“RIETBOK”
Air Accident

Electronic Scanned Version Of The Actual Final Report

As signed by the Board Members :

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"RIETBOK" AIR ACCIDENT REPORT

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This Report has been compiled substantia1ly in accordance with the recommended "Summary of Accident Report" contained in Appendix 3 to ICAO Annex 13, namely International Standards and Recommended. Practices on Aircraft Accident Inquiry, with certain additions and modifications.

AIRCRAFT ACCIDENT REPORT

RELEASED:

SOUTH AFRICAN AIRWAYS

VICKERS VISCOUNT 818 ZS-CVA

IN THE INDIAN OCEAN OFF KAYSER' S BEACH,

APPROXIMATELY 15 NAUTICAL MILES SOUTH-WEST

OF THE BEN SCHOEMAN AIRPORT, EAST LONDON

13th MARCH 1967

SUMMARY

(a) General

On 13th March 1967 Vickers Viscount aircraft ZS-CVA, "Rietbok", was on a scheduled public transport flight No. SA 406 from Port Elizabeth to Johannesburg via East London and Bloemfontein. Its Estimated Time of Arrival at East London was 1714 GMT, but the weather there was poor. The captain had indicated that he would probably overfly East London, but that he would have a look at conditions there before deciding to do so.

The last communication from the aircraft was when it notified East London Airport Control that it was "at 2,000 ft. with the coastline in sight". It is estimated that the aircraft was then between 20 and 15 nautical miles from the Airport and that the time was approximately 1709 GMT. At 1710.08 GMT the aircraft crashed into the sea. The approximate position of the crash was 33°13.45' S. , 27°38.3' E.

On board were Captain Gordon Benjamin Lipawsky, First Officer Brian Albert Richard Trenwith, 3 cabin crew and 20 passengers. Air-sea rescue operations were put in hand promptly, but there were no survivors. Bits of floating wreckage, consisting mainly of cabin interior fittings, were recovered by naval vessels and other pieces were washed ashore.

The main wreckage of the aircraft is believed to he lying at a depth of between 180 and 220 feet, approximately 1½ miles off-shore. Extensive salvage operations were attempted, but were hindered by murky water, a current up to 8 kts. and dangerous sea conditions.

(b) Cause of the Accident

The available data is not sufficient for the originating cause of the accident to be determined with any degree of probability. In the opinion of the Board certain possibilities can be excluded as being inconsistent with the evidence and/or as being remote and improbable: among these possibilities are structural failure, failure of controls or control surfaces, multiple engine failure, instrument failure, explosion, fire, a "bad weather" accident and pilot error.

However, on the evidence the Board cannot exclude as the originating cause of the accident a heart attack suffered by the captain in the air, with ensuing loss of control of the aircraft, and with the first officer being unable in the time available to regain sufficient control to prevent contact with the sea.

(c) Responsibility for the Accident

The Board’s investigation has revealed no breach of duty or other culpable failure on the part of any person.

1. INVESTIGATION

l.1 History of Flight

South African Airways Viscount aircraft "Rietbok", with Capt. Lipawsky as the pilot-in-command, departed from Johannesburg on the after-noon of 13th March 1967 on a scheduled public transport flight to Port Elizabeth with stops at Bloemfontein and East London. On the initial take-off from Jan Smuts Airport the nose-wheel did not retract because of a minor malfunction. The aircraft returned and the fault was rectified. This incident has no bearing on the subsequent accident.

On arrival at East London at 1550 GMT on the down flight weather conditions were poor, but the aircraft landed without difficulty after an instrument approach on runway 28. 0n the take-off from East London at 1615 GMT the aircraft was involved in a bird strike. It was carefully inspected for damage after landing at Port Elizabeth, and was passed as serviceable. This incident also has no bearing on the subsequent accident.

"Rietbok" was to return as S.A.A. Flight No. 406, a scheduled public transport flight, from Port Elizabeth to Johannesburg with stops at East London and Bloemfontein.

At Port Elizabeth Capt. Lipawsky took on board 2,000 lbs. of fuel in excess of the normal sector fuel uplift, on the basis that he may have to overfly East London and proceed to Bloemfontein. He also instructed that the 2 passengers bound to East London should be notified that the aircraft would probably not land there because of the weather. One of these passengers thereupon withdrew from the flight, but the other, Mr. Max Melmed, though told by Capt. Lipawsky that the chances of landing at East London were only 10%, decided that he would embark and would stay over-night in Johannesburg if necessary.

Capt. Lipawsky, who has been described by his superiors in South African Airways as a model pilot, was well known for his ability and caution. He had landed at East London previously on many occasions, and had had extensive experience of similar weather conditions. Moreover, he had himself landed at East London in similar conditions approximately 1-3/4 hours earlier, on the down trip, but on the return flight he would not have reached East London before dark.

"Rietbok" made a normal take-off from Port Elizabeth at 1641 GMT and climbed to Flight Level 90.

At 1646 GMT it reported that it was climbing through 5,000 feet, and that it estimated the NDB (non-directional radio beacon) at Port Alfred at 1659 GMT.

