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M.C.A.P. 112

MINISTRY OF CIVIL AVIATION

CIVIL AIRCRAFT ACCIDENT

Report of the Court Investigation
on the Accident to
COMET G-ALYV
on 2nd May, 1953

LONDON: HER MAJESTY'S STATIONERY OFFICE

1953

THREE SHILLINGS NET

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To The Secretary to the Government of India,
Ministry of Communications,
NEW DELHI.

SIR,

By Notification No. 17-A/17-53 dated 8th May, 1953, issued by the Central Government under Rule 75 of the Indian Aircraft Rules, 1937, I was appointed to hold a formal investigation of the accident which occurred near Calcutta to the Comet aircraft G-ALYV of the British Overseas Airways Corporation on the 2nd of May, 1953, when engaged on a scheduled flight from Calcutta to Delhi, resulting in the death of all the crew and passengers on board. By the same Notification the Central Government was also pleased to appoint—

- (1) Shri K. M. Raha, Deputy Director General of Civil Aviation ;
- (2) Shri N. Srinivasan, Design Department, Hindustan Aircraft Limited ; and
- (3) Mr. T. R. Nelson, Senior Inspector of Accidents, Ministry of Civil Aviation, United Kingdom,

to act as assessors to the said investigation.

Accordingly, I arrived at Calcutta Airport, Dum Dum, on 14th May and obtained from Shri M. H. Limaye, the Aerodrome Officer, a general idea of the disaster and from Shri Y. R. Malhotra, the Inspector of Accidents, information regarding the investigation into the disaster which he had already made since his arrival at the scene of the accident on the 3rd of May.

Early next morning, I went with the assessors, Shri Malhotra and Shri G. P. Shahani, Secretary of the Court, to the scene of the accident at Jagalgori and met there the District Magistrate, the Sub-divisional Officer, the Police Officers and the representatives of the British Overseas Airways Corporation, as well as Messrs. Lett, Pardoe, Folliard and Halsey who had been sent from England and were engaged in collecting, studying and assembling the parts of the wreckage. We inspected those parts, which had been distributed over a wide area and returned to Calcutta Airport late at night.

At the scene of the wreckage I held a public inquiry and recorded the statements of five eye-witnesses from the neighbourhood who claimed to have seen the disaster. The public hearing was continued on the next day in a hall in the Rest House of the Calcutta Airport which had been placed at our disposal. On Sunday, 17th of May, two of the assessors, Shri Srinivasan and Mr. Nelson, went again to Jagalgori, made further study of the wreckage and left instructions that the relevant parts should be taken to the Calcutta Airport. Evidence was recorded from day to day till 23rd May.

On 20th May we visited the Comet aircraft of the British Overseas Airways Corporation which had arrived at the Calcutta Airport on its scheduled service and on the 21st, 22nd and 24th we further inspected the parts of the wreckage which had been brought and assembled in one of the hangars in the airport.

The representatives of the British Overseas Airways Corporation were present all through the public hearing and were allowed to assist the Court by suggesting questions to be put to witnesses, either to elicit further information or to elucidate any statement already made.

The public hearing concluded on 23rd May. A public notice had been published in the local papers requesting that any one having relevant information regarding the disaster should communicate with the Secretary.

I have now the honour to present my report together with the record of the evidence and the proceedings of the investigation. The report is the unanimous product of a very happy and cordial collaboration between me and the well-chosen assessors. I believe we have done our best to achieve unanimity.

The list of witnesses examined is set out in Appendix V.

Shri Y. R. Malhotra, the Inspector of Accidents, was present throughout and rendered every assistance to the Court and placed at its disposal all the information and data which he had collected, but none of the crew and the passengers having survived the crash and the wreckage of the aircraft having been mostly burnt and distorted, the investigation was bound to include a good deal of groping in the dark. In spite of the ability of very experienced assessors, possessing a high degree of technical knowledge, I have found it difficult to arrive at a definite and certain conclusion regarding the approximate cause of the disaster. All that we could do was to suggest the probable causes. This result is in no way due to lack of diligence or thoroughness on the part of those who sought to find a solution of the problem, but to lack of convincing data for ascertaining with certainty the real cause of the disaster, although every effort was made to secure the attendance of all witnesses to throw light on any aspect thereof, and all information available, both factual and technical, was furnished.

I must express my gratitude to the representatives of the British Overseas Airways Corporation and to the experts from England who gave me every kind of assistance in facilitating the investigation. But for their help the investigation could not have been so speedy or so complete. I must also thank the villagers in the neighbourhood of the disaster who took a keen interest in the investigation and were eager to render all possible assistance, as well as the Press for reporting the Court proceedings from day to day.

I cannot but pay my grateful tribute to the part taken in the investigation by the Court assessors. Without their skilled assistance and constant advice, I could not have discharged my task and the report which I now present with their full concurrence is in a large measure the product of their expert knowledge and the help which they ungrudgingly gave me regardless of personal inconvenience.

Lastly, I join with the assessors in recording our high appreciation of the service of Shri G. P. Shahani, the Secretary of the Court in marshalling and analysing the evidence and rendering assistance in drafting the report. I wish to record my thanks to the aerodrome officials for the excellent arrangements they had made for all those who were engaged in the investigation.

Yours faithfully,

N. S. LOKUR.

Calcutta Airport, Dum Dum.

26th May, 1953.

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REPORT

OF COURT INVESTIGATION OF THE ACCIDENT TO B.O.A.C. COMET AIRCRAFT G-ALYV ON 2nd MAY, 1953

I. ACCIDENT DETAILS

(a) *Location*: Jagalgori, a village about 24 miles, on a bearing 277° (T) from Dum Dum airport.

(b) *Date and time of accident*: 2nd May, 1953, soon after 1105 hrs. GMT (1635 hrs. IST.).

(c) *Type of flying*: Scheduled passenger flight, service No. 783/057.

(d) *Object of flight*: The aircraft was on a return flight from Singapore to London. It had taken off from Calcutta (Dum Dum) *en route* to Delhi (Palam).

(e) *Date and time of receipt of notification by Investigator*: On 2nd May, 1953, at 1445 hrs. GMT (2015 hrs. IST) the Inspector of Accidents, Civil Aviation Department, New Delhi, was notified that the aircraft was overdue, and on 3rd May, 1953, at 0400 hrs. GMT (0930 hrs. IST) he was further notified that the wreckage had been located.

(f) *Date and time of arrival of Investigator at the scene*: On 4th May, 1953, at 0930 hrs. GMT (1500 hrs. IST) the Inspector of Accidents, New Delhi, accompanied by a Senior Inspector of Accidents from the Ministry of Civil Aviation, London, arrived at the scene of the accident.

2. SUMMARY OF ACCIDENT

On its scheduled return flight from Singapore to London the Comet aircraft G-ALYV of B.O.A.C., carrying 37 passengers and crew consisting of six members, took off from Calcutta Airport, Dum Dum, on 2nd May, 1953, at 1059 hrs. GMT (1629 hrs. IST) for Delhi (Palam).

The take off was normal. However, six minutes after its take off radio communication contact with the aircraft was lost. It was last heard by Calcutta at 1105 hrs. GMT calling Delhi (Palam.) About that time some cultivators residing in the adjacent villages, Jagalgori, Chanashampur, Radhanagar and Mahishnan, at distances varying from 24 to 30 miles from Calcutta (Dum Dum), saw the

aircraft coming down in a blaze of fire through severe thunderstorm and rain, and finally crashing into a nullah. There were no survivors.

3. AIRCRAFT INFORMATION

The information is given in Appendix I.

4. CREW INFORMATION

The information is given in Appendix II.

5. PASSENGERS

Names of passengers together with their nationality and addresses are given in Appendix III.

6. WEATHER CONDITIONS

The B.O.A.C. representative was supplied with the following documents by the Meteorological Office for the use of the aircraft Commander:—

- (a) Flight forecast for the route Dum Dum to Palam together with a forecast of the expected take off conditions at Dum Dum including the expected temperatures, surface winds and pressure altitudes;
- (b) Terminal forecasts for Palam and its alternates, Jodhpur and Allahabad, and return terminal forecasts for Dum Dum and its alternate, Gaya;
- (c) A chart showing the sea-level isobars at 0300 hrs. GMT and the synoptic situation; and
- (d) A chart showing the streamlines of air movement at 30,000, 35,000 and 40,000 ft. above sea-level.

The flight forecast was collected about 2½ to 3 hours before the commencement of the flight. The other documents were collected later at different times in instalments.

The flight forecast indicated the following expected weather:—

(a) For the route from Dum Dum to 85° East:

Weather: Scattered thunder-showers, moderate turbulence.

Low cloud: 4-5/8 cumulus; base 3,000 ft., tops 15,000 to 20,000 ft.

Scattered cumulonimbus; base 1,500 ft., tops 35,000 ft.

Medium cloud: 2 to 5/8 altocumulus and altostratus; base 14,000 to 16,000 ft.

Surface Visibility: ½ to 1 nautical mile in showers, otherwise 6 to 7 nautical miles.

(b) For the route from 85° East to Palam:

Weather: Local dust haze, otherwise fair.

Cloud: 2/8 cumulus; base 3,000 ft., tops 15,000 to 18,000 ft.

Surface Visibility: 5 to 6 nautical miles.

The terminal forecast for Palam valid for the period 1000 hrs. to 1500 hrs. GMT (1530 hrs. to 2030 hrs. IST) indicated weather fair, surface wind variable 6 knots, visibility 3 nautical miles in haze, cloud 1/8 altocumulus, base 10,000 ft.

