NO RECOVERY” SCENARIO

5.3.1 Description

5.3.2 Assessment

5.3.3 Conclusion

5.3 “NO RECOVERY” SCENARIO

The “mid-air collision “ scenario suggested in the 1970 report was based on the following assumptions :

- > The Viscount was at the position estimated by the flight reconstruction based on the Shannon radio-comms transcript.
- > The Viscount crashed between 11.10 and 11.15 GMT.

The “No recovery” scenario, created by a retired Captain of British Airways, calls into question the time of the crash, since there was no recovery from the spin, and the aircraft did not fly for around 10 mn in a disabled condition.

5.3.1 Description

- > The Viscount followed its flight plan, without flying “off airways”.
- > When flying over Tuskar, a sudden event occurred; the most plausible one being a door strike, since there was an “ inherent design fault with the doors “.
- > The Viscount went into a spin, which the crew did not recover, since this was very difficult , and experienced only at one occasion, by the Vickers Chief test pilot.
- > The Viscount crashed at that place where the wreckage was located, 90 sec later, around 11.00 (GMT).

Basis of this scenario

- > The Viscount crashed circa Tuskar on its flight planned route.
- > The Viscount had an inherent design fault with the doors.
- > Evidences of a chicanery in the radio transcripts which allow to think that the Viscount was at 10.57 “over Tuskar” and not “by Bannow”.
- > No further radio messages after 10.58
- > Distance between main wreckage and the recovered spring tab part .
- > Main wreckage characteristics.

5.3.2 Assessment

- This scenario has a good internal consistency : a door strike may result in a spin, from which it is very difficult to recover. So the spin ends in an immediate crash.
- Since this scenario contradicts the transcripts of the Shannon radio-comms, these transcripts are considered by the author having been modified subsequent to the event.

The evidence of chicanery should be established by there being different times for “by Bannow” position in separate documents. The transcripts should read 10.51 when the report reads 10.57.

- > This evidence cannot be confirmed, since in the documents available, report and transcripts, the time for “by Bannow” is 10.57. There is only one document where the time given for this communication is 10.51. It is the book “Tragedy at Tuskar Rock” where in chapter 4 “Countdown to catastrophe” this message is given at 10.51. But the most probable explanation is that of a typing error, or a transcription error, since the message at 10.51 was “Level 170” , message which is not recorded in the book. In any case, the recorded message “By Bannow” should have to be at 10.57.

The chicanery in transcripts of radio-comms should also be demonstrated by non standardised procedures.

- A flight “off airways” is to be requested by the crew, and not proposed to him.
- The position messages are not in the normal form.
- The distress message is not in the normal form.

This observation is true, but should not be conclusive.

- This scenario contradicts also some key statements of witnesses qualified “reliable” by the initial Investigation Team.

If it can be accepted that non educated people, like a Spanish sailor, or a beachcomber, are not very precise in their statements , this scenario ignores the aircraft seen over Fethard.

- The inherent design fault with the doors in 1968 is not, to our knowledge, demonstrated. But it is acceptable to consider that it is a possible event.

5.3.3 Conclusion

This scenario is internally consistent, but the basis on which it has been elaborated seems too short:

- > The main one, the difference in the timing of the message “by Bannow” seems to be the result of typing errors.
- > The position where the part of the trim tab has been recovered does not mean that the tab separated in flight at that position, nor that it separated in flight.

In addition, this scenario ignores the statements of all witnesses.

This scenario is not enough substantiated to be considered realistic. But some aspects are of interest: the probability for a door strike has been assessed in the technical analysis; the fact that the author thinks that a radio-transcript can be “amended” shows that , in his Captain’s life, he may have experienced a situation of such “obfuscation“.

5.4 “AS PER WITNESSES” SCENARIOS

5.4.1 Methodology

5.4.2 Scenario “Disabled Flight”

5.4.3 Scenario “Deviation from the Flight Plan”

5.4.4 Shannon R/T Transcript critical Analysis

Refer to :

Appendix	5.4a	Track reconstruction
	5.4a.1	Lower routes within Shannon FIR (1968)
	5.4a.2	EI-AOM flight track reconstructed
	5.4a.3	Astronomic data at the time of the first EI-AOM dive
Appendix	5.4b	Sensitivity of the DART engine to the negative accelerations
	5.4b.1	Rolls-Royce operating instructions for DART 520-525 and 530 in the Viscount
	5.4b.2	Rolls-Royce operating instructions for DART, in the Fokker Friendship
	5.4b.3	Incidents involving negative “g”
Appendix	5.4.c	Rigging, symmetry and control surface checks
Appendix	5.4d	Fuel and Water method systems
Appendix	5.4.e	R/T propagation in South Ireland
	5.4.e.1	Irish radio facilities index
	5.4.e.2	Radio propagation aspects of the accident to EI-AOM, by Captain Fintan Ryan

contained in Volume II : “Appendices and Annexes”

5.4 “AS PER WITNESSES” SCENARIO

5.4.1 Methodology

Coming back to the assumptions on which were based the 1970 report conclusions, the last assumption to be questioned was the one of the geographic position of the Viscount at 11.58 (local time).

“Questioning the geographic position of the Viscount at 11.58 “ means :

“Questioning the validity of the contents of the Shannon R/T transcript.

5.4.1.1 Witnesses’ Statements

It is to be noted that, as stated by one of the major investigators of the 1968 Investigation Commission, all the statements of the witnesses located West of Waterford were ignored since considered non relevant.

Indeed, since the timing of the observations made over Fethard drove the team to conclude that the assumption of the presence of another aircraft in the vicinity was inescapable, a fortiori the presence of the Viscount West of Waterford was impossible to sustain. Consequently the statements of uneducated people, using the Mass and lunch times as reference, were ignored; and their observations were considered by the 1968 Investigation Commission as referring to the S.A.R. aircraft, which flew in the early afternoon.

Now, since questioning in that part of the study the position of the Viscount deduced from the content of the transcript, all statements have to be taken into consideration.

In addition, and for reason of completeness, since all other sources of information normally used for an investigation were no longer available, the team have proceeded to an additional “call for witnesses”.

Several answers have been received, five of them coming from people located West of Waterford.

Consequently, it has been possible to reconstruct the flight of the Viscount, based on 46 witnesses independent statements.

- In order to help in the understanding of the flight reconstruction, each witness is identified by a code of five figures.

- > The first one identifies the observation zone
 1. between Cork and Old Parish
 2. Old Parish (Dungarvan) area
 3. between Old Parish and Tramore , and Tramore aera
 4. between Tramore and Kennedy Arboretum
 5. between Kennedy Arboretum , Ballykelly and Fethard
 6. Fethard area
 7. Fethard to Tuskar Rock
- > The second and the third ones identify the rank of the witness, in the chronological order of observing the aircraft, when feasible.
- > The fourth one identifies the period when the statement was received.
 1. between 1968 and 1970
 2. after 1970 (after the publication of the accident report).
- > The fifth one identifies the type of witness .
 1. ear witness (only)
 2. eye witness (only)
 3. ear and eye witness (both)

It is considered that 1 (ear witness) is of less value than 2 and 3.

When a witness reports on something which is not exactly the plane in flight, its type is identified as NA (Not Applicable).

It is to be noted that all the witnesses have not the same value : three of them have provided with main inputs of major importance in the track reconstruction.

The first witness, a farm worker, on Sunday rest, in Youghal area, has observed the first dive.

The second one, a young farmer, caring for cattle at Tory Hill, has observed the Viscount for about 15 mn, period ended by a second dive.

The third one, manager in an Irish enterprise, has observed the Viscount over the village of Ballykally. Early in the afternoon, this man has observed for two hours a floating object, before it sunk.

The first two ones, West of Waterford, were not heard by the 1968 Investigation team.

The third one was not considered by the 1968 Investigation Commission when stating on what he had observed over Ballykally; he was considered when stating on what he had seen floating East of Hook Head. Since he had taken some pictures of the floating object, he gave them to one of the 1968 investigators, who told him that he would return this material. This was not done and these pictures are no longer traced.

5.4.1.2 Flight Reconstruction

- The flight reconstruction is worked out in two steps :
 - > The first one identifies the positions of the aircraft, as reported by the witnesses, estimated from the position of the witnesses and their indications on the heading of the aircraft as they could appreciate it.
 - > The second one relates to the timing. This is usually not very precise, so estimating an acceptable timing is a matter of several iterations to make consistent positions and speeds during the whole flight.
 - > It is to be noted that this flight reconstruction is performed on the basis of statements given by witnesses non “specialists” in aeronautics; the witnesses describe what they have seen; since they are generally not highly educated people, it is easy to identify what is observed and what is interpreted in their statements.

But, in all cases, the team had to elaborate on what was stated, and this elaboration is “speculation”, without any material piece on which to base evidence. If several interpretations may be given , the team have to try to assess on their respective probability of occurrence.

In all cases, the elaboration remains speculation: this does not prevent the speculation to become reliable if and when the various statements fit one to the others another, and allow to deduce a logical sequence of technical events.

5.4.1.3 Two possible Scenarios

If the scenario generated from the witnesses’ statements implies that the content of the transcript is wrong, it may be wrong for one of the two following reasons :

- > The first one is that the last two messages between the Viscount and the Shannon ATC result from an error introduced by the ATC officers.
- > The second one is that the Viscount crew irregularly reported the aircraft position.

Both scenarios have to be analysed.

5.4.1.4 The Scenario “Disabled Flight”

In this scenario, the statements of the witnesses are interpreted out of any constraint related to the R/T transmissions.

The witnesses’ statement describe the track of the Viscount, a timing consistent with this track and a degradation process which appears technically logic. But, if the aircraft is disabled from mn 42 on, the error in the transcript is introduced by the ATC.

5.4.1.5 The Scenario “Deviation from the Flight Plan”

If it is assumed that the error in the transcript is introduced by the crew, the statements of the witnesses are elaborated taking into account the necessity for the Viscount to emit a message in such conditions that it could be received by Shannon ATC at 11.51 and at 11.57 (local time).

The assessment aims at identifying the probability of occurrence of such a scenario.

5.4.1.6 Shannon R/T Transcript critical Analysis

If the probability of occurrence of the scenario “Deviation from the Flight plan” is considered remote, and in order not to feed another 30 years of imaginary production, the assumption of an error introduced in the transcript of Shannon radio-comms is inescapable.

The distortion between the original recording and the R/T comms transcript may result from a misinterpretation of an unreadable message, or from an intentional addition of two non-existing messages.

It is not in the skills of the team to determine why and how this happened. However, some observations, limited to the aeronautic domain, may be of interest in that difficult matter.

5.4.2 Scenario “As per Witnesses/Disabled Flight”

5.4.2.1 Description

5.2.2.1.1 Track Reconstruction

5.2.2.1.2 Aircraft Degradation Process

5.4.2.2 Assessment

5.4.2 Scenario “As per Witnesses/Disabled Flight”

5.4.2.1 Description

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5.4.2.1.1 Track Reconstruction

5.4.2.1.1.1 Positioning of the Viscount (refer maps in Appendix 5.4a2)

5.4.2.1.1.1.1 Between Cork and Old Parish.

The Viscount took off from Cork , and was instructed to left turn out radial 102, until FL 100.

Then, when out of FL 70, Cork Approach authorized a left turn on course for Tuskar.

Witness (1.01.1.3) heard, saw and identified the Viscount at short distance to the South of his house, at Aghada Hall (Rostellan). The Viscount was presumably slightly North of its cleared route.

The witness saw it, climbing steadily, at normal altitude for an Eastbound plane.

Conclusions : Between Cork and Old Parish area (Dungarvan) :

- The Viscount had a route “as per its flight plan”, possibly slightly North of it
- It was climbing, steadily, at the normal rate of climb.

5.4.2.1.1.2 Over Old Parish

One witness (2.01.2.2.), 31 years old at the time of the accident, was standing with a neighbour aged 55, near his home at Scat (North Youghal).

He saw the aircraft, and identified it as a Viscount (four engined aircraft).

From its position relative to the sun, it can be estimated that the Viscount was at an altitude between FL 90 and FL 100.

The aircraft was reported initially as steady, and was seen in this way approximately one minute, when it suddenly turned right, in a very steep turn, and lasting only a few seconds for a 180° turn; in the same time it turned, it also descended.

Then after, it spun or spiralled, almost vertically.

After about 30 seconds, the Viscount disappeared behind a hill, clearly identified since a big mast was erected on its top. The witness reported that he then prayed for the people inside the plane, since he was sure that it should crash all at once.

From the relative height of the hill and of the witness, it can be estimated that, depending from the distance of the aircraft to the witness, the altitude of the plane when it disappeared behind the hill could be between 1500 feet and 3000 feet, thus allowing altitude for a recovery.

When the aircraft was spinning, the witness did not hear anything ; it is to be noted that the wind, rather strong in altitude, was blowing from South-West. Accordingly, the witness, being West of the Viscount, could not hear it .

The direction of the wind is presumably the reason which explains that two witnesses (2.03.2.1 and 2.04.2.1) in Dungarvan “heard a loud bang”, with “no further bangs”.

- Then two boys (14 and 13 years old in 1968), witnesses (2.05.1.3) and (2.06.1.3) located in Crobally, saw an

“aeroplane flying very low,in a bit from the sea and over the land. It was circling roundat less than ½ mile from me. It did this about twice....the plane was silvery and green in colour.”

His brother stated that

“the plane was facing in the direction of Ardmore when I first saw it. It then turned a bit left towards the seaIt was flying over the cliff edge ...the top of the plane was silvery and the bottom was dark; around the sides, it was white. There were windows on both sides of itI was shown a photograph of a plane similar to the one that crashed and it is like the one I saw yesterday.”

