

REPORT BY THE INVESTIGATING BOARD ON THE ACCIDENT TO SE-HDY

PART 1 - INTRODUCTION

1. ACCIDENT DETAILS

- 1.1 Location From Ndola aerodrome control tower
8.05 nautical miles on a true
bearing 279°. Map reference
Ndola 1228D3 grid position 652657,
geographical position -
Latitude 12°58'20"S
Longitude 28°31'23"E
- 1.2 Date and time (approx.) 17th September, 1961. 2215 GMT
18th September, 1961. 0015 local
- 1.3 Operator Transair Sweden A.B., Malmo, Sweden.
- 1.4 Aircraft type and registration Douglas DC6B SE-HDY
- 1.5 Extent of damage Destroyed
- 1.6 Number of crew Four, all killed. See appendix 3.1
- 1.7 Number of passengers Twelve, all killed. See appendix 3.2
- 1.8 Type of operation Public transport - non-scheduled
(charter) flight.
- 1.9 Phase of operation Approach preparatory to landing.
- 1.10 Type of accident Insufficient altitude in approach:
collision with trees.

2. SUMMARY

2.1 Brief summary of events leading up to the accident.

2.1.1 The aircraft SE-HDY departed from Leopoldville at 1551 hours GMT on 17th September, 1961 with the Flight Plan destination stated to be Luluaburg. After clearing Leopoldville tower frequency, radio silence was apparently maintained until the aircraft called Salisbury FIC at 2002 GMT filing a revised Flight Plan which indicated the aircraft destination to be Ndola, estimated time of arrival 2235 GMT. At 2035 GMT the aircraft reported over Lake Tanganyika, indicating that it was not flying on the direct route from Leopoldville to Ndola. See appendix 1.3

2.1.2 Radio contact was made with Ndola tower at 2135 GMT. During subsequent conversations weather and landing information, and descent clearance from 16,000

to 6,000 feet, were given. The aircraft reported when it was overhead Ndola descending, with airport lights in sight. The altimeter setting was confirmed by the aircraft and at 2210 GMT the aircraft was requested to report reaching 6,000 feet. No such report and no further radio communication was received from the aircraft.

2.1.3 Eye witnesses saw the lights of the aircraft pass over Ndola airport on a Westerly heading and disappear from view. The aircraft failed to report for final landing instructions, and although it was then believed that it had changed its intention and was proceeding elsewhere, overdue action was nevertheless initiated.

2.1.4 The wreckage of the aircraft was located about eight nautical miles from Ndola airport on a bearing of 279° True. Police arrived on the scene of the accident at 1345 GMT. Only one of the occupants was found to be alive and he subsequently died.

2.2 Authority convening inquiry, appointment of accredited representatives, etc.

2.2.1 In view of the importance of the personality involved and the widespread interest in this serious and tragic accident, the Federal Government required the Director of Civil Aviation personally to lead the technical investigation, assisted by Wing Commander Evans, R.A.F., of the British High Commission to the Federation. The investigating board consisted of :-

Lt. Col. K.C.H. Barber, D.F.C.	Director of Civil Aviation, Federation of Rhodesia and Nyassaland (Chairman)
C/Capt. J. Blanchard-Sims, A.F.R.Ae.S.,	Senior Operations Officer, Federal Department of Civil Aviation.
Mr. M. Hedders, A.F.R.Ae.S.,	Chief Inspector of Aircraft, Federal Department of Civil Aviation.
W/Cdr. E. Evans, R.A.F.	Air Adviser, British High Commissioner to the Federation.

2.2.2 Representatives from Sweden - the State of Registry, the International Civil Aviation Organisation on behalf of United Nations, the International Federation of Airline Pilots Associations, and Transair the operators of the aircraft, were invited to participate in the investigation.

These persons were:-

Accredited Representatives :

Mr. E.A. Landin	Inspector of Civil Aviation, Royal Swedish Board of Civil Aviation.
Mr. J.P. Fournier	International Civil Aviation Organisation/United Nations
Capt. A.G. McAfee	International Federation of Airline Pilots Associations

Technical Advisers :

To Mr. Landin:

Dr. E. Bratt	Minister for Sweden to the Republic of South Africa.
Mr. T. Nylén, LL.M.	Legal Adviser, Royal Swedish Board of Civil Aviation.
Mr. N.S.L. Lindman	Temporarily attached to the Royal Swedish Board of Civil Aviation, as Senior Inspector of Aircraft.
Mr. O. Danielsson	Superintendent, Swedish Criminal State Police.
Mr. N. Landin, M.Sc.	Assistant Director of the Swedish National Institute of Technical Police.
Mr. A.W. Jansson	Temporarily attached to the Royal Swedish Board of Civil Aviation, as Inspector of Aircraft.

To Mr. Fournier:

Mr. T.R. Nelson A.F.R., A.C.S. M.C.A.I.	International Civil Aviation Organisation/United Nations
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On behalf of Transair Sweden, A.B., the owners and operators of the aircraft :

Capt. S. Persson	Director of Flight Operations, Transair Sweden, A.B.
Mr. E. Virving	Chief Engineer, Transair Sweden, A.B.
Mr. C.G. Hellberg	Chief Flight Engineer, Transair Sweden, A.B.

Secretary to the Board :

Mr. I.J. Berry	Senior Aerodromes Officer, Federal Department of Civil Aviation.
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PART 2 - FACTS ASCERTAINED BY INQUIRY

3. AIRCRAFT INFORMATION

- 3.1 Registration marking SE-BDY
- 3.2 Aircraft type and makers serial number Douglas DC6B serial number 43559
- 3.3 Engine type, airframe positions and makers serial numbers
Pratt & Whitney R2800-CB-17
Posn. No. 1 serial P.35865
" " 2 " P.31738
" " 3 " P.32147
" " 4 " P.35867
- 3.4 Certificate of Registration number and validity No. 1508 - validity unlimited.
- 3.5 Certificate of Airworthiness; number and date of expiry, and Flight Manual number.
The temporary C of A has no number, and is valid until 31st October, 1961. The Flight Manual has no number, it is attached to the temporary C of A.
- 3.6 Certificate of Maintenance date and time (GMT) of issue and period of validity
Issued 17th September, 1961, at 1100 GMT and valid for 24 hours.
- 3.7 Date of construction of airframe 1952
- 3.8 Name and address of owners Transair Sweden, A.B. Malmo, Sweden.
- 3.9 Gross weight: maximum permitted by the C of A for this flight, and at time of accident
Maximum authorised take-off weight 107000 lbs.
Actual take-off weight 90594 lbs.
Maximum authorised landing weight 88200 lbs.
Actual weight at time of accident 76762 lbs.
- 3.10 Loading -
- 3.10.1 Centre of Gravity limits from Flight Manual
Gross weight up to and including 87500 lbs:
Forward limit 11.0% MAC aft limit 3% MAC
Gross weight up to and including 103800 lbs:
Forward limit 14.2% MAC aft limit 3% MAC

Gross weight up to and including 107000 lbs:

Forward limit Aft limit
16.0% MLC 33% MLC
Landing gear extended.