The return terminal forecast for Dum Dum valid for the period 1000 hrs. to 1400 hrs. GMT (1530 hrs. to 1930 hrs. IST) indicated cloudy weather with temporary thunder-showers after 1100 hrs. GMT, surface winds 180° 10 knots gusting to 15 knots and 340° 45 knots temporarily after 1100 hrs. GMT, visibility 7 nautical miles generally, with 1½ nautical miles in thunder-showers, clouds 4 okta cumulus, base 3,000 ft., 2 okta cumulonimbus, base 2,000 ft. generally with 4 okta cumulonimbus, base 1,000 ft. temporarily. 2 okta altocumulus at 13,000 ft. and 4 okta alto-stratus at 10,000 ft. had also been indicated in the return terminal forecast for Dum Dum.

At 0740 hrs. GMT the following message was received by the Area Traffic Control from an aircraft VT-CQL:—

“ Storm developing 2410° N 89° E cumulonimbus 3,000 ft. moving south east direction with very strong vertical updraft ”.

The Area Control Officer passed on the above information to the Met. Office on tele-talk and also sent out the same as a CQ message for the benefit of all aircraft within the Calcutta flight information region. This CQ message was broadcast on air/ground frequencies between 0743 and 0747 hrs. GMT.

The Comet on its way to Calcutta from Rangoon sent out the following signal at 0819 hrs. GMT:—

“ Request forecast time of storm passing Calcutta ”.

In reply to the above, the Meteorological Office, Dum Dum sent the following message to the Comet at 0853 hrs. GMT:—

“ Reference your signal AAA Norwester expected Dum Dum area after 1100 hrs. GMT.”

The following special airfield warning for Dum Dum had been issued at 0945 hrs. GMT:—

“ Thunderstorm accompanied with squalls from northwest speed reaching 50 knots likely Dum Dum airfield and neighbourhood between 02 1200 hrs. GMT and 02 1600 hrs. GMT.”

The Captain of the aircraft on receiving the airfield warning referred to above visited the Meteorological Office at about 1030 hrs. GMT and he was personally briefed by and had a discussion with the Duty Forecasting Officer.

Subsequently an airfield warning issued by Palam and received at Dum Dum was passed on to the Area Traffic Control at 1120 hrs. GMT as an addressed message for the Comet in flight but this message was not acknowledged by the Comet.

The actual weather conditions at Dum Dum at the time of take off were as follows:—

Weather: Variable sky.

Surface wind: SSW 13 knots.

Visibility: 7 nautical miles.

Cloud: 2 okta cumulus, base 2,500 ft.,
1 okta cumulonimbus, base 3,000 ft.
Total amount 3 okta.

The norwester affected Barrackpore first and Dum Dum later.

The sequence of development of weather at Dum Dum and Barrackpore between 0900 hrs. and 1200 hrs. GMT as seen from the aeras and 5 m. reports recorded at the meteorological offices at Dum Dum and Barrackpore may be seen in Appendix IV.

7. NAVIGATIONAL AIDS

The navigational aids carried on board the aircraft and those available on the ground were adequate for the flight undertaken. It is considered that the navigational aids did not have any bearing on the accident.

8. FIRE FIGHTING EQUIPMENT

The fire fighting equipment on board the aircraft was adequate. There is no evidence that

it was operated either manually or automatically. This is considered to be due to the nature of the accident.

9. WITNESSES

Names of witnesses are given in Appendix V.

10. OTHER STATEMENTS

Statements on which Appendices I and II are based were received from the Ministry of Civil Aviation, London.

11. EXAMINATION OF THE WRECKAGE AND TECHNICAL INVESTIGATIONS

(a) Location of wreckage:

The main wreckage was located 24 miles from Calcutta Airport, Dum Dum, on the track from Dum Dum to Palam. It was lying in a waterlogged nullah. The main wreckage consisted of the fuselage portion from the nose to cabin bulkhead No. 26 (half way down the passenger compartment), two stub wings up to rib No. 7 attached to the fuselage with the four engines in position. The rest of the components of the aircraft were found on a track $5\frac{1}{2}$ miles in length on a heading about 334° (T). The different components of the aircraft were found in the following order on the wreckage trail:—

Port outer elevator and port top skin, starboard outer elevator together with starboard bottom mainplane skin, port tailplane with parts of rear cabin structure top fuselage skin, port inner elevator, starboard wing skin, sections of port fuselage side panel, starboard tailplane, fin and rudder, both outer wing panels, rear portion of the fuselage and the main wreckage in the nullah, as shown in the sketch in Appendix VI.

The terrain on which the wreckage was found is flat consisting of paddy fields.

(b) General observations:

There were no scratches on the soft ground where the different components of the aircraft had fallen. It indicated that the pieces had fallen in almost a vertical direction with no forward velocity.

(c) Condition of wreckage:

The main wreckage had been on fire. The main body of the aircraft had fallen into the nullah in an inverted position. There was severe damage on the structure of the aircraft due to impact and due to fire. Some of the separated fuselage panels had no evidence of fire damage. The rear fuselage

unit had been damaged by fire and the portion aft of the pressure dome indicated severe damage due to impact. The port and starboard extension wing had severed from the main wing outboard of rib No. 7. Part of the port wing tip had melted due to fire damage. A deposit of smoke was found all along the leading edge of the flap and aileron, both on the port and on the starboard wings. The port aileron showed impact damage at three points on the trailing edge. The starboard wing had suffered severe impact damage at the wing tip. A small piece of the rear fuselage was found in the starboard wing. The leading edge of the starboard wing had suffered impact damage in the air between ribs Nos. 7 and 14, and there were metal scratches all along the leading edge from the place of the impact right up to the wing tip.

(d) Technical examination of the wreckage:

Examination of the wreckage indicated that—

- (i) The undercarriage and flaps were in the fully retracted position.
- (ii) The throttle levers were broken and jammed. All the four throttles were in the "half-open" position.
- (iii) High pressure and low pressure fuel cocks were "on".
- (iv) The flying control system changeover levers were in their normal position.
- (v) The elevator and aileron trim settings were about normal. The rudder trim setting could not be determined.
- (vi) The cabin was being pressurized as disclosed by the spill valves.
- (vii) The fire extinguishers had not been operated, nor was there any evidence of any emergency procedure having been taken.
- (viii) Both the extension wings had failed at a station outboard of rib No. 7. On an examination of the wing panels it was noticed that the top panels had failed in tension while the bottom panels had failed in compression, indicating thereby a down-load failure of the wing. The top panels between ribs Nos. 7 and 12 indicated bending failure. The bottom panel consisting of several small pieces had sheared off at several points. The top and bottom panels on both the wings had severed from the main wing at rib No. 7. The aileron with its tab was in position on both the extension wings. The extension wing outboard of rib No. 12 with the aileron was found as one piece.

- (ix) *Tailplane*: The port tailplane had suffered a heavy impact damage in the air right from the leading edge to the rear spar along its chord at a station close to No. 2 hinge bracket. The outboard tailplane had been completely severed from the inner unit at the above station due to impact. There was no structural damage on the tailplane panels outboard of No. 2 hinge bracket. The port inboard tailplane had broken off its attachment at the fuselage and at the front and rear spar points. The inboard piece had again broken into two pieces along the span somewhere in between the two spars. The No. 3 hinge bracket on the rear spar indicated an inboard side load. The No. 4 hinge bracket had sheared off at its centre. The starboard tailplane had suffered impact damage in the air at the inboard leading edge. The two front and rear spars had failed near the root attachment.
- (x) *Elevators*: The port elevator had been cut into two pieces along its chord close to the No. 2 hinge bracket. The inboard elevator piece indicated a skin collapse and had torn off its attachment to the operating torque tube. The elevator spar showed bending failure at a station in between No. 3 and No. 4 hinge brackets. It indicated a compression failure on the top flange and a tension failure at the bottom, that is, a down load failure. The mass balance appeared to have detached itself in a downward direction due to the inertia load. The starboard elevator spar had failed in bending significantly at the same point as on the port elevator. The compression failure at this point was severe and a collapse of the spar seemed to have sheared off the mass balance from its attachment to the elevator tip ribs. The No. 3 hinge brackets on the tailplane showed an outboard side load. The elevator had separated into two at a place in between the No. 2 and No. 3 hinge brackets. The inboard portion of the elevator had been torn off its attachment to the torque tube. There was no damage on the tailplane around the point where the elevator spar had failed in bending. The bending failure of the elevator spar was localized at a particular station and there was no

evidence of impact damage at this section. The elevator skin panel had suffered diagonal wrinkles due to tension field on a down load.

- (xi) *Fin and Rudder*: The fin had broken off its splice point at the insulation joint box. There was no structural damage on the fin panels. The top rudder hinge bracket had been twisted in a clockwise direction and the bearing had been sheared off its mounting on the bracket. The central rudder hinge bracket was intact and the hinge bolt had sheared off on the port side. The top rudder had broken at its jabroc attachment point to the lower rudder. The mass balance had detached from its attachment to the rudder tip. The lower fin and rudder had suffered extensive impact damage. The rudder operating torque tube had impact marks at several places.
- (xii) *Fuselage*: The fuselage had failed at frame No. 26 close to the attachment station of the fuselage to the centre section wing. The fuselage panels indicated tension failure at the top and compression failure at the bottom. Some of the loose panels aft of bulkhead 26 that had detached themselves from the main body were not burnt. The rear fuselage had been affected by fire in the cabin portion.

12. COMMUNICATIONS

The communication equipment carried on board the aircraft as well as the ground facilities were adequate for the flight undertaken.

The aircraft contacted Dum Dum Aerodrome Control on radio-telephony frequency 118.1 Mc/s. and obtained clearance to taxi and later to take off from runway 19 left. After take off the aircraft was cleared to change over to Dum Dum Approach Control frequency 119.7 Mc/s. The aircraft reported to Approach: "Departing Dum Dum on course to Delhi".