It reported Port Alfred at 1658 GMT, that its Flight Level was 90, and that it estimated East London at 1714 GMT. Its computed ground speed from Port Elizabeth to Port Alfred, according to this report, would have been 240 knots, and, according to its ETA, its ground speed from Port Alfred NDB to the East London NDB would have been 225 knots. After the aircraft reported Port Alfred control of the flight was handed over by Port Elizabeth Air Traffic Control to East London Airport Control. At 1658.43 GMT the aircraft contacted East London Airport Control and was given a weather report. A tape recorder at Port Elizabeth recorded all radio conversation between Port Elizabeth and the aircraft. There was no tape recorder at East London, but the RT transmissions from the aircraft to East London were received at Port Elizabeth and, except for the last message, were recorded on the tape there. The last message was heard by the Port Elizabeth Controller, but was too faint to be recorded on the tape. The times of these various communications have been investigated and adjusted with the assistance of Professor Gordon Lauf of the Department of Land Survey in the University of the Witwatersrand.

The Controller in the East London Tower testified that the weather given to the aircraft was 8/8ths Nimbo Stratus at 200 feet to 300 feet overhead, 1owering on the approaches to runway 28; continuous drizzle; visibility ¾ of a mile; ground temperature plus 16 °C.; QNH 1025. Save for the QNH and the darkness, this weather was identical to that reported to the aircraft before it landed at East London at 1550 GMT on the down trip, that is approximately 1-3/4 hours previously. The Tower Controller testified that the aircraft was advised that the runway to be used was No. 28. At 1659.09 GMT the aircraft acknowledged the weather and requested descent clearance from Flight Level 90. Clearance was given by East London Tower and acknowledged.

The Tower Controller at East London testified that he requested the aircraft to call outbound over the NDB at 4,500 feet, but his evidence is based on recollection and he himself conceded that it might not be accurate.

The Port Elizabeth tape recorded the aircraft as reporting that it was 20 miles out, seaward of the coastline and descending through 4,000 feet. The time of this report has been fixed at 1706.27 GMT. At 1707 GMT, obviously in reply to a communication from East London Tower, the aircraft reported "Roger. We will attempt as approach on runway 10". It is the last message en the tape record at Pert Elizabeth. On the evidence, this report meant that the aircraft would line up on runway 10 and descend to company limits of 500 feet above the ground (approximately 935 feet above sea level); the reason for this was that the low cloud at East London " comes and goes", and that on the approach the requisite safe visual references and visibility conditions might well have been encountered. No State. procedure is laid down for an instrument approach on runway 10, but there can be no objection to it provided the proscribed S.A.A. minima are observed. However, the aircraft never reached the stage of commencing an approach on any runway.

According to the Tower Controller at East London the aircraft was advised after reporting that *it* would attempt an approach en runway 10, that "runway 10 is out for landing" because of 1ow cloud, but that the VASI lights on runway 10 and on runway 28 had been turned full on. He added that this was acknowledged by the aircraft, but this is not recorded on the tape at Port Elizabeth.

Shortly after the report at 1707 GMT the critical pre-accident phase of the flight commenced. According to the East London Tower Controller, the aircraft reported to East London that it was "at 2,000 feet seaward, with the coastline in sight". This reference to 2,000 feet with the coastline in sight (but not the reference to seaward) was heard by the Air Traffic Controller at Port Elizabeth, but was too faint to be recorded on the Port Elizabeth tape. According to the best estimates available to the Board, this transmission from the aircraft probably occurred at approximately 1709.12 GMT but there is a margin for error here of the order of 30 seconds.

The aircraft probably crashed, according to the best estimates available to the Board, at 1710.08 GMT. Eye-witnesses on land, who observed the aircraft's anti-collision beacon from distances of approximately 1½ to 2½ miles, describe it as having been visible for some seconds. It was fairly low, out to sea, moving approximately parallel with the coastline towards East London, and flying approximately straight and descending. The inference from an examination of these portions of the wreckage which have been recovered is that it probably struck the water in a nose down attitude with the port wing low. Two of the three eyewitnesses heard the noise of the engines (the third witness was elderly and deaf), and all three heard the report of the aircraft hitting the water.

There is no evidence of any further communication from the aircraft after that described above at approximately 1709.12 GMT. The indications are that in the 56 seconds approximately (but allowing for an error of the order of 30 seconds) subsequent thereto the aircraft descended 2,000 feet and that it struck the sea at a fairly high speed.

As already stated, the aircraft hit the sea at approximately 33°13.45' S., 27°38.3' E., at 1710.08 GMT. At this time darkness had already fallen.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	5 (2 pilots plus 3 cabin crew)	20	Nil
Non Fatal	Nil	Nil	Nil
None	Nil	Nil	Nil

1.3 Damage to Aircraft

The aircraft is a total loss. Only small portions of wreckage have been recovered.

1.4 Other Damage

All cargo was lost, save that a small quantity of mail was washed ashore. This mail was sent to the Postmaster General for disposal. There is no evidence of damage to anything outside the aircraft.

1.5 Crew Information

Captain Gordon Benjamin Lipawsky, the pilot-in-command of "Rietbok", was 48 years of age. He was in possession of a valid airline transport pilot's license, No. 211A, valid for the period 1st December 1966 to 30th June 1967. He was qualified on numerous multi-engined land aircraft, including the Vickers Viscount. His instrument rating was valid from 1st December 1966 to 30th June 1967, and entitled him to conduct NDB, ILS, GCA and VOR approaches. His last instrument rating renewal test, which he passed, was conducted on 13th October 1966. His last medical examination for the purpose of Air Navigation Regulations was held on 17th November 1966 when he was passed fit for 6 months with effect from 1st December 1966.

