AIR ACCIDENT INVESTIGATION UNIT

THIS IS A REFORMATTED VERSION OF
THE ORIGINAL REPORT ON
ACCIDENT TO
VISCOUNT 803 AIRCRAFT EI-AOM
NEAR TUSKAR ROCK, CO. WEXFORD
ON 24th MARCH, 1968

REPORT ON AN INVESTIGATION
MADE UNDER REGULATION 7 OF THE
AIR NAVIGATION (INVESTIGATION OF ACCIDENTS)
REGULATIONS, 1957 (S.I. No. 19 of 1957)

The Report into this accident was originally published in 1970. Due to continued public interest in this accident, the Report is republished on the Department of Public Enterprise web-site.

In order to publish the Report on a web-site, it has been necessary to electronically re-format the Report. The effect of this re-formatting has been to increase the print size, and to re-organise the pagination of the Report. No editorial changes have been made to the contents of the Report.

The attachment to the Report, a map of the general area of the accident, was originally published in approximately A2 size. To facilitate the reader, this version of the Report contains this map in two formats.

The first format is the map reduced to a single A4 size, so that the complete map can be viewed. This, however, results in some loss of detail.

The second format consists of the map split into three pages, each to original size, which can be used to produce a full size mosaic of the original.

The Appendices to the Report were not included in the original published report, but were available to be inspected at the Offices of Transport and Power, as noted in the last page of the Report.

The originals appendices were produced on manual typewriters, with manual drawings and black and white photographs. These originals have been re-mastered into electronic format, and are now available as a separate report on this web site.

DEPARTMENT OF TRANSPORT AND POWER

A.A.P. No. 6

ACCIDENT TO
VISCOUNT 803 AIRCRAFT EI-AOM
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Map showing the general area of the accident and locations of witnesses to whom reference is made in the Report.

ACCIDENT TO VISCOUNT 803 EI-AOM
NEAR TUSKAR ROCK, COUNTY WEXFORD,
IRELAND ON 24 MARCH 1968.

1. INVESTIGATION

1.1 History of the flight

Aircraft: Viscount type 803. Registration: EI-AOM.

Owner: Aer Lingus Teoranta.

Operator: Aer Lingus-Irish International Airlines.

Crew:
Commander: Captain Bernard O'Beirne.
Co-Pilot: First Officer Paul K. Heffernan.
Air Hostess: Miss Anne Kelly.
Air Hostess: Miss Mary M. Coughlan.
Passengers: 57
All fatally injured.

Place of Accident: 1.7 nautical miles from Tuskar Rock with Tuskar bearing 280º.

Depth: 39 fathoms (234 feet).

Date and time: 24 March 1968, at approximately 11.10 hours.

Note: All times are G.M.T. except where otherwise mentioned.

Viscount aeroplane type 803, registration: EI-AOM departed from Cork Airport at 10.32 hours en route for London operating as Aer Lingus Flight 712. The take-off was normal. The flight was cleared by Air Traffic Control to proceed via Airways Blue 10, Green 1 at flight level 170 (17,000'). At 10.38, when the aeroplane had passed through 7,000', clearance on course to Tuskar was given. At 10.40, after the flight had reported it was by Youghal at 7,500' climbing to 17,000', ATC Cork suggested that if desired, the flight could route direct to Strumble. No direct acceptance of this suggestion was received. At 10.57.07 the flight reported "by Bannow (a reporting point on the route at 51º 68' N - 06º 12' W) level 170 (17,000') estimating Strumble at 03". The flight was instructed to change to the London Airways frequency of 131.2, and this was acknowledged by the reply "131.2". The time of this call was 10.57.29.

At 10.58.02, London Radar intercepted a call (garbled and simultaneous with another call) which appeared to be, and was later confirmed as "Echo India Alpha Oscar Mike with you", and eight (8) seconds later, a call was intercepted which was interpreted as "Five thousand feet descending spinning rapidly". This call was also heard by another Aer Lingus aircraft en route Dublin-Bristol (The word "Five" was later, after repeated acoustic analysis, interpreted as more likely to be the word "twelve".) This was the last call received from the aircraft. At 11.10, London ATC advised Shannon ATC that they had no radio contact with EI-AOM. At 11.13 London advised Shannon that they had requested Aer Lingus Flight EI 362 (Dublin-Bristol) to search west of Strumble. This flight descended to 500' in good visibility, but saw nothing.

Between 11.13 and 11.25, efforts were made to make radio contact with the flight, with no result, and at 11.25 a full alert was declared. At 12.36 a report from the U.K. was received by Haulbowline that wreckage had been sighted in position 51º 57' N, 06º 10' W Rosslare Lifeboat was proceeding, but two surface vessels within 4 nautical miles of this position saw nothing.

At 12.52 hours the Air Corps reported that they had dispatched a Dove aeroplane and a helicopter to search. At 13.10 hours there were ten aircraft from the U.K. in the search area. At 15.30 hours the reported sighting of wreckage was cancelled. Nothing positive was discovered on this day. On 25 March 1968, at 06.15 hours, the search was resumed by aircraft and ships from the U.K., and at 12.41 hours, wreckage was sighted and bodies recovered from a position 6 nautical miles north-east of Tuskar Rock. More floating wreckage was reported scattered for a further 6 nautical miles north-west of this point. The Irish Naval Service ship, L.E. Macha, which had been on patrol off the north-west coast, joined in the search on 26 March 1968, and took over duty as Search Controller.

A total of 13 bodies was eventually recovered in the search during the next few days, together with a quantity of light floating wreckage-mostly cabin furnishings, and some baggage, seat cushions, and the wheels and inner cylinder from the port main landing gear. One additional body was recovered later.

The position of the main wreckage remained obscure in spite of prolonged and diligent search by sonar equipped ships of the British Navy and trawling by Irish trawlers-"Glendalough" from Kilmore Quay and "Cu na Mara" of the Irish Fisheries Board (An Bord Iascaigh Mhara).

Eventually, on 5 June 1968 "Glendalough" hauled in position 1.72 nautical miles from Tuskar Rock with Tuskar bearing 280º, in 39 fathoms and brought up a quantity of positively identifiable wreckage. The "Cu na Mara" in the same location also brought up wreckage. On the following day more wreckage was brought up by these trawlers, and divers from H.M.S. Reclaim confirmed a mass of wreckage "like a scrap yard" in this position. Subsequent salvage operations confirmed that a major portion of the aircraft at least was located here. Two eye witnesses, one a sailor on a coastal vessel, who thought he had seen an aircraft crash into the sea but did not report it at the time, and another witness on shore, who saw a splash in the sea near the Tuskar Rock, gave the time as between 11.10 and 11.15. The position lines of these two witnesses approximately cross the location where the main wreckage was eventually found.

1.2. Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	4	57	-
Non-Fatal	-	-	-
None	-	-	-

1.3. Damage to aircraft

The aircraft was totally demolished by violent impact with the sea. The bulk of the wreckage was found in 39 fathoms of water with all parts lying in close proximity.

About 60-65% of the aircraft (by weight) was recovered, and included the major parts of three engines, a few parts of the fourth, and all four propellers, the almost complete primary structure of the wings from tip to tip, and the fin and rudder.

None of the wreckage displayed any evidence of fire or explosion. No part of the tail planes or elevators were recovered, with the exception of small portions of the spring tab and trim tab.

The recovered wreckage revealed extensive damage to the whole structure, which virtually disintegrated.

1.4. Other damage

There is no evidence of other damage.

1.5. Flight crew information

Captain: Bernard O'Beirne. Born 11 March 1933.

Captain O'Beirne was aged 35 years. He served in the Air Corps from March 1953 to March 1956. He joined Aer Lingus in March 1956. He completed technical courses on the following aircraft-D.C.3, F.27, Viscount, Boeing 720-048 and 707. His total flying time was 6,683 hrs. of which 1,679 were on Viscounts.

He held a valid Airline Transport Pilots Licence (No 126) endorsed for command on Viscount aircraft. He had been medically examined and passed fit on 2 January 1968. He also held a Flight Navigators licence (No. 8) issued to him on 13 October 1961.

First Officer: Mr. Paul Heffernan. Born 23 October 1945.

Mr. Heffernan was aged 22 years. He did his flying training with Airwork Services Training at Perth, 1965. He joined Aer Lingus in 1966 as a second officer-he held a British Commercial Pilots licence. He successfully completed his conversion course and passed the technical examination for Viscounts. He was issued with an Irish Commercial Pilots licence with Viscount endorsement and instrument rating on 9 June 1966.

His total flying time was 1,139 hours of which 900 was on Viscounts. In March 1968, Mr. Heffernan was informed that he had been successful in the technical examination for the grant of a Senior Commercial Pilots Licence. He advised the Department of Transport and Power that he would call for this licence some time during the week commencing March 25. He was rostered away from his normal base of operations, Dublin Airport, for the week ending March 24.

Flight Times

Four Months Preceding the Accident

	Captain O'Beirne	Mr. Heffernan
December	32.1 hrs.	21.15 hrs.
January	8.4 hrs.	21.55 hrs.
February	21.85 hrs.	38.35 hrs.
March	38.2 hrs.	32.2 hrs.
Total	100.55 hrs.	113.25 hrs.