The Approach Control gave clearance to climb under Visual Flight Rules and to call when passing 7,500 ft. The aircraft was also informed that a Dakota aircraft from Delhi cruising at 7,500 ft. was expected to arrive at Dum Dum at 1115 hrs. GMT. The Approach Control then passed QNH to the aircraft, but no acknowledgment of this was received from the aircraft. No further communication was received from the aircraft on this frequency despite several calls

which were subsequently made by the Approach Control when they did not receive the expected call from the aircraft which it should have sent on passing 7,500 ft.

The Approach Control Officer contacted Area Control and was informed that they were in contact with the aircraft. The Approach Control Officer, therefore, did not attach any special significance to the lack of the expected communication from the aircraft to Approach Control.

The aircraft contacted Area Control at 1102 hrs. GMT on wireless-telegraphy and reported: "Departed from Calcutta 1059 hrs.—Estimated time of arrival Palam 1320 hrs.—Climbing to 32,000 ft." It was on the strength of this message that Area Control had replied in the affirmative when Approach Control had enquired if they were in contact with the aircraft; and this was the last communication received by Area Control from the aircraft.

At 1105 hrs. GMT the Communications' radio operator at Calcutta heard the aircraft calling Delhi. Delhi acknowledged and asked the aircraft to pass its message, but there was no response from the aircraft. The radio operator at Calcutta then called the aircraft informing it that Delhi was ready to receive the message. Despite repeated calls thereafter, there was no response from the aircraft. At about 1120 hrs. and 1139 hrs. GMT Area Control passed messages regarding Palam and Gaya weather to Communications for transmission to the aircraft. Communications attempted to pass these messages to the aircraft but they were unable to make contact. The Communications were not worried as they thought that the aircraft might have temporarily suspended communication due to thunderstorm. However, this fact was not known by the Area Control Officer, who presumed that normal communication with the aircraft was being maintained.

At 1158 hrs. GMT Delhi enquired if Calcutta Traffic Control was in communication with the aircraft as a Dangermet report was held up at Palam. As a result of this, Calcutta Area Control checked with Communications and were informed that no message addressed to Calcutta had been received from the aircraft since the one at 1102 hrs. GMT. It was then realised that all radio contact with the aircraft had already ceased.

13. SEARCH AND RESCUE ACTION

After it was known that communication with the aircraft had been lost, the Area Control

Officer sent signals to aerodromes in the neighbourhood as well as to other Area Controls and a general broadcast was also made on the air-ground frequencies. The aircraft was expected to land at Palam at 1320 hrs. GMT and at 1325 hrs. GMT the long-range R/T Operator was asked to find out from Palam if the aircraft had landed there. As soon as the information was received that the aircraft had not landed, the distress action was started. Messages were passed to Howrah and Sealdah Railway Controls. Police wireless was used to alert all police outposts. Military Headquarters was also informed as well as the I.A.F. at Barrackpore and the Chief Secretary, West Bengal, was also informed for passing information to all the districts. The Aerodrome Officer, Gaya, was particularly requested to alert the police and commence search in the areas between Gaya and Calcutta. Similar request was made to the Aerodrome Officer, Asansol.

All aircraft which were leaving Calcutta whether for Delhi or Karachi were asked to keep a look-out. No aircraft was sent out that evening for search, as it was considered that no useful purpose would be served at that time on account of weather conditions and darkness. Delhi was asked and it confirmed that search action was being taken from that side also.

One of the villagers who saw the crash communicated it to the Village Daroga and to the Sub-Inspector of Police, Jangipara Police Station, who happened to be in a neighbouring village for some investigation. He immediately went to the scene of the crash and found the two parts of the aircraft burning. He sent a messenger to the Police Station. It being a third-class Police Station, the only means of immediate communication was the Railway Telegraph Office. But the Station Master, who was asked to send a wire, found that the through wire-line from Jangipara to Howrah Maidan was defective on account of heavy storm and so he tried to send the message by train wire from station to station. He has given the details of the steps taken by him, and no message was in fact received at the Dum Dum Airport till next morning. Prompt steps were taken by the Police to cordon off the area. None of the crew or passengers was alive. On the morning of 3rd May, 1953, a B.O.A.C. York as well as two Indian Air Force aircraft commenced searching and information was received at Dum Dum Airport from the Police Headquarters, Lallbazar, Calcutta, that two aeroplanes seemed to have collided in the air and that the police officer had gone to the spot for investigation. As soon as this message was

received, Area Control informed the search aircraft to proceed to the position reported by the police. A ground party which included the Airport Health Officer, the first-aid equipment and B.O.A.C. operations staff, proceeded to the B.O.A.C. City Office where it was confirmed that the position of crash given by the police was correct and that the wreckage was that of the Comet. The land-party then proceeded to the site of the accident.

Out of the 43 persons on board the aircraft only 40 bodies were recovered, and the remaining three must have been destroyed in the fire.

14. DISCUSSION OF THE EVIDENCE

The ill-fated jet aircraft Comet, G-ALYV, operated a scheduled service from London to Singapore. On its return flight from Singapore on 2nd May, 1953, it landed at Dum Dum Airport at 0940 hrs. GMT (1510 hrs. IST).

At the airport the normal procedure was carried out as described by Mr. Jones, the Senior Station Officer, B.O.A.C., at Calcutta, who was in charge of the general supervision of all airport traffic handling arrangements as well as supervision of the operational side.

Documents examined show that the aircraft held a valid Certificate of Airworthiness and a valid Certificate of Maintenance. At the time of take-off, its laden weight was below its regulated weight for departure from Calcutta (Dum Dum) and its C.G. position was within the safe limits. The Captain was an experienced pilot with adequate experience on Comet aircraft. He had also considerable flying experience of the route. Other members of the operating crew of the aircraft had the requisite qualifications and experience. They all held valid licences.

The Captain was duly briefed and given a clearance certificate which was duly signed by him. Before landing, he was informed of the expected storm at the airport after 1100 hrs. GMT (1630 hrs. IST). After landing, he was informed of the weather forecast that the storm was expected between 1200 and 1600 hrs. GMT (1730 and 2130 hrs. IST). A warning of the expected storm was also issued by the Area Control Officer, which was received by Mr. Wheeler, the Station Officer of the B.O.A.C., and passed on to the Captain of the Comet. It was to the effect that a thunderstorm accompanied by squalls from the northwest with speed reaching 50 knots was expected over Dum Dum and neighbourhood between 1200 hrs. and 1600 hrs. GMT (1730 hrs. and 2130 hrs. IST). Both of

them then went to the meteorological office where the Captain had a discussion with the Officer on duty, Shri Chakraverti. It seems that the Captain was more anxious to ascertain the weather at the terminal (the Palam Airport) where he was to land than about the en-route weather.

The weather minimum for Comets at Calcutta has been described in a B.O.A.C. Manual as follows:—

“Subject to the I.L.S. and the non-directional beacon being serviceable, the take-off conditions for Dum Dum on runway 19 (which was the runway that the aircraft had used) is cloud base 300 feet and visibility 1,000 yards.”

The actual conditions at Dum Dum at the time of take-off were well above this minima and as regards the en-route weather minima, no specific instructions are issued, and it is left to the discretion of the Captain of the aircraft. The Captain of the Comet, following his discussion with the Meteorological Officer, decided to take off, and taking off at 1059 hrs. GMT (1629 hrs. IST), he encountered the squall within six minutes thereafter. About half-an-hour later Mr. Vlotman flew from Dum Dum Airport to Karachi in a K.L.M. Constellation and though he encountered the storm at a distance of 12 or 15 miles, he safely passed through it at an altitude of 4,500 feet. Of course, he was going in a slightly different direction, but he had been briefed by the meteorological office at Dum Dum that there was a system of cumulo nimbus clouds not far from Calcutta to the west. Unfortunately, the storm which the Comet encountered, as the eyewitnesses from the neighbouring villages state, was unusually severe. The Captain was not only well-qualified, but had considerable experience of weather conditions on this route. He was therefore fully competent to judge the weather forecast en route and the warning given, and make up his mind whether to take off or not. It would not be right to accuse him of any imprudence in taking off in spite of the warning.

It would not be out of place to point out here that the Director-General of Civil Aviation has issued a Notice to Airmen No. 33 of 1952, dated 31-10-1952, requiring that at aerodromes where the service or flight originates and at intermediate halts, the Pilot-in-Command or the Flight Operations Officer (Flight Despatcher) duly licensed by the State of Registry, should report in person to the Air Traffic Control Officer for briefing before commencement of the flight. No flight despatcher having been thus licensed by

the State of Registry, it is incumbent on the Pilot-in-Command to report in person to the Air Traffic Control Officer, who should insist upon such attendance before signing the clearance certificate. But as stated by Mr. Jones, the procedure followed is for the Flight Operations Officer to go to all the briefing departments at the commencement of his tour of duty and make a record of the briefings. In the present instance, the Operations Assistant Sundararaman collected the briefing and obtained the clearance certificate from the Area Control Officer, which he handed over to the Captain. The Pilot-in-Command usually does not report personally to the Air Traffic Control Officer. This procedure is a clear violation of the notice issued by the Director-General of Civil Aviation. In the present case, however, this has no direct bearing on the investigation as there is no doubt that the Captain of the Comet was in full possession of the briefings and all the information relevant to his flight.