- From the same village, Crobally , a housewife (2.07.1.3)

...”saw the planeover the cliff.....it was going in the general direction of Dungarvan, but at times, it appeared to me it was trying to turn back towards Cork. It appeared to be grey in colour.”
- In Ballytrissane, a farmer (2.08.1.1)

“did not see the plane, (but)heard the sound of a plane flying very near where I wasit appeared to be nearly over my head or a little to the South of me, that is towards the sea.”
- In Ballymacart, a farm labourer (2.09.1.2) saw

“one plane with four enginesgoing towards Cork....another oneat the same height, was going towards Mine Head....it was darkish grey colour.”
- In Ballinroad, a farmer and his sister (2.10.1.1 and 2.11.1.1)

“heard the sound of a plane which was passing somewhere to the South.....it could be flying about a mile from here.”
- Finally , at Ballintlea, a lady, school teacher (2.12.2.3) well remembers

“seeing and hearing the planeflying over land at the time having come from Youghal/Ardmore.”

Conclusions : Over the “Old Parish” area :

- A Viscount crossing 9 to 10.000 feet suddenly interrupted its climbing, and dived in a spin (possibly a spiral), right handed, over land or most likely quite a few nautical miles at sea.
- It recovered from its dive, and appeared to a witness to be attempting to go back to Cork.
- It was seen for two left turns, above the cliffs at Crobally, then heading North-East, seen or heard from Ballytrissane, Ballymacart, Ballinroad and Ballintlea.
- During this phase of the flight, it flew at low altitude, at a maximum height of no more than 1000’ to 2000’ feet.

5.4.2.1.1.3 Between Old Parish and Tramore, and over Tramore Area

- A Waterford crystal blower (3.01.2.3), playing football with his brother near the road of Corbally More saw

“a four engine aircraft, which sounded like the Viscount which I flew one week ago for my wedding tripappearing at low altitude, over Newtown, at mid-way between Tramore and Great Newton head.

The Viscount crossed Tramore bay, climbing steadily , at low rate of climb, in such a way that it remained visible above the road hedges.

The noise sounded normal, growing when approaching, then disappearing.”

- In the same time, from Tramore area, his cousin (3.02.2.2) had a glance on a large aeroplane flying over Brownstown Head, which made a left steep turn, descending and disappearing behind Brownstown Head cliffs.

Conclusions :

From Old Parish to Tramore, the Viscount was not observed. It was presumably low altitude, most of the time over the sea.

It then was observed flying low, over Newtown (South Tramore), crossing Tramore Bay, heading slightly South of Brownstown Head, gaining some hundreds of feet.

Then, suddenly turned left, descending down to nap of the earth, heading North.

5.4.2.1.1.4 Between Brownstown Head and the Kennedy Arboretum.

A young boy (4.01.2.3) , 13 years old, was feeding cattle in his father’s field below the wooded area of Tory Hill:

“A large aeroplane approached the field that I was inThe aeroplane came from the Dungarvan direction, but it turned left after having passed Tramore; it left Waterford on its left. It was, very low altitude. The plane approached the field as if to land, but suddenly it turned right, and climbed....

I identified a Viscount; I was able to read letters on its side.

After the turn, it headed towards the Saltees, but when arriving above of the hills, it suddenly descended and disappeared.

I saw it for about 10 minutes, 6 minutes from Tramore to Tory Hill, and 4 minutes after the right turn.”

Conclusions :

From Brownstown Head to Tory Hill, a Viscount was seen heading to Tory Hill, at very low altitude.

After a steep turn right, it gained altitude for about 3 to 4 mn , and then, again, suddenly, dived.

5.4.2.1.1.1.5 From Kennedy Arboretum, around Slievecoiltia Hill, to Fethard.

- A witness (5.01.2), still alive, staying in Ballykelly, stated that :

“While still in the church, attending the mass, and just before the end of the Mass, all attendants heard a heavy sound, getting louder”

but no one saw anything, at that instant.

Later on, just after they went out of the church, maybe 2 to 2 ½ minutes after the sound, while they were on the public place, all of them saw a Viscount, without doubt identified as a Viscount since the witness recognized the colours, the windows and the call-sign letters on the hull.

The Viscount was heard for about 2 mn, when it was visible for 1 mn.

The Viscount appeared from behind the hill (Slievecoiltia), coming from the North-East, heading South-West, very low in altitude. It was so low that the horizon line, defined by the hill was seen above it.

It flew in the exact direction of the steeple of the church, but it avoided it at the very last moment thanks to a left turn.

It then headed South-East, over the Kennedy Arboretum, still low in altitude, but slightly climbing.”

The Viscount flew so near these witnesses, that they considered the sound as “enormous”.

- South-East from Ballykelly, while praying in a cemetery, two ladies

heard the plane passing “between the cemetery and Campile” (witness 5.02.2.1).

- Further South-East, along the road near Ballykeerogebeeg (North Campile), a lady (5.03.2.3) cooking in her kitchen was called by her daughter. She

went out of her house, and “saw the aircraft she had heard from inside. It was heading South-East, towards Fethard, at an altitude which could be 1000 feet.

Conclusions

The Viscount, in the area of Kennedy Arboretum, experienced presumably a second dive, which was seen from Tory Hill and heard from Ballykelly.

Once again, the crew recovered at very low altitude, flew around Slievecoitlea Hill, over Ballykelly; then headed to Fethard at an altitude around 1000 feet.

5.4.2.1.1.1.6 Over Fethard Area

Several witnesses heard and saw a plane in that area. (They were all interviewed by the 1968 Investigation Commission .Their statements were interpreted as a possible substantiation for a second aircraft.)

- An agricultural labourer (witness 6.01.1.3) living in Saltmills, stated :

“...I heard a noise from what I thought was an average sized aeroplane coming from the Dunbrody Abbey direction.

I looked up and sawthe plane, ...but it now appeared to be going in the Baginbun Hook Head direction, and seemed to me to beapparently descending.

I viewed the aeroplane for approximately 30 seconds and I lost sight of it when I considered it to be in a position approximately over Loftus Hall.”

- A 12 years old girl (6.02.1.3), staying at Fethard, stated :

“I heard the noise of a plane and my mummy said it was a funny noise.

I went out to the garden in front of my home. I saw a plane travelling from the direction of the Protestant Minister’s house towards the Saltee Islands.

As the plane was travelling, it kept gradually winding away to its right on towards Slade. I kept watching it until it disappeared, and it was still going as I could hear it for a while.”

- Two young boys, 12 and 11 years old, playing bows and arrows near their home at Ralph (6.03.1.3 and 6.04.1.3) stated :

(My brother) “told me to look at a plane that had passedI looked at itThe plane was travelling away from me in a South Easterly direction over Baginbun.....The plane was travelling at medium height.”

His brother confirmed separately the statement in every way, making a firm deposition .

- A farmer, living at Loftus Hall, but feeding cattle at Slade at the moment he heard the plane (witness 6.05.1.1), stated :

“I heard the noise of a plane coming from the Hook Head lighthouse direction. In my estimation this plane was between the Baginbun lighthouse and Slade village.....The sound faded away gradually as if the plane was going away from me. I did not look at this plane....

About 3 or 4 minutes later, I heard the noise of a plane back again, the noise seemed to be from between Slade and the Saltee Islands.....This noise was much louder and then sounded as if it was over my head.....

The noise from this plane lasted for about 2 mn, and then cut out suddenly.

In my opinion, if this was the same plane I heard on both occasions, it definitely altered course and turned back towards the land.....”

- A lady (6.06.1.3) was cooking in her kitchen, at Grange Square. She said:

“.....I heard the noise of a plane. I went out into the backyard. I saw a plane approachingI would say it would be in the direction of the Saltee Islands. I watched for a few minutesIt was travelling something lower than other planes. Then I went back into the kitchen. About a minute later I heard a loud bang,I did not see or hear anymore after that.”

- Her husband (5.07.1.1) was 200 yards South of the home. He said :

“... I heard a very heavy noise of a low flying aircraftdid not see the aeroplane, but from the sound, it was going in the direction of the Keeragh Islands.....”

Conclusions :

An accurate track reconstruction over Fethard is difficult to obtain. However, it seems probable that a Viscount arrived from Campile, Dunbrody Abbey over Saltmills, slight turn right for heading to Baginbun Head, then it carried out a steep turn right towards Slade, after which heading North and again turn right and fly over Fethards, slightly South of Grange, heading to the Keeragh Islands, when after one minute, something happened which made a big sound.

The altitude did not vary too much, presumably around 1000 feet.

Several witnesses were definitely persuaded that it was a Viscount.

5.4.2.1.1.1.7 From Fethard Area to Tuskar Rock

This part of the trajectory is over the sea, so no witness reported seeing the plane, with the exception of a Spanish sailor on a German ship, who saw what is now believed to be the Viscount at the exact moment of the crash.

- This Spanish sailor (7.09.1.2) was steward on board of the MS Metric. He said :

“I thought I saw a plane at an altitude of some three meters falling. It was more or less like a flashon impact some water was thrown up into the air, but in a moment the sea was normal.”

- A 17 years old boy (7.08.1.1), living at Bring, stated :

“I heard a noise like water running from a big pile of stones at the beach on a bad day. I looked out to the sea and I saw a column of water on the left side of the Tuskar, about at the spot where the Irish Lights ship anchors.....I did not see anything going into the water”

Both points are consistent with the location of the main wreckage.

- Prior to the crash, an event may have been observed from the shore : indeed witness 7.06.1.NA. stated :

Standing at the point called “the bar”, near to Tacumshane Lake,

“.....I was looking at the waves breaking over Black Rock. After some time I looked to my left; at a point between Black Rock and Carnsore Point, I saw what appeared to be a mushroom of water out to sea. I would estimate it to be about nine miles out.”

This position could be consistent with a track from Keeragh Island to Tuskar.

- 15 other persons living in the area between Greemore point and Carnsore point heard a heavy noise.

However all of them may not refer to the same event. In particular, some of these 15 seemed having heard the noise a few minutes before the others.

- After the crash, from 1.30 pm to 3.30 pm, a metallic object was observed by 4 witnesses, from 2 different places : Newtown and Slade.

This object drifted during this time from a point located 4 to 5 nautical miles East of Fethard to a point West-South-West of the Great Saltee for 2 or 3 nautical miles.

Conclusions :

The track reconstruction, between Fethard and Tuskar cannot be precise, since the aircraft flew over the sea.

However, it is probable that a part separated from the aircraft when it was flying 4 to 5 nautical miles East of Fethard: this was heard, and the separated part was observed.

It is possible that some other part separated between Black Rock and Carnsore Point; but this is not cross checked visually.

It is certain that two witnesses saw the final impact point, since their statement is consistent with the location of the main wreckage.

5.4.2.1.1.2 Timing

All times are local times in this section since the witnesses have made their statements using the local time.

Local time is GMT + 1.

It is to be noted that in Winter 1967/68, there was no Winter time, for the first time. Consequently, there was no change of clock during March 1968.

The time of their observations, as estimated by the witnesses, give the following sequence :

- Crobally : 11h55mn , to be amended since the clock was at least 3 mn fast at the last check made on Thursday before, which should result in a possible correction by 5 mn, so, 11h50 min
 - Ballytrissnane : about 11h45 min
 - Ballymacart : about 11h55 min
 - Ballinroad : between 11h30 and 12.00 h
 - Tramore : no timing
 - Tory Hill : around noon
 - Ballykelly : noon, with a better confidence than the others, since it was exactly at the end of the Mass.

Assessment

- The distance flown from Cork to Tuskar, estimated according to the witnesses is 135 nautical miles.
 - The take-off is recorded at 11.32 h
 - The crash is observed between 12.10 h and 12.15 h
 - This makes an average ground speed about 190 kts.

- Flying for about 40 to 45 mn, with a wind observed and after-casted blowing from 200° for 15 kts between the surface and 3000 feet, makes an average airspeed roughly 10 kts less.

Consequently, the average indicated speed of this disabled aircraft should be around 180 kts; this speed seems quite realistic.

- From Cork to Old Parish area, the plane was flying normally, and a witness confirms that situation .
- For a spin to have taken place at a distance between 35 and 45 nautical miles from Cork; say 40 miles , it would have taken place over the sea, for no more than 2 to 5 nautical miles from the shore.

The ground speed, during this first phase, should have been around 200 to 230 kts (faster than usual), but the estimate for Strumble given to the ATC by the Captain indicates that he intended to go faster than usual..

Since the second dive, over the Kennedy Arboretum, is situated 45 nautical miles after the first one, the plane should have taken 14 minutes to cover the distance.

The time of this second dive is 11.58 h, according to the London radio-comm records.

This makes the following sequence :

- take-off from Cork :	11.32
- first dive, 2 nautical miles ashore Old Parish and	
- time to recover and orbit over Crobally :	11.42 to 11.44
- flight duration till Kennedy Arboretum :	14 min
- second dive :	11.58 h

This is not inconsistent with witnesses' estimates.

- The crash is located 50 nautical miles from the second dive.

At an average ground speed around 190 kts, it should take about 16 mn flight; consequently the most probable hour for the crash is 12.14 h, which is consistent with the witnesses' observations.

The clock of the witness (7.08.1.1) who saw the “splash” was considered very precise in the 1970 report. This may be not confirmed according to a statement given in July 2001 by this witness, but it is a matter of a few minutes.

The timing “12.14”, in that scenario results from the global flight path reconstruction rather than from the reading of a more or less precise clock.

Conclusions :

A timing which appears to be consistent with the statements of most of the witnesses, and which fits with the performance characteristics of the Viscount is the following:

- . 11.32 h take-off from Cork
- . 11.42 – 11.44h first dive over Old Parish
- . 11.58 h second dive over Kennedy Arboretum
- . 12.14 h crash

which means 32 mn flight in a disabled condition.