Duties from Wednesday, 20 March-CREW BASED AT CORK

		Duty From	Time To	Flight Time
20 March, Wednesday Flt 702	From Dublin	14.00	15.45	0.35 overnight
21st March, Thursday Flt 710/713	To London	09.00	13.40	3.25 overnight
22 March, Friday Flt 710/713 760/761	To London To Birmingham	09.00	18.40	6.20 overnight
23 March, Saturday Flt 710/713 720/721	To London To Shannon (Diversion) To Manchester	09.00	18.40	6.15 overnight
24 March, Sunday Flt 712	To London	10.00		

1.6. Aircraft information

Registration: EI-AOM.

Aircraft Type and Serial Number: Viscount 803, Serial No. 178. Built by Vickers Armstrong (Aircraft) Ltd. for KLM (Royal Dutch Airlines).

Certified as approved for issue of Certificate of Airworthiness on 25 October 1957. The aircraft was registered as PH-VIG.

Purchased from KLM by Aer Lingus on 2 November 1966. Flown to Prestwick Airport on 3 November 1966 for overhaul and conversion per Aer Lingus Specification EAD/239/KLM Issue 8, sections 1, 2, 3, 4 and 5, and Routine Maintenance and Check 4 per approved Aer Lingus Maintenance Schedule Serial No. 1/C 32 and Operating Plan, by Scottish Aviation Ltd.

Performance Test Flight, Aircraft Weighing, and Compass Swing carried out by Scottish Aviation Ltd.

The aircraft was certified on completion of work by Scottish Aviation Ltd. on 14 February 1967.

The aircraft went into service with Aer Lingus on 18 February 1967.

CERTIFICATE OF REGISTRATION

The aircraft was cancelled from the Dutch Register on 25 November 1966. Registered on the Irish Register as EI-AOM and Certificate of Registration No. 396 issued on 29 November 1966.

CERTIFICATE OF AIRWORTHINESS

Irish Certificate of Airworthiness issued on 14 February 1967, and valid from 14 February 1967 to 13 February 1968. Renewed from 14 February 1968 to 13 February 1969.

MAINTENANCE RELEASE
The aircraft had a current Maintenance Release which had been issued and signed on 8 March 1968 at 06.30 hours, on completion of Inspection Number 5, with a validity period of 350 flying hours or 80 days elapsed time.

	Flying Hours	Landings
Total Aircraft Flying Hours and landings up to 3 November 1966	16,586	14,664
Total Aircraft Flying Hours and landings up to 23 March 1968	18,806.60	16,923
Total Aircraft Flying Hours and landings while in service with Aer Lingus	2,220.60	2,259
Total Aircraft Flying Hours and landings from Last C of A Renewal to 23 March 1968	160.40	185
Total Aircraft Flying Hours and Landings from issue of Last Maintenance Release to 23 March 1968	71.80	91

ENGINES INSTALLED IN AIRCRAFT AS OF 23 MARCH 1968
Manufacturer: Rolls Royce-Ltd.
Type: Dart 510A.

No.1 Engine Serial No. 5195
Total Hours up to 23 March 1968, 15,315.60 hours.
Total Hours since last overhaul up to 23 March 1968, 3,047.60 hours.
Date of last overhaul, 23 May 1966 (Overhauled by Alfa Romeo).
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.2 Engine Serial No. 5217
Total Hours up to 23 March 1968, 14,601.60 hours.
Total Hours since last overhaul up to 23 March 1968, 3,384.60 hours.
Date of last overhaul, 28 January 1966 (Overhauled by Rolls Royce Ltd.).
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.3 Engine Serial No. 5839
Total Hours up to 23 March 1968, 14,635.60 hours.
Total Hours since last overhaul up to 23 March 1968, 355.45 hours.
Date of Last Overhaul, 25 October 1967 (Overhauled by Rolls Royce Ltd.).
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.4 Engine Serial No. 5374
Total Hours up to 23 March 1968, 15,965.80 hours.
Total Hours since last overhaul up to 23 March 1968, 1,676.30 hours.
Date of last overhaul, 13 February 1967 (Overhauled by Rolls Royce Ltd.).
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

PROPELLORS INSTALLED IN AIRCRAFT AS OF 23 MARCH 1968
Manufacturer: Dowty Rotol Ltd.
Type: R 130/4/20/4/12E.

No.1 Propeller Serial No. 130/57/212
Total hours up to 23 March 1968, 14,056 hours.
Total hours since last overhaul up to 23 March 1968, 2,999 hours.
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.2 Propeller Serial No. 130/57/218
Total hours up to 23 March 1968, 16,890 hours.
Total hours since last overhaul up to 23 March 1968, 3,263 hours.
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.3 Propeller Serial No. 130/57/377
Total hours up to 23 March 1968, 15,412 hours.
Total hours since last overhaul up to 23 March 1968, 1,009 hours.
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

No.4 Propeller Serial No. 130/57/287
Total hours up to 23 March 1968, 15,976 hours.
Total hours since last overhaul up to 23 March 1968, 1,560 hours..
Last Certificated Check carried out and date, Inspection No. 5 on 8 March 1968.

The weight and centre of gravity were within limits.

The type of fuel used was Aviation kerosene (JP-1).

1.7. Meteorological information

After-cast for 24 March 1968, of weather conditions from Cork Airport at 10.32 to 17,000 feet over Tuskar Rock at 10.52 approximately and thereafter at 17,000 feet to Strumble at 11.03 hours.

General Situation

The route was covered by a slightly unstable south-southwesterly air flow at all levels. A complex slow eastwards-moving cold front lay 200º-020º from Cornwall to north east Wales at 11.00 hours. The frontal surface was at 17,000 feet approximately over Strumble at this time.

Winds and Temperatures

13,000 feet:-210/50, -18ºC bec. Strumble 210/60, -14ºC
17,000 feet:-210/60, -27ºC bec. Strumble 210/72, -22ºC

Cloud

Cork-Tuskar:
Small amounts Stratus base 1,000 feet, tops 2,000 feet
6/8 Cumulus, Stratocumulus base 1,500 feet, tops 5,000 feet
4/8 Cirrus base 20,000 feet.

Tuskar-Strumble:
3/8 Stratus base 500 feet, tops 1,500 feet
6/8 Altostratus base 12,000 feet, tops 15,000 feet
becoming at Strumble 8/8 Altostratus base 10,000 feet, tops 17,000 feet.
5/8 Cirrocumulus base 20,000 feet.

Turbulence

Severe turbulence very unlikely. Maximum possibility moderate at Strumble at 17,000 feet.

Icing

Severe icing very unlikely.
Maximum possibility light at 17,000 feet at Strumble.
Possibility moderate at lower levels (6,000-13,000 feet) at Strumble.

Thunderstorms

Probability virtually nil.

Note

No aircraft reports of significant weather were received in the Meteorological Service.

1.8. Aids to navigation The following aids to navigation were available:
Cork: VOR
Strumble: VOR
Tuskar: Marine NDB
Dublin VOR was notified by NOTAM to be out of service during the relevant period.
The aircraft was not within radar cover from Dublin and there is no report of its having been observed by any radar station.

1.9. Communications
Communications were exchanged between the aircraft and the Air Traffic Services at Cork and Shannon which were normal except that the transmissions from the aircraft to Shannon were described as very poor. The aircraft had been instructed to change frequency to that of London Airways in order to effect change over of control but did not do so in the normal way. Instead, two signals within eight seconds of each other were intercepted by London Radar, at 10.58.02 and 10.58.10, and these were the two last radio contacts with the aircraft.

1.10. Aerodrome and ground facilities
Not relevant to this accident.

1.11. Flight recorders
Flight Recorders were not carried in this aircraft.

1.12. Wreckage
A considerable amount of debris was found floating on 25 March 1968 in the area north-cast of the Tuskar Rock. It was not until 5 June 1968 that the main wreckage was located by an Irish trawler ("Glendalough" - Skipper W. Bates) and subsequently recovered by divers and salvage vessels of the Royal Navy, and by vessels of the Naval Service and Irish Fisheries Board (BIM). Additional wreckage was recovered by trawling by Skipper W. Bates 18 months after the crash.

The wreckage after visual inspection on recovery was transported by Army vehicles to the headquarters of the Air Corps, Casement Aerodrome, Baldonnel, where the airframe components were assembled in a hangar on a timber frame, as closely as possible in their correct relationship to each other.
The engines and propellers and other components and instruments were, after visual inspection, subjected to strip' examination and test at the various makers works under the supervision of the Department's Inspectors.
A small but significant item of wreckage consisting of a portion of elevator spring tab from the port elevator was picked up on the beach between Rosslare Harbour and Greenore Point, seven miles west of the position of the main wreckage. This item is not capable of flotation. It was entangled in seaweed and was found six months after the accident.

1.13. Fire
No signs of fire were found in any of the recovered wreckage.

1.14. Survival
The accident was not survivable. There was evidence that the pilot and co-pilot had fastened their shoulder harnesses. There was some medical evidence which indicated that some at least of the passengers had their seat belts fastened at the time of the impact into the sea.

1.15. Tests and research
(i) The recovered parts of all four engines and all four propellers were dismantled and examined at the relevant manufacturers works.
Examination of the damaged engines and propellers revealed marked similarity between all four.
The damage was consistent with violent impact with the sea with the propellers turning at low revolutions, all four propellers showing evidence of being on the flight fine pitch stops.
No evidence of any pre-impact defect or damage was found in the engines or propellers.