There is evidence that for about 6 months prior to 16th August 1965 Capt. Lipawsky had been complaining of a choking feeling. This was fully investigated medically. The investigations included radiology. He was also treated by Dr. H. Penn and Dr. Alan Penn, ear nose and throat specialists, between May and August 1965. The treatment was apparently successful.

Capt. Lipawsky was regarded by the chief instructor and by the chief pilot of South African Airways as a model pilot. Statements have been taken from a number of first officers, who flew with him, and they are unanimous as to his outstanding ability and positive emphasis on caution and safety. He had a total flying time, up to 11th

March 1967, of 12,344 hours 40 minutes. His total time on Viscounts was 3,231 hours. During the 90 days preceding the accident his total flying time was 256 hours 40 minutes. During this period none of the statutory maxima, as laid down by Air Navigation Regulations, was exceeded.

First Officer Brian Albert Richard Trenwith was the co-pilot on "Rietbok". He was 31 years of age. He held an airline transport pilot's license, No. 393 A, valid for the period 21st February 1967 to 20th July 1967. He was licensed to fly various multi-engined land aeroplanes, including the Vickers Viscount. He was a Grade 3 flight instructor on all types of aircraft up to and including an all-up weight of 3,500 lbs. His instrument rating was valid for the period 21st February 1967 to 20th July 1967, and entitled him to do NDB, ILS, GCA and VOR approaches. His last instrument rating renewal test, which he passed, was conducted on 3rd February 1967. His last medical examination for the purpose of Air Navigation Regulations was held on 10th January 1967 when he was assessed fit for 6 months with effect from 21st January 1967. His total flying time up to 11th March 1967 was 3,995 hours. His total flying time on Viscounts was 109 hours 55 minutes. During the 90 days preceding the accident his total flying time was 109 hours 55 minutes (representing his total time on Viscounts). During this period of 90 days none of the Statutory maxima, as laid down by Air Navigation Regulations, was exceeded.

During his career as a pilot before joining South African Airways Mr. Trenwith had an indifferent record in the written examinations for his various professional qualifications as a pilot. However, after joining South African Airways he underwent extensive training, and proved satisfactory both in flight tests and in written examinations. The Board is satisfied that he was fully qualified for his duties.

The cabin crew on "Rietbok" on its last fatal flight consisted on Senior Flight Steward P.L. Bezuidenhout. born on 21st April 1940; Flight Steward Z. de Beer, born on 11th October 1949; and the Air Hostess, Miss A.P. van der Poel, born on 28th April 1944. The Board is satisfied that each of these persons had been properly trained and was fully qualified for duty.

1.6 Aircraft Information

(a) The aircraft, serial No. 317, was owned and operated by South African Airways. The aircraft was originally purchased in 1962 from a Cuban airline, CUBANA. It was constructed in 1958. Certificate of Airworthiness No. 1755 was issued on 10th March 1962, and endorsed for categories a, b, c, d, e and f. This certificate was renewed regularly, and was valid at the time of the accident.

The aircraft was fitted with 4 Rolls Royce Dart Mark 525 Turbo Prop engines. A scrutiny of the airframe log-books, each of the engine log-books, and each of the propeller log-books shows that all required modifications had been incorporated and that the aircraft had been properly maintained.

The Board is satisfied that all inspections and maintenance procedures had been properly carried out up to the time of the aircraft's take-off from Port Elizabeth on 13th March 1967, and that the aircraft was fully air-worthy and serviceable.

(b) The Board it satisfied that the all-up weight of the aircraft at all relevant times was well below prescribed maxima, and that the aircraft had been properly loaded before take-off from Port Elizabeth on 13th March 1967. The Board is also satisfied that the centre of gravity during the last flight was within prescribed limits.

(c) Adequate fuel of the correct type was on board at the time of the accident, and from subsequent investigations and analyses, conducted in the course of the investigation of the accident, the Board is satisfied that the fuel had not been contaminated and was in all respects satisfactory.

1.7 Meteorological Information

(a) The crew had been fully briefed before take-off from Port Elizabeth on weather conditions en route to East London and on the actual weather conditions at East London. Before take-off from East London the first officer obtained the weather forecast for the route, and also the weather report. The substance of the report was drizzle, visibility approximately one mile, 8/8ths stratus at 400 feet. The forecast indicated probable deterioration. It is probable that instrument meteorological conditions were encountered en route, but, as appears from the report from the aircraft at 1709.12 GMT, the coastline was in sight from a height of 2,000 feet. Visibility conditions are established to some extent by the evidence of the eye-witnesses, who saw the aircraft's anti-collision beacon from distances of approximately 1 ½ to 2 ½ miles. The cloud base and visibility at East London Airport itself, as estimated by the Tower Controller, were below company limits for night approaches, but it is well known that the weather at East London "comes and goes", and it was therefore entirely proper for the captain to see for himself whether or not the weather, as and when an attempted approach was made, was sufficiently clear to enable him to land in safety. In the event, the accident occurred before any such approach was carried out.

(b) Darkness had fallen at the time of the accident.

(c) There is no evidence of any “front” conditions or turbulence, and the meteorologists testified that none would have occurred in the conditions reported.

1.8 Aids to Navigation

The aids to navigation available on the 13th March 1967 were as follows:

East London

Main NDB (270 Kc)
Locator NDB
VOR
VDF
DME
VASI (for both runways 10 and 28)
APPROACH LIGHTS (for runway 28 only).