5.4.2.1.2 Aircraft Degradation Process

5.4.2.1.2.1 First Spin over Old Parish

Witnesses' statements

- Witness 2.01.2.3
 - a Viscount was climbing steady
 - suddenly, it turned right, steep, descending
 - then, after 180° turn, it dived, almost vertically, while turning on the right
 - it disappeared in that attitude behind the hill
- Witness 2.05.1.3
- Witness 2.06.1.3
- Witness 2.07.1.3
- Witness 2.12.2.3
 - 4 eye witnesses, all in Old Parish area, saw a large plane; 2 of them identified a Viscount, with propeller Nr 3 looking “bent” (feathered).

Conclusions :

These statements described a sudden loss of control, not caused by a collision with an aircraft or a drone, which resulted in a spin (or a spiralling), from which the aircraft recovered .

The initial conditions of this loss of control are :

- pitching down
- steep turning right .

Analysis and explanatory assumptions :

The similarity study and the technical analysis have resulted in the identification of the most probable causal factors of the initial loss of control.

Taking into account some operational observations may help in rejection of some causal factors which may otherwise have been technically possible.

- The alternative power supply disruption may be disregarded as a probable cause, since the aircraft was flying by day, out of the clouds.
- The icing is also not probable, since the meteo aftercast gives over Cork 2/8 to 4/8 Cu SC, base 2000 feet, top 6000 feet, with ISO 0° at 3000 feet.

The Viscount, at that time, was climbing, according to its messages to Cork ATC, at a climbing rate of 1500'/min. So it remained less than 3 mn, in a zone 4/8 cloudy.

The others remain possible causes; however since a recovery was observed, this cancels some types of events.

- Failure of the aircraft primary structure.
- The damage in the tail caused by the deterioration of the bulkhead cannot be sudden and complete, like in the Vanguard which crashed in Belgium.
- The strikes by birds, doors,should not destroy the structural resistance of the tail, but only the normal shape of the profile, so decreasing the negative lift of the tail.
- According to the test pilot of the Viscount program, at Vickers, a spin which does not result from a stall implies usually an engine malfunction.

However, because of the recovery, can be eliminated :

- The propeller system failures
- The multiple oil loss-seizure
- The multiple overheat/burnout .

As a conclusion, **the probable cause of the initial event is one that has decreased suddenly the negative lift of the tailplane** or an extreme pitch control input.

Since the Viscount was seen turning right descending, it may be deducted that this decrease of lift applied only to the port tailplane/elevator.

- This sudden decrease of the negative lift of the port tailplane origins a nose down movement together with a roll movement on the right, thus inducing a right turn.
- This movement, down and right, generated at the level of engine Nr 3 and still more engine Nr 4, a negative acceleration which could last at least 2 to 3 seconds.

The DART engine is known for being quite sensitive to negative g (refer appendix 5.4d) : these negative accelerations create a disturbance in the fuel flow and in the oil pressure supplied to the torque meter ; the engine will auto-feather the prop if the throttles are in sector for climbing when a lack of power appears.

There is no safety feature preventing from auto-feathering an engine when the other engine on the same side auto-feathers.

As a consequence, both engines on the same side, both submitted to negative accelerations, can auto-feather; thus creating all conditions for a spin.

Conclusion :

An assumption which fits with the observations of the witnesses and with the characteristics of the Viscount could describe the sequence prior to the first spin as follows:

A sudden event decreases the negative lift of the port tailplane. This event may be :

- A bird strike, destroying only the skin of the tail. At 10.000 feet in the Dungarvan area, such birds are relatively common (refer Appendix 3a).
- A disconnect of an elevator tab.
- A leakage of pressurized cabin air through a crack in the rear bulkhead , which could “derivet” the skin of the lower surface of the port tailplane.

The loss of the negative lift induces a movement of the plane nose down, right wing down, turning right, resulting in negative accelerations with particular effects upon engines Nr 3 and Nr 4.

These engines will auto-feather, thus increasing the diving and turning movement in a spin.

A single loud sound was heard by two witnesses. It is not clear if this sound has been generated by the initial event or during the spin and recovery phase.

5.4.2.1.2.2. Crew Reaction: Spin Recovery

Witnesses' statements

- No witness attended the manoeuvre of recovery
- Witnesses 2.06.1.3 and 2.07.1.3 stated the following :
 - 2.06.1.3 : When I was looking at the aircraft, I noticed that one of the propellers was bent in towards the plane. This was the one facing the land when the aircraft was facing Cork.....

Statement complemented later by : “the aircraft which I saw yesterday was a very big plane. All the propellers but the one that was bent were moving.”

- 2.07.1.3 : “I saw an aircraft in the sky about a ½ mile away. My brother said to me that one of the propellers was bent. I looked at the plane and saw that the propeller on the right wing was bent. There were two propellers on this wing and it was the inside one that was bent. It was bent downwards.”
- No other witness did report on a “bent” propeller.

Conclusion :

- The Viscount was seen spinning for about 30 sec..
- It was not observed during the recovery.

Analysis and explanatory assumptions :

The only experience of a spin successfully recovered was by the test pilot of Vickers together with a CAA co-pilot.

They succeeded when they re-created the air flow around the tailplanes surfaces, by use of power, in order to make them efficient.

They succeeded also because the test pilot experienced during his training courses spins on Spitfire, Buccaneer,(all aircraft quite difficult to recover from a spin), and because of his psychological characteristics.

The crew of the EI-AOM Viscount succeeded in the recovery taking benefit of the Captain's experience on Spitfire.

It is possible that this time was used for unfeathering the propeller Nr 4.

Afterwards, there remained, possibly, 2000 to 3000 feet consistent for the recovery, which may have resulted, presumably, in large positive accelerations, which could have caused further degradation in the structural integrity of the aircraft, mainly in the tail. It is considered a good estimation that 1500 feet are necessary to recover the plane, after the initiation of the first recovery action.

After the successful unfeathering of the propeller Nr 4, and the successful recovery of the aircraft, the crew succeeded in the unfeathering of propeller Nr 3. But the aircraft may have been sufficiently damaged at that stage to have reduced handling capabilities.

It is however understood why the crew gave priority to these urgent manoeuvres versus the emission of an alarm message. After the recovery, something in the radio VHF subsystem could have been damaged, and the aircraft was too low in altitude to have good radio-comms with Shannon.

5.4.2.1.2.3 Handling Capabilities of the disabled Aircraft

Witnesses' statements

A lot of statements describe the attitude of the Viscount :

o At Crobally

2.05.1.3 : “I saw an aircraft flying very low...it was circling round ...it did this about twice ...the plane was facing towards Cork and immediately before it swung around in the opposite direction...”

2.07.1.3: “I saw the plane and it was flying very low over the cliff...it was going in the general direction of Dungarvan, but at times it appeared to me it was trying to turn back towards Cork. It appeared to be weaving or going in a zig-zag mannerI did not notice anything wrong with the propellers.”

2.10.1.1 : “I thought the sound of the engines was peculiar. They seemed to be labouring. My sister Margaretsaid to me : “Is that plane making a funny noise ...”

2.12.2.3 : The plane “was pulling hard and making a dreadful noise .”

3.01.2.3 : “I saw the Viscount crossing the Tramore bay, at low altitude, slightly climbing steadily, until it disappeared behind the hedges of the road.”

3.02.2.3 : “ I saw, in a glance, a large aeroplane turning left, quite fast, and descending till it disappeared behind the cliffs of Brownstown Head.”

4.01.2.3: “I saw a plane coming from Dungarvan, turning left, leaving Waterford on its left. It was descending, unsteady in roll, down to a height so low that the grass was bent by the air flow. This lasted about 6 mn.

When it arrived on me, I was so afraid that I laid flat on the ground.

It then turned to the right, by a steep turn, and , climbing steadily, headed towards the Saltees.”

Conclusions:

- The Viscount has been observed :
 - . By time, quite unsteady in roll, in particular when flying very low
 - . By time, steady, in particular when climbing
- It has been heard :
 - . Making a “funny” noise
 - . The engines seemed to be labouring.

Analysis and explanatory assumptions :

- The Viscount was obviously disabled : this was technically logic, this was observed and heard .
 - Technically logic : this could be explained :
 - By the initial event, if this one was not of transitory nature
 - By the consequences of the accelerations suffered during the recovery from the spin
 - Observed :
 - By time quite unsteady in roll, in particular when flying very low
 - By time steady, in particular when climbing
 - Heard :
 - Making a “funny” noise
 - The engines seemed “labouring”.
- As a consequence of the damages suffered by the plane, it had reduced handling capacities.

In the Final Accident Report of the BOURAQ Viscount PK-IVS, dated 24th June, 1981 (Vickers) stated :

“A study of aerodynamic tail loads for the estimated weight, balance, speed and altitude was made. It was calculated that in level flight a download of 1100 lbs existed, and that sudden application of elevator could give rise up to 15000 lbs, equivalent to 46.000 lbs-ft root bending moment.

The **stick forces required** would be very high, **up to 450 lbs** , if the spring tab were inoperative.”

Although the weight, balance, speed, altitude and aircraft model are not the same as in the Bouraq case, it is evident that extremely high control effort would be required for EI-AOM to recover from such a manœuvre and during the flight after the recovery.

- A possible way for the crew to lighten this effort was to use the pitch-up effect of the engines when increasing their power.

This could be the explanatory assumption why the plane was observed steady in the climbing phases, and unsteady in the others.

- The other way was to transform the nose down tendency in a steep right turn to avoid crash on the ground,. But the accelerations suffered during the spin and the recovery .may have resulted in a twist of the aircraft. A different angle of attack of the port and the starboard side of the tailplane may explain that, when initiating a right turn, the port tailplane stalls, when the starboard does not, and transforms a normal right turn in a steep right turn, thus making the Viscount very difficult to control in heading.
- In addition, the flutter, which may be the reason why the witnesses heard “funny noise”, would probably have resulted in control difficulties.
- As a result, this crew may have been in the same situation as that of a Breguet Atlantic of the Dutch Navy.

Following a mistake in maintenance, this crew lost the control of the port tailplane in flight.

The crew needed some power on the engines to prevent too high pitch down tendency, thus having only a very narrow window of speed for managing a descent.

This window was so narrow that the Captain decided for a ditching instead of landing at an airport.

It is to be observed that the download of the tail plane of the Atlantic is much lower than that of the Viscount.

With regard to the Viscount, it may be assumed that, if there was a failure in the command or in the fixation of a tab, the crew was in a dead-end situation :

- They could hardly control the pitch down tendency (being obliged to transform the pitch down in steep turn right to avoid crashing).
- In order to help them in countering the nose down tendency, they had to set high power on the engines, thus climbing and making impossible any landing or ditching.
- This may explain why the crew did not come back to Cork, or did not perform a distress landing or ditching : They **could not do it**, however they probably made an attempt to ditch between Brownstown Head and Tory Hill, at Tramore Bay or to land North of Waterford .

- Another matter to question is “why did the crew not try to contact the ATC for reporting on what happened, and for indicating their intentions ?”

At the time of the spin, Shannon had three aircraft under control :

One of them (EI 112) left the Shannon frequency at 10.43 and could not be used as relay if AOM emitted after this time. Another one (GAPMC) left the Shannon frequency at 10.47, and could be used as relay. Since this aircraft did not relay, it can be assumed either that the Viscount did not emit before 10.47, or that it emitted but its radio set tuned on the ATC frequency was out of order.

After the minute 10.47, the Viscount was the only aircraft on the frequency ; it had to fly above 2500 feet to successfully contact Shannon if the Woodcock Hill system of Shannon was operative, or over 4500 feet if the local system at the airport was being used.

Conclusion :

After the recovery, the Viscount may have suffered, at least, further damage in the tail plane, resulting in the need of a high control effort by the crew..

In order to avoid crashing, the crew could only, by time, roll on to transform a nose-down movement towards the ground, in an horizontal turn which became very difficult to control because of the damages in the rear part of the aircraft. The crew could also lighten the muscular effort on controls by applying power on the engines, thus being unable to descend for a safe forced landing, or ditching.

5.4.2.1.2.4 Second Spin over Kennedy Arboretum

Witnesses' statements

4.01.2.3.1 stated :

“After the right turn over Tory Hill, the Viscount headed towards the Saltee Islands, for 3 to 4 mn climbing steadily . When arriving at the distance of the hills, it dived suddenly, and disappeared behind the hill.”

This dive was very steep; it spun turning right.

5.01.2.3 stated :

“While we were still in the church, just before the end of the Mass, we heard a heavy sound getting louder and louder.

Then we got out of the church.

About 2½ mn after having heard the sound, we saw a Viscount, appearing from behind the strawberry hedge, coming from the North-East, at very low altitude.”

- Conclusion :

The event was seen from Tory Hill and heard from Ballykelly.

Analysis and explanatory assumptions :

There are no apparent reasons that the same process as over Old Parish applies or not. Indeed, the initial event over old Parish surprised the crew. The loud bang which was heard from 2 witnesses in Dungarvan was replaced in Ballykelly by a heavy sound becoming louder and louder.

Over the Kennedy Arboretum, the crew was already alerted.

The second spin could result from the same cause as that explained in the Bouraq accident report :

(Pitch down) “....which the pilot would instinctively try to correct in the normal manner. With the associated changes in stability and stick force characteristics, this could result in an inadvertent over-correction producing such a considerable pitch up that the stall could be reached within seconds.”

This second process seems to be considered, since the crew were already fighting against the pitch down tendency for 15 mn, so could very well over-correct, the engines being at high power level, enough to gain more than 5000 feet within 3 to 4 mn.

It is possible also that, even without any over-correction, a transitory increase in the tail asymmetry justify a sudden nose down movement together with a steep right turn, thus initiating a spin.

With respect to radio-comms, it is normal that, since the crew had given up a possible intention to come back to Cork, to land or to ditch, the Captain decided to gain altitude and to contact London to call for help, if Shannon did not answer. Indeed the altitude of the airfield at Davidstow, (UK antennae nearest to Fethard) is about 1000 feet giving an altitude for line of sight VHF for AOM of about 5000 feet.