(ii) An item which warranted particular investigation and test was the pitch datum motor potentiometer from the Smiths SEP 2 Automatic Pilot.
This component, when opened for examination after recovery from the sea-bed, revealed internal damage which it is virtually certain could not have occurred in the accident, but must have been present in the component for some considerable time.
The damage consisted of deformation of one slip ring contact so that it was out of contact with the slip ring.
The other slip ring contact was deformed and lifted so that it would have excessive pressure on the slip ring.
The outer turn of the anti-backlash spring was deformed. The three contact wiper wires were not lying in line with each other as they should, and the tail of the wiper plate to which the wires are attached was bent down on the moulding. The deformation of the wiper wires and plate had caused the loss of wiper contact pressure, and a test indicated a partial open circuit in the pitch datum potentiometer. Extensive testing of this component, on the ground and in the air was done to determine the effect of this defect on the behaviour of the aeroplane.

(iii) A portion of cabin bulkhead, made of plywood and plastic at first believed to be from the bulkhead between the toilet and the passenger cabin, but later identified positively as from between the cabin and the radio compartment, bore marks and indentations containing pellet-like inclusions which were not unlike the traces left by the explosion of a home-made bomb. This item was intensively examined by explosion experts, but the hypothesis of an explosion was definitely disproved after X-ray examination of a similar bulkhead from a Viscount aeroplane undergoing overhaul revealed identically similar marks and indentations. The pellet-like inclusions consisted of a type of filler used in the Aer Lingus work-shops to fill up unwanted screw holes in the bulkheads.

(iv) When checking the tab-spring pretension on the rudder torque tube it was found that an incorrect spring had been fitted and that the one fitted was similar to the spring used on the elevator torque tube, which has a lower rate. This item was therefore given special consideration and research was conducted to ascertain the possible effect of this on the behaviour of the aeroplane.

(v) A thorough and detailed investigation was carried out on the remainder of the wreckage recovered, not only with a view to discovering the probable cause of the accident but also to study the break-up pattern and to establish if possible the aircraft configuration and attitude at impact

(vi) **Post mortems and autopsies**
Fourteen bodies were recovered from the sea. Post mortem examinations were made on all of these, and internal autopsies were made on ten bodies.
In all cases, there was evidence of gross damage to most of the vital organs, and severe head and leg injuries. There was no evidence of drowning in any case.
There was an almost universal absence of pulmonary embolic phenomena.
There was no evidence of inhalation of fumes or the products of combustion.
All bodies were examined for the presence of carboxyhaemoglobin. In no case was a significant quantity discovered.

2.-ANALYSIS AND CONCLUSIONS

2.1. Analysis

2.1.1. Study of similar accidents to Viscount aeroplanes

2.1.1.1.
The accident to EI-AOM presents a considerable element of mystery not only as to why the accident occurred, but also as to what happened to the aeroplane to account in a rational way for the evidence so far available.
A large amount of wreckage was recovered from the sea, but some vital items of evidence are probably still on the sea bed. It would not be impossible for some such item to become washed ashore or otherwise recovered in the future which might provide positive evidence at present lacking.
Owing to the lack of a firm lead to a probable cause, a study was made of every reported accident to Viscount aeroplanes since the introduction of the type into service in 1952, in order to see if any of these disclosed any pattern of events which might throw some light on the mysterious events of 24 March 1968.
A large proportion of these can be eliminated as having no features of similarity with the accident to EI-AOM. The great majority were of a relatively minor nature, the causes of which were readily determined and appropriate preventive action taken where necessary. Many of the accidents were due to mid-air collisions, collision with terrain or obstacles, heavy landings and other causes, and many were those in which the particular type of aeroplane involved had little or no relation to the probable cause. They could have happened to almost any aeroplane.

2.1.1.2.
Of the relatively few which occurred to Viscount aeroplanes in normal en route cruising flight, several were caused by doors opening or engine or propeller troubles, but after which the aeroplane was successfully landed. Immediate remedial action was of course taken in all these cases to obviate recurrence, either by modification of the component or equipment concerned or by the issue of appropriate operational or inspection instructions. Icing of control surfaces was diagnosed in several instances, and some were considered to be due to structural failure in heavy turbulence.
There were several cases of test manoeuvres or training exercises in which the strength of the aeroplane was exceeded resulting in deformation or failure of the wing or tail structure and there is one well authenticated case of collision with a swan at 6,000 feet which caused rupture of the tail surfaces.

2.1.1.3.
There have been cases in which, although a safe landing was actually effected, some other additional factor-which might have been present in the case of EI-AOM-could have caused a situation from which recovery would have been impossible.
Thus, failure of cabin or baggage compartment doors could result-in addition to sudden decompression-in the door or part of it striking the tail plane. There is one reported case where baggage falling out of a forward baggage compartment after door failure fouled an inboard propeller. These cases could have resulted in catastrophies.
In no case reported is there a positive finding which when associated with the evidence available on EI-AOM would be indicative of an initial causative factor.
There have been two cabin fires and two engine fires amongst the accidents reported but there was no trace of fire anywhere in the wreckage recovered from EI-AOM.

2.1.1.4.
There have been seven accidents the reports of which are inconclusive, and which might seem to have some points of similarity with EI-AOM. They also include marked points of difference:-

(i) A Viscount flying at night in clear weather free from turbulence and icing, cruising at 16,500 feet, crashed after a steep dive twenty four minutes after its last and normal routine communication. The cause of the accident could not be established, but there is a reference qualified by the statement that there was little substantial supporting evidence-to possible sudden malfunctioning of the auto-pilot and/or a sudden failure of electrical power rendering it impossible for the crew to retain control of the aircraft.
The main difference between this accident and that of EI-AOM is that it took place at night and most probably in Instrument Meteorological Conditions (IMC) when such failures could well result in loss of control.

(ii) A Viscount cruising normally, entered an area of bad weather, including the presence of cumulo-nimbus clouds, lost height and broke up in flight. The abstract report says that no evidence is available which might explain the departure from normal cruising level. It states that it is possible, even highly probable, that turbulence was a determining factor.
Here, the main difference is the apparently fairly positive evidence of major structural break-up in flight, and of the probability of dangerous turbulence in the area where the accident occurred.

(iii) A Viscount approaching a coastal aerodrome in poor weather in failing light, signalled that it was "at 2,000 feet with the coastline in sight". It was estimated that the aircraft crashed into the sea one minute later. The report excludes such possibilities as structural failure, failure of controls or control surfaces, multiple engine failure, instrument failure, explosion, fire, a "bad weather" accident, and pilot error. It is stated that on the evidence, the originating cause cannot be excluded as being "a heart attack suffered by the captain in the air and the co-pilot unable to regain sufficient control in the time available to prevent contact with the sea".
The main difference in this case is that there is nothing in the EI-AOM evidence which would warrant inclusion of such a possibility as a causative factor. Additionally, the aircraft was at only 2,000 feet, descending when apparently all was well, whereas EI-AOM was at 17,000 feet, in level cruising flight.

(iv) A Viscount in cruising flight went out of communication and emerged from low cloud in a steep dive from which it did not recover. A statement has been issued recently (on 25 May 1970) indicating that there was evidence of electrical failure.
The main difference is that this aircraft was in IMC (Instrument Meteorological Conditions) prior to the accident, and electrical failure involving instrument failure would be much more serious in these conditions than those which prevailed in the case of EI-AOM. In any case there is evidence that complete electrical failure did not occur in EI-AOM.

(v) A Viscount en route for three hours and ten minutes in fine weather and daylight crashed six minutes after a message had been received stating that descent was being started at that time. A report has not yet become available, but it has been stated in a preliminary account of the accident that one wing was found half a mile from the main wreckage.
Though there are some elements of similarity in the circumstances here, the evidence of the finding of the detached wing would, if substantiated, be indicative of a definite structural break-up prior to impact. In the case of EI-AOM, all the main structure of the wings was found in the main wreckage area.

(vi) The accident which was ascribed to collision with a swan at 6,000 feet is of considerable interest, and was studied in relation to EI-AOM.
The accident was caused by the impact of a "whistling swan" on the left tail plane, which wrecked it enough to cause failure and loss of control of the aeroplane.

Birds similar to this type are not unfamiliar in the south east of Ireland. Enquiries elicited the information that few ever fly so high as 17,000 feet and migration rarely takes place in day time, especially round about mid-day. The direction of migration from Wexford would be northward, and not south east, and expert opinion considers that owing to the good weather that prevailed prior to March 24 most if not all of the large birds (geese) would have left. The possibility that EI-AOM collided with a large bird is regarded as extremely remote, especially in the light of certain other evidence discussed later in this analysis.

(vii) A Viscount en route at 8,000 feet on an IFR flight plan crashed approximately 14 minutes after acknowledging a revised ATC clearance. No communications indicating any trouble were received. The aircraft struck the ground right side up with wings approximately level in a pitch attitude of about 8º nose up. The wreckage was impacted on five trees, two through each wing and one through the tail cone.

Moderate to heavy icing in cloud was expected in the area. The report concludes that due to discrepancies in the anti-icing instructions, several engines flamed out due to delayed activation of the engine ice protection system, and eventually all four propellers feathered, and airspeed and height were lost together with attendant electrical energy. Efforts to restart the engines by diving succeeded with one engine, and this resulted in an assymetrical power condition. The aircraft eventually struck the ground with no forward speed.

The main difference here is that the accident occurred in an area where icing was expected, and also that the cruising height was only 8,000 feet, whereas in the case of EI-AOM, the height was 17,000 feet and risk of icing was very slight if any.
There is some similarity between this case and EI-AOM in respect of the final descent, which appears to have been with low forward speed, but very high rate of descent.