All these were checked on 14th March 1967.

The main NDB was not coding (as notified in NOTAM No. 38/67, dated 20th February 1967), but its signal was good and the frequency correct. The Locator NDB was satisfactory. The VOR was not operating (as notified in NOTAM No. 44/67, dated 9th March 1967). The VDF was not operating (as notified in NOTAM No. 62/65, dated 13th September 1965). The DME, VASI and Approach Lights were serviceable.

The Board is of the opinion that aids such as VOR and ILS would have been of considerable assistance to the pilot of "Rietbok", but that the existing aids were sufficient to enable him to find East London comfortably, and to carry out a safe let-down procedure on runway 28 or on runway 10. On the evidence, the accident was not due to inadequate aids, though the presence of further aids might have enabled more information to be obtained on the movements and precise position of the aircraft at all relevant times.

Port Elizabeth:

NDB
VOR
VDF
DME
VASI
APPROACH LIGHTS.

All these were checked on the morning of 14th Match 1967 and found to be serviceable.

Port Alfred:

NDB.

This was also checked on l4th March 1967 and found to be serviceable.

1.9 Communications

Full VHF and HF RT facilities existed at East London and at Port Elizabeth, and on the aircraft.

The cessation of all communications from the aircraft after it had reported being at 2,000 feet is regarded by the Board, on the probabilities, as having been due not to an electrical or radio failure, but to an occurrence in the air which prevented both pilots from transmitting, and which was associated with the reason for the accident.

1.10 Aerodrome and Ground Facilities

East London Airport was equipped with full aerodrome and ground facilities, and its runways were of sufficient length and in serviceable condition.

1.11 Flight Recorders

There was no flight recorder carried on "Rietbok". The only record of the flight is the tape record at Port Elizabeth of conversations between Port Elizabeth and the aircraft, and of part of the conversations between the aircraft and East London.

1.12 Wreckage

Very little of the wreckage has been found. Portions were picked up by naval vessels on the evening of 13th March 1967, and other pieces were washed ashore at various points down the coast. At least one piece was washed ashore over three hundred miles from the probable point of the crash.

The wreckage consists of portions of bulk-head, portions of interior cabin panelling, portable galley equipment, seats, windows, cushions and an hydraulic accumulator from the nose-wheel compartment.

The main wreckage of the aircraft is believed to be lying at a depth of between 180 and 220 feet, about 1 ½ miles off-shore. The position of this wreckage has been fixed by reference to an oil slick, which was observed by a naval vessel searching the area on the night of l3th/l4th March 1967, and by reference to an electro-magnetic plot compiled by Underwater Technical Research Centre (Pty.) Ltd. The point of origin of the oil slick was fixed by the naval observers, and was found to remain static for approximately 7 hours, despite a strong current. Samples of the material were obtained by another vessel and later analysis showed it to be aviation kerosene. The electro-magnetic plot showed a number of metallic objects on the sea floor in the

general area of the crash, but the plot of highest intensity coincides with the point of origin of the oil slick.

The Department of Transport organised extensive salvage operations, involving special vessels and equipment, underwater television cameras, and diving teams, but it was not reasonably possible to reach the wreckage. Sea conditions were difficult and dangerous, and murky water and a strong current made diving conditions impossible. Because of these problems, and the high daily cost of the salvage operations, the search eventually had to be called off. Nevertheless, this Report would not be complete without some reference to the efforts and enterprise of the Department and of the particular officials concerned.

1.13 Fire

There is no evidence of fire.

None of the eye-witnesses saw a fire; there is no sign of fire in the wreckage recovered; and there was no report from the aircraft of fire.

1.14 Survival Aspects

An ALERFA and subsequent DETRESFA were originated promptly. Two naval vessels, S.A.S. "Mosselbaai" and S.A.S. "Johannesburg", put out from East London as soon as possible, and searched the area. They were joined by the tug "Steytler" and the pilot vessel "Craigie". During the early hours of 14 March 1967, a Shackleton aircraft of the South African Air Force arrived to assist, but could not then be profitably employed because of poor visibility. Later, from about 6.15 a.m. on 14th March 1967, the Shackleton, together with a South African Air Force Dakota, joined the search.

During the evening of 13th March 1967, several bodies, in which all life appeared to be extinct, were sighted by one of the naval vessels. These bodies could not be recovered because of the high seas, and were soon lost to view in the rain and darkness.

The Board wishes to make special mention of the effectiveness of the permanent Search and Rescue organisation and procedures established by the Department of Transport, and of the efficiency with which the Search and Rescue operations were commenced and carried out by the officials of the Division of Civil Aviation, the S.A. R & H., the S.A. Navy and the S.A. Air Force respectively. The Board is satisfied that every step was taken to find and rescue any possible survivors.

Regard being had to the evidence of the velocity with which the aircraft probably hit the water, it is believed that there could have been no survivors.

1.15 Tests and Research

The Board heard evidence from witnesses at East London and Pretoria, and also received in evidence a number of written statements and exhibits. The Board carried out inspections in loco, and its individual members investigated data on the maintenance and operation of Viscount aircraft, on the characteristics of the route between Port Elizabeth and East London, on emergency procedures, on pilot training and testing in S.A. Airways, on Air Traffic and Airport control, and on all other relevant and possibly relevant matters. In addition the following investigations were carried out :

(a) Flight Tests were carried out at various altitudes over the sea, and with the 3 eye-witnesses at their respective observation points. Each was invited to indicate when the height of the test aircraft most closely approximated that of "Rietbok" on the night of the accident.