The call “EI-AOM with you”, using the call sign of the aircraft and not the flight number is conform to the procedure edicted in the FCOM of Aer Lingus “Emergency landing and evacuation – Chapter 18-4 Page 1 – Distress call”. The use of the registration letters rather than the flight number may also have been due to pressure of work. Under even moderate pressure it is difficult to remember the flight number because it changes depending on route and time of day. The registration letters on the Viscount 803 were written in big letters on the instrument panel.

Conclusion :

A second spin is technically possible, following a crew member’s inadvertent over-correction, or aircraft deformation, whilst the plane was climbing at high rate of climb, with engines set at full power.

This action could induce a high Angle of Attack leading to a stall, and the asymmetry in tail-lifts, triggering a spin or a spiral.

The aircraft could have been again recovered out of the spin. The people in Ballykelly church heard the power increase of the engines, necessitated by the recovery procedure, but supplementary damage may have been suffered by the aircraft.

5.4.2.1.2.5 Between Ballykelly and Tuskar Rock

Witnesses' statements

5.01.2.3 stated :

“When flying over Ballykelly, the Viscount passed so near to the place close to the church that its sound was enormous.

The plane seemed well under control : no variations in the continuous sound, all propellers rotating, tail seemed intact.

Nothing trailing, nothing flapping, no smoke emitted by the engines, no mist emitted by the wings.

However the passengers were visible inside the plane, through the 10 rear windows. They were looking outside, and were all bent forward, contorting on the back of the forward seat”.

5.03.2.3 stated:

“When getting out home, I saw the back of a plane, climbing slowly steadily, heading towards Fethard. Nothing seemed abnormal, except that it was flying much lower than those usually observed in that area.”

6.01.1.3 staying at Saltmills, stated :

“I heard a noiseI looked up and saw three small black clouds...

....the planeseemed to me to be unsteady and apparently descending

...I did not notice a particular alteration in the noise...but what drew my attention was the abrupt change of course when it came out of the cloud...there was no trace of smoke or fire out of any part of the aeroplaneit came out of the cloud as if was fired out of it and it turned to the right with a very sharp angle of bank ...”

6.02.1.3 staying at Fethard, 2 nautical miles South of Saltmills, stated:

I heard the noise of a plane and my mummy said it was a funny noise....

I went out to the garden....my home is facing South and the Saltees Islands would be South East....

I saw a plane travellingtowards the Saltees Islands...

The outer half of the left wing was on fire and a piece of the end of the tail. The noise from this plane was very loud, rough and was like the noise of a Hoover finishing up . The aircraft was coming from the West; when the aircraft was approximately South (from the witness) it was turning back to the right, towards Hook Head .”

Her brother's statement was reported as :

“Her brother, who was in a different part of the village also saw the same thing ...that is that the aircraft had the wings and the tail all red and looking funny..

He also told ...that it was making a particular noise, like if it had a motor bike inside.”

6.03.1.3 staying with 6.04.1.3 at Ralph, one nautical mile South-West of Fethard, stated :

“.....my brothertold me to look at a plane that had passed. I look at it and saw that the outer half of the right hand wing was very red and appeared to be on fire. The plane was travelling away from me in the South East direction over Baginbun....The plane sounded normal...”

This statement is “....correct in every way and I have nothing further to add to it” by 6.04.1.3.

The statement of the boy was complemented by the following :” I told my father that a plane passed and that the wing was on fire, but he said it was the sun shining on it”.

6.05.1.1 staying ½ mile West of Slade Village, stated :

“I heard the noise of a planethe noise of this plane appeared to be normal....

...3 to 4 minutes later, I heard the noise of a plane back again....the noise of this plane lasted for about 2 minutes and then cut out suddenlythe noise cut so fast that I didn't think it was distance away from caused it ...”

6.06.1.3 staying at Grange, 1 mile North of Fethard, stated :

“....I went out into the back yard and I saw a plane approaching a black cloud , the nose of the plane as far back as the wings was as if in this cloud

...the cloud seemed to me about the size of a large hay shed, and it appeared to me to be revolving around and travelling away from me ...

...I watched to see this plane come out of this cloud but it did not ...

...the cloud in which the plane went into was not the same as normal clouds. It looked like more a smoky colour to me in the sky .

....I could not give my opinion as to the noise of it ...

Then I went back into the kitchen . About a minute later, I heard a loud bang, like an explosion blowing up a quarry. It died away like a thunder. I did not see or hear anymore after that.”

6.07.1.1 staying 200 yards South of 6.06.1.3 stated :

“...(I) heard a very very heavy noise of a low flying aircraft(I) did not see the aircraft, but from the sound, it was going in the direction of the Keeragh Islands..”

6.08.1.NA living on a farm at Gorteens, just South of Saltmills, stated :

“.....on Sunday 24th March, between mid-day and one o'clock, a small pigeon type bird landed in my yard...the bird appeared to me to be completely immersed in some sort of liquid. This liquid did not dry at all on Sunday , ...was partially dry on the following Monday...it (the bird) stayed on the farm for 3 to 4 days...

The liquid on the bird appeared to be colourless and it did not appear to be lubricating oil because the bird could fly during the period”

7.01.1.NA staying in Newton-on-Sea with 7.02.1.NA and 7.03.1 NA, stated :

“...At about 1.45 pm, ... I went out. I looked out to sea in a South Easterly direction towards the big Saltee Island.....

I saw a silver coloured object on the water about 3 miles West of the Great Saltee Island. This object appeared to me to be about 7 to 8 square feet like a sheet of galvanise.

I went back into my homeafter about half an hour. Then I came out again and the object was visible in the same place : it did not move East or West, but could have moved out...

Some time shortly after 3.15 pm.....I gave up the watch and went in home.”

7.02.1.NA stated :

“After the 1.30 pm newsI went out to the rear of my home ...and I saw an object on the water to the right of the Great Saltee Island, but further out to sea. It appeared to be of silvery colour and was shining in the sun...

This object used to rise up at times on the crest of the waves for a few minutes and then to disappear again for a few minutes.

It looked like the wing of an aircraft”

7.03.1.NA stated :

“...I went to the rear of my homemy mother pointed out an object to me in the water West of the Great Saltee Island.

It was about a $\frac{1}{4}$ of the distance between the Great Saltee and the Coningbeg, and this object was further out to sea ...

This object was silver colour and it used to rise up on the crest of the waves for a minute and a half at times depending on the size of the wave, and then it would disappear for a few minutes. It appeared to me to be about 8 feet square like a sheet of iron, the top piece, when it used to lift straight up, appeared to be tapered in slightly on top.

It looked to me to be the wing of a plane

After (3.30 pm) I left it and I did not look out there again until next day....”

7.04.1. NA stated :

“...I visited Slade ...I arrived there at 2.45 pm local Summer time

...I noticed a bright object in the water on the horizon, slightly to the South-West of the Greater Saltee IslandI got my field glasses....

The object was aluminium in colour. The centre portion was submerged. The left hand portion was oval in shape. The right hand portion uneven and its protrusion above the water was more pronounced than the left hand side.

It appeared that the oval shaped portion was at time awash and the right hand portion was breaking the waves.

I kept it under observation for approximately 5 to 7 minutes.

.....

I left....approximately for 25 mn.

I returned to my original position, and again observed

The object had moved slightly to the left in the direction of the South-East current ...

....after watching for another short period, it disappeared from sight.

The last portion to be sighted was the right hand portion. My last sighting was approximately 3.30 pm local time.”

7.05.1.1. staying at Shilmore, less than 1 mile North of Carnsore Point, stated :

“... I heard a bang off Nethertown (between Tuskar and Barrels).

I remarked to my daughter: what noise is that ? (She) replied that it is like thunder, to which I replied :that is not thunder.

Theresa went out and she saw a very low darkish coloured cloud in a position off Nethertown between the Barrels and Tuskar, out to sea. I would estimate the time of this occurrence at about between 3 to 5 minutes after noon.”

7.06.1.NA staying at “the bar”, near Tacumshane Lake, stated :

“...at a point between Black Rock and Carnsore Point, I saw what appeared to be a mushroom of water out to sea...”

From 7.10.2.1. to 7.21.1.1., thirteen witnesses, staying between Rosslare and Carnsore point , have heard :

- an unusual sound.
- a noise like thunder
- a heavy noise like thunder
- a noise like thunder but short, rather like a tyre burst
- a heavy bang like thunder, short and sharp like a tyre burst but heavier

7.08.1.1. staying at the Bing, near Greenore Point, stated :

“I heard a noise like water running from a big pile of stones on the beach on a bad day...

...I saw a column of water

...I didn't see anything going into the water and I didn't hear the noise of any plane beforehand.”

7.09.1.2., on board MS Metric, stated :

“... I thought I saw a plane at an altitude of some three meters falling It seems to me that it fell on its left wing.”

Conclusion :

- > The Viscount was observed at Ballykelly and by Campile, steady, slightly climbing , without any external sign of being damaged.
- > Over Saltmills, it was descending, unsteady, it emitted 3 small black “clouds”, but sounded “normal”.
- > Over Fethard, it was spraying around itself what could be “swirling clouds” which, when looked at against the sun, could be similar to a fire accompanying the plane when seen in the direction of the sun. The plane then was emitting a loud and rough noise, like a motor bike.
- > Over Ralph, it continued to spray fuel.
- > Over Grange, 3 to 4 minutes later, it continued to spray fuel . East of Grange for one minute, a loud bang was heard, at least by two witnesses.
- > A part of the Viscount, shaped like a wing, possibly separated from the Viscount when the bang occurred, since 4 witnesses saw it from 1.30 pm to 3.30 pm, drifting South-East in the sea.
- > No one saw or heard anything from the plane from East Grange to a line between Carnsore point and the Barrels. A mushroom of water was observed on that line and a low darkish cloud.

Several people in the area around Carnsore point heard a heavy noise, or a bang, or a tyre burst, but it is not possible to identify the time when they heard this noise to conclude if it was the separation of a second part of the aircraft, or the final crash.

Analysis and explanatory assumptions :

- The same observations with regard to the sequence of steady and unsteady phases call for the same explanations as between Old Parish and Tory Hill.
- In addition, presumably as a consequence of the second spin, the fuel system and the engines have initiated a degradation process.
 - > The FCU delivered in the Saltmills area an uncontrolled fuel flow to 3 of the 4 engines, resulting in the 3 observed black clouds.
 - > A leakage in the fuel circuit became apparent from the time when flying over Fethard, and during the 4 to 5 minutes the Viscount was observed over the peninsula. This leakage could come from a partial disconnection of two pipes, or from a damaged valve ; as an example, it can be noted that, in the wreckage, the starboard valve of the Refuel/Defuel system was found partly open (refer Appendix 5.4f).

This assumption may be given more confidence following the 6.08.1.NA statement about the bird which landed in the garden of a farmer at Gorteens; this bird was completely immersed in a sort of liquid which could not be lubricating oil, but which could be fuel or hydraulics.

- > During its flight over Fethard, the sound emitted by the Viscount became different, and from a normal sound of turbine (as a Hoover...) became a sound as the one of a motor bike... This latter could be the sound of a part of the tail fluttering more and more.
- > As a consequence of this increasing flutter, it is not technically unacceptable that a part, like the port elevator, separated from the plane, East of Grange.

The metallic piece has the form of a wing, however much smaller. It may have, when separated, an air trajectory and an attitude when entering the sea which allows it to float, without being destroyed at the impact. It seems that it floated for at least three hours.

- > The trim tab, which is a part of the port elevator was found on a beach, near Carnsore Point. This means that, when the elevator separated, the trim tab should have remained linked to the fuselage by the actuating rods.

It then detached shortly before or at the crash.

- > It is not so easy to assess if there had been a second part separated, in the vicinity of the Barrels, should this part be the starboard elevator or the port tailplane.
- > After the second spin, the degradation process of the aircraft accelerated. This was illustrated through :
 - Engines dysfunctionning = black clouds
 - Fuel streaming = swirling cloud leakage
 - Increased flutter = generating noise like a motor bike .

This resulted in the separation of what may have been all or part of the port elevator, East of Fethard peninsula.

- > After that separation, the crew succeeded in keeping the Viscount in flight for about 8 minutes.
- > After 5 to 7 minutes of such still controlled flight of the disabled aircraft, it probably lost its port tail plane, in the vicinity of the Barrels.

5.4.2.1.2.6 The Crash

The conclusions of the 1970 report :

- > As conclusions of the examination of the wreckage, Dowty stated that “one of two possible operating conditions could be indicated :
 1. A steady state condition with idling fuel flow
 2. A steady state condition with zero fuel flow.

Dowty complemented his statement, writing :

- The aircraft was right way up
- Possibly in a nose down attitude of not more than 45°
- Having a high rate of descent at impact
- Having a true forward speed less than 130 kts if fuel flow on idle
- Having a true forward speed less than 200 kts if fuel flow on Ø.

Rolls-Royce stated :

- The aircraft was right way up
- It is difficult to accurately assess the degree of nose down attitude. However, the general impression was of a nose down attitude, possibly as steep as 45°.
- The aircraft may have hit the water somewhat port wing first.
- It would seem reasonable to suppose that all four engines were alight, but with throttles closed, engines idling, and propellers windmilling on or about the flight fine pitch stop.

These observations were used as the basis of the 1968 investigation team conclusions, stating:

(§ 2.1.4.7 of the 1970 report)

“...the aircraft went into the sea

- On a steep flight path
- With relatively low forward speed (< 130 kts)
- With a very considerable vertical speed.

The attitude at impact was of the order of

- o Right way up
- o At least 15° nose down
- o ...slightly banked attitude to the right . It was also stated that “there is some contradictory evidence”.

-

(§ 2.1.4.8 of the 1970 report)

“...the engine and propellers evidence points towards the engines being at low power at impact...

....two possible operating conditions .