2.1.2. Examination of Wreckage

The examination of the recovered wreckage, together with the medical, operational, meteorological and communications evidence, while providing a reasonably clear picture of the final impact with the sea, did not reveal clear evidence of the primary cause of the accident, or of the behaviour or condition of the aeroplane in the interim between the loss of communications and the estimated time of impact.

It should not be forgotten that while every effort was made to avoid inflicting any further damage on the salvaged wreckage, the extremely difficult and arduous nature of the operation of securing, lifting, and transporting the wreckage inevitably resulted in some further damage being suffered in some cases. Whenever this occurred, it was generally easily identifiable by the nature of the marks and by their relative freshness compared with the crash damage, which had of course been affected by prolonged immersion in the sea, in some instances, such as the fin and rudder, for up to eighteen (18) months.

The indications are that the airframe was substantially intact at impact, with the possible exception of the tail planes and elevators. The only parts of these to be recovered so far were the small portions of spring tab and trim tab but there is no direct evidence that the tail planes and elevators were not in position.

The portion of trim tab from the starboard elevator was recovered from the main wreckage area, and it is possible that the rest of the starboard tail plane and elevator is still in the area. The portion of the spring tab from the port elevator was found remote from the main wreckage site. The significance of this is discussed in para. 2.1.2.1.

The evidence from the examination of the propellers and engines and of the damage to the recovered parts of the engine mountings and front fuselage indicates that the aircraft went into the sea on a steep flight path with relatively low forward speed (less than 130 knots) and with a very considerable vertical speed component. The attitude at impact was of the order of at least 15º nose down and right way up. There is some contradictory evidence as to the lateral attitude, but the concensus indicates a slightly banked attitude to the right. The configuration at impact appears to have been that of normal flight, with landing gear and flaps retracted, but with all four propellers on the flight fine pitch stops.

2.1.2.1. Significance of the portion of elevator spring tab

No evidence of structural failure in the aeroplane, nor of pre-impact damage to the airframe of a catastrophic nature has been found, but a portion of the elevator spring tab from the inboard end of the port elevator was picked up on the beach between Rosslare Harbour and Greenore Point, seven miles from the location of the main wreckage. This is one of the only two pieces of the tail plane and elevator assembly that were recovered. The other piece of elevator tab, from the trim tab on the starboard side, was found in the main wreckage area. The possible failure of the elevator spring tab may have been associated with a structural failure in the elevator or tail plane, but no evidence of such failure has been found.

The piece of spring tab found on the beach was not capable of flotation, but was found 6 months after the accident, entangled in seaweed. The tidal currents flowing in the area where the main wreckage lies are mainly along a NE-SW line, whilst those between Tuskar and the coast flow round Greenore Point. It is highly improbable that the piece of spring tab, which was torn open and could not float, would have become entangled in seaweed-which is not prevalent in the wreckage site-and drifted ashore from there to a point 7 miles away, between Greenore Point and Rosslare Harbour. It is considered very probable that it fell in the sea much closer to the coast, became entangled in the seaweed on the bottom which is much more frequently encountered fairly close inshore, and eventually was washed ashore during rough weather. Local information on the movement of flotsam and jetsam in the area strengthens this view.

There is thus a probability that this piece of the spring tab-which is a component required for the proper fore and aft control of the aeroplane-became detached in the air prior to final impact, but the evidence is inconclusive.

2.1.2.2. Analysis of defect in Auto-pilot
The defect found in the Auto-pilot gave rise to much conjecture about its possibility as a primary cause. Tests were conducted, in collaboration with the makers of the Auto-pilot and Aer Lingus, and considerable investigation and discussion on theoretical lines ensued.
All known cases of auto-pilot deficiencies in Aer Lingus Viscount aeroplanes were reviewed and assessed. Precautionary measures were taken by issue of inspection instructions pending the result of the investigation.

Examination of Aer Lingus maintenance records indicates that the particular component in which the defect was found (the pitch datum motor potentiometer) had given no reported trouble and had not been worked upon during its time in service in Aer Lingus aeroplanes.
It has not proved possible to determine how the internal defect arose, but the component had apparently given satisfactory service for eighteen months prior to the date of the accident to EI-AOM.
The discussions proved protracted and inconclusive, and it was decided that the best course was to modify a pitch-datum potentiometer so that the open circuit characteristic-which could result from the defect found in EI-AOM's component-could be introduced at will, and to test it in flight.

The modified component was accordingly fitted in the auto-pilot of a Viscount made available by Aer Lingus, and arrangements were made for a test flight, which took place on May 12 1969, conducted by a team which included a British Aircraft Corporation test pilot and flight test observer, an Aer Lingus Flight Captain, the Inspector of Accidents and an Operations Officer (pilot) of the Department of Transport and Power. The tests covered conditions more severe than those which could have resulted from the precise defect found, and were summarised as follows:-

The results obtained indicated that under all the conditions of test, a failure or re-engagement of the pitch datum potentiometer does not cause (a) any condition of hazard to the aeroplane, (b) that the total "g" did not exceed 0.55 to 1.4 and (c) that during the "stick free" pitch oscillation, the minimum flight speed encountered did not fall below 1.29 VSI (VSI is the appropriate stalling speed).
Accordingly it is considered that the defects found could not be the initiating cause of the accident.

2.1.2.3.
The effect of the incorrect spring fitted in the rudder torque tube was investigated, and it was concluded that this had no bearing on the cause of the accident.

2.1.2.4.
The combination of these defects would have a minor effect on the flying characteristics of the aeroplane but not to any hazardous extent. The unwanted forces produced can be readily overridden or eliminated by manual control action by the pilot.

2.1.3. Consideration of Probabilities

2.1.3.1.
The evidence derived from the investigation of the wreckage and the post mortems does enable a number of primary causes of accidents to be virtually discounted as highly improbable. Amongst these can be included:-

(a) Failure of the basic airframe structure-contra indicated.
(b) Explosion-contra indicated.
(c) Fire in the air-contra indicated.
(d) Engine failure or malfunction-contra indicated.
(e) Propeller failure or malfunction-contra indicated.
(f) Fuel contamination or shortage-contra indicated.
(g) Sudden cabin decompression-no evidence.
(h) Malfunction of flying controls-no evidence.
(i) Malfunction of auto-pilot-contra indicated.
(j) Failure of electrical system-contra indicated.

There is also available evidence which while not always providing positive contra-indication, does reduce possibilities to the level of improbability.

Amongst these are included:-

(a) Icing-Meteorological evidence states that severe icing was very unlikely.
(b) Turbulence-Meteorological evidence states that it would have been slight. None reported by other aircraft.
(c) Thunderstorms-Meteorological evidence classes the probability as virtually nil.
(d) Collision with bird(s)-No evidence of birds in the vicinity at 17,000 feet. Evidence of bird flight at that height and in the relevant area at the relevant time is negative.
(e) Sudden incapacitation of pilot in command. Very improbable, and even contra-indicated by the terms of the messages intercepted by London Radar.
(f) Disturbance by or amongst passengers. Cannot be entirely ruled out by positive evidence, but like *(e)*, appears to be contra-indicated by the messages.

2.1.3.2.
The following possibilities are in a different level of probability from the foregoing:--
(i) Collision with another aircraft-no direct evidence.
(ii) Upset due to evasive action or turbulent wake-no direct evidence.
In order to examine the relative probability of these, a close study of the probable time scale of events was made, derived from the evidence of witnesses.
The number of witnesses is small, totalling 29 and of these, only two were eye-witnesses of the final crash.
The evidence of the witnesses who saw or heard unusual events at or about the approximate time of the accident is at least on first sight apparently conflicting and confusing.
It is necessary to take into account the generally accepted fact that the evidence of nonexpert-and indeed often of expert witnesses-cannot be depended on without independent substantiation in such matters as the type, colour, number of engines, height, speed, sound, manoeuvres, direction of flight, etc. of the aircraft involved, albeit given in all good faith. Nevertheless this type of evidence must be given close examination, and cannot ever be set aside as unworthy of consideration. In the present investigation, the witnesses all appeared to be very reliable, and most of them were interviewed at least twice, once very shortly after the accident, and again later. In no case was there any material change in the statements made in the original interviews.

2.1.3.3.
In this accident, the evidence on the timing of significant events is of great importance, and has a profound bearing not only on the probable movements of the aeroplane prior to the final crash, but also on any plausible hypotheses which could be evolved concerning the probable initial cause of the accident.
The evidence on timing has therefore been subjected to very close examination and analysis. Every effort has been made to eliminate guess work or casual estimates of time, for it is well known that persons normally have a very hazy recollection of particular times, or are mistaken in the reading of clocks and watches by often quite large amounts.

The reliability of time pieces also comes into question and whenever possible independent checks have been made to verify the accuracy and reliability of those time pieces referred to in the evidence. In a number of cases, times can only be given as fairly wide approximations, but the range of these has been considered, and due allowances made.
Whenever evidence on timing appeared to be probably unreliable it was of course rejected after due consideration of the implications involved.

2.1.3.4.
At 10.57.29 the flight acknowledged an instruction from ATC Shannon to change frequency to that of London Airways.
This was acknowledged by the laconic reply consisting of repetition of the frequency concerned-" 131.2". This exchange of messages was quite in line with normal practice, though not in accordance with formal procedure, but this is not thought to be of any particular significance.