What exactly happened when the Comet encountered the storm and what the crew did, is difficult to say. According to one eye-witness, there was a thud of something falling behind a hay-stack and he saw that it was something like shining metal. Evidently, it was part of the fuselage of the Comet. He then saw a blaze of fire in the sky. Another eye-witness saw a flash of light and looking up saw that a plane was on fire. He heard a bang in the sky and saw the plane split into two, one piece falling into a nullah burning violently, and the other falling to the ground and burning at some distance. He heard two more loud reports after a minute or two. In his opinion, the storm on that day was unusually violent.

All this must have taken place at about or immediately after 1105 hrs. GMT (1635 hrs. IST). Till then the Comet was in radio communication and the contact ceased thereafter. All subsequent attempts to contact it proved fruitless.

We have no evidence before us to indicate sabotage, or a stroke of lightning or faulty workmanship or defective material. There being thus no direct evidence as to the cause of the failure of the Comet to get safely through the storm, we have to infer it from the state of the wreckage, which was distributed over a large area.

There is no doubt that, as an expert witness Mr. Lett has stated, the aircraft suffered a complete structural failure in the air and thereafter the aircraft was on fire in the air. One of the assessors has, after a careful inspection of the

wreckage, arrived at a deduction which is embodied in his note in Appendix VII. The reasons given by him for the conclusion are quite plausible. But we think that a further prolonged and technical study of the wreckage is necessary to verify his deduction and determine the sequence of failures. This, in Mr. Lett's opinion, may take about nine to twelve months, and it is hoped that this will be done by the State of Registry of the aircraft as soon as possible.

15. FINDINGS

The Court finds that :—

- (i) The aircraft held a valid Certificate of Airworthiness. It had been maintained in accordance with the approved maintenance schedules and held a valid Certificate of Maintenance.
- (ii) The crew held valid licences and were competent to undertake the flight. The Captain had considerable flying experience on the route.
- (iii) The all-up weight did not exceed the regulated weight and the position of the centre of gravity was within the safe limits laid down in the load and trim sheet.
- (iv) Before departure the Captain was in possession of all the relevant meteorological and air traffic control information required for the flight. This included the warning of a thunder-squall.
- (v) The aircraft encountered a norwester squall with thunderstorm shortly after take-off when climbing to its cruising altitude, and suffered structural failure in the air which caused fire.
- (vi) An examination of the wreckage on the site did not reveal any sign of sabotage, lightning damage, faulty workmanship, defective material or power plant failure.

16. PROBABLE CAUSE OF THE ACCIDENT

The accident was caused by structural failure of the airframe during flight through a thundersquall. In the opinion of the Court the structural failure was due to overstressing which resulted from either :—

- (i) Severe gusts encountered in the thunder-squall, or
- (ii) Overcontrolling or loss of control by the pilot when flying through the thunder-storm.

17. RECOMMENDATIONS

The Court recommends:—

- (i) That the wreckage should be transported as soon as possible to the State of Registry and its detailed technical examination be undertaken with a view to determine the primary failure and to consider if any modification in the structure of the Comet aircraft is necessary; and
- (ii) That consideration should be given to the desirability of modifying the flying control system of the Comet aircraft in order to give the pilot a positive “feel” of airloads exerted on the control surfaces.

(Sgd.) N. S. LOKUR,
Court.

(Sgd.) K. M. RAHA,
Assessor.

(Sgd.) N. SRINIVASAN,
Assessor.

(Sgd.) T. R. NELSON,
Assessor.

CALCUTTA AIRPORT,
DUM DUM.
26th May, 1953.

APPENDIX I

AIRCRAFT INFORMATION

- (a) *Registration Marking* G-ALYV.
- (b) *Aircraft type and maker's serial number* Comet DH 106 series 1 06008.
- (c) *Engines* Four, De Havilland Ghost 50 Mark I.
Port Outer No. 3033.
Port Inner No. 3091.
Starboard Inner No. 3055.
Starboard Outer No. 3077.
- (d) *Certificate of Registration* .. No. R 3218/1.
- (e) *Certificate of Airworthiness* .. No. A 3218.
Date of expiry 21st April, 1954.
Flight Manual G-ALYV, A.3218.
- (f) *Certificate of Maintenance*—
Date, time and place of issue .. 30th April, 1953, 0430 hrs. GMT at London Airport.
Period of validity 73 flying hours from the time of issue.
- (g) *Year and place of construction of airframe* 1952 at Hatfield, England.
- (h) *Name and address of the owner* .. British Overseas Airways Corporation, Airways House, Great West Road, Brentford, Middlesex, England.
- (i) *Gross Weights*:—
Maximum authorised weight of the aircraft 107,000 lbs.
Regulated weight for take off from Dum Dum airport .. 99,220 lbs.
Actual weight for take off from Dum Dum airport 94,327 lbs.
Estimated weight at the time of the accident 93,007 lbs.
- (j) *Loading*:—
 (i) *Centre of gravity limits*—
Forward limit 0.935 feet forward of the datum (landing gear extended) 23.8 per cent. S.M.C.
 0.900 feet forward of the datum (landing gear retracted) 24.0 per cent. S.M.C.
Aft Limit 0.815 feet aft of the datum (landing gear extended) 33.8 per cent. S.M.C.
 0.850 feet aft of the datum (landing gear retracted) 34.0 per cent. S.M.C.
- (ii) *Centre of gravity position at take off and at the time of the accident* The load distribution and trim sheet indicates that at the time of take off the centre of gravity was within the safe limits. There is no evidence to indicate that the centre of gravity was not within the safe limits at the time of the accident.
- (k) *Airframe history* Number of flying hours at departure from London Airport on 30th April, 1953, 1,623 since new. Calculated aircraft hours at the time of accident 1,649.

(k) *Airframe history—contd.*

Modification State:

Additional hinge fitted to ailerons, modification 571/6-3-53.

Modified Elevators CTE 783A Issue 2 and balance weights fitted 20-4-53 (modifications 616, 675 and 691) under B.O.A.C. modification CM. 5258.

Accelerometer (modification 242) removed 13-4-53.

Strengthening of Trailing Edges modification 290 embodied.

Rudder, elevator and aileron trim spring struts fitted to latest standard on 5-3-53.

Inspection Instructions complied with:

No. 24 Check depth of swaging on flap cables.

No. 25. Check for foul between under-carriage door servodyne push rod and undercarriage door operating lever.

No. 30. Aileron servodyne lever at bulkhead 26 inspected for movement on attachment bolts.

No. 41. Messier filters checked for batch numbers (fatigue of casing reported).

No. 42. Equaliser circuits checked for resistance value.

No. 44. Hydraulic pipe adaptors on bulkhead 26 checked.

No. 45. Aileron hinge link (No. 1) bushes checked for security.

Major Incidents:

8-6-52—Beirut.—Undershot on landing. Starboard outer, centre and inner flaps damaged by boundary fence. Changed, together with strut support 6 CF 4255A and flexible pipe, forward wheels.

28-7-1952—Delhi/Karachi.

Aircraft subjected to heavy turbulence. 7 G recorded on instrument.

Aircraft checked at Karachi. Pop rivet in port mainwheel, blister on top wing surface, starboard inner extension pipe removed, bushes and runners inspected.

Note:—Pop rivet replaced by Chobert at Main Base and Metalistic bushes and Capasco bushes in starboard inner extension pipe renewed.

20-8-1952—Karachi.

Starboard main oleo attachment forging cracked. Main oleo changed.

3-4-1953—Rome/London.

A radio unit short circuited and caught fire.

(l) *Engine history* *Engine fitted in No. 1 position of aircraft G-ALYV:*

Engine 3033.—Total hours run at departure from London Airport—773.
Hours since overhaul at departure from London Airport—
Nil.

Engine received and installed in aircraft G-ALYS/4—5-1-1952.

1st Check I at 131 hours—8-4-1952.

2nd Check I at 248 hours—7-7-1952.

Time expired at 357 hours—16-8-1952.

Overhauled at De Havilland's—7-10-1952.

1st Check I since overhaul at 123 hrs.—10-12-1952.

2nd Check I since overhaul at 259 hrs.—17-1-1953.

Time expired at 417 hrs.

Overhauled at De Havilland's—15-4-1953.

Engine fitted to G-ALYV—28-4-1953.

Hours run—Nil.

(k) *Engine history—contd.*

Turbine Disc serial No. G1089D12.
Impellor (Modification 708) serial No. G1016.
Both fitted at last overhaul.
Date 15-4-1953.

Modifications 735 and 750 embodied.
Pipes reworked to Modification 792.

Engine fitted in No. 2 position of G-ALYV:

Engine 3091. Total hours run at departure from London Airport—
555. Hours since overhaul at departure from London
Airport—142. Hours since 1st Check I—Nil.

Received London Airport—3-9-1952.
1st Check I at 146 hours—17-10-1952.
2nd Check I at 277 hours—26-11-1952.
Time expired at 413 hours—17-1-1953.
Overhauled at De Havilland's—13-3-1953.
1st Check I at 142 hours—22-4-1953 (since overhaul).

Turbine Serial No. G1094D12.
Impellor (modification 708) serial number G1086.
Both fitted at last overhaul.
Date—13-3-1953.

Modifications 735 and 750 embodied.
Pipes reworked to modification 792.

Engine fitted in No. 3 position of G-ALYV:

Engine 3055. Total hours run at departure from London Airport—768.
Hours since overhaul at departure from London Airport—
316. Hours since 2nd Check I—Nil.

Received with aircraft G-ALYV position 2—14-6-1952.
1st Check I at 138 hours—8-7-1952.
Unserviceable fractured impellor at Livingstone 156 hours.
Returned to De Havilland's.
Partially overhauled.
2nd Check I at 298 hours—22-10-1952.
Time expired at 453 hours—25-10-1952.
Overhaul at De Havilland's—23-1-1953.

1st Check I (since overhaul) at 158 hrs.
2nd Check I (since overhaul) at 316 hrs.