- a) a steady state with idling fuel flow and a true forward in speed of less than 130 kts
 - b) a steady state with zero fuel flow and a true forward airspeed of less than 200 kts
- > ...the more probable condition is thought to be a)
- > It is probable therefore that the forward component of air speed at impact was less, probably considerably less than 130 kts.

- Based on the engines and propellers manufacturers observations, and taking into account the operational considerations, the conclusions relative to the aircraft attitude at the impact with the sea may be different.

Assessment

- An operational approach of the crash analysis calls for the identification of the event which transformed a disabled aircraft into a non-flying aircraft.
- This event may be, in the situation where the engines should be at Ø fuel flow, a starvation of the engines.

Indeed, it is not conceivable that the crew deliberately cut off the fuel near Tuskar Rock at sea (i.e. for ditching). A starvation is possible since there was 2 x 210 gallons in the inner tanks at take-off.

According to the Section 12 of Appendix 4a (page 42/50) of the 1970 report, the fuel content of the inner tanks was 2 x 110 gallons at the minute 58, thus estimating 2 x 35 gallons at the minute 14.

It was observed in the wreckage that the inner tanks were still used at the moment of the crash.

Since a streaming of fuel has been observed over Fethard, it is possible that a starvation occurred around the minute 14, thus resulting in a crash at Ø fuel flow.

In this case, the aircraft should remain partially controllable up to the very end of the flight, and an attitude at impact about 15° nose down and 15° left bank is realistic. The airspeed should be around 180 kts, as during the flight, since the aircraft is controllable.

- However some observations make this assumption quite improbable :
 - The crew, who demonstrated all during this disabled flight a real operational skill, should have reacted .
 - The Rolls-Royce report concludes : “....All the engine evidence points towards the engines being at low power at impact”.
 - The engines, as stated in the Dowty report, should have auto-feathered, and there is no trace in the wreckage for even the beginning of such operation;
 - The aircraft being still controllable and the engines/propellers system being designed to avoid large increase of drag, there is no reason for the aircraft to get a “very considerable vertical speed”.

If the autofeathering did not operate, as per design, then the aircraft should have drastically pitched down under the cumulated effect of the propellers drag and the decreased down lift, and should have crashed inverted.

- The event, which led to the final impact, may be the separation of the port tailplane.

Some observations support this assumption :

- “Something “ has been seen, between Carnsore Point and the Barrels.
- The sequence of degradation should have been similar to those accidents where such separations have been observed.
- Since the aircraft becomes then uncontrollable, the crew cannot react.

- There is some evidence that, if the engines/propellers systems could be steady, the aircraft was not : indeed the bending of the bolts retaining the first stage compressor ring was :
 - For engine Nr 1 : downward and starboard
 - For engine Nr 2 : downward and starboard
 - For engine Nr 3 : upward
 - Engine Nr 4 : was not recovered.

This may indicate a movement of the aircraft around its centre of gravity when crashing.

- The fact that the reduction gear Nr 4 was less badly damaged than those of Nr 1 and 2, and its torque shaft was neither fractured nor cracked could allow to assume that the engine Nr 4 could have separated from the main body when crashing;

This, in addition, is in line with the fracture observed on the starboard outer wing.

These observations could allow to assume that rather than “a slightly banked attitude to the right”, the consensus should prefer a crash :

“right way up, with a banked attitude by 45° to the right, nose down by 45° or more.

- At the crash, the tail separated from the main body, the vertical empennage breaking at the impact since it was 45° inclined on the horizontal.

Presumably the engine Nr 4 and the outer starboard wing separated.

Presumably also, “the port wing was torn off on impact, releasing the port main wheels, allowing about a dozen bodies and seats to float out, and the wreck subsequently settled port side down, trapping bodies, luggage and buoyant fittings”. (Report from the Head of Royal Navy detachment at Rosslare to the C.I.C. Plymouth – dated 1.5.68).

▪ Conclusions

However operating conditions at the time of the crash “Steady state conditions of the engines and the aircraft, with zero fuel flow and a true forward speed of less than 200 kts “ are possible, it seems more probable that the crash resulted in the separation of the port tailplane, following the separation of the port elevator that occurred 5 minutes before, thus making the aircraft uncontrollable;

The operating conditions at the time of the crash should have been :

- Steady state of the engines at idling fuel flow, and of the propellers at flight fine pitch stop.
- The attitude of this uncontrollable aircraft should show the following :
 - > Nose down by at least 45°
 - > Left bank angle by 45°
 - > Airspeed much more than 200 kts, with a forward component less than 130 kts and a considerable vertical speed.

In this case, the vertical speed should not result from a stall, but from the pitch down movement due to the cancellation of the negative lift of the tail.

This fits with the statement of the Spanish sailor, “.....it seems to me that it fell on its left wing” . From that distance, he could not have identified a left wing low if the bank angle was no more than 15°.

5.4.2.2 Assessment of the Scenario “as per Witnesses”

In this scenario, the positioning and the timing are self consistent; they fit with the witness statements; except during its legs over the sea, the flight was continuously observed, and the air mobile identified as a Viscount.

The statements given by the witnesses allow for technically logic assumptions explaining the degradation process of the aircraft; the duration of this degradation process is similar to this of the other accidents of the same similarity family, around 30 mn.

But two messages transcribed from the Shannon radio-comms cannot fit with this scenario.

10.51. ⁴⁸	712	- Level at 170
	Shannon	- Roger, report at Bannow
10.57. ⁰⁷	712	- 712, By Bannow, level 170, estimating Strumble at 03
	Shannon	- Roger, say again time By Bannow. I got the Strumble estimate OK
	712	- 57
	Shannon	- OK, time 56.5. Change to London AWYS 131,2. Good Bye.
	712	- 131,2.

The information contained in this messages is entirely incompatible with the track reconstructed here-above, which shows that, at that time, the aircraft was at lower altitude, somewhere between Old Parish and the Kennedy Arboretum.

5.4.3 Scenario “As per Witnesses/Deviation from the Flight Plan”

5.4.2.1 Flight Reconstruction

5.4.2.2 Assessment

5.4.3.2.1 Filing-up of an IFR Flight Plan

5.4.3.2.2 Decision to divert from the flight plan

5.4.3.2.3 Preparation for Execution of the Diversion

5.4.3.2.4 Diversion Execution

5.4.3.3 Conclusion

5.4.3 Scenario “As per Witnesses/Deviation from the Flight Plan”

Since it is difficult to imagine that the Shannon ATC introduced a distortion between the original recording and the R/T comms transcript, the first assumption is to consider that the crew, deliberately, decided to divert from their flight plan and to report wrong positions at regular timing.

5.4.3.1 Flight Reconstruction

Based on this assumption, the low altitude flight observed by several witnesses is not the consequence of a damage suffered by the Viscount, but the execution of the deliberate will of the Captain. Explainable reasons : touristic or familial flight over a place or a person well known by him, or deviating flight at the request of a passenger, (for instance, an American passenger may have asked to fly over the Kennedy’s house).

It is to be noted that every pilot knew that, when flying at low altitude (lower than 2 to 3000 feet) in a zone located East of the hills South-East of Shannon, the VHF radio waves propagation being poor, the transmissions between the aircraft and Shannon ATC could not be usually established.

It is to be noted also that the Viscount was observed after its first dive, when flying over Old Parish, at low altitude. Then, it was continuously observed from Tramore to Brownstown Head, Tory Hill, Ballykally and Fethard area. Along this track, it was observed above 2000 to 3000 feet only in the vicinity of the Kennedy Arboretum.

If, in order to communicate with Shannon ATC, the Captain had to climb the aircraft in a pop-up manoeuvre at the minutes 51 and 57, this manoeuvre could have taken place only :

- a) Between Old Parish and Tramore, when flying over the sea, out of the sight of any witness.
- b) In the vicinity of the Kennedy Arboretum, where the Viscount was observed climbing and then descending
- c) Between Fethard and Tuskar Rock, when flying over the sea, out of the sight of any witness.

1st supposition : The Viscount was over Kennedy Arboretum at 51.

An argument in favour of this scenario is that, since the Viscount did not crash when flying over the ground, the crew had the control of the aircraft; and since the Viscount avoided (for example) the steeple of the Ballykally church and then headed just between the hills, this meant that the crew had full control of the aircraft.

If the crew had the full control of the aircraft after the descent observed over Kennedy Arboretum, this means that the Captain had gained altitude for his radioing message, then descended and continued his “diverted” flight.

Those observations drive to the assumption that the Viscount should have flown over Kennedy Arboretum at mn 51.

It is to be noted that the max. normal operating speed of the Viscount is 230 kts(air speed) and that the speed not to exceed (VNE) is 270 kts.

In this case, if the Captain initiated the descent at 42, flew over Old Parish for 1 or 2 mn, then, direct to Tramore, and according to the reconstructed track at low altitude to Brownstown Head and Tory Hill, the average ground speed should have been 365 kts **which is impossible**.

Consequently, the Viscount could not be over the Kennedy Arboretum at 51.

2nd supposition : The Viscount was over Kennedy Arboretum at 58.

Then, the first pop-up should have taken place at mn 51, out of the sight of any witness, somewhere over the sea between Old Parish and Tramore.

Let us suppose that it was quite at the end of the flight leg over the sea (even if this is in a certain way contradicted by a witness who saw the Viscount appearing at very low altitude behind Newton village).

In this case the average ground speed between Old Parish and Tramore should be 215 kts, which is quite realistic.

From Tramore to Tory Hill at low altitude, and climbing from Tory Hill, in such a way that the Viscount was above 3000 feet at 57, and above 5000 feet at 58, the average ground speed is around 250 kts, which is slightly high, but acceptable, in particular if the Captain was in a hurry to respect his ETA Strumble (min 03) , which in any case, could not be respected.

The damaging initial event should then occur above the Kennedy Arboretum, and the last part of the flight (positioning, timing, and degradation process) should have been the same as in the above described scenario (as per witnesses/disabled flight).

The argument related to the Viscount handling easiness at Ballykally is no longer valid.

Consequently, **the track reconstruction** should be **described as follows**:

- | | |
|---------|---|
| 11.32 h | Take off from Cork |
| 11.42 h | After having established the R/T liaison with Shannon, and having given the ETA Strumble, beginning of the deviation from the flight plan. Rapid descent and flight at low altitude over Old Parish, then to Tramore. |
| 11.51 h | Pop-up over the sea to transmit the message “Level at 170” |
| 10.57 h | When passing 3000 feet, climbing, heading towards the Saltees and Strumble, reporting as if at the FIR boundary. |
| 10.58 h | While climbing, above 5000 feet, a sudden event damages the tail of the Viscount, thus resulting in a spin turning right, which was observed from Tory Hill. |

Distress message : “EI-AOM with you..” relayed to London ATC by two aircraft in flight, but also recorded on London tape.

Then, flight similar to what has been described in the here-above scenario “disabled flight”.

5.4.3.2 Assessment

In order to determine the level of probability of occurrence of such a scenario, each step of the “deviation “ process is to be analysed:

- Filing up of an IFR flight plan
- Decision to divert from the flight plan
- Preparation for executing the diversion
- Diversion execution.

5.4.3.2.1 Filing up of an IFR Flight Plan

It may be necessary to know what an IFR flight plan is.

A flight plan is a pseudo-contract between the Captain and the ATS : the ATS commits itself to inform the Captain for preventing any collision, managing horizontal and vertical separations, for assuring a safe take-off, climbing, en route flight, descending and landing inside the complex traffic which exists around the major airports; and for providing any necessary help in case of in flight unexpected event.

On the other side, the Captain commits himself to follow at the best the routing instructions , fixed in the flight plan, to report to the ATS when necessary and to react adequately to the information given by the various ATCs. In all cases, the Captain remains responsible for assuring the prevention of collision and the safety of his environment.

In order to assure these commitments, strict procedures have been implemented. A “flight plan” format is filled in by the crew before take-off .

Since it is a flight of public transport, the rule is that the flight plan is IFR, which means that the maximum services (as listed here above) are provided by the ATS to the crew.

But it was possible, in the late sixties, to request on those parts of the flight path, as decided by the Captain, to fly under VFR conditions. In that case, the ATC provide traffic announcement and the Captain assumes the total responsibility of the flight safety, towards his passengers and toward the external world.

When the flight plan is filled in, the ATC who has received it, phones and faxes it to the other concerned ATCs.

The crew has to ask the ATC for the clearance before starting up which is given when the traffic density allows for.

The crew then asks the flight clearance, before take-off. The clearance is given by the ATC, eventually with some modifications necessitated by the traffic situation. The crew's read back of the clearance is compulsory.

Whilst the flight is going on, the ATC provides the crew with any relevant information, and the crew reports on the flight progress and possible events.

Some specific procedures, very strict, are implemented between the different ATCs to follow the flight, without error or omission. One of these procedures, at the time, was the "strip", which allowed a controller to get a clear situation of the flight he had under control. The basic check was to control that the information written on the strip was according first to the flight planning, and secondly to the contents of the crew reporting messages.

One of the major services provided to the crew by the ATS was an efficient guidance when entering the crowded zones around the major airports.

Consequently, these zones were very soon equipped with radars, assuring a positive control of the aircraft, being usually (it was the case of EI-AOM) fitted with a transponder, able to give the identity of the "transponding" aircraft.

At the time, the radar coverage between the zones over the large airports was not complete; for instance, the radar coverage between Cork and London was nil from Cork to East Strumble.

Consequently, when flying under an IFR flight plan from Cork to London, two reporting points were of particular importance: the FIR boundary, when the control responsibility of the aircraft switched from the Irish ATS to the British ATS, and Strumble, from where London ATC had to calculate the best flight elements to manage the best trajectory down to the landing.

The ETA at the FIR boundary was not a key factor; the ETA Strumble was for London AWYS a key information: as such, Strumble Head was VOR/DME/Beacon equipped for accurate reporting.

On that Sunday morning, it can be observed that the IFR flight plan was written by the F 712 copilot, without any reference to a possible VFR leg. It was a "scheduled flight", under a standard and repetitive flight plan.