2.1.3.5.
At 10.58.02, 33 seconds later, London Radar intercepted a call-unfortunately simultaneously with another call from a different aircraft but which was later confirmed as "Echo India Alpha Oscar Mike with you". This message was not in the form generally used by Aer Lingus flight crews, in which the call sign used is the flight number. Furthermore, the message did not begin with the usual preamble, in that it did not contain the call sign of any ground communication station.
The message was not in the recognised form of a distress or urgency message. Nevertheless, it seems probable that the message was intended to convey an element of urgency or distress, and that the aircraft was in difficulties at the time of transmission.

2.1.3.6.
At 10.58.10, a message was intercepted by London Airways/Radar, eight seconds after the reception of the message "Echo India Alpha Oscar Mike with you". This second message was at first and by many hearers of the recording, interpreted as "Five thousand feet descending spinning rapidly".
This message was also intercepted by Aer Lingus flight 362 and by BOAC flight 506, each of which immediately reported the fact to London Airways.
There was considerable background noise in the recording, and therefore the record was subjected to intensive research by experts, including the Civil Aeronautics Board and the F.B.I. in the U.S.A., to whom a copy of the record was sent for analysis. Acoustic research to eliminate unwanted noise was undertaken by the Institute of Industrial Research and Standards, and after repeated play-back of a re-recording it was later agreed by the majority of listeners that the first word, which had been thought to be "Five" was in fact "Twelve".

If it was assumed that EI-AOM was at 17,000 feet at 10.58.02, and-as at first interpreted-was at 5,000 feet at 10.58.10, the vertical component of velocity would have been 1,500 feet/sec, or over 1,000 mph, which is quite an impossible speed for this aircraft to have attained.

If it is assumed that the aircraft started to descend from 17,000 feet immediately after the last message to Shannon, it would have had to descend to 5,000 feet in 41 seconds; this would mean an average vertical velocity component of 200 mph, which is not considered feasible. Such a rate of descent could not be developed instantaneously of course, but would necessitate a more or less gradual deflection from a horizontal flight path to a near vertical one.
These two figures being improbable, it is most unlikely that the level of 5,000 feet was in fact the level existing when the message was transmitted, but is much more likely to have been 12,000 feet in accordance with the later interpretation of the record.

2.1.3.7.
Using the figure of 12,000 feet, and assuming that descent began at the time of the first intercepted call, the aircraft would have lost 5,000 feet in 8 seconds or 37,500'/min. which is an extreme figure not considered possible.
The time of 41 seconds for a height loss of 5,000 feet gives an average rate of descent of 7,320 feet per minute.

2.1.3.8.
The only available evidence of the time of impact with the sea is that obtained from two independent eye-witnesses.
One of these, No. 17, was on shore, near Greenore Point. This witness is considered very reliable. He described seeing a large splash in the sea near the Tuskar Rock at approximately 11.15 hrs. He gave a fairly firm estimate of the time, because he looked at a clock just before the incident. The clock has been checked and keeps good time, and is generally kept accurate to within one minute by reference to radio broadcast time signal. It is considered that the time he observed could have been 11.12 hrs. but not earlier.

The other witness, No. 19, was a seaman on a passing ship. He caught a fleeting glimpse of an aeroplane falling into the sea with a big splash, near the Tuskar Rock and in line with it. According to the ship's chart, she was abeam Tuskar at 12.00 noon, local time and at 12.10 local time would have been in a position (on course 175º, Tuskar 108º, 7 miles) where an object in the sea in line with the Tuskar would have a bearing almost coincident with the location where the main wreckage was found, and on a reciprocal of the line of sight of witness No. 17 on shore near Greenore Point.
These witnesses evidence appears to be quite reliable, and gives an impact time of between 11.10 and 11.15 with probability tending towards the earlier figure.

2.1.3.9. Timetable of events

Time: G.M.T.		
1.	10.57.29 33 secs.	EI-AOM acknowledged a request from Shannon to change frequency to London Airways 131.2 Mcs.
2.	10.58.02 8 secs.	London Radar intercepted call "Echo India Alpha Oscar Mike with you".
3.	10.58.10	London Radar intercepted call "Twelve thousand feet descending spinning rapidly".
4.	10.55.- 11.0	Ten witnesses, Nos. 8 to 12 and 22 to 26 inclusive, near Broadway Village, heard loud noise like very sharp roll of thunder. (One heard a double "clap", like thunder, from Tuskar Rock direction).
5.	10.45.- 11.05	Witness No. 2 at Fethard-on-Sea saw an aeroplane partly enveloped in a swirling cloud. Subsequently heard noise "like thunder". Aeroplane went off SE towards Saltees.
6.	10.45.- 11.15.	Witness No. 1 at Fethard-on-Sea saw aeroplane come through three small black clouds, "as if fired out of them", descending and unsteady. Aeroplane went off in southerly direction.
7.	10.45- 11.15. (dinner at 11.30/12.00 (Mass over at10.40).	Four (4) witnesses, Nos. 3, 3(a), 4 and 4(a), "after Mass and before dinner", at Fethard saw an aeroplane with very red colour on wings and tail ("as if on fire", but no smoke). Aeroplane went off in a south easterly direction.
8.	11.02.	Two (2) witnesses, Nos. 13 and 14, near Carnsore Point heard noise like thunder (a bang) and No. 13 saw a dark cloud low in the sky between Tuskar and Barrels Rock.
9.	11.10- 11.15.	Witness No. 19 on ship saw aeroplane dive into sea near Tuskar, and throw up column of water.
10.	11.11- 11.15.	Witness No. 17 near Greenore Point heard loud noise (like "water running off rocks"). Saw column of water near Tuskar. Noise verified by another witness, No. 19, at this point ("like stones tipped out of a lorry").

2.1.3.10.
It is clear from the evidence on the timing of events that in the extremely short period between the last exchange of communications with Shannon and the interception by London Airways of the signal "Twelve thousand feet descending spinning rapidly" a catastrophic upset was suffered by the aircraft which brought it from normal cruising at 17,000 feet in relatively good weather conditions to a situation which could have been either a fully developed spin or a spiral dive, 5,000 feet lower, losing height at an average rate of descent of over 120 feet/sec.
If descent had continued at this rate the aircraft would have hit the sea in another 98.5 seconds, at 10.59.48.5.

2.1.4. Discussion of witnesses evidence on sightings and sounds

2.1.4.1.
Two witnesses, No. 17 on shore at Greenore Point and No. 19 on a small ship almost abeam Tuskar Rock, saw a column of water go up (the man on the ship saw what he thought was a large bird-but later realised was an aeroplane-dive into the water, raising a large splash). The location of the position indicated by these witnesses coincides very closely with the position in which the main wreckage was later found. In each of these two cases, the time of the occurrence is given as between 12.10 and 12.15 hrs. local time (11.10 and 11.15 hrs. G.M.T.).
The timing by witness No. 17 at Greenore is well substantiated since this witness-because he was going to a football match-looked at a clock (known and found to keep good time) just prior to going outdoors, where he heard a rumbling noise out at sea "like water running off rocks" and saw the column of water rise. The time he observed was approximately 12.15 hrs. local time). It seems probable that he saw the minute hand of the clock in a position after 12.10, but possibly not as late as 12.15. His evidence on the noise he heard was substantiated as to time by another witness, No. 18, who heard the sound but was not in a position to see anything.

2.1.4.2.
At or just before 12.00 hrs. local time, ten witnesses in the area between Greenore Point, Carnsore Point and the village of Broadway about 3 miles inland from the coast, heard a loud noise described as "like a very sharp roll of thunder". One of these witnesses was very specific and described the noise as "a loud short clap of thunder, followed by a short sharp clap". A witness, No. 15, on the coast 4 miles north of these heard a sound, at about 12.00 local time, like "a very loud whoosh". Two witnesses, Nos. 16 and 16(a), on the coast near Greenore Point heard a loud sound, described by No. 16 as "a loud boom, like a jet coming out of a cloud" and by No. 16(a) as "a rumbling sound, like thunder". Consideration has been given to the possibility that what these witnesses heard was the sound of the actual crash into the sea, since the time would approximate to the theoretical impact time referred to in para. 2.1.3.10.
If this were so, the very different descriptions of the sounds heard are difficult to reconcile, even making due allowance for the subjectivity of interpretations of sounds. The witnesses inland heard sounds like thunder, and one of them gave a description which agrees closely with that of the sounds caused by a sonic boom.

On the other hand, witness No. 15, on the coast 4 miles north describes the sound as a very loud "whoosh" sound. His timing might not have been very accurate (he gave no precise time, other than about 12.00 local) but the description agrees tolerably well with that of the two witnesses, Nos. 17 and 18, referred to in para. 2.1.4.1. at Greenore Point-noise "like water water running off rocks", and "like stones being tipped out of a lorry".
It is concluded that those who heard the "whoosh" sound probably heard the actual impact, but that those who heard the noise "like thunder" heard something else, probably a sound made in the air, and carried on the wind, which was southerly at sea level. The "thunder" occurred approximately 10 minutes earlier than the probable sound of impact at the time given by witnesses Nos. 17 and 18.

2.1.4.3.
At times given as between 11.45 hrs. local/12.15 hrs. local, six witnesses, Nos. 1, 2, 3, 3(a), 4 and 4(a), in the Fethard-on-Sea area, 28 miles west of the impact location, saw an aeroplane, which flew in approximately a North West to South East direction. This was described by witness No. 1 as coming out of three small black clouds, with a sudden sharp turn "as if fired out of the clouds". Witness No. 2 described seeing an aeroplane, with the nose and portion of the wing enveloped in a small dark cloud, which travelled along with the aeroplane, "swirling". The cloud "looked about the size of a large hayshed". The aeroplane went in the direction of the Saltees. Shortly afterwards, this witness heard a bang which died away "like thunder". Another witness No. 2(a), in the vicinity heard the same sound, but was not in a position to see anything.