Turbine Disc serial No. G1172D12 hours run 768.
Impellor (modification 481) serial No. G1213 fitted at last overhaul.

Modifications 735 and 750 embodied.
Pipes reworked to modification 792.

Engine fitted in No. 4 position of G-ALYV:

Engine 3077. Total hours run at departure from London Airport—600.
Hours since overhaul at departure from London Airport—
319. Hours since 2nd Check I and rectification—Nil.

Received London Airport—4-7-1952.
Despatched to Cairo as spare—15-7-1952.
Fitted to G-ALYV 17-7-1952 at Cairo.
Unserviceable Impellor 1-8-1952, hours run 65.

(k) *Engine history—contd.*

Rectified at De Havilland's.

1st Check I at 138 hours—19-9-1952.

2nd Check I at 280 hours }
Turbine blades damaged }^{14-11-1952.}
Engine overhauled 29-12-1952.

1st Check I since overhaul at 164 hours—17-2-1953.

2nd Check I since overhaul at 319 hours—31-3-1953.

No. 2 Turbine Bolt broken found during 2nd Check I. Rectified at De Havilland's—17-4-1953.

Impellor (modification 481) serial No. G1385 hours run 534.

Turbine Disc serial No. 1276D12 hours run 600.

Modifications 735 and 750 embodied.

Pipes reworked to modification 792.

(m) *Defects discovered during investigation*

None.

APPENDIX II

CREW INFORMATION

(a) HISTORY OF CAPTAIN MAURICE WILLIAM HADDON:

1. Date of birth: 21st June 1916.
2. Qualifications: Air Line Transport Pilot's Licence No. 8959 issued 13-6-1949, valid to 5-6-1953, and incorporating Flight Radio Telephony Licence (Group I ratings include De Havilland 106 Comet Series I).
(Captain Haddon held a 1st class (Modified) Air Navigator's Licence and Post Master General's W/T Licence in addition under the old licensing regulations.)
3. Initial training: 1935-38—Air Service Training Ltd., Hamble.
4. Corporation Record (British Airways Ltd. and B.O.A.C.):—

(i) Appointments:

1-12-1938	Engaged as Probationary Second Officer.
1-5-1939	Promoted to Second Officer.
1-12-1939	Promoted to First Officer.
27-3-1941	Appointed Acting Captain (Lockheed 10A only).
1-8-1941	Appointed Acting Captain (Lockheed 10A and 18 only).
1-1-1942	Appointed Acting Junior Captain.
1-4-1942	Promoted to Junior Captain.
1-9-1944	Promoted to Senior Captain 2nd Class.
1-2-1951	Promoted to Senior Captain 1st Class.

(ii) Main Operational Experience:

1938-39	European Services.
1940-41-42-43	Trans African Operations.
1944-45	Middle East Operations.
1945	Miscellaneous operations from the U.K.
1946-47-48	Services from the U.K. to Singapore/Hong Kong/Karachi/Calcutta.
1948-49	Seconded to Eagle Airlines, Teheran.
1949-50-51-52-53	Services from the U.K. to Hong Kong/Baghdad/Tokyo/Singapore/Buenos Aires/Nicosia/Cairo/Johannesburg/Rio de Janeiro/Bahrein.

5. Flying Times (to 16-4-1953).

(i) Prior to Joining B.O.A.C.

	1st Pilot		2nd Pilot	
	Day	Night	Day	Night
Miscellaneous light aircraft	306	31	86	4

(ii) With B.O.A.C.:

Lockheed 10A	251	—	100	11
Fokker XII	—	—	2	—
Lockheed 14	395	—	1,191	2
Junkers JU.52	—	—	47	—
Lockheed 18	831	—	81	—
Armstrong Whitworth 27 (Ensign)	1,120	6	254	2
D.H.95 (Flamingo)	21	—	14	9
Douglas C.47	184	1	4	1
Short S.25, S.25 (Mk. 5)	1,271	157	212	18
D. H. Dove and Oxford	172	1	2	1
Argonaut (C.4)	953	373	7	—
Comet I	283	156	115	35
Total	5,787	725	2,115	83

Total flying as Pilot: 8,710 hours plus 27 hours as Navigator.

6. Recent Flying Experience:

Total of 147 hours day and 78 hours night flying on Comet Series I aircraft during the six months prior to departure from U.K. on 16-4-1953.

7. Last six monthly check:
Examined 6-11-1952—result satisfactory.

8. Relevant Comet I Training:
Basic Gas Turbine Course .. 17-12-1951 to 21-12-1951.
De Havilland Technical Course 31-12-1951 to 16-2-1952.
Flying Training 12 hours 41 minutes.
Check Flight 2 hours 22 minutes.

9. Previous Accidents:

<i>Date</i>	<i>Details</i>	<i>Capacity</i>	<i>Remarks</i>
15-10-1939	Lockheed 14 G-AFKD overshot on landing at Shoreham.	2nd Pilot	No responsibility attached to First Officer Haddon.
27-5-1944	A.W.27 "Elsinore" carried out a "belly" landing at Jiwani.	1st Pilot	Capt. Haddon commended for exceptional airmanship.
23-4-1952	Comet G-ALYU landed heavily at Khartoum with resultant slight damage to the aircraft.	1st Pilot	Capt. Haddon admonished.

10. Flying carried out on Comet I aircraft during 90 days preceding the accident :
146 hours (including 39 hours after departure from the U.K. on 16-4-1953).

11. Flying experience through Calcutta:
April, May and June, 1944, on Ensigns.
April and May, 1946, on Hythe class Flying boats.
Further experience of Indian operations in other months during 1946 to 1951 on Argonauts.
Experience on Comets in 1953.

(b) HISTORY OF FIRST OFFICER ROBERT GEORGE WILLIAM STRANGE:

1. Date of birth: 8th November, 1920.

2. Qualifications: Air Line Transport Pilot's Licence No. 26144 issued 23-12-1949 and incorporating General Flight R/T Licence valid to 23-5-1953 (Group I endorsements include D.H. 106 Comet I).

Flight Navigator's Licence No. 2052 issued 11-4-1951 valid to 23-11-1953.

3. Initial Training: Royal Air Force.

4. Corporation Record:

(i) Appointments:

13-12-1946 .. Engaged as First Officer.

29-4-1948 Appointed Acting Junior Captain (on secondment to Eagle Airlines, Teheran).

6-2-1949 Reverted to First Officer (on completion of duties with Eagle Airlines).

(ii) Operational Experience;

(Prior to joining B.O.A.C. experience gained in the U.K./U.S.A./Middle East/India.)

1947 U.K./India (training and special flights).

1948 Services from Teheran (Eagle Airlines).

1949/53 Services from the U.K. to Hong Kong/Singapore/Colombo/Abadan/Calcutta/Tokyo/Baghdad/Cairo/Teheran/Bahrein/Entebbe/Rio de Janeiro/Buenos Aires/Karachi and miscellaneous European destinations.

5. Flying Times (to 16-4-1953):
 (i) Prior to joining B.O.A.C.

	1st Pilot		2nd Pilot	
	Day	Night	Day	Night
Single-engined aircraft	100	5	73	1
Twin-engined aircraft	883	308	124	33
Multi-engined aircraft	99	27	32	2
 (ii) With B.O.A.C.:				
Lancastrian	—	—	20	—
Dakota	6	2	177	38
Dominie	21	2	1	1
Oxford/Consul/Dove	300	2	64	3
Argonaut	8	—	1,240	558
Comet I	—	—	148	113
Total ..	1,417	346	1,879	749

Total flying experience as Pilot: 4,391 hrs.

6. Recent Flying Experience:

Total of 145 hours day and 113 hours night on Comet Series I aircraft during the six months prior to departure from U.K. on 16-4-1953.

7. Result of Last Check:

Examined 30-10-1952—result satisfactory.

8. Relevant Comet I training:

- No. 10 basic gas turbine course at CTU Medow bank .. 5-8-1952 to 8-8-1952.
- Comet Technical course De Havilland 11-8-1952 to 26-9-1952.
- Summary of experience Link (Comet conversion) .. 11.30 hrs.
- Flying Training observing 8.48 hrs.
- Flying Training Dual 7.09 hrs.
- Check flight 1.44 hrs.

9. Previous Accidents: Nil.

10. Flying carried out on Comet I aircraft during the 90 days preceding the accident:
 121 hours (including 39 hours after departure from the U.K. on 16-4-1953).

(c) HISTORY OF ENGINEER OFFICER ALBERT LYTTLETON GILMORE:

1. Date of birth: 11-4-1918.

2. Qualifications: Flight Engineer's Licence No. 115 issued 14-12-1946, endorsed D.H.106 Comet Series I, valid to 18-10-1953.
 Aircraft Maintenance Engineer's Licence No. 5287 issued 11-11-1946 (not current).

3. Corporation Record:

Appointments:

- 1-9-1945 Engaged as Flight Engineer (acting Fourth Engineer).
- 1-3-1946 Promoted to Third Engineer Officer.
- 1-6-1947 Appointed Engineer Officer "C".
- 1-3-1949 Promoted to Engineer Officer "B".
- 1-8-1951 Promoted to Engineer Officer "A".

4. Flying Times (to 16-4-1953).											
(i) Prior to joining B.O.A.C.:											<i>No. of hours</i>
Ferrying and test flying, single twin and multi-engined aircraft (Air Transport Auxiliary)											500
(ii) With B.O.A.C.:											
Short 25, 25 mark V.45											3,411
York											19
Hermes											1,230
Comet I											835
Total flying experience as Engineer Officer											<u>5,995</u>

5. Recent Flying Experience:

Total of 330 hours on Comet Series I aircraft for six months prior to departure from U.K. on 16-4-1953.