At that instant, the Captain was presumably not aware that he should have later to take a decision about a possible diversion from the flight plan; if not, he should have filed up the flight plan by himself, and should have warned the controller, either in a written form (mixed VFR/IFR in the flight plan); or in an oral procedure which was sometimes used at that time, according to the controllers interviewed.

5.4.3.2.2 Decision to Divert from the Flight Plan

If this decision was a “last minute” decision, it could have been taken up to the minute 42, when a witness saw the Viscount diving.

However, it may be noticed that, even after the take-off, some statutory procedures existed, allowing the Captain to divert from his IFR flight plan. He could have asked for a “PLN deviation”; or for a VFR clearance on a sequence of the IFR flight plan adequately modified; or for a cancellation of his IFR flight plan, since he could later on deposit in flight another IFR flight plan.

One of these procedures would have prevented the Captain from incurring the risk of taking a non statutory decision: a low altitude deviation may always be observed from the ground by anybody able to report to the relevant authority, and after such a deviation, the Captain may become vulnerable in front of his copilot, or other crewmen; he may be blamed by his company; he may suffer higher sanctions, up to temporary interdiction to fly.

In addition, a diversion initiated at flight level 90 or 100, would imply a second climb phase, with the related fuel consumption and consequently the necessity of a justification to be given by the Captain to the Airline.

However, it is observed that, at that time, and with Captains having been combat pilots, such risks were not considered by them determinant.

In addition, the radar coverage was not continuous, and allowed for large deviations without any possible detection. The controller could not know that the aircraft was not where it had to be, nor that it was where it was.

Consequently, without taking into consideration the psychological characteristics of Captain O’Beirne, which were reported to be at the full opposite to such decision, it is possible to suppose that the Captain decided to divert irregularly from his IFR flight plan : it was a Sunday morning, spring time, exceptional good visibility, favourable downwind, flying on his birth place, without any other flight in the vicinity : a Shamrock in his domain..!

5.4.3.2.3 Preparation for Execution of the Diversion

No ETA Strumble had been noted on the flight plan. However, since such flight was daily flown, as soon as the Viscount took off, the controller, by himself, gave the ETA Strumble at 07., normal flight duration between Cork and Strumble.

When the Viscount was proposed by the ATC to fly direct to Strumble without passing over Tuskar, the crew gave an ETA at 03 : 4 mn sooner than the normal flight duration. The difference between the distances (Cork-Tuskar-Strumble and Cork direct Strumble) is about 4 nautical miles. The practice in those days was to add a minute if the directed track route was granted. Four minutes seem a bit high unless a higher speed than normal (average ground speed of 251 kts instead of 222 kts) was to be used.

This was said at 41.

If, at that minute, the Captain had the intention to divert, he should have given an ETA later and not sooner.

If he had decided to divert later on, at the very last minute before descent, he should have contacted Shannon to give another ETA Strumble as long as he was at high altitude. This should have taken place before beginning the descent.

5.4.3.2.4 Diversion Execution

- The track reconstruction shows that this diversion can be described as follows:
 - 11.42 Descent over Old Paris
 - 11.42 – 11.44 Fly low altitude over Old Parish
 - 11.44 – 11.51 Fly low altitude over the sea
and Pop-up at 51
 - 11.51 – 11.55 Fly low altitude from South Tramore to
Brownstown Head, East Waterford, Tory Hill

Each of these flight legs is to be cross-checked against the statements of the witnesses.

5.4.3.2.4.1 Descent over Old Parish

A descent with 57 passengers on board is not a fighter exercise. The descent rate should remain within 2 to 3000 feet/min maximum; the turn rate should also remain rather smooth.

According to a single witness (2.01.2.3), the Viscount showed a steep right turn, then dived almost vertically. The rate of descent would have been so high that the witness made a prayer for the people on board since he was sure the aircraft was to crash.

The fact that the Viscount was not in a smooth descent is confirmed by a lady, (2.02.2.1), ex-pilot, ear-witness, who states : “I have long experience of engine tunes of aircraft and a very keen sense of hearing.....I thought that the plane sounded ‘rather rough’ “.

Both statements tend to prioritise the assumption that the Viscount was in a disabled condition from the very beginning, i.e. 11.42.

5.4.3.2.4.2 Flight at low Altitude over Old Parish

A touristic flight over Old Parish may be considered since:

- Witness 2.05.1.3 stated : “I saw an aircraft flying very low,it was circling round ...it did that twice.
- Witness 2.07.1.3 : “I saw the plane, and it was flying very low over the cliff. It was going in the general direction of Dungarvan...”

These observations may refer to an aircraft flying for touristic purposes ,but this type of flight is contradicted by the following statements :

- 2.05.1.3 and 2.06.1.3 saw an aircraft, with propeller Nr 3 “bent”.

It is difficult to imagine a feathering/unfeathering exercise when making this type of touristic diversion.

- 2.07.1.3 “...it appeared to be weaving or going in a zig-zag manner ...”
- 2.10.1.1 “ I thought the sound of the engines was peculiar. They seemed to be labouring. My sister Margaretsaid to me : Is that plane making a funny noise ?”
- 2.12.2.3 (ex-teacher) “The plane was pulling hard and making a dreadful noise.”

Complemented by :

- “..on that day the plane was certainly in trouble passing over this area. I heard an unusual noise which sounded as if the engine was ‘labouring’, and I said to the other members of the household ‘that plane is in trouble’ and they said the sound is unusual”.

Consequently, there is again a tendency to prefer the assumption for a disabled flight over Old Parish.

5.4.3.2.4.3 Flight low Altitude over the Sea and Pop-up near Tramore, over the Sea

This leg of the flight was performed out of the sight of any witness.

However, it may be observed that the witness 3.01.2.3, saw the Viscount appearing at very low altitude just North of Newtown Head. If there had been a pop-up at 51, this man would have seen the Viscount, at the top of its trajectory, since the visibility was excellent.

5.4.3.2.4.4 Flight at low Altitude from South Tramore, Brownstown Head, East Waterford and Tory Hill

This leg of the flight was observed by three witnesses, who could have observed a touristic low altitude flight:

- 3.01.2.3 “I saw the Viscount crossing the Tramore Bay, at low altitude, slightly climbing steadily ...”
- 3.02.2.2 “ I saw, in a glance, a large aeroplane turning left, quite fast, and descending till it disappeared behind the cliffs of Brownstown Head”.”
- 4.01.2.3 “I saw a plane coming from Dungarvan, turning left, leaving Waterford on its left. It was descending, unsteady in roll, down to a height so low that the grass was bent by the air flow....It then turned on the right, by a steep turn, and climbing steadily, headed towards the Saltees.”

However, it may be noted :

- The unsteadiness in roll , at very low altitude, which would be a dangerous crew attitude with 57 pax behind, if it was the will of the crew.
- The heading towards the Saltees, and not direct to Tuskar or Strumble, which should have been the normal manoeuvre if occurring at the end of the diversion.

In that scenario, the spin over the Kennedy Arboretum is the initial event of the degradation process of the Viscount.

5.4.3.3 Conclusions

Although an irregular deviation from the flight plan is possible, since :

- There was no positive radar coverage in that area, at low altitude
- The “aura” of the Captains, ex Combat pilots, was imposing enough not to take care of the risks that such a manoeuvre could make them to incur.
- The Viscount was the only aircraft flying in that area, all weather conditions being excellent.

The assessment drives to the conclusion that this scenario is of a very remote possibility, because of :

- The psychological characteristics of the Captain , as reported by several of his relatives and friends.
- The several existing procedures, at that time, to make a “regular” diversion from the flight plan. If the Captain had decided to satisfy the request of a passenger, for instance, there is no doubt, according to his fellow captains, that he would not have chosen to proceed irregularly.
- The inconsistency of the ETA Strumble correction, if the crew had decided to proceed in that irregular diversion. All along the diversion path, this ETA became more and more unrealistic; and the Captain knew that this was the key information for London to manage at the best his arrival trajectory to London airport.
- The excess of fuel consumption to be justified to the Airline.
- And mainly, this supposition is contradicted by the witnesses located in Youghal or Old Parish, and raise questions with regard to the statements of the witness at Tory Hill.

Consequently, at this stage , the present study is in a situation quite similar to the one of the 1970 report :

In 1970, the (non) conclusion was : under the assumptions that the transcripts are exact, and that the time of the crash is exact, the air-mobile sighted over Fathead cannot be the Viscount ; “the conclusion that there was such another aircraft in the area is inescapable”.

This sentence fed a 30 years controversy.

Today, the conclusion could be : under the assumption that the crew did not do anything irregular, the conclusion that the transcript of the Shannon radio-comms does not describe the exact R/T is inescapable.

In order to avoid a new 30 years war, a deeper analysis of that conclusion is to be made.

5.4.4 Shannon R/T Transcript critical Analysis

5.4.4.1 Aim of the critical Analysis

5.4.4.2 Data available

5.4.4.3 Witnesses' Statements

5.4.4.4 Analysis and explanatory Assumptions

5.4.4.5 Assessment

5.4.4.6 Conclusion

5.4.4 Shannon R/T Transcript critical Analysis

5.4.4.1 Aim of this critical Analysis

- Despite the apparent similarities between both situations, at this step of the present study and at the end of the 1970 investigation, they are fundamentally quite different.

Indeed, in 1970, the inconsistency between the estimated position of the Viscount at 58 and the observations made around noon by the witnesses located in Fethard drove the Investigation Commission to envisage a possible mid-air collision : this collision had a direct impact on the accident process.

Now it is clear that the inconsistency between the last two messages of the Shannon R/T transcript and the positions of the Viscount as observed by the witnesses has no impact on the accident process : these two messages do not influence the initial event, the degradation process of the aircraft, the crash, and they do not influence the reaction time of the ATS for launching the Search and Rescue actions, since everything was adequately made by London ATC.

So the scenario “as per witnesses/disabled flight”, cannot be a source of imaginative speculations : it is the only answer of the Intern’l Team to their task “to shed further light on the Tuskar Rock accident”.

- Consequently the Shannon R/T transcript critical analysis is aimed simply at reducing the inconsistency which still exists inside this unique answer.

It does not present any interest for the Intern’l Team to identify who is at the origin of this possibly incorrect transcript; the Team is not skilled for that.

What is of interest is to assess on the probability of occurrence of such an irregular transcript , which misled the 1968 Investigation Commission when they based the track reconstruction on the R/T transcript.

This assessment is to be conducted keeping in mind that the Shannon ATC is a governmental service, with strict operating procedures and highly motivated civil servants (as observed during the interviews which were conducted by the Intern’l Team).

The subject matter of assessment will never be the actors themselves, but the procedures, as they appear through the data remaining available and the interviews of the still alive witnesses.

5.4.4.2 Data available

The data available is :

a) Cork

- the transcript of the messages between Cork (TWR and APP) and 712, from 10.26 to 11.21
- the progress strips at Cork ATC
- a summary of interviews made at Cork on April 3 by the Aer Lingus Internal Investigation Commission

b) Shannon

- the transcript of the messages between Shannon ATC and 712, from 10.39 to 10.58 and an intermediate “aide-mémoire”
- the transcript of the Shannon London telephone line, from 10.36 to 10.44
- the cover letter of the Chief ATC Officer, dated 25.3.68 (addressee not identified) together with
- the watch supervisor’s report and log of action, on duty from 11.00 Z on the 24th March).
- the reports of the ATC officers on duty this March 24, 1968
- the progress strips at Shannon ATC.

c) London

- a copy of the original tape, recording the last 2 messages of EI- AOM
- the transcript of the messages between London ATC and EI 712, EI 362, BOA 507, ...from 10.53 to 11.09
- the Aircraft Accident Report for use by ATCOS
- log extracts from 11.00 to 20.40 on 24th March
- cover letter from the Chief controller to the Centre Superintendant LATC and two reports from D and Radar Controller
- report from Duty Controller at Sopley Radar.

5.4.4.3 Witnesses' Statements

5.4.4.3 Witnesses' Statements

Since the Senior Officer Head of Shannon ATC (1968) the Shannon Supervisor on duty till 11.00 Z and the relief Controller taking on at 10.55, are all deceased, the witnesses who were interviewed were :

- The Shannon Supervisor, who was on duty from 11.00 (GMT) till the end of the afternoon ; and the Controller on duty in the morning, up to 10.55 (GMT).

a) Supervisor statements

- the watch Supervisor assumed duty from his predecessor at 11.00 Z.

When taking over, he got the information that EI-AOM Departed Cork

Airport at 10.32 Z, estimating London Airport at 11.48 Z.

Reported Bannow at 10.57 Z , FL 170 , Estimating Strumble 11.03 Z.

- at 11.10 Z, London ATC advised Shannon ATC : no radio contact with EI-AOM.

- at 11.13 Z, London Supervisor advised Shannon Supervisor : no radio contact with EI-AOM ; London had asked EI 362, flying from Dublin to Bristol , to search for West of Strumble.

When he heard that, the witness thought that London had been too fast,

because London did not report on the last messages they got from EI-AOM.

At this time, he did not realize of the seriousness of the situation.

- at 11.18 Z : he instructed Shannon to call EI-AOM on all frequencies and facilities.

- at 11.25 Z : he informed Cork ATC “ full alert” on flight.

- at 11.35 Z : London advised that they “are scrambling two Shackleton and one helicopter”.

- at 11.36 Z : Senior ATC Officer home advised.

- around 12.15 Z: Senior ATC Officer arrived.

- the Supervisor remained in the OPS room till 18.30 Z, with an exception of 50 mn for lunch around 13.30 Z.

So he could not listen to the original R/T comms recording during this afternoon, nor the day after.

He now presumes that he could have read the transcript in 1970, at the request of the Investigation Commission.

He then did not notice anything abnormal in the transcript.

- during the afternoon, possibly soon in the afternoon, the Controller on duty from 10.55 Z reported to him that he did not recall exactly if the Viscount had acknowledged his instruction to switch on London Awys.