3.10.2 Actual C of G position at commencement of flight and at time of accident

C of G position at take-off between 20.0 and 26.9% MLC.
C of G position at time of accident between 17.1 and 25.3% MLC

3.11 Airframe history -

3.11.1 Flying time since manufacture 16340 hours

3.11.2 Flying time since last overhaul 7210 hours

3.11.3 Flying time since last periodic check 105 hours

3.11.4 Modifications All applicable FAA Airworthiness Directives have been complied with

3.12 Engine history

3.12.1 Flying time since manufacture

No. 1 (P.35865)	5521 hours
" 2 (P.31738)	5886 "
" 3 (P.32147)	7927 "
" 4 (P.35867)	4848 "

3.12.2 Flying time since last overhaul

No. 1 (P.35865)	518 hours
" 2 (P.31738)	390 "
" 3 (P.32147)	278 "
" 4 (P.35867)	1091 "

3.12.3 Flying time since last periodic check

No. 1 (P.35865)	105 hours
" 2 (P.31738)	105 "
" 3 (P.32147)	105 "
" 4 (P.35867)	105 "

3.12.4 Modifications All applicable FAA Airworthiness Directives have been complied with

4. CREW INFORMATION

4.1 Name Hallonquist, Per-Erik Bo.
Duty Pilot in Command

Age	35 years
Type of licence	Swedish Airline Transport Pilot's licence number D-193.
Aircraft class	Single- and multi-engined land aircraft.
Type Ratings	Douglas DC-3, Curtiss C-46/ C-20-T, Douglas DC-6.
Instrument Rating and date of last check	Included in the licence. 28th June, 1961
Date of last medical examination	24th April, 1961.
Expiry date of licence	31st October, 1961.
Types flown	Bucker Bestmann, Harvard, Focke Wulf, "Stieglitz", Fieseler Storch, Saab B17, Saab J21, Douglas DC-3, Curtiss C-46, Douglas LC-6, Douglas DC-6B.
Time on accident type:	LC-6 1266 hours DC-6B 179 hours
Time on type in past 90 days	DC6/6B 205 hours
Time on type in past 24 hours	7 hours
Grand total	7841 hours

Captain Hallonquist started his flight training in the Swedish R.A.F. in 1946 where he remained until 1953. In 1947 he was issued with a Private Pilot's licence. A Commercial Pilot's licence was issued to him in 1953. At about this time he had further flight training for 4 months with Air Service Training Limited, England. He obtained his Airline Transport Pilot's licence in 1955. He was also the holder of a valid Flight Radio Telephony Operator's licence number 4447. He was employed by Transair as a co-pilot on DC-3 in 1954, and was promoted to captain on DC-3 in 1955 and on Curtiss C-46 in 1957. During October-November, 1959, he was given theoretical and practical training on DC-6 aircraft under the supervision of Scandinavian Airlines System. In December, 1959, he commenced flying as a captain on DC-6 for Transair. His total instrument flight time and night flight time was 2669 hours. He had not been involved in any previous flying accidents.

4.2 Name	Litton, Lars Olof.
Duty	Co-pilot
Age	29 years
Type of licence	Swedish Airline Transport Pilot's licence number D-360
Aircraft class	Single- and multi-engined land aircraft
Type Ratings	As a captain, Douglas DC-3, Douglas DC-6. As a co-pilot, Curtiss C-46.
Instrument Rating and date of last check	Included in the licence. 6th April, 1961.
Date of last medical examination	17th July, 1961
Expiry date of licence	31st January, 1962
Types flown	Cessna 140, Luscombe Silvaire, Piper Cub, Ercoupe, Maister V, D.H. 89, Airspeed Consul, Klemm 35, Douglas DC-3, Curtiss C-46, Douglas DC-6, Douglas DC-6B.
Time on accident type	DC-6 506 hours DC-6B 216 hours
Time on type in past 90 days	DC6/6B 261 hours
Time on type in past 24 hours	17 hours
Grand total	2707 hours

First Officer Litton had his first flight training at a private Swedish flying school, and obtained his Private Pilot's licence in 1953. A Commercial Pilot's licence was issued to him in 1955. He obtained his Airline Transport Pilot's licence in 1961. He was also the holder of a valid Flight Radio Telephony Operator's licence number 4443. He was employed by Transair as a co-pilot on DC-3 and Curtiss C-46 in 1958. During November, 1960, he was given theoretical and practical training on DC-6 aircraft under the supervision of Scandinavian Airlines System. In December, 1960, he commenced flying as a co-pilot on DC-6 for Transair. His total instrument flight time and night flight time was 835 hours. He had not been involved in any previous flying accident.

4.3 Name	Wilhelmsson, Nils-Goran
Duty	Flight Engineer
Age	27 years
Type of licence	Swedish Flight Engineer's licence number MF-129
Type Ratings	Curtiss C-46, Douglas DC-6
Date of last medical examination	17th July, 1961
Expiry date of licence	31st July, 1962.
Time on accident type	DC-6 1173 hours DC-6B 195 hours
Time on type in past 90 days	DC6/6B 311 hours
Time on type in past 24 hours	17 hours
Grand total	2630 hours

Mr. Wilhelmsson was also the holder of a valid Swedish Aircraft Maintenance Engineer's licence number MA-411. He completed a course at a Swedish Municipal Technical School for ground engineers during the years 1949-1951. During the years 1952-1957 he was employed as a ground engineer with a Swedish civil air carrier, and also with the Swedish R.A.F. He was employed as a ground engineer by Transair in 1957 and started to work as a flight engineer on Curtiss C-46 with Transair in 1958. During March, 1960, he completed theoretical and practical training on DC-6 aircraft under the supervision of Scandinavian Airlines System.

4.4 Name	Ahrens, Nils-Erik
Duty	Reserve Captain
Age	32 years
Type of licence	Swedish Airline Transport Pilot's licence number D-199
Aircraft class	Single- and multi-engined land aircraft
Type Ratings	Douglas DC-3, Curtiss C-46, Douglas DC-6.
Instrument Rating and date of last check	Included in the licence 3rd May, 1961.