(b) Numerous flight plots were compiled, covering the range of possible speeds and heights of the aircraft over the different phases of flight from the time the aircraft was abeam of the Port Alfred NDB to the point where it probably hit the sea.

(c) The lengthy tape record at Port Elizabeth was played over for possible further data.

(d) Prof. Gordon Lauf of the Department of Land Survey in the University of the Witwatersrand was consulted on the problems of (i) fixing accurately the movements and positions of the aircraft from the time it reported being abeam of the Port Alfred NDB, and (ii) fixing the exact times of the various radio messages transmitted from the aircraft and the exact time at which it hit the sea.
Prof. Lauf's work took several days, including a day at East London and Port Elizabeth Airports and two days at Jan Smuts Airport. His calculations and findings, and especially those fixing times, have been of great value to the Board.

(e) At the request of the Board, Mr J. Adam, Deputy Chief Executive of S.A. Airways, Capt. J.A.G. Rademan, Chief Pilot, Capt. S. Pienaar, Chief Flying Instructor, and Capt. Bruce Forsyth, of S.A.A. Operations collaborated in drawing up plots covering probable flight movements of "Rietbok" from take-off at Port Elizabeth to the time of the accident.

(f) The Board had a number of consultations and discussions with officials of the Division of Civil Aviation and of S.A. Airways.

(g) Mr. B. Aston, Chief Test Pilot of the British Aircraft Corporation, kindly flew out from England, and, apart from giving evidence, consulted at length with individual members of the Board on possible causes of the accident. Mr. Aston has accumulated profound knowledge and experience of the design, construction, performance and idiosyncracies of Viscount aircraft, and is aware of the details of every major accident involving Viscount aircraft.

(h) The Board studied a number of reports of similar accidents elsewhere in the world.

(i) Mr. D. Struwig, as a Member of the Board, carried out with members of S.A. Airways technical staff a detailed survey of the pieces of wreckage recovered from the sea, and of the apparent forces to which each piece had been subjected.

(j) The Board consulted Dr. Bernard van Lingen, Specialist Physician and Cardiologist, on the possibility of Capt. Lipawsky having had a heart attack, and on the effects of such an attack in the air.

(k) The Board deliberated at length on the evidence, and examined and endeavoured to test every reasonable possibility. Certain information was offered and various theories were advanced by members of the public, some of whom are technically qualified; all this information was investigated and each of these theories received proper consideration.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

Capt. Lipawsky was an experienced pilot of above average ability and with a positive attitude towards safety. He had taken on extra fuel at Port Elizabeth to over-fly East London, and he had indicated to passengers at Port Elizabeth that there was very little prospect of a landing at East London.

When the accident occurred the aircraft was not yet in the approach phase, and should not have been below an altitude of 2,000 feet. How then did it come to be at sea level?

The first possible cause to be explored is pilot error. The Board has rejected as wholly improbable a deliberate descent to low altitude in an attempt to remain below the cloud base. Such a step, in the circumstances, would have been contrary to sound airmanship and also hazardous, and on the weather report nothing would have been

gained by it. In the Board's opinion the over-whelming probability is that Capt. Lipawsky's intention was to stay at approximately 2,000

feet until he commenced his approach.

The circumstances surrounding unintentional descent must now be considered. An altimeter error is unlikely. There were 2 independent altimeters, each of which would have been looked at when the QNH was set. An altimeter mis-reading is possible, but unlikely in the limited altitude range within which the aircraft had operated in the flight from Port Elizabeth, and even more unlikely after the reports of descent to 4,000 feet and 2,000 feet respectively, assuming the correctness of those reports (for which assumption there are good reasons.

Another possible cause of involuntary descent is pilot disorientation. The Board has studied the literature on this aspect, and the available records of certain accidents attributable to this cause. Factors which have been weighed in the present case are that the Captain may have been fatigued by the cumulative stress of the nose-wheel incident after the first take-off from Jan Smuts Airport, the bird strike in the take-off from East London on the down trip, the consequent delay at Port Elizabeth, which caused him to be late, and the unfavourable weather report at East London; and that, after the Tower Controller at East London put him off his proposed approach on runway 10, he may have changed and re-changed the aircraft heading rapidly so as to position himself for an approach on runway 28; and that, in the changing conditions between IMC and VMC, such rapid and/or steep turns may have led to disorientation, with an inadvertent increase in the rate of descent.

Such a sequence of events cannot be discounted, and indeed there is good reason to believe that the aircraft may have been involved in turns or some other maneuver which caused it to lose distance (see below). However, there are difficulties in accepting such a train of events as the cause of the accident. Firstly, it depends in two fundamental respects on pure speculation. Secondly, it conflicts with the evidence of the Tower Controller at East London, as eventually revised by him. Thirdly, it is most improbable that a pilot of Capt. Lipawsky's experience of night flying and instrument flying would have been wholly visual and "off his instruments" at any relevant stage, even though the coastline was in sight. Fourthly, steep or rapid turns on instruments would not be attempted except in an emergency. Fifthly, even if disorientation took place, it is difficult to accept that it caused a descent of the order of 2,000 feet or a loss of control so extensive and so enduring as to prevent recovery within the probable height and time components.