He considered that as a request to go and listen to the play-back. He authorized the Controller to go to the play-back room, together with a technician to listen to the recording.

From his point of view, it is not possible to envisage that a team including a technician may change anything to the recording , either by an addition or by a subtraction.

He thinks that the Controller, even if remaining some time alone in the play-back room, should not have the technical capacity to make any change.

In addition the procedures were very strict.

The involvement of the Senior ATC officer cannot be considered , since his personal characteristics (he was educated in the Air Corps) and since the enormous risk this should imply in front of his subordinate.

From the witness' point of view, duplication of a tape record can be made in Shannon premise, but not any change on the original record.

b) Controller's statements

The witness was on duty, at the desk, from 8.30 Z to 10.55 Z. He then went out for lunch . He came back 50 to 60 mn later, for another period at the desk. He left the OPS room around 15.15 Z.

When at the desk, he controlled EI-AOM from 10.39 Z, (his first contact with Shannon) to 10.55 Z.

Since he knew personally the 1st officer of EI-AOM, Mr Heffermann, he is of the opinion that the Capt'n was operating the R/T.

10.39.⁴⁵ Z : “By Youghal” – The witness considers it was a clear message .

10.40.⁰⁰ Z : Acknowledge of the direct routing to Strumble : unreadable ; but the repetition was clear (his opinion is that the Capt'n, at the first answer, had his microphone too far from his mouth).

10.41.⁰⁰ Z : “Passing FL 90” – Clear

10.51.⁴⁸ Z : “level at 170” – slightly weak, but readable

At 10.55 Z , the witness left the OPS room.

After the witness left the OPS room at 15.15 Z, he went into the special room where the play-back equipment was installed; that room was locked ; the equipment also.

No one had the right to enter alone into the room. The junior officers were not authorized to penetrate, even for maintenance purpose.

Usually, when a controller had, for professional purpose, to listen to a play-back record, he was accompanied by either another controller, or a supervisor, or a technician (detached from the Post Office Service).

In the present case, the witness does not remember who was accompanying him when he heard the original tape.

He heard the tape between 15.30 and 16.00 Z. He focused his attention on that part of the record corresponding to his time on duty, but he heard the complete tape. He does not remember of anything abnormal.

He did not know how long a single tape could record : in his opinion, it was 24 hours. And the change of the tape could take place near to noon, or very soon in the afternoon. He does not remember when exactly the tape was replaced on that Sunday.

There was another tape for the recording of the phone conversations with London, presumably with the same characteristics.

According to the rule, he did not contribute in the generation of the transcript. He read it only two years later, when the accident report was published and the annex related to the radio-comms forwarded to ATC Shannon.

At that time, he observed that there were two errors in the report : Shannon (and not Cork) gave the authorisation “Direct to Strumble”, and the Viscount acknowledged (when it was stated in the report that it did not). These remarks were not transmitted to the Head of the Investigation Team since they were considered by the Senior ATC Officer of minor importance.

Summary of the ATC witnesses' statements

From their recalls, they did not notice anything abnormal in the execution of the procedures on that day, neither by themselves, nor by their fellows on duty. None of them contributed, in accordance with the procedures, to the writing of the transcript of the radio-comms ; when they reread it, they did not identify anything abnormal.

- c) These statements of ATC members may be usefully complemented by those of one of the major responsible members of the 1968 Investigation Commission, who stated that :

- > The estimated position at 58 was derived from the messages read on the Shannon R/T transcript.
- > The Investigation Commission was concerned for long by a “1½ minutes early at Bannow, ...but taking into account the accurate position was indeterminate since the transfer to ATC London depended on the traffic at any particular moment”.
- > Since the estimated position at 58, all statements provided by witnesses located West of Waterford were ignored, and considered not relevant to the Viscount but to the Search airplanes in the afternoon.
- > He listened by himself to the tape recording of the Shannon R/T on the Wednesday or Thursday following the Sunday of the accident. He listened to that tape at the occasion of a visit that the Commission paid to Shannon ATC.

“The tape I heard was readable because I had a copy of the transcript made by ATC experts. The footnote ‘RT transmissions from EI 712 were generally very poor’ referred to is put on every transcript I ever saw. It is the same as ‘Errors and omissions excepted’ .”

- > The Institute of Research and Standards made a loop to determine the altitude (5000 or 12000 feet). They made a copy of this loop (connecting the first minutes of the London AWYS comms recording to the last few minutes of the Shannon tape). This was sent to the USA (for further acoustic research).
- > The tape(s) on which were recorded the Shannon ATC R/T with EI-AOM have been re-used by the ATC around the years 1976, after the authorization had been given to the ATC by Dublin ATS.

5.4.4.4 Analysis

The period of time to be analysed for a better appreciation of the 1968 Shannon ATC procedures, spread from 10.32 Z, take-off time, to 11.25 Z “Full alert on Flight”.

The first step in the analysis is to comment the Shannon R/T transcript and the Shannon-London telephone line transcript.

5.4.4.4.1 R/T Transcript (all Z times)

The R/T on Shannon frequency was preceded by the last communications with Cork.

▪ At 10.38

(Cork time) : EI 712	712, out of FL70
Cork	Roger, 712 clear in course
	Change to Shannon 127,5
EI 712	Cheerio

Comment : the average climb rate from take-off is 1150 Feet/mn

- At 10.39.⁴⁵ : EI 712 Good morning
- | | | |
|----------------|---------|--|
| (Shannon time) | Shannon | Good morning |
| | EI 712 | By Youghal passing through 75 climbing
to 170 Tuskar 57 |

Comments :

1. According to the SATCO (refer Appendix 5.4h), following a question asked in the course of the Investigation (October 13, 1969), the exact time on the recorder was 54 sec later. Consequently 10.39.⁴⁵ should read 10.40.³⁹ (comment valid for the whole transcript).
2. Between 10.38 (Cork time) and 10.39.⁴⁵ (Shannon time) which means either 1mn, 45 sec or 2 mn 39 sec (exact time at Shannon), the Viscount climbed 500 feet. A discontinuity appears in the climb rate, which shows a “timing” problem.

- At 10.40.⁰⁰ : Shannon: 712, if you wish, you may route direct to Strumble
- | | |
|-----------|--|
| EI 712 : | (unreadable) |
| Shannon : | Your transmission is fairly unreadable here. Confirm you are accepting a direct routing to Strumble. |

EI 712 : Affirmative, estimating Strumble at 03.

Shannon : Roger, call cruising.

Comments :

1. Everything said after the proposal “you may route direct to Strumble” is not transcribed in an “aide-mémoire” which was presumably used by the Investigation Commission since this document is in their files.
2. It is possible that the error which is introduced in the accident report, stating that there was no acknowledgment by EI 712 is in relation with the existence of this “aide-mémoire”. However, the certified transcript is dated 25 March, 1968.
3. The ATC on duty considers that the “unreadable” answer of EI 712 could be due to a wrong position of the microphone near the mouth of the Captain. According to the same, what was said just before and just after was clear.
4. The estimate Strumble at 03 comes after an unreadable message and a message giving the estimate to Tuskar at 57. An estimate direct Strumble at 03 is approximately 4 mn sooner than the estimate via Tuskar, when it should not be, in the usual conditions, sooner than 1 mn.

A discontinuity appears in the estimates, between 10.39.⁴⁵ and 10.40.⁰⁰.

- At 10.41.²⁰ :
Shannon : your present level
EI 712 : passing 90
Shannon : arrange your climb to cross the boundary at 170
EI 712 : unreadable

- The transcript, then, shows messages with GAPMC and EI 112.

EI 112 leaves Shannon frequency at 10.43.¹⁵.

GAPMC leaves Shannon frequency at 10.47.⁰⁰.

- From 10.47.⁰⁰ : EI 712 is the only flight controlled by Shannon.

Comments :

1. Shannon asks for the present flight level of EI 712 at 10.41.²⁰, 1 mn 30 sec after having been informed that EI 712 was crossing FL 75, climbing.

Shannon does not include the flight identification in his call, when 2 other flights were listening on his frequency.

It may be questioned how, 1 mn after the last exchange, EI 712 knew that the question was to him , if he was not the only flight under Shannon control.

2. Between 10.39.⁴⁵ and 10.41.²⁰, EI 712 climbed 1500 feet; the average climb rate is 1000 feet/mn.
3. The second unreadable message is not followed, as for the first one, by a request of acknowledgment.
4. Two messages being considered “clear” by the controller are preceded and followed by 2 “unreadable messages”. No further unreadable messages were transcribed.

- At 10.51.⁴⁸ : EI 712 : level at 170
 Shannon : report at Bannow

Comments :

1. The origin of the call from EI 712 is not identified, but, at that time EI 712 was the only flight controlled by Shannon. In addition, the controller stated that he could identify the voice of the Captain, since the transmission was good.
 2. The average climb rates are as follows :

from 0 to FL 170 : 850 feet /mn

from FL 90to FL 170 : 760 feet/mn.
- The Controller on duty changed at 10.55 .

- At 10.57.⁰⁷ : EI 712 : 712, by Bannow, level 170, estimating
Strumble at 03
- Shannon : Say again the time “by Bannow” I got the
Strumble estimate OK
- EI 712 : 57
- Shannon : OK Time 56½; change now to London
Airways 131,2
- EI 712 : 131,2.

Comments :

1. The Controller on duty reacts to the time observed when passing “by Bannow” whereas he does not react to the estimate Strumble at 03.

Between the theoretical position of “By Bannow” and Strumble, the distance is 44 nautical miles; an estimate Strumble at 11.03 implies a ground speed by 440 kts, which is, by far, impossible.

But the Controller reacts to an inaccuracy of 30 sec on a past event !

It is to be observed that the estimate Strumble was of major importance for London ATC, who had in charge to manage at the best the introduction of the EI 712 flight in the Heathrow traffic.

2. The correction made by the Controller on duty with respect to the timing at “By Bannow” is considered by the still alive witnesses in line with his psychological characteristics.

Taking these characteristics into account, the estimate Strumble confirms the discontinuity observed at 10.40.⁰⁰.

3. The exact time on the recorder when the ATCO said 56½ was 10.57.½ (refer document in Appendix 5.4h).

- The transcript stops at 10.57.²⁹; this prevents of any analysis of what was radioed later on that frequency. Was there any garbled, or unreadable EI 712 emission around 10.58 ? When were emitted further calls to EI 712 ?

5.4.4.4.2 Shannon London Telephone Line Transcript (all Z times)

- At 10.36.⁰⁰: Shannon : 712 is FL 170 and it is Strumble at 11.07
London : OK

Comments :

The estimate Strumble at 07 is consistent with the flight plan filed up by the copilot.

- At 10.38.²⁰: Shannon : Have you any objections to the Irish 712 routing direct from Cork to Strumble ?

10.39 London : None at all.

Comments :

This request to London is made just before EI 712 switches on Shannon frequency, at 10.39.⁴⁵

Acceptance from London cleared direct routing proposed to EI 712 at 10.40.

- Between 39 and 43, exchange of information on Flight Speedbird 501.

- At 10.43.⁰⁰ : Shannon : A revision on Aer Lingus 712. It is estimating Strumble at 11.03 and is routing Cork direct to Strumble ...

 London : OK

- Exchange of information on flight EI 362.

10.44 : Shannon : Aer Lingus 712 is routing direct to Strumble. Is
that OK ?

London : Yes that's all right.

Comments :

- An estimate direct Strumble at 03 should be consistent with a take-off Cork at 10.27.
- The Shannon transcript stops at 10.44; this prevents of any analysis of what has been exchanged between Shannon and London controllers on duty, which could allow to cross-check the various logs of actions and reports made by each of the concerned personnel.
- This is of interest in particular for the period just after minute 58, when the London Controller informed and questioned his Shannon partner about the distress message.
- The London transcript has been requested from the London ATC through the AAIB; but the quest was unsuccessful.

5.4.4.5 Assessment

A valuable assessment should need some complementary information which is not available at the present day .

The unavailability of the original tapes is of importance.

The duration of the two Shannon radio and telephone transmission transcripts should have covered up to 11.25, when the “full alert” was declared.

A valuable information could refer to the conditions under which were executed the previous EI 712 flights between Cork and Heathrow.

5.4.4.6 Conclusion of the critical Analysis of the Shannon R/T Transcript

- Since there are on one hand about 50 independent witnesses,
- since each of their statements is consistent with the other ones, and allows for a complete track reconstruction and for a technically logical description of the degradation process of EI-AOM,
- since there is on the other side, the transcript of two messages which were exchanged on the Shannon ATC frequency during a period of time when EI-AOM was the only flight under their control,
- since several questions are still pending, and cannot be answered , unfortunately,.

the opinion of the Intern'l Team is that the weak side of the inconsistency is that of Shannon ATC. But this opinion cannot be evidenced.

This opinion gives some light on the reasons why the 1968 Investigation Commission could not conclude their accident report.

Neither this opinion, nor the final truth, if it can be obtained at a time, has a direct impact on the accident process, from the initial event to the Search and Rescue activities.

5.5 CONCLUSIONS OF THE OPERATIONAL ANALYSIS

5.5 CONCLUSIONS OF THE OPERATIONAL ANALYSIS

5.5.1 The 1970 Report concluded that :

- if EI-AOM was, at 10.58, at a position near to the one according to the flight plan, in accordance with the radio-comms transcripts,
- if EI-AOM crashed at Tuskar Rock between 11.10 and 11.15, as it results from the statements of two witnesses considered as reliable,
- then the air mobile which was sighted over Fethard, coming from a North West direction at low altitude could not be the Viscount,
- as a consequence, it had to be another one, which could have collided with EI-AOM before it was sighted over Fethard.

5.5.2 The first check was to assess on the internal consistency of such a suggested scenario :

- was a collision by an unmanned aircraft possible ?
- could the colliding air mobile be the one which was observed over Fethard ?