Date of last medical examination	28th April, 1961
Expiry date of licence	31st October, 1961
Types flown	Tiger Moth, Focke Wulf, "Steiglitz", Fieseler Storch, Klemm 35, Harvard, Buckler Bestmann, Saab Safir, Saab B.17, Vampire, Saab J29, Piper Cub, Luscombe Silvaire, Airspeed Consul, Douglas DC-3, Curtiss C-46, Douglas DC-6, Douglas DC-6B.
Time on accident type	DC-6 738 hours LC-6B 122 hours
Time on type in past 90 days	DC6/6B 241 hours
Time on type in past 24 hours	10 hours 40 minutes
Grand total	7107 hours

Captain Ahrens started his flight training in the Swedish R.A.F. in 1947, where he remained until May, 1954. In 1947 he obtained his Private Pilot's licence. A Commercial Pilot's licence was issued to him in 1948. Around June, 1954, he was employed as a pilot with a Swedish air carrier engaged in agricultural flying. In 1955 he obtained a Senior Commercial Pilot's licence. He was given an Airline Transport Pilot's licence in 1956. He was also the holder of a valid Flight Radio Telephony Operator's licence number 4402. He was employed by Transair as a co-pilot on DC-3 in 1955 and was promoted to captain on DC-3 in 1956, and on Curtiss C-46 in 1958. During October and November, 1960, he completed a course of theoretical and practical training on DC-6 aircraft under the supervision of Scandinavian Airlines System. In November, 1960, he commenced flying as a captain on DC-6 aircraft for Transair. His total instrument flight time and total night flight time was 1500 hours. He had not been involved in any previous flying accident.

5. WEATHER INFORMATION

5.1 The last routine weather observation taken prior to the accident was made by the Meteorological Office staff at Ndola at 1900 GMT on 17th September (3½ hours before the accident). This observation was recorded on a Form M.O. 48 (serial

number 17) and passed to the Air Traffic Control Officer. It contained the following information:-

Mbala - 17/9/61 1900 GMT

Surface wind - direction 110°(M) speed 10 knots

Visibility - 5 miles

Present weather - fine, slight haze.

Cloud - nil

QNH - 1019.9 mbs (30.12 ins)

QFE - 875.6 mbs (25.86 ins)

5.2 The following is an extract from the autographic record for 2200Z on 17th September, 1961.

Surface pressure 876.7 mbs i.e. 25.89 ins giving a
QNH of 30.15 ins (1021 mbs)

Screen temperature - 70° F.

Surface wind - 120/9 kts (True)

5.3 The following is the weather report transmitted by Mbala Air Traffic Control to the aircraft SE-EDY at 2137 (38 minutes approx. before the accident).

Surface wind 120°(M) 7 knots

Visibility 5 to 10 miles with slight smoke haze

Control QNH 1021 mbs

QFE 877 mbs

5.4 Moonset - 0024 GMT - 1st Quarter

6. NAVIGATION AIDS

6.1 Aids available on this flight

Leopoldville - NDB and VOR

Mbala - NDB, VLF and DME

6.2 Aids fitted to the aircraft

1 ea US Army Type EE-16 Magnetic Compass

2 ea Pioneer Bendix D120 Master Direction Indicator

2 ea Collins Type 331A-2 Course Line Indicator

2 ea Pioneer Bendix 36105-1J-15-C1 Magnetic Indicator

2 ea 51Y-1 ADF Receiver

1 ea 16002-1-C Flight Path Computer

2 ea 51 R-ELV Receiver (VOR/ILS)

- 2 ea 51 V-2 GS Receiver (ILS)
- 1 ea MEL-7A Marker Receiver (ILS)
- 1 ea ANQ-10 Receiver Transmitter (Radar)

6.3 Aids used and their effectiveness.

6.3.1 Navigation was not a significant factor in this accident as the aircraft arrived safely over the destination airport of Ndola. All the aids at 6.1 above were fully serviceable throughout the duration of the flight.

6.4 Maps, radio facility charts, etc.

6.4.1 It was not possible to ascertain what maps were actually used during the flight. However, as the aircraft completed a flight from Leopoldville to Ndola via the Southern end of Lake Tanganyika, the maps used were obviously sufficient for the purpose.

6.4.2 The operators of the aircraft, Messrs. Transair, have stated that all let-down and destination information is obtained from the Jeppesen Route Manual. A copy of this manual was recovered from the wreckage and, although badly burned, it was possible to ascertain that it had been amended by "IL" on 11/9 to include amendment number 34. The approach chart sheet for Ndola was missing, and it is possible that it was removed by the captain and placed in front of him whilst carrying out his approach to the airport. It was ascertained from a complete copy of the manual that the information regarding Ndola was correct. In addition, a copy of the U.S. Air Force publication "Flight Information Publication - Terminal (Low Altitude)" dated July, 1961, was found in the wreckage. There is no mention of Ndola in this publication but Ndolo aerodrome, situated on the outskirts of Leopoldville, is included. Certain notes appear in green on the Ndolo sheet and on the top cover of the publication. These notes may be significant in that there is reason to believe that Ndolo was not used by large aircraft at any time after the issue of this particular publication (July, 1961) and in that at least one of the notes on the Ndolo sheet appears to relate to Ndola. The relative approach altitudes, shown on the Ndolo sheet are substantially lower than those applicable to Ndola.

7. COMMUNICATIONS7.1 Data on communications and their functioning.

7.1.1 The aircraft obtained take-off clearance from Leopoldville tower on VHF and was airborne at 1551 GMT. The Investigating Board has found no evidence to show that this aircraft had any radio communication after leaving Leopoldville until 2002 GMT when contact was made with Salisbury FIC on 5521.5 kc/s. H/F R/T communication with Salisbury FIC was maintained successfully until 2132 GMT when the aircraft was told to contact Ndola approach. At 2135 GMT the aircraft contacted Ndola on 119.1 mc/s and maintained VHF communication until the last contact at 2210 GMT when it was overhead the airport. Recordings of H/F R/T conversations between the aircraft and Salisbury FIC on 5521.5 kc/s and also between the Salisbury FIC ATOC and Ndola tower ATOC on 6915/3682 kc/s are at appendices 1.4 and 1.5. Extracts from the ATC log at Ndola are at appendix 1.6. There were no tape recording facilities at Ndola for recording radio communications.

8. GROUND INSTALLATIONS8.1 Condition of aerodrome and installations.

8.1.1 Ndola aerodrome has one bitumen runway 10/28 which is 6650 feet long by 100 feet wide, and is an all-weather aerodrome. The aerodrome is normally manned with ATC, communications, meteorological, and fire fighting staff during the hours 0400-1600 GMT and to cover scheduled movements outside these hours. The aerodrome and all facilities were fully serviceable during the night of 17th/18th September, 1961 and communication staff were on duty throughout the night. ATC and fire fighting personnel remained on duty from 1600 GMT on the 17th until 0115 GMT on the 18th.

9. FIRE FIGHTING EQUIPMENT

Due to the ignition of large quantities of fuel, estimated to be in excess of 1,000 imperial gallons, released by the rupture of the tanks during the crash, the wreckage was largely consumed by fire. The crashed aircraft was not found for some considerable time and therefore no fire fighting activities took place.

10. EXAMINATION OF WRECKAGE AND TECHNICAL INVESTIGATION

10.1 General Observations

10.1.1 Examination of the site of the accident indicated that the aircraft had first struck the tops of trees when on a heading of about 120° (M) at a shallow angle and a moderate rate of descent. The first point of impact with the tree tops is 66 feet higher than the point of impact of the nose of the aircraft with the ground. The linear distance between the two points is 760 feet, giving an average angle of descent after the first impact of 5° .