Four of the witnesses, Nos. 3, 3(a), 4 and 4(a), in this area described seeing an aeroplane, going in a south-easterly direction with very red colour on part of the wings and tail "as if on fire" but no smoke was seen. The colour of the aeroplane was not green or white. The timing of these observations can be taken as reasonably accurate, since in this area on a Sunday, the events of Mass ending and the middle day dinner being placed on the table are of great regularity throughout the population. The witnesses described the sightings as after Mass but before dinner.

It was thought that perhaps some of these witnesses had observed the flight of one of the search aeroplanes, a Dove of the Air Corps, which is coloured silvery grey, with bright red/orange "dayglo" paint on the extremities, but the only Dove aircraft in the vicinity that day did not arrive there until after 1.45 hrs. local time.

2.1.4.4.
The witnesses were all quite firm in respect of timing. Consideration must be given to the possibility of EI-AOM, having descended over the sea in a spin or spiral dive, and having been restored to a degree of controlled flight, then flying westward and appearing over Fethard-on-Sea in the period between 10.45 and 11.15 G.M.T. (11.45-12.15 local time) and then turning south east out to sea near Hook Head, and flying back over the sea to east of the Tuskar Rock, and then crashing into the sea.

2.1.4.5.
If these events took place, the aeroplane would have had to travel a total of over 60 miles in the period-between 10.58 and 11.10 or 11.15 hrs. i.e. in 12-17 minutes, at least at 212 mph. The actual air mileage would be greater than 60 miles since the flight path could not have been just straight out and back between some point near the Tuskar Rock to Fethard-on-Sea and return. The fact that no witnesses on land between Fethard-on-Sea and Greenore Point saw the Viscount indicates that if it did fly between these points it was well out to sea.

It is extremely unlikely, though not impossible, for the aeroplane to have been flown at a speed of over 200 mph in the disabled condition resulting from having been brought out of the spin or spiral dive. During this period, no communication whatever was received from the aircraft. If the aeroplane had been capable of being flown at or near its normal cruising speed, it is extremely difficult to account for the fact that no RIT signals were received after 10.58.10. From these considerations, it seems a reasonable assumption that EI-AOM was never in the neighbourhood of Fethard-on-Sea after 10.58, but that it did fly in a disabled condition for 10-15 minutes over the sea between Strumble and Tuskar.

2.1.4.6.
The shoulder straps of the safety harnesses of both Flight Crew members were found to have been fastened at the time of impact.
The particular harness in EI-AOM is of the inertia reel type, which provides considerable freedom of movement to the wearer except when subjected to sudden accelerations.
It is not possible, therefore, to draw any significant conclusions from the fact that the harnesses were fastened, since with the inertia reel harness, it appears to be customary for Flight Crew to leave the harness on during flight while normally seated.
There is some evidence that some of the passengers seat belts were fastened, but this is not considered very conclusive, although there is an indication that the seat belt sign in the cabin was switched on. These items of evidence are mentioned as possible indications of fore knowledge of an emergency condition by the crew, but are most inconclusive.

2.1.4.7.
The presence of two small ships in the neighbourhood of Tuskar-in one of which was the witness, No. 19, who saw the aeroplane enter the sea and throw up a great column of water-might have influenced the flight crew to attempt a ditching, even in the probable condition of defective longitudinal controllability. Two factors militate against this-firstly the complete lack of communications, and secondly the presence of a very good firm sandy beach between Greenore Point and Carnsore Point, of which the crew must have been aware.

The alternative is that after a period of some minutes of effort by the crew to control the aeroplane, it finally went completely out of control, in a stalled condition from a relatively low height, and struck the water with a high rate of descent and on a steep flight path-possibly between 45º and 60º to the surface of the sea, but with the fore and aft axis of the aeroplane inclined nose down at approximately 15º. The landing gear was up and the flaps were fully retracted. Since forward component of speed was probably less than 130 knots, as indicated from examination of the propellers, it seems probable that the throttles were deliberately closed shortly before the final impact.

2.1.4.8.
The forward component of airspeed at impact is not easily determinable, but the engine evidence points towards the engines being at low power at impact, and the propeller evidence substantiates this. All four propellers were on the flight fine pitch stop, and two possible operating conditions could give rise to this:-

(a) A steady state with idling fuel flow and a true forward airspeed of less than 130 knots.
(b) A steady state with zero fuel flow and a true forward airspeed of less than 200 knots.

Of these, the more probable condition is thought to be (a):- engines alight with throttle closed and idling fuel flow selected.
This would be consistent with the throttles having been deliberately closed shortly prior to the final impact with the sea, to minimise the impact forces by obtaining maximum propeller drag, and this is a probability.
It is probable therefore that the forward component of airspeed at impact was less-probably considerably less-than 130 knots.

2.1.4.9.
If the aircraft seen over Fethard-on-Sea was not EI-AOM, then some other aircraft must have been in the vicinity. The number of witnesses who described the aircraft include the two whose evidence is most remarkable. Witness No. 2 describes the aircraft as being enveloped in a cloud up to the wings, and that this cloud appeared to be revolving and travelling along with the aeroplane.

This witness also heard a subsequent bang which died away like thunder. Witness No. 1 saw the aircraft emerge in a sharp turn from three small black clouds "as if fired from them". These accounts could be satisfactorily explained by a supersonic aeroplane coming out of a dive, causing a boom and the small clouds and then flying past witness No. 2 with the wing covered in condensation cloud typical of near sonic speed in humid air. (This phenomenon should not be confused with the condensation trail seen behind aircraft at great heights).

The aircraft with part of wing and tail brightly coloured "as if on fire" and seen by other witnesses in Fethard-on-Sea was almost certainly the same one, since the times and direction of flight agree. (The aircraft disappeared towards the Hook Head-Saltees direction-south to south east of Fethard-on-Sea).

2.1.4.10.
Enquiries have not elicited any other information regarding the possible presence of another aircraft in the vicinity, but if the evidence of time of impact is accepted, and this seems to be reasonably reliable, the conclusion that there was such another aircraft in the area is inescapable. No aeroplanes have been reported missing, but there remains the possibility that an unmanned aircraft, either a drone target aircraft or a missile might have been there. It is to be noted that the firing ranges in the U.K. were closed on Sunday 24 March 1968.

Several witnesses from locations on shore as widely separated as Hook Head, Witness No. 6, (south of Fethard-on-Sea) and Newtown, Witness No. 7 (north of Fethard-on-Sea) saw an object in the sea in the vicinity of the Coningmore Half Tide Rock during the afternoon of March 24 and one witness No. 21 on shore near Carnsore Point saw a large splash in the area at or about 12.00 noon local time.
This evidence would not be inconsistent with the supposition that an unmanned aircraft had fallen in the sea, and remained afloat for some hours. No further evidence of this has come to light, and no sighting was made by any of the search aircraft in the vicinity during that afternoon and on the days following. Witness No. 7 saw a ship pass between the floating object and the shore, but as it continued on course, he concluded that the object was of no interest. The area was later searched with no result, and no trawlers recovered anything from the area which is frequently fished. Nevertheless, the evidence of the sighting is regarded as sound and not readily set aside.

2.1.4.11.
There have been several accounts of "upsets" of aircraft being caused by such factors as clear air turbulence, stalling while in climbing attitude, evasive manoeuvres to avoid collision with another aircraft or wake turbulence from another aircraft.
The two former causes do not seem probable though not impossible, but either of the second two possibilities would, in the light of the evidence discussed in the foregoing paragraphs, seem to become rather more credible.

2.1.4.12.
Taking into account all of the presently available evidence and assuming that the observations of sightings, sounds and timing by the few witnesses available were reasonably accurate and reliable, it is possible to evolve a hypothesis which rationalises the otherwise inconsistent elements in the evidence, and presents a coherent, if improbable story.
This hypothesis envisages that while Viscount EI-AOM was in normal cruising flight at 17,000' and within 6 minutes of reaching Strumble Head, another aircraft, which could have been a manned or unmanned aeroplane or a missile, passed in close proximity, possibly even colliding with the tail of the Viscount, causing an upset which led to a manoeuvre which was either a spin or a spiral dive from which the Viscount was recovered in a disabled condition, to fly thereafter for approximately 10 minutes over the sea before control was finally lost.

The other aircraft could have been the one seen over Fethard-on-Sea, and might have fallen in the sea near the Saltee Islands.
In considering this very speculative theory, attention must be given to a number of matters which discount it's credibility.
These include the fact that no aircraft, civil or military, manned or unmanned, were reported, or known to have been in the area at the relevant times, nor was any aircraft other than EI-AOM reported missing on that day. The missile and target ranges on the Welsh coast are closed on Sundays, and were known to be inoperative on Sunday 24 March 1968.

No aircraft carriers were operating in the area.

The altitude of 17,000' at which EI-AOM was cruising is considered unlikely to be used by military aircraft. The manoeuvre of recovering a loaded Viscount aeroplane from a spin or a spiral dive would require a very remarkable feat of airmanship on the part of the pilots. In fact there is only one known case in which this was effectively accomplished during a test flight by expert test pilots. Even in that case, the airframe suffered some distortion of the tail unit.