6. Result of last six monthly check:

Examined 3-2-1953—result satisfactory.

7. Flying carried out on Comet I aircraft during 90 days preceding the accident:

214 hours (including 39 hours after departure from the U.K. on 16-4-1953).

(d) HISTORY OF RADIO OFFICER ALFRED SAMUEL WOOD:

1. Date of birth: 22-10-1921.

2. Qualifications: Flight Radio Operator's licence No. 1015 issued 16-8-1950 valid to 18-8-1953.

3. Initial Training: Royal Air Force.

4. Corporation Record:

(i) Appointments:

8-11-1943 Seconded from R.A.F.
 8-11-1943 Appointed Third Radio Officer.
 14-9-1946 Promoted to Second Radio Officer (Established)
 1-6-1947 Appointed Radio Officer "B".
 1-9-1952 Promoted to Radio Officer "A".

(ii) Operational Experience :

1943-44, 1945-46 .. South Africa/Middle East/Indian and Trans-African operation.
 1947-48 Services from the U.K. to Hong Kong/Karachi/Singapore/Taranto
 1949 Services from Hong Kong.
 1950/53 Services from the U.K. to Damascus/Tokyo/Bahrein/Calcutta/Lyddah/
 Singapore / Teheran / Nicosia / Cairo / Johannesburg / Entebbe / Beirut/
 Colombo.

5. Flying Times:

(i) Prior to joining B.O.A.C.											<i>No. of hours</i>
..											29
(ii) With B.O.A.C.:											
Short S.23/30/33/25/25 Mark 5											5,601
Argonaut											1,118
Comet I											542
Total											<u>7,290</u>

6. Recent Flying Experience:

Total of 227 hours on Comet Series I aircraft during the six months prior to departure from U.K. on 16-4-1953.

7. Last six monthly check:

Examined 29-1-1953—result satisfactory.

8. Flying carried out on Comet I aircraft during 90 days preceding the accident:

130 hours (including 39 hours after departure from the U.K. on 16-4-1953).

(e) HISTORY OF STEWARD GEORGE WILLES IRWIN:

1. Date of birth: 11-6-1924.
2. Corporation record:
Appointments:

1-10-1947	..	..	Engaged by B.O.A.C.
26-2-1948	..	..	Commenced flying duties as Steward II.
1-11-1949	..	..	Appointed A/Steward I.
1-10-1950	..	..	Promoted to Steward I.
3. Flying Times:
With B.O.A.C.:
On York and Hermes—No record available.
On Comet Series I—530 hours.

(f) HISTORY OF STEWARDESS PATRICIA RAWLINSON:

1. Date of birth: 4-7-1926.
2. Corporation record:
Appointments:

17-10-1952	..	..	Engaged as Stewardess Trainee.
8-12-1952	..	..	Promoted to Stewardess III and posted to Comet Fleet for flying duties.
3. Flying Times:
With B.O.A.C.:
Comet Series I—160 hours.

APPENDIX III

PASSENGERS

	<i>Name</i>		<i>Nationality</i>	<i>Address</i>
1.	Mr. M. B. A. F. Aris	British	..	160, Jalan Kluang, Batu Pahat, Singapore.
2.	Mr. A. B. Avila	British	..	36, Theatre Road, Calcutta.
3.	Mr. E. W. Bateman	British	..	c/o Fairy Point Mess, Changi, Singapore.
4.	Mr. P. R. Brown	British	..	c/o N. T. Brown, Rusham House, Whitehall Lane, Egham, Surrey.
5.	Mr. J. T. Cartwright	British	..	c/o Harrisons & Crosfield Co. Ltd., 1-4, Great Tower Street London.
6.	Miss J. S. Cohen	U.S.C.	..	c/o S. S. Cohen, 901, Chauncey Avenue, Baltimore, Ma.
7.	Mr. N. B. Collins	British	..	No. 6 Winsor Park, Thompson Road, Singapore.
8.	Mrs. P. Farquharson	British	..	Kellydon T.E. Salana P.O., Assam.
9.	Mr. G. K. Farquharson	British	..	Kellydon T.E. Salana P.O., Assam.
10.	Mr. B. K. Featherstone	British	..	c/o Deputy Judge Advocate-General's Office, Singapore.
11.	Miss A. A. Hamilton	British	..	c/o Mrs. A. M. Studd, 97, Whitely Road, Singapore.
12.	Mr. F. J. Kemlo	British	..	Harrisons & Crosfield, Singapore.
13.	Mr. R. A. Landsman	British	..	Titaghur No. 1 Mill, 24, Pargannas, West Bengal.
14.	Mr. F. J. L. Leonard	British	..	6, St. Nicholas Flats, Singapore.
15.	Mr. W. J. London	British	..	c/o Lever Brothers, Kuala Lumpur.
16.	Mrs. D. H. Maltman	British	..	Dishergarh P.O., Burdwan Dist., West Bengal.
17.	Miss M. G. Maltman (child)	British	..	Dishergarh P.O., Burdwan Dist., West Bengal.
18.	Dr. B. Maung	Burmese	..	16, Sooniram Park, Rangoon.
19.	Mr. I. C. G. Milne	British	..	Foreign Office, Hong Kong.
20.	Mr. J. E. Milne	British	..	Phillobari Tea Estate, Doom Dooma, Assam.
21.	Mr. F. Mitchell	British	..	33 Chancery Lane, Singapore.
22.	Mr. H. A. Morton	British	..	c/o Harrisons & Crosfield, London.
23.	Mrs. H. P. Morton	British	..	c/o Harrisons & Crosfield, London.
24.	Mr. B. A. R. Nasarudin	British	..	81, Hale Road, Kuala Lumpur.
25.	The Hon. T. D. Oldham	British	..	c/o 5, Tyalla Road, Toorak, Victoria.
26.	Mrs. K. M. Oldham	British	..	c/o 5, Tyalla Road, Toorak, Victoria.
27.	Mr. H. G. Pearson	British	..	Majulighur T.E. Sootea Road, Assam.
28.	Mrs. H. G. Pearson	British	..	Majulighur T.E. Sootea Road, Assam.
29.	Mr. C. C. Po	Burmese	..	3, Prome Court, Prome Road, Rangoon.
30.	Mr. J. J. A. Boxas	Filipino	..	c/o C. A. Boxas Co., P.O. Box 1918, Manilla.
31.	Mrs. K. M. Smythe	British	..	c/o H. W. Smythe, Penang 79.
32.	Miss P. A. Smythe (baby)	British	..	c/o H. W. Smythe, Penang 79.
33.	Mr. P. K. Snead	U.S.C.	..	c/o Anglo-Chinese Boys' School, Lahad Road, Ipoh.
34.	Mr. D. P. Storey	British	..	Imperial Tobacco Co. of India, 37, Chowringhee, Calcutta.
35.	Mr. K. Teck Ee	British	..	c/o Mr. Loke Yaik Chee, 18, Kia Peng Road, Kuala Lumpur.
36.	Mrs. K. Teck Ee	British	..	c/o Mr. Loke Yaik Chee, 18, Kia Peng Road, Kuala Lumpur.
37.	Miss A. M. Whistler	U.S.C.	..	c/o Mrs. Hazel Whistler, 1605, Benita Avenue, Berkeley 9, California.

APPENDIX IV

AEROS AND 5M/5B REPORTS OF DUM DUM AND BARRACKPORE DURING THE PERIOD 0900Z-1200Z OF 2-5-53
A—DUM DUM

Sr. No.	Nature of message	Time of observation in GMT	Total cloud amount	Surface wind		Surface visibility	Plain language			QFE	QNH	
				Direction	Speed (knots)		Present weather	Past weather	Significant clouds			
							First layer	Second layer				
1	Aero	0900	4 Okta	S	16	7.0 Nautical miles	3 Okta Cu base 2,500'	1 Okta Cb Base 2,000'	Cloudy	Cloudy	1001.0 mbs. 29.56 ins.	1001.5 mbs. 29.57 ins.
2	"	0930	3 Okta	SSW	13	7.0 "	1 Okta Cb Base 2,000'	—	"	"	1000.6 mbs. 29.55 ins.	1001.1 mbs. 29.56 ins.
3	"	1000	4 Okta	SSW	13	7.0 "	3 Okta Cu Base 2,500'	1 Okta Cb Base 2,000'	"	"	1000.0 mbs. 29.53 ins.	1000.5 mbs. 29.55 ins.
4	"	1100	3 Okta	SSW	13	7.0 "	2 Okta Cu Base 2,500'	1 Okta Cb Base 3,000'	"	"	999.0 mbs. 29.50 ins.	999.5 mbs. 29.52 ins.
5	MMMMM (Thunderstorm)	1135	7 Okta	NW	31	1.8 "	4 Okta Cb Base 1,200'	3 Okta Fs Base 400'	Thunderstorm with rain	"		
6	Aero	1200	Overcast	NW	45 (Gusty)	440 yds.	5 Okta Cb Base 1,200'	3 Okta Fs Base 400'	Thundersquall with rain	"	1002.3 mbs. 29.60 ins.	1002.8 mbs. 29.61 ins.

The maximum gust velocity recorded at Dum Dum was 62 miles per hour at 1145 hrs. GMT.

I hereby certify that the meteorological observations recorded in these two sheets represent the actual weather (aeros and 5 MS) at Dum Dum and Barrackpore as recorded at the Meteorological Offices at these two places during the period 0900 to 1200 GMT on 2-5-1953.