10.1.2 The propellers of the aircraft cut through the uppermost branches of the trees, and the severed branches, together with pieces of rubber from the propeller de-icing boots, were the first items to be found along the wreckage trail. The left wing tip was severed from the aircraft at an early stage indicating that the aircraft was probably in a slightly left wing-low attitude and the swath cut by the aircraft through the trees indicated an increasing angle of left bank. As the left outer mainplane of the aircraft collided with the trunks of the trees it was progressively demolished. At the same time the propellers and the fuselage suffered increasing damage by impact with trees and detached pieces were scattered along the wreckage trail.

10.1.3 The nose of the aircraft, with the fuselage, centre section empennage and right wing largely intact, struck a 12 foot-high anthill and the fuselage cartwheeled about the anthill swinging through approximately 180° and suffering complete demolition from further impact with trees and ground. Fire, fed by fuel from the burst tanks, covered the main wreckage and spread 350 feet back along the wreckage trail.

10.1.4 The intensity of the fire melted and fused most of the aluminium alloy of the wing centre section and fuselage. The four engines were broken from their mountings and severely damaged by impact and the subsequent fire. See Wreckage

10.1.5 A ground search was organised using more than 160 policemen covering the area indicated on the map at appendix 1.7. The search failed to reveal any parts of the aircraft which had been detached prior to impact with the trees.

10.2 Condition of the wreckage.

10.2.1 The main wreckage was contained in an area approximately 60 feet by 90 feet and its disposition is shown on the wreckage plan at appendices 1.1 and 1.2. With the exception of the empennage, the fuselage aft of the rear pressure dome, and the left hand outer (No. 1) engine, the whole of the concentrated main wreckage was badly damaged by fire. The photographs at appendix 1.9 show the extent of destruction. The wing assembly, comprising left and right inner sections and right hand outer, came to rest correct side uppermost and had been attached to fuselage and power plants prior to impact. The right hand wing and flying control surfaces were badly damaged by impact and this occurred as the wing fell on to the trees in a vertical movement. The empennage was inverted with upper halves of the vertical stabiliser and rudder broken off, the complete right hand stabiliser and elevator were also detached. The left hand inner (No. 2) and the right hand inner (No. 3) engines, together with their respective propellers and nacelles were extensively incinerated. The fuselage nose section including the cockpit was broken up and scattered in an area centred approximately 100 feet before the nearest part of the main wreckage. The fuselage forward of the rear pressure dome was completely destroyed by impact and subsequent fire, the seats, interior fittings and galley equipment being scattered over a wide area. The landing gear assemblies were located in the main wreckage. The left hand wing tip was recovered some 600 feet from the main wreckage, parts of the left hand outer wing being

located in the flight path between these two positions. Fire had not occurred prior to impact. The detailed technical report on the condition of the wreckage will be found at appendix 1.8.

10.3 Technical Examination of the Wreckage.

10.3.1 The accident site was surveyed by two land surveyors of the office of the Northern Rhodesia Government Divisional Surveyor, Mlola, who prepared a grid reference of the site showing contour lines at one foot intervals, position of large anthills and heights of some trees in the wreckage path which had been cut and damaged. The grid reference was marked out on the site by the surveyors using stakes and string, location of damaged trees referred to on the grid drawing being indicated by indexed pegs. The area covered by the grid was 168,000 square feet (840' x 200').

10.3.2 All items of the wreckage were examined at the site for unusual features, relevant settings were recorded where applicable and the parts marked or labelled with the grid reference in which they had been found. The position of all significant parts of the wreckage are plotted on the Wreckage Plan at appendices 1.1 and 1.2

10.3.3 Various samples of ash, metal and fabric were taken from selected locations in the wreckage by the Chief Research Officer of the Rhodesian Selection Trust, Kalalushi, and subjected to laboratory examination and analysis to check for evidence of explosive agents. A copy of the report prepared following this analysis is contained at appendix 1.10.

10.3.4 A detailed technical report is at appendix 1.8. However, examination of significant wreckage produced the following facts -

10.3.4.1 Landing Gear. The left hand gear assembly was in the "down" position, shown by both pairs of down latch locking lugs in contact and fully engaged with the actuating strut piston at bottom of stroke (fully extended). The right hand gear assembly

actuating strut piston was also fully extended, but the down latch locking lugs were broken; this type of breakage would occur only if the lugs were in the fully locked "down" position. In the case of the nose gear assembly the actuating strut piston rod had fractured at the cylinder with the piston at the top of the stroke, indicating that this assembly was also in the fully down position. The landing gear control lever was recovered spring loaded in the landing gear "down" position. The door operating mechanism was also found in the "open" position. There is no doubt that the landing gear was selected "down" and fully locked "down" at the time of impact.

10.3.4.2 Wing Flap System. The flap operating handle was recovered damaged and burnt, the plunger housing was loose on its quadrant which was bent and indicated that the operating handle plunger was in the 5th slot at the time of impact; this represents the 30° flap down position. The quadrant has eight positions 10°, 15°, 20°, 25°, 30°, 35°, 40° and 50°. The plunger assembly was detached from the operating handle, therefore no positive indication is given by this control, although it is probable that the selector was in fact at the 30° position at the time of impact. The flap position indicator had markings on the dial at the 30° position consistent with the pointer having probably been in this position. All four flap actuating struts were recovered - left hand units loose, right hand units in position. Piston rod extensions were checked but were considered unreliable since the left hand units were wrenched from the wing in the crash and the right hand units were in the full flap "up" position. The right hand wing flaps would be

forced into the "up" position in the crash and since the hydraulic pipes to the actuating struts were broken the pistons would move with the flaps.

10.3.4.3 Flying Controls. It is considered that nothing significant can be deduced from the position of any of the flying controls and surfaces. The only components that might have given some indication were the trim tab actuators. However, these are cable operated and were forced to the extreme in one direction, the direction being dependent on the order of breaking of the operating cables.

10.3.4.4 Engine and Propellers. An examination of the engines and propellers revealed no sign of failure or malfunction prior to impact. Inspection of the propeller stop ring assemblies confirmed that the angular setting of all propellers was in the constant speed range. Therefore, it is considered that the engines and propellers were operating in a normal manner and developing power at the moment of first impact.

10.3.4.5 Altimeters. All three altimeters were set at approximately the correct QNH for Ndola airport at the time of the accident. The controller had given 1021 mb (30.15" Hg) and the altimeter pressure settings were :-

1st Pilot's instrument	30.14" Hg.
2nd Pilot's instrument	30.16" Hg.
Navigator's instrument	30.17" Hg.

The pointers on all altimeters were loose and the readings unreliable. See appendix 1.11 for a report by the United States Civil Aeronautics Board.

10.3.5 During the period 24th to 30th September, the wreckage was transported from the crash site to the hangar at Ndola airport where the major components and

those parts which could be recognised were placed in their relative positions on the hanger floor on a planned layout of the aircraft. See appendix 1.12.