Taking into account the location of the UK ground bases and the performance characteristics of the 1968 air-to-air and surface/ship-to-air missiles, it can be stated without ambiguity or restriction that :

- it is possible that a collision or a near collision occurred,
- it is impossible that the colliding missile or drone be the air-mobile sighted over Fethard.

This scenario presents a fundamental inherent inconsistency, and cannot be an acceptable explanation of the accident.

5.5.3 The second step was to assess on a possible collision with a manned aircraft.

In this respect, several possible occurrences of mid-air collisions with a manned aircraft have been presented, most of them based on partial realistic observations. Their weakness comes from the fact that they have to ignore several other observations which should have made the story inconsistent if they had not been ignored.

When complete scenarios are implemented, their probability of occurrence is to be assessed against the complete set of observations made from the ground, the technical and operational considerations to be fulfilled for a collision to occur, and the technical and operational considerations which cannot be ignored after the occurrence of a mid-air collision.

On that day, **none of the eventual collisions with a manned aircraft**, reported to the team, **could be successfully assessed against the witnesses' observations, and the relevant technical and operational considerations.**

5.5.4 Since the “mid-air collision” scenarios could not describe a fully consistent accident sequence, it was time to question the assumptions on which it was based :

- the first assumption questioned was the time of the crash, and the questioning was due to the fact that there were no obvious technical reasons allowing for a partial recovery,

- **this scenario is internally consistent, but** it is not technically or operationally evidenced. In addition, **it ignores all the statements made by several witnesses.**

5.5.5 The last point to be checked was to question the position of the Viscount at 10.58, which means to question **the validity of the transcripts** on which is based this estimated position.

The real position of the Viscount at 10.58 may be different from the one estimated from the contents of the transcript for two reasons :

- either the position of the ac was irregularly reported by the Flight crew in the two last messages received by Shannon ATC
- or the transcript of the two last recorded messages was irregularly produced by the ATC officers.

5.5.6 Although an irregular deviation from the flight plan is possible, since, in particular, the radar coverage was not positive, at low altitude, in the area of Waterford, **a detailed assessment drives to the conclusion that such a scenario is of a very remote possibility.**

5.5.7 Consequently the scenario “as per witnesses/disabled flight” is the ONE which fits with all the ground witnesses statements, and which describes in an acceptable operational and technical way the degradation process of the Viscount.

Its reliability comes from the number of independent statements which fit one to the other; its reliability cannot come from evidence, since, at the present stage, no pieces of material evidence are available.

5.5.8 The last two messages transcribed from the Shannon R/T comms **cannot fit** in that scenario, **but the real existence or not existence of these two messages has no consequence in the Viscount accident sequence.**

In 1968, a track reconstruction based on these messages has driven the Investigation Commission to a non-conclusive report.

Now the questioning of these two messages allows for a unique and consistent explanation of what was observed from the ground.

6. CONCLUSIONS OF THE STUDY

The International Team (IT) reached the following conclusions :

6.0 : Historical background

6.0.1 The formal accident report (AAP) N° 6 issued on 30 June 1970 was deficient in that insufficient effort was made to thoroughly reconstruct the track of the aircraft and that pertinent material was excluded.

6.0.2 The Review Report issued in June 2000 is a thorough, impartial and professional review of files pertaining to the accident. It clarified many issues and uncovered significant new material.

6.0.3 The data still available today, on which to base a study, are as follows .:

- All requested accident reports from other Viscount accidents obtained from the respective national AIUs.
- Partial files of AOM accident investigation
- Partial technical data of the Viscount aircraft.
- Partial operational data.of the Viscount.

No Aer Lingus maintenance record and no material part of the EI-AOM were provided for examination but several witnesses' statements, either delivered in 1968 or later, were available.

Consequently, the present study cannot lead to the issuance of an ICAO type accident report. In accordance with the mission letter, this study is aimed at shedding further light on the circumstances surrounding the accident to Air Lingus Vickers Viscount 803 EI-AOM.

6.1 : With respect to the presence of another air mobile :

6.1.1 The 1970 accident report AAP N° 6 was inconclusive and although no cause was found, the suggestion was made in the report that the presence of another aircraft in the area was inescapable.

As a consequence, several “Theories” attempted to provide consistent answers, such as :

- Collision or near collision with a missile,
- Collision or near collision with a drone,
- Collision with a manned aircraft.

And some others, including “conspiracy” theories, which are still alive

6.1.2 An analysis based on the technical and operational characteristics of the British missiles and drones operated in 1968, shows a collision between such air mobiles launched from the U.K ranges or ships and the Irish Viscount, in the vicinity of Tuskar Rock, was technically possible but it is impossible that, after the collision, this unmanned aircraft be seen over Fethard, in the conditions reported by the witnesses.

The analysis of the scenario based on a collision with a manned aircraft shows that, although such a scenario is operationally possible, it does not fit in with the statements of witnesses. And there is no aircraft which could have crashed on that day.

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The scenario based on the assumption that AOM never recovered from its initial loss of control ignores the statements of all the witnesses and is lacking substantiation.

The International Team have carefully examined all aspects of the tests conducted in the U.K ranges and of the sea and air activities performed on that Sunday. It is their opinion that all theories involving the presence of another aircraft can be rejected.

6.2 : With respect to the Flight reconstruction :

6.2.1 All ways explored being “dead ends”, the only one remaining was to question the basis on which the 1968 investigation was built.

This basis, used for the AOM Flight reconstruction, was the radio-comms transcript of Shannon ATC.

6.2.2 Following the statements of the witnesses, who answered the “call for witnesses” emitted at the end of the year 2000, and taking into account the statements received in 1968, which were discounted at the time, since they could not fit with the flight construction based on the R/T transcripts, it was possible to reconstruct the following EI-AOM accident process.

- First loss of control over Old Parish between 11.42 and 11.44 (local time)
- Disabled flight from Old Parish to Tramore Bay, Brownstown Head, Tory Hill and Kennedy Arboretum
- Second loss of control over Kennedy Arboretum at 11.58 , and emission of the distress message on London Airways control frequency
- Disabled flight around Slievecoiltra Hill, over Ballykally, Fethard, Saltees Islands , the Barrels
- Crash at Tuskar Rock.at approximately 12.15 .

The aircraft degradation process lasted for around 30 minutes and included the separation of an object, possibly the port elevator or part of it , East of Fethard , and probably the separation of the port tailplane over the Barrels.

It is to be noted that the above description is based on the statements of 46 witnesses, 24 of them being eye witnesses, and 8 of them having identified a green and silver coloured Viscount. The statements given in March/April 68 were laid with the Gardai.

As a consequence of the number of eye-witnesses, the opinion of the International Team is that the Flight track reconstruction is essentially as described in § 6.2.2, and not as described in the 1970 accident report.

6.2.3 : The content of the last two messages radioed on the ATC Shannon frequency reporting “ levelling at FL 170” and “ By Bannow, flight level 170”, cannot fit with that flight reconstruction.

6.2.4 A possible assumption has been to consider that the crew irregularly reported the aircraft position in each of these two messages. However, a detailed assessment drives to the conclusion that this deviation out of the IFR flight plan is an hypothesis which is extremely unlikely.

6.2.5 Consequently, the inconsistency between the track reconstruction and the R/T Shannon transcript can be solved only if it is possible to identify the cause of an error in the transcript of the R/T communications issued by Shannon ATC.

The data available today, and the interviews of the two still alive witnesses do not allow for such an identification.

However some observations may be significant :

- The original tapes are not available : either they have been lost when the holder Service moved, or they have been re-used by Shannon ATC (in the seventies) with the authorisation of hierarchical Authorities.
- The extracts of the tapes, transcribed as relevant by Shannon ATC do not cover the complete period to be analysed.
- There is no exhaustive detailed chronological reports of the controllers and of the supervisor acting at the time of the accident.
- A detailed analysis of the contents of the messages indicates some discontinuities in the flight parameters, or some atypical reactions either from the acting Controller, or from the Captain (e.g: ETA Strumble).

Consequently, the opinion of the International Team is that the procedures which were applied in ATC Shannon at the time of the accident were either not well adapted (in particular for specific period of a transition between routine and emergency), or not carefully applied.

6.2.6 : However, it is of importance to note that a dysfunctionning in Shannon ATC, if any occurred, did not have any detrimental consequence on the cause of the accident, nor on the degradation process of the Viscount.

6.3 : With respect to the cause of the accident :

6.3.1 The method for identifying the probable cause of the AOM accident could not be based on the observation of the material parts of the wreckage, which were not available.

As a consequence, the International Team took advantage of the lessons learned from events in the whole life of the Viscount and certain other aircraft types, and compared to the AOM accident, those accidents which showed a similar loss of control, followed by some period of disabled flight.

6.3.2 This comparison concludes that the initial events causing a degradation process of the aircraft similar to the one suffered by EI-AOM could be :

- Door strike
- Bird strike
- Spigot rupture in the spring tab mechanism
- Structure failure
- Severe recovering manoeuvres,

alone , or in conjunction one with the other (s).

6.3.3 The technical investigation carried out as part of the initial investigation and presented as appendix material to the 1970 report was thorough and shows the enormous amount of dedicated work which went into the search, salvage and engineering investigation of the accident. Nevertheless it must be noted that with the exception of the fin, portion of the rudder and portions of two elevator tabs, nothing was recovered aft of the rear pressure bulkhead. The tailplanes, elevators and fuselage structure in the tailcone area were all missing.

6.3.4 Since the Investigation Commission accepted the position of the manufacturers which was not to open discussion on the matters related to the non-recovered parts, no conclusions on what could have happened to the empennage were established.

6.3.5 No maintenance documentation specific to the actual aircraft, was made available to the International Team.

There is no reason that the International Team contest the 2000 Review conclusions :

- There is no evidence to suggest that any omission or error in the Inspection Visit 2.04 of the previous 1967 December contributed in any way to the accident.
- But serious errors in Aer Lingus maintenance scheduling may be indicative of a less than ideal work culture existing in the airline at that time.

6.3.6 The present technical analysis, which accepted that there was impairment of the pitch control and lack of lateral stability of the aircraft, resulted in the identification of the need to consider as possible causal factors, the following events :

- Door strike
- Bird strike
- Metal corrosion
- Maintenance error
- Metal fatigue
- Flutter

which could have damaged or affected the following components :

- Tailplane
- Elevator, including tabs
- Systems : pitch control

6.3.7 Operational considerations made possible to “narrow the field” of the possible assumptions.

A door strike or a failure of the main structure of the aircraft could be discounted as an initial triggering factor of the EI-AOM upset.

A review of the aircraft in-service experience, and, in particular, a number of defects and accidents which occurred posterior to that of EI-AOM, lead to the International Team’s opinion as follows :

- **An initial event, which cannot be clearly identified , is considered to be some form of distress affecting the horizontal tail of the aircraft. Possible causal factors are metal fatigue, corrosion, flutter or a bird strike.**
- **It is possible that the sensitivity to negative accelerations of the engine fuel control unit and oil pressure supply to torquemeter system were contributory factors.**
- **The recovering manoeuvres of the aircraft following the initial upset and the subsequent flight would have been outside the airworthiness certification envelope and may have resulted in some deformation of the structure.**
- **A progressive failure of the structure of the port tail plane and elevator is consistent with the observations relating to the ultimate attitudes of the aircraft.**

Excessive spring tab free play resulting in the fatigue failure of a component in the tab operating mechanism could have induced a tailplane-elevator tab free flutter condition.

The consequence of a 6hz tab free induced elevator/tailplane flutter, according to the manufacturer, would be the generation of large elevator and tailplane forces capable of exciting the fuselage, thus producing severe vibrations.

The loads induced in the tail-plane would be sufficient to cause a structural fatigue failure within the time scale observed for EI-AOM.

6.3.8 :There was no involvement of any other aircraft or missile.

6.4 : With respect to the crew behaviour:

6.4.1 : Several witnesses statements support the opinion that the Viscount EI-AOM left the track planned in the Flight Plan.

6.4.2 : From the available data, it may be concluded that this deviation from the Flight Plan was most unlikely to have been due to a deliberate decision of the Captain.

6.4.3 The observed aircraft attitudes, with sudden and rough variations of the flight and engines parameters led to the opinion that the impairment of the stability of the aircraft was the cause of such exceptional movements for a transport aircraft.

6.4.4 The crew had to face a situation when, after the first upset, the aircraft was out of its certification envelope.

Extremely high control forces, possibly reaching as high as 450 pounds, had to be manually countered. The crew probably used the pitching effect of the engine power to stabilize the aircraft in pitch.

The tail, probably asymmetric from suffering damage may have affected the stability of the Viscount.

The very poor manoeuvrability of the Viscount during the degradation process explains why the crew could not come back to Cork, nor land or ditch on the large strands they know along the coast.

It is the International Team's opinion that it was a major achievement for the crew to be able to keep this aircraft flying for more than half an hour, with such poor manoeuvrability characteristics. This showed remarkable intrinsic and professional level of experience : It is equitable to acknowledge such a performance.

6.5 : Final comments :

6.5.1 : It is the International Team's opinion that the track reconstruction can be considered of factual nature, since it is substantiated by the consistent statements of so many witnesses, whilst the cause and the causal factors of the initial event and the description of the degradation process of the aircraft are of conjectural nature, since there is no longer available any piece of evidence.

6.5.2 The quest of further objective technical data appears to be an lengthy (and possibly unsuccessful) process, and, very costly in the present conditions.. For information, an estimate from BAe to the very first Request For Quotation is given in Appendix 6.a.

6.5.3 The Maintenance Files are no longer available in the Aer Lingus or in the Irish CAA archives.

6.5.4 The last 25 mn flight of AOM and AOF aircraft show noticeable similarities.

A further examination of the EI-AOF accident files may be of interest.

As a conclusion, the International Team is of the opinion that the files of the EI-AOM accident should be closed.