(Sgd.) C. RAMASWAMY,
Meteorologist (23-5-1953)

B—BARRACKPORE

Sr. No.	Nature of message	Time of observation in GMT	Total cloud amount	Surface wind		Surface visibility	Plain language			QFE	QNH
				Direction	Speed (knots)		Present weather	Past weather	Significant clouds		
								First layer	Second layer		
1	Acro	0900	4 Okta	S	11	8.0 Nautical miles	Cloudy	Cloudy	3 Okta Cu Base 3,000'	1 Okta Cb Base 2,500'	1001.4 mbs. 29.57 ins.
2	"	1000	2 Okta	S	7	8.0 "	Cloud dis-solving	Variable Sky	1 Okta Cu Base 3,000'	1 Okta Cb Base 2,500'	1000.1 mbs. 29.53 ins.
3	"	1100	4 Okta	SSE	5	8.00 "	Cloud developing	Cloudy	3/8 Cb Base 2,000'	—	998.5 mbs. 29.49 ins.
4	MMMMM (Thunder)	1105	6 Okta	SSW	7	6.7 "	Thunder heard	"	4 Okta Cb Base 2,000'	2 Okta Sc. Base 2,000'	
5	MMMMM (Thundersquall)	1121	Overcast	NW	45	1.9 "	Thunderstorm with rain	"	6/8 Cb Base 1,800'	2 Okta Fs Base 400'	
6	MMMMM (Low clouds)	1130	"	NW	48	440 yds.	"	"	4 Okta Cb Base 1,500'	4 Okta St Base 300'	
7	Acro	1200Z	"	NW	18	1.1 Nautical miles	"	"	5 Okta Cb Base 1,500'	3 Okta Fs Base 400'	1003.8 mbs. 29.64 ins.

(True copy)

(Sgd.) S. MULL
Director,

Regional Meteorological Centre, Calcutta.

APPENDIX V.

WITNESSES

<i>Name</i>	<i>Occupation</i>
1. Narayan Chandra Ghosh	Cultivator, village Cagalgori (nearest to the place of crash).
2. Chandra Bidhu Singh Ray	Cultivator, village Thanashampur.
3. Nurari Nohan Ray .. ..	.. ..
4. Avash Chandra Singh Ray	Landholder, village Mahishnan.
5. Kishori Mohan Chakravarti	Shepherd, village Jagalgori.
6. M. John Robert Jones	Senior Station Officer, B.O.A.C., Calcutta.
7. Edward Wheeler	Station Officer, B.O.A.C., Calcutta.
8. John Blitz	Station Engineer, B.O.A.C., Calcutta.
9. D. R. Bhatia	Station Superintendent, Burmah Shell Service Station, Dum Dum.
10. Manoranjan Dey	Sub-Inspector of Police, Jangipura Police Station, Dist. Hooghly.
11. Karuna Kinker Mukerjee	Station Master, Jangipura Railway Station.
12. Gregory Gomes	Sub-Divisional Officer, Serampur.
13. D. K. Ghosh	Fuelling Superintendent, Burmah Shell, Dum Dum Airport.
14. P. E. Glover Jackson	Assistant Aerodrome Officer, Dum Dum Airport.
15. S. N. Mondal	Assistant Aerodrome Officer, Dum Dum Airport.
16. Sudhir Chandra Chakravarti	Assistant Meteorological Officer, Dum Dum Airport.
17. L. Foster	Station Officer, B.O.A.C., Dum Dum.
18. K. Sundararaman	Operational Assistant, B.O.A.C., Calcutta.
19. J. K. Bahram	Assistant Aerodrome Officer, Dum Dum Airport.
20. J. Nath	Assistant Aerodrome Officer, Dum Dum Airport.
21. G. K. Guha Roy	Radio Operator, Dum Dum Airport
22. P. K. Roy Chowdhary	Radio Operator, Dum Dum Airport.
23. M. G. Gidwani	Aerodrome Operator, Dum Dum Airport.
24. Yaswant Ram Malhotra	Inspector of Accidents, Civil Aviation Dept., Government of India, New Delhi.
25. James Herbert Lett	Investigating Officer, Accidents Investigation Branch, Ministry of Civil Aviation, London.
26. John George Magrath Pardoe	Surveyor, Air Registration Board, Croydon, England.
27. C. R. H. Cooke	Technician, Aeronautical Service Ltd., Dum Dum Airport.
28. C. J. Vlotman	Pilot, K.L.M., Amsterdam.
29. C. Ramaswami	Meteorologist-in-charge, Calcutta Airport.
30. Madhav Hari Limaya	Aerodrome Officer, Dum Dum Airport
31. G. B. Seth	Security Officer, B.O.A.C., Dum Dum.

APPENDIX VII

PROBABLE CAUSE OF STRUCTURAL FAILURE (As deduced by Shri W. Srinivasan, Assessor)

A technical examination of the wreckage has supplied several significant features that indicate a structural failure during flight in stormy weather conditions. Fire is a subsequent occurrence that has spread from the wing tanks on to the main body of the airplane. A study of the different components and their nature of failures strongly suggests primary failure of the elevator spar in bending due to a heavy down-load imposed on a "pull-up" by the pilot when the aircraft encountered a sudden down-gust during its flight across a "nor'wester squall".

WEATHER DATA

The Comet during its climb about 6 minutes after take-off met stormy weather conditions. The "nor'wester squall", according to meteorological experts, consists of a column of rising hot air currents in the "formative" stage covering an area varying between 30 and 40 square miles. The up-gusts created increase in speed as they rise in altitude towards the cloud base. The squall may even consist of many vertical cells at different stages of formation. Mixing with the cloud and the surrounding air, the "mature" stage starts with a down-pour of rain and consequent down-gusts of velocities varying between 15 and 50 miles per hour. Definite data on the gust velocities occurring in these nor'wester squalls, so characteristic of the Calcutta region during May and April, cannot easily be obtained even with the modern equipment and facilities. However, up and down gusts varying in intensity from 15 to 50 miles per hour at different altitudes are possible during the stormy weather conditions. On evidence by experienced pilots, it has been noted that the best way to fly through a storm or squall is to cut across at 90° with manual controls (i.e., without auto-pilot). While flying through a thunder-squall, the Captain takes over the controls and tries to maintain the attitude of the aircraft the same. The co-pilot keeps a watch on the A.S.I. and controls the throttle with a view not to exceed the specified limit manoeuvring speed.

PRIMARY FAILURE

A close examination of the spar in either elevator shows a bending failure at a station in between the No. 2 and No. 3 outboard hinges. It is a down-load bending with compression at the top flange and tension at the bottom. It is significant that this failure is of a localised nature with no damage over the surrounding area either in the tailplane or elevator skin, in spite of the subsequent impact damage observed on other portions of the structure. This elevator down-load failure may have been due to a "pull-up". The down-load on the tail-unit seems to have caused a fuselage failure in bending at bulkhead No. 26. The top panels have failed in tension and the bottom panel in compression.

During flight in a down-gust, the aircraft not only loses altitude, but it takes a nose-down attitude. The air speed increases. The pilot immediately reacts to keep the attitude of the aircraft the same by a "pull-up" and the co-pilot throttles back the engines for reducing the speed to keep it within the specified limit. The wreckage reveals that all the four throttle controls were found in the "half-open" position. The aircraft has responded to the corrective action taken, but a sudden elevator failure must have imposed a heavy down-load on the wings with the resulting wing failure at about Rib No. 7. It is also significant that the extension wings have failed at about the same station points on both sides. The extension wing panels have tension failure at the top and compression failure at the bottom. The above structural failure must have been so rapid that the crew and the passengers have been subjected to a high positive "G" first during the "pull-up" and perhaps a higher negative "G" on elevator failure. The inner panels of the outer wing between Ribs 7 and 12 have flapped up and down and detached themselves at Rib 7 by bending failure.

PROBABLE SUCCESSIVE FAILURES

The detached wings lagging behind the main body of the diving aircraft may have impacted the tailplane on the port side and the fuselage on the starboard side. It is difficult at this stage to determine exactly the flight path of the two extension wings after separation in relation to the main body of the diving aircraft and say exactly which portion of the wing hit the tail-end of the fuselage and tailplane. The starboard extension wing has suffered heavy impact on its leading edge. There are indications to show that it has been hanging on to some metal panels chafing its leading edge right along the spar. The starboard tailplane has an impact damage on the inboard leading edge.

The rudder appears to have been torn off its support to the fin by an impact. The fin has broken at the insulation box. The fin and rudder do not have any evidence of structural failure due to air-loads. It is highly improbable for the surfaces to have sustained the air-loads that could damage the hinge bolts and brackets as seen on the wreckage. The direction of the broken hinge bracket piece indicates that the impact load has come from the operating side. The way the inboard elevators have sheared off their mounting on the torque tube also suggests their damage due to sustained impact loads from the control side. An examination of the tail

portion of the fuselage reveals that it has suffered some impact in air from one of the wings. The starboard extension wing leading edge may have struck the fuselage tail and imposed the heavy loads on the elevator and rudder control torque tubes mounted at bulkhead 52. These loads could have sheared off the rudder from its support, broken the fin also at the insulation box and broken the inboard elevators off its hinge support. A heavy impact on the torque tubes will naturally shear the control surfaces off their hinge supports. The port wing aileron trailing edge has impact marks at three places. It is difficult at this stage of the investigation to match any impact damage with that found on the tail-unit or any other component. But there are indications that the port wing has caused the damage on the port tailplane.

Fuel from the outboard tank appears to have run along the wing span through the nose of the aileron right from Rib 7 to the wing tip. The detached extension wings with kerosene smeared all over, during their flight path across the jet blast have picked up fire. That explains the deposit of smoke on the wing at several places along the span.