Even if the First Officer was flying the aircraft at the time, it is most unlikely that Capt. Lipawsky would have permitted the aircraft to lose so much height or to get out of control or that he would have failed to correct an incipient or potential loss of control.

The Board's conclusion is therefore that while pilot disorientation is a possible cause, it is improbable that it in fact caused the accident.

The cessation of communication from the aircraft, after reporting that it was at 2,000 feet, is significant. On the probabilities there was no electrical failure, for the anti-collision beacon was seen by 3 eye-witnesses until the aircraft went into the sea; moreover, in case of electrical failure there was an emergency system which cut the anti-collision beacon, inter alia, out of the circuit. It is equally improbable that there was a total failure of all three independent radio transmitters, i.e. the two VHF and one HF radio systems. It is possible that a transmission from East London Tower blocked pro tem the use of the same frequency by the aircraft, but the Tower Controller's evidence is against that, and besides, it is unlikely that any such blockage would have been maintained for more than 20 seconds at a time.

On the other hand it is probable that the cessation of communication was associated with the reason for the crash, and therefore that something occurred in the air which prevented both pilots from transmitting. In this regard the type of microphone in use was such that, to transmit, it had to be taken off a hook and held up to the mouth, and a switch on the microphone then had to be actuated. In any situation in the air requiring both hands to control the aircraft, the pilot would not have been able to transmit and would have had to depend on his co-pilot. For instance, if for some reason the Captain collapsed onto the yoke or onto the console of throttles and switches, the co-pilot would have been faced with the problem of pushing him away with one hand and trying to control the aircraft with the other hand, with no opportunity to transmit meanwhile.

It is unlikely that the aircraft simply flew into the sea because of cloud or fog; visibility was such that it had reported that the coastline was in sight, and its anti-collision beacon was seen thereafter from positions on land about 1 ½ to 2 ½ miles away, until it crashed into the sea. However, it was a dark night, with no visible horizon, and some degree of instrument flying must have been necessary. Instrument Meteorological Conditions would in any event have been encountered before reaching East London, as the crew well knew.

There was no turbulence in the weather conditions then prevailing, and no evidence of lightning.

The engines were heard by 2 of the 3 eye-witnesses. One of these witnesses, Bantu Headman Fana, whose evidence was

impressive, described the noise of the engines as being similar to that made by a heavy lorry going downhill. He indicated that the noise

was considerable. The noise of the aircraft striking the water, and the evidence of violent impact revealed by portions of the wreckage, indicate that the aircraft flew into the water, and that there was no attempt at a controlled ditching, such as would have occurred if multiple engine failure had occurred.

The 3 eye-witnesses saw the anti-collision beacon for a few seconds before the crash. Their evidence suggests that the aircraft was in a normal or approximately normal attitude, and descending, but not steeply. There was no indication in their evidence of structural failure or failure of any controls. The aircraft was not on its back; it was not rolling or spinning; and it was not plummeting. However, it may have been descending fast; in this regard an angle of descent of only 5° (which need not have been discernable to the eye-witnesses viewing merely a red light moving across a dark and horizonless sky) could have produced a rate of descent in excess of 2,000 feet per minute.

Numerous calculations have been made to cover the different speeds and rates of descent of the aircraft within the range of normal and acceptable practice. The results of all these analyses are the same in one important respect, namely that, if the aircraft had been proceeding normally towards East London until it hit the water, it would have crashed several nautical miles beyond the point where it did. The only basis on which the point of the crash can be reconciled with normal flight towards East London is by assuming that the fix of 20 miles out given by the aircraft at 1706.27 GMT was under-stated by as much as 11 miles. The possibility must be considered that the DME at East London was defective, but it was checked shortly afterwards and found to be correct, and the Board has therefore discounted as improbable any material error in the fix of 20 mi1es. Furthermore, according to the evidence, Capt. Lipawsky would have been positioning himself by his radar, and he knew the coastline intimately. A possible explanation for this apparent difficulty in the time-distance ratio is that the aircraft did a gentle turn of anything between 270° and 360° after it had turned back from its original heading, preparatory to an approach on runway 10. This would account for the loss of distance, although the accident must then have occurred later than 1710.08 GMT by approximately 1 ½ to 2 minutes.

However, if the accident in fact occurred at 1710.08 GMT, then the time lapse between the aircraft's last communication (i.e. that it was at 2,000 feet, with the coastline in sight) and the accident would have been that between approximately 1709.12 GMT and 1710.08 GMT, i.e. 56 seconds, but a margin at approximately 30 seconds each way should be allowed in the calculation of the first of these times. Hence a time of between 26 and 86 seconds probably elapsed between the last communication and crashing into the sea. On the eye-witness evidence, a time lapse of only 26 seconds is improbable; but in a period of as much as 86 seconds the aircraft could have lost 2,000 feet

consistently with what the witnesses observed. Then, in the same time, the aircraft, consistently with what the witnesses saw, might have doubled back in a steep turn or some other manoeuver, lost distance and reverted in some such manoeuver to a direction approximating its earlier course. The circumstances in which the aircraft would have engaged in such a manoeuver would be consistent with an occurrence in the air which prevented both pilots from transmitting.

There was no evidence of fire or explosion in the wreckage. The eye-witnesses spoke of a noise like an explosion when the aircraft went into the sea, but no such noise was heard prior to impact.