10.3.6 Following removal of the wreckage from the accident site, the area where the wreckage and bodies had lain between grid line 64 and the track (shown on appendix 1.1) was then raked and sifted using $\frac{1}{4}$ " sieves. This operation produced further pieces of the aircraft, cartridges, cartridge cases, bullets, coins and small items of personal property. With the exception of the aircraft parts all items were handed to Northern Rhodesia Government C.I.D. representatives. The raked residue which did not pass through the sieves was collected and moved to the Ndola airport hanger for further investigation.

10.3.7 The large fused blocks of metal salvaged from the fuselage and centre wing area were broken into small pieces and any visible unmelted parts suspended in the blocks removed for identification and examination. The thinner sections of blocks were broken by sledge hammer and chisel, but it was necessary to break up the heavy blocks by steam hammer.

10.3.8 All fused items and burnt rubble still adhering to the wreckage was removed and this, together with the residue from the breaking operation and heaps of debris, shovelled from the crash site, were sifted through " sieves. This second sifting operation produced further pieces of the aircraft, cartridges, cartridge cases, bullets, coins and small items of personal property.

10.3.9 To assist in the detailed technical examination of the wreckage all items removed from the crash site were segregated in the hanger in the following divisions:-

All structural parts of the aircraft that could be identified together with the power plants and propellers were placed in approximate correct positions in the aircraft layout mentioned at 10.3.5 above.

The respective hydraulic, pneumatic, electrical systems, etc.

Small unburnt pieces that could be identified as some part of the wing structure.

Small burnt pieces and pieces embedded in fused blocks that could be identified as parts of the wing structure.

Small unburnt pieces that could be identified as parts of the fuselage structure.

Small burnt pieces and pieces embedded in fused blocks that could be identified as parts of the fuselage structure.

Broken pieces from fused blocks from which all visible unmelted pieces had been removed.

Dust from sifting operations.

Small miscellaneous parts, bolts, nuts, small cabin articles, etc.

10.3.11 Special Technical Investigations and Tests

10.3.11.1 The three altimeters recovered from the first and second pilots and navigator's flight panels were forwarded for detailed specialist examination and report to be carried out under the auspices of the Civil Aeronautics Board, Washington. The relevant report is at appendix 1.11.

10.3.11.2 Samples of ash and burnt wreckage taken from selected positions at the accident site were analysed and checked for the presence of explosive agents, with negative results. The relevant report is at appendix 1.10.

10.3.11.3 All residue from the accident site was raked together and sifted to retrieve all ammunition reported to have been carried in the aircraft, and to search for any bullets or missiles inconsistent with the weapons carried in the aircraft. At the same time a search was made for any foreign objects

or parts of such objects which could have contained explosive agents. The result of these searches was negative.

10.3.11.4 All fire-arms and ammunition recovered from the wreckage were taken by the Northern Rhodesia Police who carried out appropriate investigation. This investigation proved that none of the bullets in the fire-arms had been fired. A report of the ballistics expert is attached at appendix 1.13.

10.3.11.5 All parts of the aircraft were examined for bullet holes or signs of explosion or sabotage. Certain items were segregated and formed the subject of special investigations by the Northern Rhodesia Police and by Swedish Government experts. No bullet holes or evidence of sabotage were found.

10.3.12 At 1430 GMT on 2nd November, 1961, the hangar at Ndola airport, containing the wreckage, was locked and sealed in the presence of two members of the Investigating Board.

PART 3 COMMENTS AND FINDINGS

11. RECONSTRUCTION OF FLIGHT UP TO THE ACCIDENT

11.1 The information available to permit a reasonable reconstruction of the flight is vague and incomplete. The time of departure from Leopoldville was 1551 GMT and the following position reports were made during the flight:-

Over reporting point 432E (07°40'S - 30°33'E) at 2035 GMT	
Abeam Kasama	at 2106 GMT
Abeam Ndola (NDB)	at 2147 GMT
Over Ndola airport	at 2210 GMT

Consequently, there must be some conjecture in any attempt to reconstruct the flight or what should be considered as the most likely route followed by the aircraft. See appendix 1.3. This will be particularly true for the portion of the flight between Leopoldville and the point where the position report was made at

2035 GMT. The flight plan indicates that the initial cruising altitude should have been 13,500 ft (FL 135) but at 2035 GMT the aircraft reported cruising at 17,500 feet (FL 175). Since there is no indication as to when the aircraft climbed from FL 135 to FL 175, this part of the flight has been computed as if the climb to FL 175 was made immediately after take-off from Leopoldville. It has also been assumed the climb was made in still air at a true airspeed of 184 knots. This climb should then have taken about 35 minutes and should have covered about 108 nautical miles over the ground. The only upper wind information available to the Board for FL 175 covers that portion of the probable route from reporting point 432B to Ndola airport. During the period of the flight this wind is believed to have been 070° - 100°(T) at 10 to 15 knots. For computing purposes a wind of 085°(T) at 15 knots has been used for the portion of the flight from 432B to Ndola airport and it has been assumed that for the portion of the flight Leopoldville until reporting time 2035 GMT the wind was weaker and from the East; a wind speed of 5 to 6 knots has been used as the average for this purpose.

11.2 The most likely route followed by SE-BDY between Leopoldville and reporting point 432B was direct to an approximate position 04°35' South, 29°25' East, then down Lake Tanganyika to reporting position 432B.

11.3 The computation for the portion of the route that is most likely to have been followed after 432B has been made in reverse, i.e. starting from the time over Ndola airport at 2210 GMT.

At 2147 GMT the aircraft reported abeam Ndola. This was 23 minutes before arriving over Ndola. A VDF bearing (QDM 279) taken at the time of this report indicates that the aircraft was then due East of Ndola airport. Assuming the aircraft travelled at an average ground speed of 255 knots (240 TAS plus 15 knot tail wind component) from where it was at 2147 GMT until it reached Ndola, it would be logical to conclude.

that the aircraft was then 98 nautical miles from Ndola over position 13°00'S, 30°19'E. The distance from abeam Kasama to the assumed position when the aircraft reported at 2147 GMT is 170 nautical miles. The elapsed time for this portion of the flight was 41 minutes. This indicates a ground speed of 248 knots which would appear reasonably consistent with known and assumed circumstances. The distance from abeam Kasama to reporting point 432B (on a direct line from 432B to position assumed at 2147 GMT) is 150 nautical miles. This portion of the flight took 31 minutes and indicates that the ground speed would have been 290 knots. This ground speed is not consistent with the other section of the flight and in view of reported wind conditions appears to be unlikely. Since the ground speed South of the point abeam Kasama appears reasonable and consistent, the computed ground speed of 290 knots would appear to suggest that the aircraft covered a shorter distance than 150 nautical miles between 2035 GMT and 2106 GMT, and was probably 22 nautical miles to the South or South East of 432B when it reported as being over this reporting point.