It is difficult to account for the lack of communications during the presumed 10 minutes before the final catastrophe. The aircraft may have been too low for V.H.F. communication with ground stations, but if there were transmissions they should have been picked up by other aircraft.
On account of these matters, the hypothesis must remain in the realm of speculation and on present evidence cannot be given a higher status than a remote possibility.

2.2 CONCLUSIONS

2.2.1. Findings

1. The aircraft was covered by a valid and current Certificate of Airworthiness, and by a current maintenance release issued in accordance with Article 18 of the Air Navigation (Airworthiness of Aircraft) Order, 1964 (S.I. No. 141 of 1964.)

2. The Flight Crew were properly licensed and qualified for the execution of their duties.

3. The flight proceeded normally after take-off until 33 seconds after acknowledging an A.T.C. instruction from Shannon to change radio frequency to that of London Airways.

4. A signal was intercepted by London Radar at 10.58.02 reading "Echo India Alpha Oscar Mike with you".
   Eight seconds later, another signal was intercepted reading "Twelve thousand feet descending spinning rapidly". No further communications were received from the aircraft.

5. The aircraft went into the sea at between 11.10-11.15 on a steep flight path with low forward speed (less than 130 knots) and with a very considerable vertical component of speed. The attitude on impact was of the order of 15º nose down, right way up, and probably slightly banked right wing down.

6. For a reason that cannot be determined from the evidence available, the aircraft went into a spin or spiral dive or similar manoeuvre at 17,000 feet, from which a recovery appears to have been effected at some height lower than 12,000 feet. The recovery manoeuvre could not be achieved without inflicting some structural deformation on the airframe, most probably on the tail planes and elevators, causing impairment of controllability in the fore and aft (pitching) plane.

7. A portion of the elevator spring tab from the port elevator probably became detached while the aircraft was airborne.

8. A defect found in the Automatic Pilot was most fully investigated by ground and air tests. It is considered that this defect could not have been the cause of this accident.
   Substitution of an elevator spring for a rudder spring found in the rudder torque tube would have but a minor effect on the flight characteristics (feel) of the aircraft.
   These defects taken together would have an effect on the flight characteristics of the aircraft to a minor but insignificant extent, which in the case of the Auto Pilot, can be discounted by the safety measures included in the design of the equipment, and in each case by the fact that unwanted forces can readily be overridden by manual control action by the pilot. No other pre-impact defects were found. in the engines, propellers, instruments or equipment.

9. The Flight Crew were wearing their full safety harness including the shoulder straps.

10. The aircraft flew in a disabled condition over the sea for a period of at least 10 minutes, (during which no radio signals were received from it) after which fore and aft control was finally lost, and the aircraft descended with a high vertical component of speed, in a stalled condition with engines throttled back, until it struck the sea.

11. The aircraft was substantially intact when it entered the sea, except for the probable loss of all or part of the elevator spring tab. It was demolished on impact and sank immediately. The impact was unsurvivable.

12. There is evidence which could be construed as indicative of the possible presence of another aircraft or airborne object in the vicinity which, by reason of collision, or by its proximity causing an evasive manoeuvre to be made, or by its wake turbulence, might have been the initiating cause of an upsetting manoeuvre resulting in the Viscount entering a spin or spiral dive.
    There is no substantiating evidence of such a possibility, but it cannot be excluded for it is compatible with all of the presently available evidence.

2.2.2. Probable Cause

There is not enough evidence available on which to reach a conclusion of reasonable probability as to the initial cause of this accident.

The probable cause of the final impact with the sea was impairment of the controllability of the aircraft in the fore and aft (pitching) plane.

R. W. O'SULLIVAN, B.A., B.A.I., C.Eng., F.R.Ae.S.
Inspector of Accidents.
30 June 1970.

Note:

Appendices to the Report are not included herein, but may be inspected at the Offices of the Department of Transport and Power (Acronatical Section), O'Connell Bridge House, Dublin, 2. (Tel. No. 771207).