The broken wings seem to have deposited smoke on the fuselage tail during its impact. This explains the reason why the fuselage tail has deposit of smoke while the just forward fuselage panels have not. The fuselage initial failure has been at bulkhead 26. The fuselage panels (between bulkhead 24 and pressure dome) have opened out in flight and broken off its attachment at bulkhead 26. The aircraft with a stub wing and no tail-unit may have got into some type of auto-rotation during its fall and settled itself into the nullah in the inverted position with the nose pointing south-east.

REMARKS

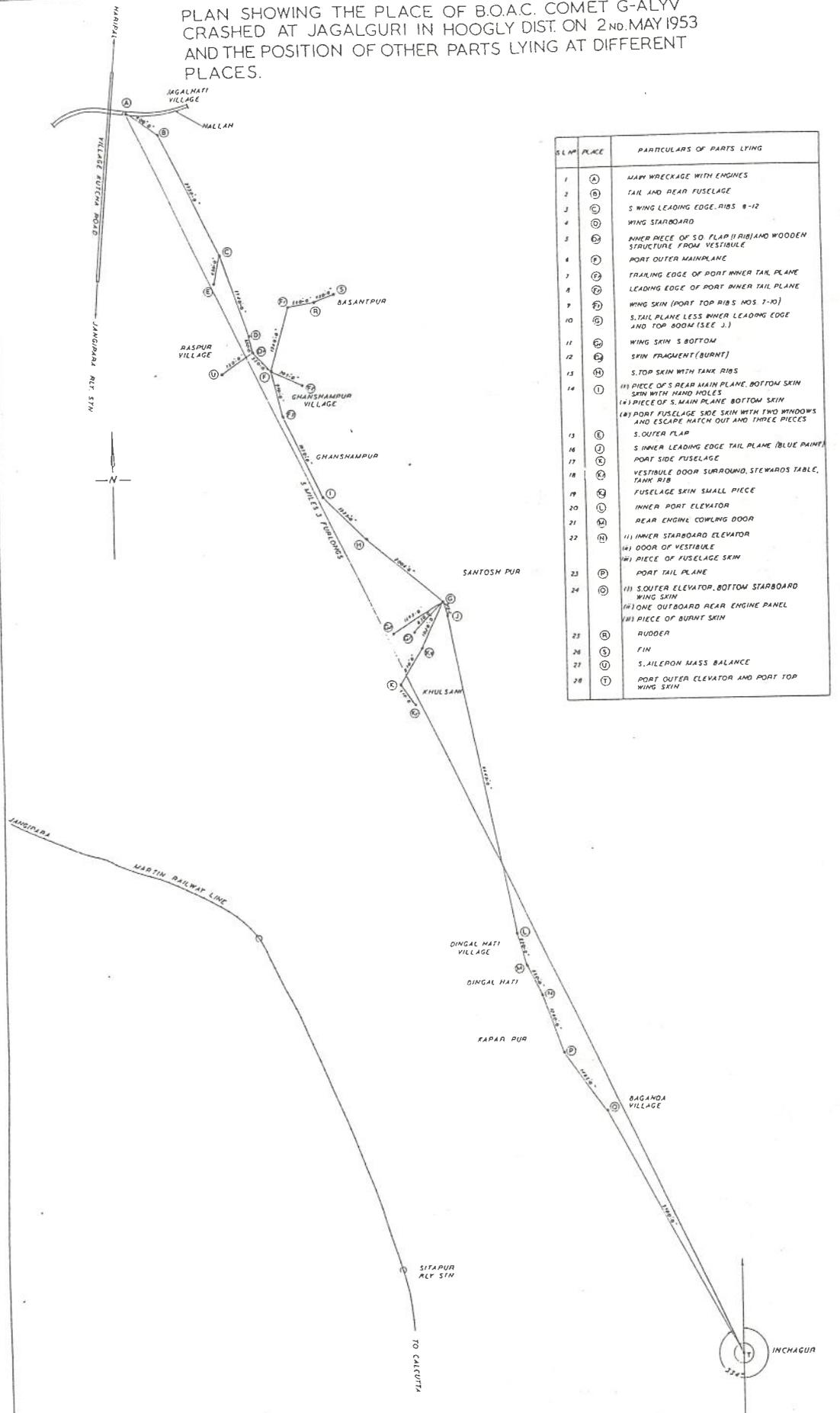
On an examination of the wreckage and the major components with the facilities available at the wreckage spot, it has been suggested that the primary failure may have been on the elevator. The metal elevator does not have a closed nose box to take the torsion loads. The triangular metal box aft of the spar forms in fact the only torsion resisting member on the elevator. The torsion will be resisted by the skin panels in tension field. There are indications on the starboard elevator to show that it has suffered a down-load and permanent diagonal wrinkles. The spar in between No. 3 and No. 4 hinges appears to have given way in bending. The spar along with the normal air-load bending will have secondary bending induced due to the tension field components on the skin panels. The elevators may have been stressed to the balancing and manoeuvring loads encountered during flight in gust conditions as per design requirements. A static test may also have been carried out to test the skin panels in tension field on a down or up load torsion in view of the absence of a closed nose section. In the absence of design details, it has not been possible to be definite on the comparative structural strength of the major components.

A sketch showing the distribution of the different components of the aircraft along the wreckage trail is appended to the Report. Normally, it may be possible to plot the trajectories of the falling bodies and predict with a certain amount of accuracy the primary failure of the aircraft. Since the aircraft disintegrated into several pieces up in the air with several successive failures and collision loads between parts and due to the fact that definite data on the wing velocities at the time of wreckage are not possible, no attempt was made to draw the trajectories and predict the primary failure.

It is understood during the investigation that the wing was subjected to a static test by the manufacturing firm during the development stage of the aircraft. On one test piece static and fatigue tests were conducted alternately. The wing failed in fatigue test and after modifications was subjected to a static test. The wing failed again at 90 per cent. of the ultimate load. The failure was attributed to the fatigue test conducted before. Modifications were carried out again and, without a re-test, it was found satisfactory for the ultimate load on theoretical considerations. The fatigue failure during static test occurred at Rib No. 7 where the cross-section changes from two heavy spars to an outboard shell construction. In this accident, again the wings have significantly failed at Rib 7. Whatever the load may be the failure at Rib 7 may indicate the lack of proper diffusion of the wing loads on to the two spars at Rib 7. In the absence of design data no definite comments can be made on the wing failure, but a further investigation on the above subject of load transfer at Rib 7 will be helpful.

It is extremely difficult during this short period of investigation with limited facilities and data to substantiate the primary failure with all details, but there are strong indications on the wreckage to suggest the primary failure of the elevator during a "pull-up". The Comet has got an elevator control system operated with booster power with no feed-back arrangement for pilot feel. It is quite probable that the pilot, who is accustomed to a sort of "feel" on the controls during manoeuvres had over-controlled the aircraft beyond the limit that would impose the design loads on the aircraft. In this respect any modification to incorporate a control "feed-back" in the elevator system will be a definite improvement.

PLAN SHOWING THE PLACE OF B.O.A.C. COMET G-ALYV
 CRASHED AT JAGALGURI IN HOOGLY DIST. ON 2ND MAY 1953
 AND THE POSITION OF OTHER PARTS LYING AT DIFFERENT
 PLACES.



S. NO.	PLACE	PARTICULARS OF PARTS LYING
1	(A)	MAIN WRECKAGE WITH ENGINES
2	(B)	TAIL AND REAR FUSELAGE
3	(C)	S WING LEADING EDGE, RIBS 8-12
4	(D)	WING STARBOARD
5	(E)	INNER PIECE OF S.D. FLAP (RIB) AND WOODEN STRUCTURE FROM VESTIBULE
6	(F)	PORT OUTER MAINPLANE
7	(G)	TRAILING EDGE OF PORT INNER TAIL PLANE
8	(H)	LEADING EDGE OF PORT INNER TAIL PLANE
9	(I)	WING SKIN (PORT TOP RIBS NOS 7-10)
10	(J)	S. TAIL PLANE LESS INNER LEADING EDGE AND TOP BOOM (SEE J.)
11	(K)	WING SKIN S BOTTOM
12	(L)	SKIN FRAGMENT (BURNT)
13	(M)	S. TOP SKIN WITH TANK RIBS
14	(N)	(N) PIECE OF S. REAR MAIN PLANE, BOTTOM SKIN SKIN WITH HANG HOLES
15	(O)	(O) PIECE OF S. MAIN PLANE, BOTTOM SKIN
16	(P)	(P) PORT FUSELAGE SIDE SKIN WITH TWO WINDOWS AND ESCAPE HATCH OUT AND THREE PIECES
17	(Q)	S. OUTER FLAP
18	(R)	S. INNER LEADING EDGE TAIL PLANE (BLUE PAINT)
19	(S)	PORT SIDE FUSELAGE
20	(T)	VESTIBULE DOOR SURROUND, STEWARDS TABLE, TANK RIB
21	(U)	FUSELAGE SKIN SMALL PIECE
22	(V)	INNER PORT ELEVATOR
23	(W)	REAR ENGINE COWLING DOOR
24	(X)	(X) INNER STARBOARD ELEVATOR
25	(Y)	(Y) DOOR OF VESTIBULE
26	(Z)	(Z) PIECE OF FUSELAGE SKIN
27	(AA)	PORT TAIL PLANE
28	(AB)	(AB) S. OUTER ELEVATOR, BOTTOM STARBOARD WING SKIN
	(AC)	(AC) ONE OUTBOARD REAR ENGINE PANEL
	(AD)	(AD) PIECE OF BURNT SKIN
	(AE)	RUDDER
	(AF)	FIN
	(AG)	S. AILERON MASS BALANCE
	(AH)	PORT OUTER ELEVATOR AND PORT TOP WING SKIN