12. DISCUSSION OF THE EVIDENCE

12.1 There is evidence that an intended flight using either OO-RIC or SE-ELY to carry Mr. Hammarskjöld to Ndola was proposed on Sunday morning to start at 1600 GMT on Sunday 17th September, 1961. In fact SE-EDY was used and took off 9 minutes early at 1551 GMT.

12.2 Captain Hallonquist apparently did not wish to file a flight plan for this last flight, and the ATCO Leopoldville suggested at 1500 GMT that he should file a departure plan for destination Luluabourg. Hallonquist did so and on it stated his endurance was 13 hours 25 minutes.

12.3 The U.N. Air Commander, Leopoldville, knew only 45 minutes prior to take-off that destination was Ndola. No one except the aircraft crew concerned appeared to have any knowledge of the proposed route and flight level. This route proved to be

entirely different from that followed by OO-RIG, the aircraft carrying Lord Lansdowne, which was to arrive and depart Ndola before the arrival of SE-BDY, the aircraft carrying Mr. Hammar-skjold. The route followed by SE-BDY was apparently Leopoldville Lake Tanganyika and then South to abeam Ndola.

12.4 SE-BDY did not contact Nairobi FIC but was in H/F radio contact with Salisbury FIC from 2002 GMT, when it was still outside the Salisbury FIR. During subsequent conversations until it was handed over by FIC to Ndola approach at 2132 GMT, the aircraft passed information comprising an abbreviated flight plan giving flight level, routing and ETA Ndola.

12.5 From 2135 GMT the aircraft worked Ndola approach on VHF during which time it was cleared to commence its descent at 2157 GMT from 16,000 feet to 6,000 feet, and was asked to report "top of descent". It did not do so but presumably commenced its descent at that time and flew overhead Ndola airport from East to West at approximately 2210 GMT Sunday 17th September at normal circuit altitude or less. The aircraft was asked to report reaching 6,000 feet after stating he was overhead Ndola, but failed to do so.

12.6 When over the airport the aircraft was heard and observed by a number of witnesses none of whom noticed anything unusual in its flight. The flashing red anti-collision light on top of the aircraft fin was operating and the navigation lights were switched on "steady". It had already indicated

its intention to land at Ndola as it had given an ETA of 2220 GMT. SE-BDY apparently flew overhead Ndola radio beacon 2.5 nautical miles West of the airport and apparently continued on a normal procedure turn and letdown. The aircraft was reported as low over the beacon and very low during the procedure turn. Although it had only been cleared down to 6,000 feet MSL (1840 feet above Ndola aerodrome) it did not report as having reached that altitude and, in fact, hit trees and the ground at a shallow angle of 5° or less, at what appears to have been normal approach speed, at an altitude of 4,357 feet MSL with its undercarriage locked down, flaps

partially extended, and with all 4 engines developing power and all the propellers in the normal pitch range, heading towards the Ndola radio beacon on a landing approach. The 3 cockpit altimeters were set correctly, within fine limits, to the QNH setting given by Ndola. These altimeters are American instruments and cannot be set to QFE settings at Rhodesian altitudes; in addition, it is normal Transair practice to set all altimeters to QNH. However, had it been possible to set the captain's and first officer's altimeters to QFE, then by setting one at QNH and the other at QFE a simple subtraction of indicated heights would have given the height of the aerodrome as a check of the instruments.

12.7 Smoke from a factory chimney near the airport may have been drifting across the approach to runway 10, but it is considered that this had no bearing on the cause of the accident as the pilot of a DC4 which landed at 2035 GMT saw the smoke but had no difficulty whatever in carrying out a visual approach and landing. As the surface wind speed and direction did not alter appreciably between the time the DC4 landed and the time of the crash, the smoke conditions at the time that SE-BDY was carrying out its approach would be similar to those seen by the pilot of the DC4.

12.8 No. 2 engine of SE-BDY was slightly damaged by one small calibre bullet on the morning of Sunday, 17th September at Elisabethville. It was thoroughly inspected and repaired by the afternoon of the same day at Leopoldville. The Transair maintenance staff carried out a very thorough inspection of the aircraft and no further damage was found. The Investigating Board has no reason to doubt the serviceability of SE-BDY for this flight.

12.9 Although Ahreus and Litton had flown from Leopoldville to Elisabethville and return on the night of Saturday, 16th September, Captain Hallonquist had not flown for over 24 hours prior to the flight to Ndola and appeared rested and

in good spirits before take-off. In fact he was apparently most anxious to make the flight. There were crew bunks and sleeping bags on the aircraft.

12.10 Captain Hallonquist was almost certainly seated in the aircraft captain's seat at the time of the impact and co-pilot Litton was almost certainly in the starboard pilot's seat. The three pilots were well qualified and were experienced on the DC6 and had each flown over 100 hours in the Congo within the 6 weeks prior to the crash.

12.11 SE-BDY may have been carrying two parachute flares and while there is no doubt that the magnesium content of these flares would intensify the fire at the crash there is no evidence to show that they caught fire or were dropped prior to the crash.

12.12 There is no evidence that special security arrangements for this aircraft were made at Leopoldville, therefore the possibility for a saboteur to place an infernal device on board this aircraft prior to take off, or to otherwise interfere with it, cannot be precluded. However, no evidence was found which points to sabotage as the cause of the crash. There is no sign of explosion or fire in the air, and the aircraft appears to have been under full control until it hit the trees, and all remaining control system parts appear to have been in good order at the time of impact.

12.13 No evidence has been found to support the suggestion that SE-BDY was shot down by ground fire or by offensive aircraft. In fact the weight of evidence is all against such actions having taken place. The aircraft indicated that once it crossed into the Salisbury FIR it intended to remain outside Congolese territory. SE-BDY had its normal night flying lights on when in the vicinity of Ndola - these included the anti-collision light which would be visible for miles. It is unlikely that the captain would leave these lights on if he realised he was being shot at or chased,

or even if he was concerned about such action being taken against him. The one Katangese Fouga fighter bomber trainer was examined at its base at Kolwezi by some members of the Board and the calibre of its two machine guns noted. No such calibre bullets (or any bullet holes) were found in the wreckage. In fact no bullets inconsistent with weapons carried in the aircraft were found. Local witnesses at Kolwezi have stated that the Fouga had never been operated at night. After examining information from the aircraft manufacturers, the Board is satisfied that Ndola is beyond the Fouga's combat range from Kolwezi - the only known airfield from which it could operate. The aircraft commander stated that he had never violated the Federal border and that he had never shot down an aircraft. There was no radio transmission from SE-BDY indicating that it was being, or had been, shot at or attacked and there was no evidence of bullet or shell injury to the crew which might have prevented such transmission. Up to approximately 2210 GMT on 17th September the pilot was in contact with Ndola tower and was acting and talking normally and the aircraft was seen and heard to be flying in a normal manner. From that time on, for the remaining 5 minutes or so of the aircraft's flight, it was under observation by many police officers on duty and by three witnesses in particular, except for the last 20 or 30 seconds when SE-BDY apparently went below the line of vision of one of them who was standing on a fourth floor balcony. No strange bullets or anything resembling parts of a shell, grenade or rocket have been found and no bullet holes or damage consistent with offensive action have been found in the wreckage. Neither of the pilots made any transmission which indicated trouble or alarm from the time when it was overhead Ndola to the time of the crash (2215 GMT approx.). The aircraft crashed on track, and the wheels and flaps were down - which again points to a normal descent and approach. If the aircraft had been under attack or if the pilots had been worried about such a possibility, the logical thing would have been for them to retract the wheels

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and flaps, increase power to take avoiding action, switch out the lights and warn the aerodrome. The weight of evidence clearly predominates in favour of a situation that was normal and correct, except that SE-BDY was about 1,700 feet lower than it should have been at this point. The Board does not hold the view that the pilot was flying low intentionally.