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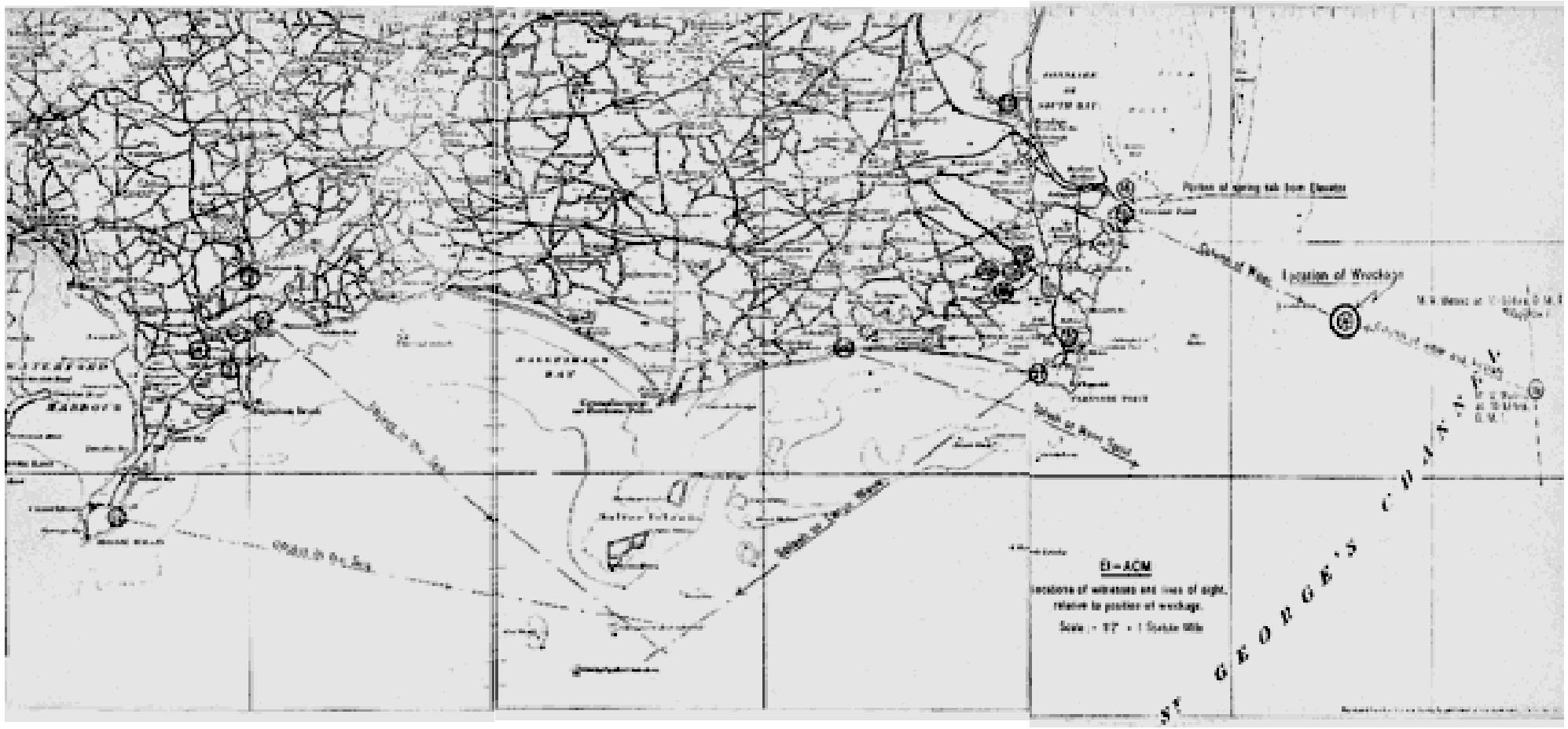
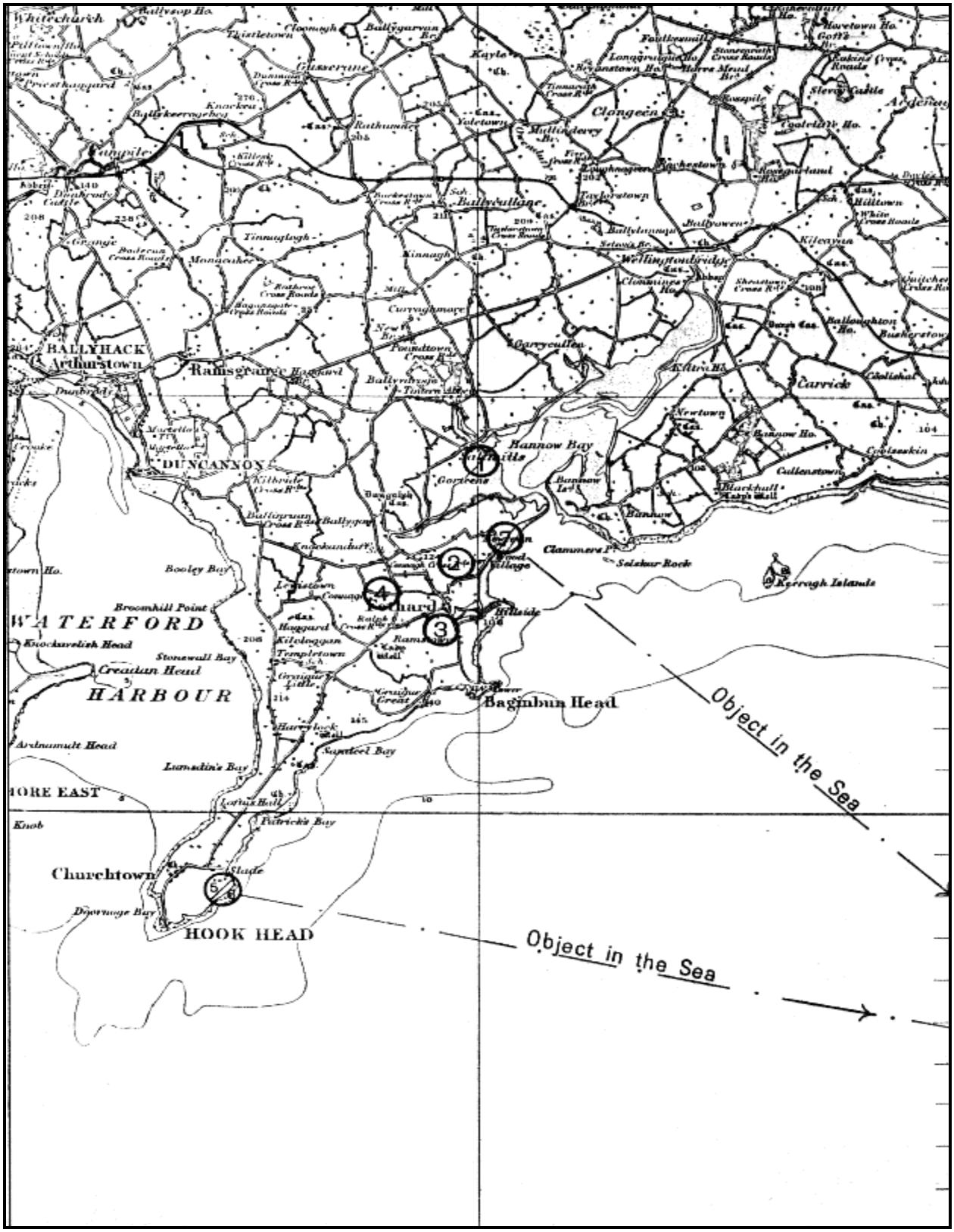
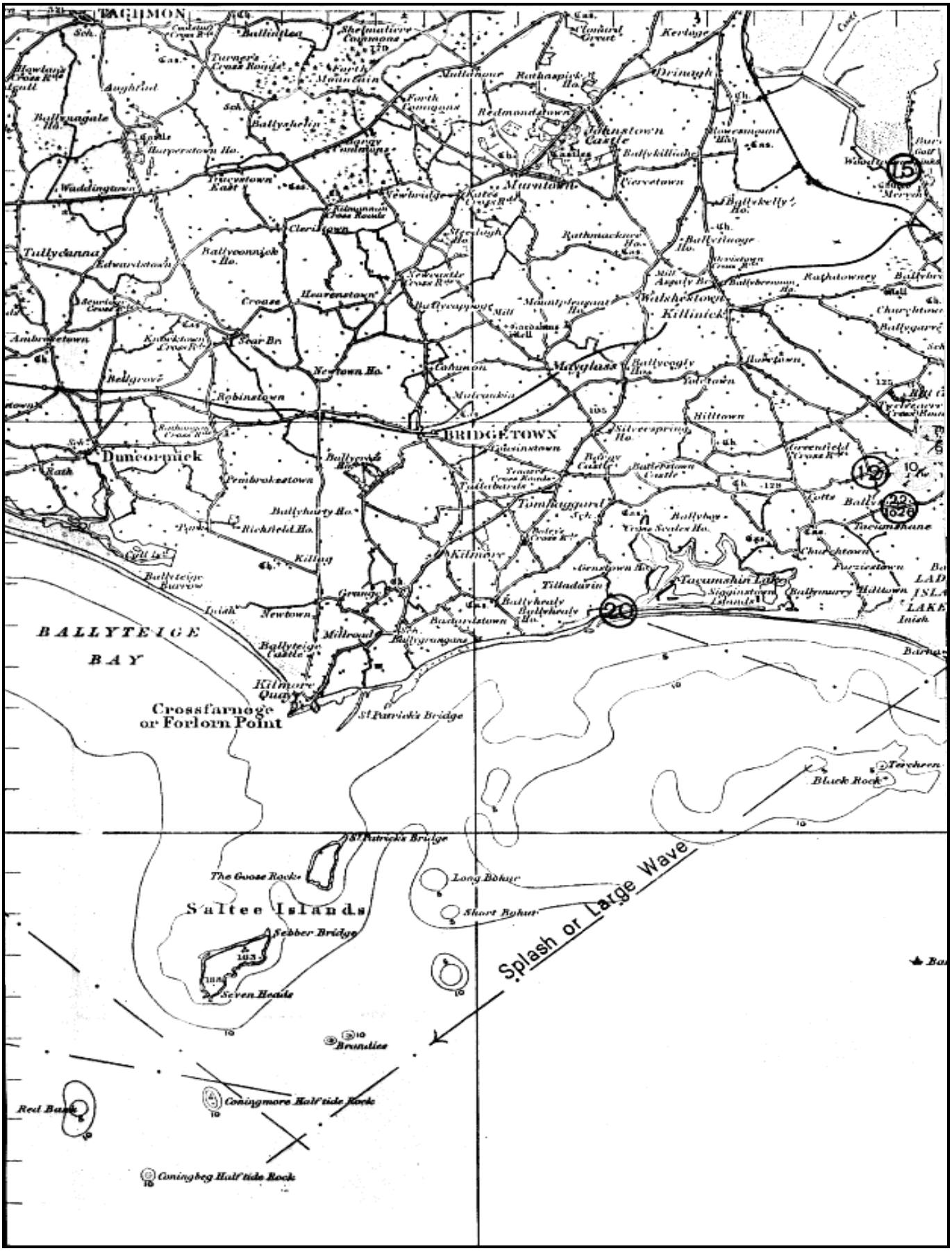
3. Map showing the general area of the accident and locations of witnesses to whom reference is made in the Report.





Section A of Main Map



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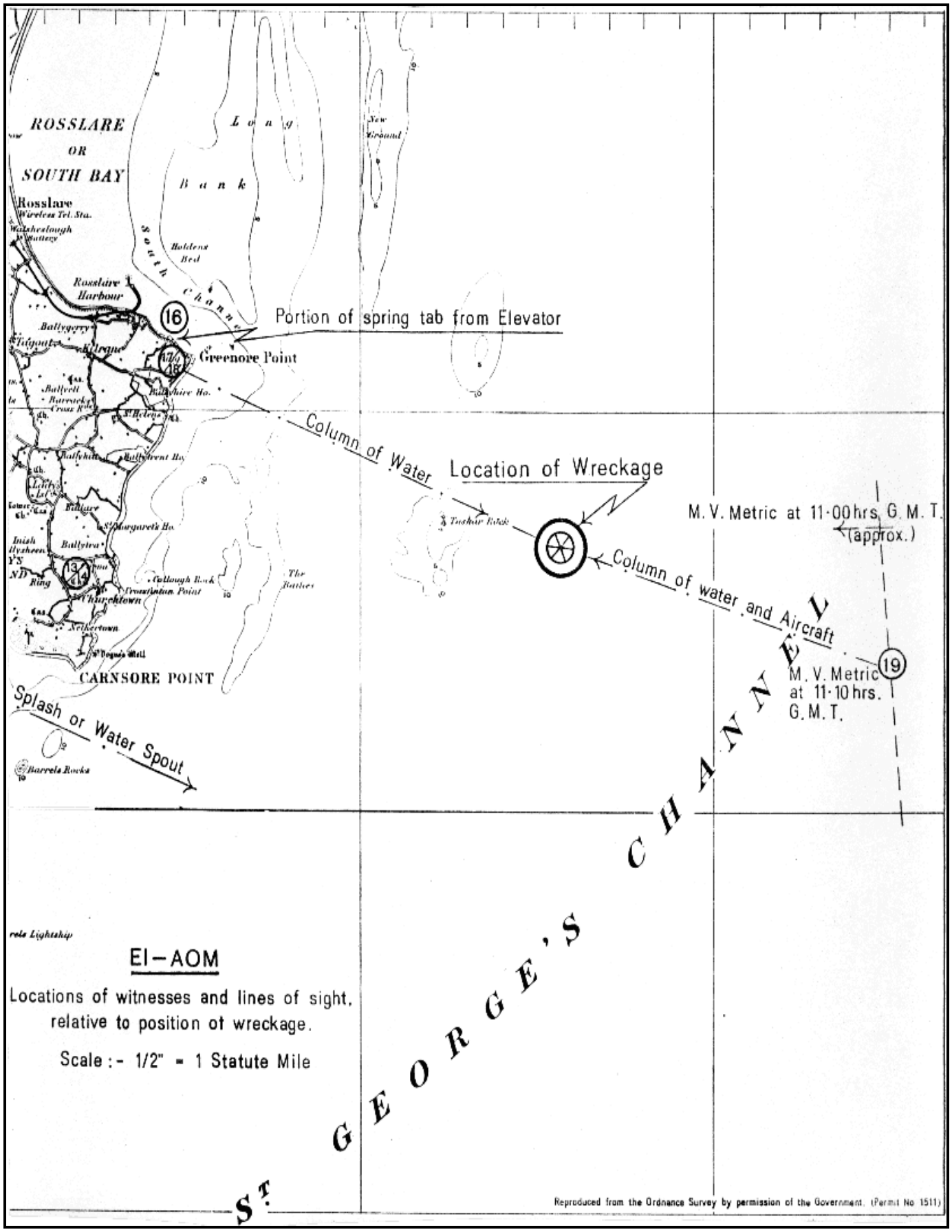

Section C of Main Map