No other aircraft were in the area, and apparently there were no vessels. In the darkness it is unlikely that any birds were about, besides which the Viscount structure, including the windscreen and tail, would, at a speed of the order of 180 knots, easily have withstood a bird strike.

Colonel Matheson, of the South African Railways Police, testified on investigations into the background of every passenger, crew member, and other person associated with the aircraft. Colonel Matheson negatived sabotage as a possible cause. From the circumstances surrounding the crash itself, there is no reason to believe that the airworthiness of the aircraft had been affected in any way.

The Board has considered the possibility of incapacitation of both pilots by a leakage of some noxious gas or by the explosion of an hydraulic reservoir or oxygen cylinder. However, the evidence is against this.

On all the evidence the Board has found it improbable that the originating cause of the crash was any of the following :

(a) failure of the structure or of any of the control surfaces or control actuating mechanisms;

(b) multiple engine failure;

(c) electrical failure;

(d) flight instrument failure;

(e) explosion;

(l) fire;

(g) turbulence;

(h) poor visibility due to the bad weather or to the darkness;

(i) altimeter error or misreading;

(j) disorientation;

(k) flying in the pre-approach phase at too low an altitude;

(1) collision with some object in the air, such as a bird;

(m) sabotage affecting the airworthiness of the aircraft;

(n) incapacitation (including loss of vision) of both pilots by noxious gas or explosion.

On the evidence, the Board has not been able to exclude as the originating cause of the crash the possibility that the Captain suffered a heart attack in the air and collapsed, causing loss of control of the aircraft, and that the First Officer could not in the time available regain sufficient control to prevent the aircraft from hitting the sea.

In this regard there is evidence that Capt. Lipawsky had suffered various symptoms suggestive of cardio-vascular trouble. with characteristic conscientiousness he had referred his troubles to his medical adviser , and had submitted to examinations, and to treatment, after which there had been no more symptoms. His physical condition had been carefully checked when his licence was renewed. However, on the medical evidence all conditions conducive to a fatal cardio-vascular seizure could have been present without showing any clinical signs.

The Board has referred to a number of reported cases of pilots having heart attacks in the air. In some of these cases control of the aircraft by the co-pilot was impaired and the aircraft crashed. In at least one of these cases, in the U.S.A., the captain, aged 59 years, had an established history of cardiovascular disease and diabetes mellitus which he concealed from the civil aviation authorities. Yet he continued to pass all his six-monthly airline pilot's medical examinations, the last of which took place less than 2 months before he crashed an airliner after suffering a coronary insufficiency in the air.

In the U.S.A. the C.A.B. records as at 5th May 1966 contain several cases of pilots dying of heart attacks in the air between 1961 and 1966, and in addition the records on aviation accidents in the U.S.A. indicate that a heart condition either caused or was suspected in 5 cases in 1959, 7 cases in 1960, 6 cases in 1961, 3 cases in 1962, 1 case in 1963, 5 cases in 1964, 10 cases in 1965, and 1 case in 1966 (up till 22nd April 1966). Cases have been reported in other countries.

The following accidents, among others with similar results, may be mentioned here:

(i) In South Africa, in approximately 1936, the pilot of a light aircraft collapsed and died in the air after a heart attack. His body impaired control of the aircraft, but his 2 young passengers succeeded in dragging him out of the pilot's seat, and one of them then crash-landed the aircraft.

(ii) On 24th May 1961, an Australian National Airlines DC4 crashed 2 ½ miles from Brisbane Airport. The conclusion of the Board of Inquiry reads as follows:

> "The available evidence points to the probability that this accident was caused during the pre-landing circuit when Captain Norriss endeavoured to leave his seat under the influence of a disordered cardiac function and, in the course of so doing collapsed across the engine control console in such a way as to bring all four throttle levers to the closed position depriving First Officer Adams of the throttle movement necessary to avoid a crash-landing oft the airport."

Both crew members were killed and the aircraft totally destroyed in the crash.

(iii) On 14th December 1962 a Flying Tiger Line Super Constellation crashed during an ILS approach. All 5 persons on board sustained fatal injuries. The Board of Inquiry found that the probable cause of the accident was the incapacitation of the pilot-in-command (because of coronary artery disease), at a critical point in the approach, resulting in a loss of control of the aircraft from which the co-pilot was unable to recover.

(iv) On 22nd April 1966, an American Flyers Airline Lockheed Electra crashed into a hill near Ardmore Airport. The crew of 5 and 78 passengers died and the aircraft was destroyed. The Board determined that "the probable cause of the accident was the incapacitation, due to a coronary insufficiency, of the pilot-in-command at a critical point during a visual, circling approach being conducted under instrument flight conditions".

In the case of Viscount aircraft, tests conducted in England have shown that a pilot who collapses is not likely to jam the yoke so as to prevent all movement thereof (though that can still happen with the pilot's head in a certain position). However, the Board is satisfied that if the captain should collapse, and especially if that should occur after releasing his safety belt (as in the case of the Australian DC4), serious impairment of flight and/or engine controls can take place.
A co-pilot may have great difficulty in coping with the problem of

pushing or pulling the captain's body away from the yoke or the console, and of having to recover control of the aircraft under instrument flying conditions.