12.14 The overwhelming weight of reliable evidence is that at the time SE-BDY was the only aircraft in the air in the vicinity of Ndola.

12.15 There is no evidence of any in-flight fire or explosion in SE-BDY. There is no singeing, discolouration or burning of the tree tops prior to the beginning of the ground fire which extended back from the final wreckage point some 120 yards, which is some 200 yards after the aircraft first touched the tree tops. The first pieces of wreckage of the aircraft were found in the direction of flight from the first point of impact with the tree tops. These were pieces of propeller rubber de-icing boots, then the port wing tip, pieces of port outer wing, propeller blade, etc. There was no evidence of fire damage on those pieces which were not in the area of ground fire.

12.16 Medical evidence shows that two bodies were found to have bullets, fragments of exploded cartridge cases and percussion caps in the skin, the subcutaneous tissues or the muscles. These bodies had ammunition in their vicinity in the wreckage, and the orientation of the bullets within the tissues did not support any contention that they had been fired from any consistent direction. The pathologists consider that these injuries resulted from explosion of ammunition in the fire. The bullets found in the bodies have been microscopically examined by ballistics experts and it was ascertained that they had not passed through the barrel of a fire-arm. Three or four other severely burned bodies were found to have pieces of partially melted aircraft metal superficially sited on them. The pathologists considered that this resulted from the incineration of bodies in the presence of aircraft wreckage and in no way suggests fragmentation from an explosion. None of the foreign objects was found in an individual in any way responsible for flying the aircraft. No other bodies were found to have any foreign metal fragments in them. The summary

and conclusions from the medical report are at appendix 3.3.

12.17 The temporary survivor of the crash made several statements during the 5/6 days he was in hospital. Medical evidence regarding this is that those statements made on the 18th September are unreliable because he was delirious at that time and that statements made during the last 24 hours of his life, with regard to sparks in the sky, may also have no significance as he was then uremic and part of the picture of this disease is spots and flashes of light before the eyes.

12.18 The route taken by the pilot of OO-RIC was virtually direct from Leopoldville to Ndola and passed within 60 miles of Kolwezi. The aircraft was in radio communication with both Kamina and Elisabethville and had its anti-collision beacon and navigation lights illuminated. Until a short time before departure it was generally believed that this aircraft would be carrying the U.N. Secretary General. OO-RIC arrived safely at Ndola without any interference en route.

12.19 The possibility that one of the three American DC3 aircraft parked (2 at Ndola and 1 at Elisabethville) might have been in radio contact with SE-BDY and may have instructed it to divert or had knowledge of the intention to do so was investigated. The evidence of the senior American officer and of the other two aircraft captains is that there was no communication by any of these three aircraft with SE-BDY.

12.20 The remains of the aircraft control mechanisms, power plants and systems have been meticulously examined and no evidence was found of failure or malfunction. This fact, together with the evidence at the crash site and of the mass of the observers' evidence as to the aircraft's behaviour, indicate that there was no technical defect or structural or material failure.

12.21 It was noted that the aircraft captain's altimeter, which was in comparatively good condition, was found disconnected from the static supply. However, had there been a break in the static line as a result of disconnection during flight, the effects would have been immediately apparent as the captain's VSI would have remained stationary, and the airspeed indicator and altimeter would have under-read, i.e. the indicated height would have been lower than the actual height. In other words it would have erred on the safe side. The Board cannot see how this can have any significance as a causal factor in the accident. Additionally, as the co-pilot's and navigator's static instruments were connected to a separate supply any

discrepancy in the readings should have been obvious. The simple misreading of an altimeter, however, cannot be ruled out as a possibility.

12.22 Amounts of up to 7% of carboxyhaemoglobin were found in the two pilots in control, the radio operator and Mr. Serge Barrau as well as 2% in Mr. Hammarskjold's body, while all others which it was possible to test were negative. The pathologists have stated that these amounts are not significant.

12.23 Because the aircraft flew over the airport and away to the West, some of the witnesses thought that it was going elsewhere or was communicating with another station. Similarly, when the aircraft did not land some witnesses thought that Mr. Hammarskjold had changed his mind and had diverted the aircraft back to its starting point or to Elisabethville. However, the investigation has satisfied the Board that the aircraft was almost certainly engaged in some form of procedure turn preparatory to a landing approach.

13. SEARCH AND RESCUE ACTION

13.1 The relevant documents defining Search and Rescue action to be taken in respect of a missing aircraft are:-

- 13.1.1 "PROCEDURES FOR SEARCH AND RESCUE WITHIN THE SALISBURY SEARCH AND RESCUE AREA" - Reference 334/3 dated 6th October, 1959.
- 13.1.2 "AIR TRAFFIC CONTROL INSTRUCTIONS" Department of Civil Aviation dated September, 1960.
- 13.1.3 "STATION STANDING INSTRUCTIONS - NDOLA AIRPORT" dated June, 1961

13.2 The above documents state inter alia in this case that initiating action should have been taken by Ndola ATS Unit thirty minutes after the latest ETA of SE-HDY, i.e. at 2245 GMT. In spite of the fact that the "INCERFA" signal was not originated until 2342 GMT and was not despatched until 0016 GMT, other correct action was taken by Ndola airport staff.

13.3 The ATOC Ndola continued to try and contact SE-BDY on both VHF channels from 2215 GMT onwards and queried Ndola police for reports of an aircraft crash. He also communicated with Salisbury FIC and initiated a "communication search" and checked other aerodromes for news.

13.4 The Ndola and Kufulira police originated ground search action by sending out Land Rover patrols in the early hours of the morning from both places to investigate a report of a flash in the sky North West of Ndola. These patrols which started at 0145 GMT found nothing significant. The Ndola control tower was closed at 0115 GMT and there was a communicator left on duty who knew how to contact the Airport Manager.

13.5 The RRAT search action which started on Monday morning was finally successful at about the same time as ground reports from Africans reached police and airport authorities.

13.6 If the Africans who witnessed the crash or heard the explosion had reported the fact to any authority they could have led police or rescue vehicles to the scene of the accident before daylight. No such report was made until about 1300 GMT on Monday 18th.

14. SPECIAL TESTS

14.1 In view of the diversity of opinion amongst witnesses as to height above ground and as to what lights were showing from SE-BDY whilst over or in the vicinity of Ndola airport, an experiment was carried out using a LO6 aircraft belonging to Transair, and flown by a Transair crew with one of the Board's observers (who is also the Director of Flight Operations of Transair) acting as second pilot. Two members of the Board were in the aircraft observing the flights.

14.2 During this experiment the aircraft was flown over Ndola airport and out over the crash site on the night of 9th October, 1961, making five different runs at varying heights with different combinations of lights showing, at different power settings and speeds. Full details of these flights are at appendix 1.14.

14.3 During these tests the pilot followed the let-down pattern detailed in the Jeppesen route manual as used by Transair crews, and on each occasion it was noted that the aircraft flew over, or very close to, the crash site and on approximately the same heading as the swath through

the trees. (The crash site in the forest was identified by Police Land Rover vehicles stationed there with their headlights illuminated).

14.4 Whilst this flying was being carried out all but one of the relevant witnesses were placed in the positions they held on the night of the accident and were accompanied by members or observers of the Board. These witnesses were given forms to complete which requested information regarding height, direction, noise and lights of the aircraft being used in the tests as compared with what they saw and/or heard on the night of the accident.

14.5 An analysis of the results of these flights, together with discussion with the witnesses at the time, shows that the majority of witnesses were emphatic that the aircraft on test was never as low as SE-BDY on the night of the accident. As the lowest flight during the tests was 6,000 feet (1840 feet above ground) over the airport and 5,300 feet (934 feet above the tree tops) over the crash site, it would seem to indicate that SE-BDY was low over the airport and very low during the turn to approach the airport. In fact this points to SE-BDY being below 6,000 feet MSL when overhead the airport and certainly much lower than the obstacle clearance limit of 4,660 feet (500 feet above the airport) specified on the Ndola approach chart in the Jeppesen Route Manual, after passing over the airport and during the turn to approach. The majority of the witnesses indicated that SE-BDY was showing its flashing red anti-collision light and navigation lights on "steady", with the power settings and speed consistent with a normal circuit and approach.

14.6 In addition, two special flights were made using DC3 aircraft with members of the Board flying in the aircraft as observers on each occasion. The first flight was made at night, carrying out an instrument procedure let-down to Ndola aerodrome, to investigate whether the town and aerodrome lights may have been confusing to a pilot strange to the area. It was agreed that the lights did not cause confusion. The second flight was made immediately

before dusk to simulate as nearly as possible a DC6 carrying out a procedure approach. The speed was maintained at 140 knots. In each case the test aircraft flew approximately overhead the crash site on approximately the same heading as the crash swath through the trees, and the Board is satisfied that SE-BLY was carrying out a procedure approach when it crashed.

15. CONCLUSIONS

- 15.1 The aircraft was correctly certificated and had been maintained in accordance with the approved maintenance schedule.
- 15.2 The aircraft was correctly loaded with the C of G within prescribed limits.
- 15.3 No evidence could be found to suggest failure or malfunction of the aircraft control mechanisms, power plants or systems. The evidence at the crash site and the mass of observers' evidence as to the aircraft's behaviour indicate that there was no technical defect or structural or material failure.
- 15.4 The three altimeters installed in the aircraft were recovered and it was possible to determine that the correct QNH for Ndola was set on each instrument.
- 15.5 The crew held valid licences appropriate to their duties and had not exceeded the prescribed flight time limitations.
- 15.6 All navigational aids and radio facilities at Ndola were fully serviceable and operating at the time of the accident.
- 15.7 The weather at the time of the accident was fine with slight smoke haze and the night was dark and there was no cloud. The moon was in its first Quarter and set at 2224 GMT.
- 15.8 SE-BLY had been cleared by the ATCO Ndola down to 6,000 feet MSL after checking the QNH and was asked to report reaching 6,000 feet. The aircraft did not report reaching 6,000 feet but passed overhead Ndola airport and overhead (or nearly so) the Ndola NDB. It had almost completed the procedure turn when it struck the tree tops. Its wheels

were extended and the flaps partially extended at the time.
The aircraft first touched the tree tops at a height of 4,357 feet MSL. Ndola airport is 4,160 feet MSL.

15.9 SE-BLY was showing the correct external lights up to the time of the accident.

15.10 The pathologists have stated that no medical cause for this accident has been found and that there exists no medical evidence of sabotage.

15.11 PIC Salisbury and Ndola Tower had sufficient information regarding SE-BLY's position, destination and ETA for their control purposes.

15.12 The Control Tower was closed down at Ndola airport on the night in question after INCOMM action had been initiated but not resolved. A communicator was on duty throughout the night who could have recalled staff if required.

15.13 Certain African charcoal burners could have reached the crash site by 2245 GMT and led rescuers to the crash before daylight had they so wished.

16. CAUSES.

16.1 The Investigating Board is of the opinion that the evidence available does not enable them to determine a specific or definite cause.

16.2 The following list gives the Board's opinion of the possibilities. The order of listing is not intended to indicate any degree of priority.

16.3 The wilful act of some person or persons unknown which might have forced the aircraft to descend and collide with the trees.

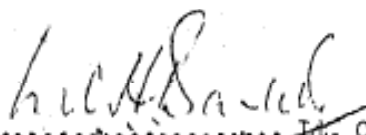
16.3.1 Comment. The Board is of the opinion taking into consideration the extent of the destruction of the aircraft and the lack of survivor's evidence, that this possibility cannot be completely ruled out. The Board is, however, satisfied, on the weight of evidence available to it that it is an unlikely possibility.

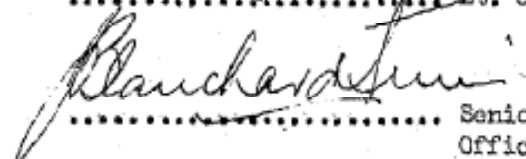
16.4 Some undetermined defect in the engines, the airframe, control mechanisms or systems, beyond the power of the crew to remedy in the air that might have induced the forced descent of the aircraft.

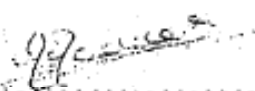
16.4.1 Comment. Despite intensive examination of the wreckage no such defect has been discovered. The weight of evidence suggests that the aircraft was airworthy and fully controllable immediately prior to collision with the trees.

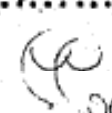
16.5 Descent of a fully controllable aircraft into the trees due to (a) some misunderstanding of the aerodrome altitude or (b) some sudden incapacitation of the three pilots on board or (c) some misreading of the aircraft's altimeters or (d) some incorrect altitude indication on at least one of the aircraft's three altimeters, or some combination of (a) to (d).

16.5.1 Comment. In the opinion of the Board the probable cause of the accident lies within this group.


..... Lt. Col. Chairman


..... Senior Operations Officer


..... Chief Inspector of Aircraft


..... W/Odr. R.A.F.