2.2 Conclusions

The available data is insufficient for the cause of the accident to be determined. On the evidence the Board has found it improbable that the originating cause of the crash was any of the following:

(a) failure of the structure or of any of the control surfaces or control actuating mechanisms;

(b) multiple engine failure

(c) electrical failure;

(d) flight instrument failure;

(e) explosion;

(f) fire;

(g) turbulence;

(h) poor visibility due to the bad weather on to the darkness;

(i) altimeter error or misreading;

(j) disorientation;

(k) flying in the pre-approach phase at too low an altitude;

(1) collision with some object in the air, such as a bird,

(m) sabotage affecting the airworthiness of the aircraft;

(n) incapacitation (including loss of vision) of both pilots by noxious gas or explosion.

However, on the evidence the Board cannot exclude as the originating cause of the crash a heart attack suffered by the Captain in the air, with ensuing loss of control of the aircraft, and with the First Officer being unable in the time available to regain sufficient control to prevent contact with the sea.

2.3 Responsibility

There is no evidence of any breach of duty or of any other

culpable failure on the part of any person.

3. RECOMMENDATIONS

3.1 The Board makes the following recommendations:

(a) Provision should be made for automatic recording of radio conversations between aircraft and airport control towers at all major airports, in conformity with ICAO Annex 11.

(b) Accurate time checks should be given by airport control towers to every aircraft prior to taxi clearance, and such time checks should be read into the recorded conversation.

(c) ATC procedures (including approach and let-down procedures) at East London should be reviewed.

(d) By reason of the particular weather problems at East London, the existing aids should be extended to include ILS (it is understood that this is already in hand).

(e) Consideration should be given to the fitting of flight recorders to all S.A. Airways aircraft used for the public transportation of passengers.

3.2 The Board has noted the far-reaching medical checks imposed for licence renewals, and the additional precautions observed by S.A. Airways. It is considered that the problems of the physical and mental health of professional pilots, and of the elimination of anxiety and professional insecurity, are matters for the medical authorities concerned, to whom the appropriate investigation and recommendations should be left.

DATED at PRETORIA this 2nd day of AUGUST 1967.

Original signed by :

Mr C. S. Margo
CHAIRMAN

Mr R.H. Preller
MEMBER

Mr D.J. Struwig
MEMBER

APPENDIX

I. LIST OF WITNESSES WHO TESTIFIED VIVA VOCE

1. P. Beukes, Redakteur van " Die Landstem".
2. M.J. Meiring. Joernalis, van "Dagbreek en Sondagnuus".
3. R.D.M. Doddington, Director of Underwater Technical Centre (Pty.) Ltd.
4. T.B. Phillips, Production Manager, S.A Airways (identifying wreckage)
5. V.J.P. Adlard, Air Safety Officer, S.A. Airways (identifying crew).
6. J. Germishuys, Chief Inspector of Flying, Division of Civil Aviation.
7. J.J. G. Coetzee, Manifesklerk, S.A. Lugdiens, Port Elizabeth.
8. K.B. van der Mescht, Laaiklerk, S A. Lugdiens, Port Elizabeth.
9. E.D. Henegen, Air Traffic Controller, Port Elizabeth.
10. J.H. Venter, Aviation Technician, S.A Airways, Port Elizabeth.
11. J.C. Picton, Air Radio Technician, Dept. of Transport, Port Elizabeth.
12. J. Scholtemeyer, Chief of Navigation Services, Dept. of Transport.
13. R. P. Channer, Chief Air Radio Technician, Dept. of Transport.
14. R.A. van Zyl, Weather Forecaster, Dept. of Transport, Port Elizabeth.
15. W.R. Watts, Senior Technician, Dept. of Transport, Weather Office, East London.

16. G.M. Leslie, Senior Air Traffic Controller, Dept. of Transport, East London.

17. Capt. D.W. Scott, S.A. Airways pilot.

18. D.G. Tainton, S A. Airways First Officer.

19. L.Q. Hayward, Senior Met. Officer, Weather Bureau, Dept. of Transport.

20. Capt. D.W. McKe11ar, S A. Airways (flying instructor)

21. Comander D.B. Reaper, S.A. Navy (Air-Sea Rescue).

22. A.B. Lean, Director and General Manager of Underwater Technical Centre (Pty.) Ltd.

23. V.F. Holderness, S.A. Navy (Air-sea Rescue).

24. Dr. J.C.F. du Toit, Chief Medical Officer, S.A. Airways.

25. M.A. Ford (eye witness).

26. (Mrs.) M.P. Ford (eye witness).

27. Headman Fana (eye witness).

28. B. Aston, Chief Test Pilot, British Aircraft Corporation.

29. Brig. N.J. Nieuwoudt, Direkteur Militêre, Mediese en Personeelkeuring Sentrum.

30. Col. K.W. Matheson, S.A.R. & H. Police.

31. Capt. J.A.G. Rademan, Fleet Captain, S.A. Airways.

32. Capt. S. P ienaar, Chief Instructor, S.A. Airways.

33. Capt. D.D.B. Forsyth, Operations Manager, S.A. Airways.

34. F.O. Russell, Production Foreman, Viscount section, S.A. Airways.

II. LIST OP WITNESSES WHO MADE WRITTEN STATEMENTS ONLY OR WHO CAVE ADDITIONAL EVIDENCE IN WRITING.

1. P.A. Peens , Inspector of Accidents, Dept. of Transport.

2. W.A. Machin, Refueller , Port Elizabeth.

3. G.D. Nel, Vliegtuig-tegnikus, Port Elizabeth.

4. P.J.L. Venter, Weather Office, Port Elizabeth.

5. B.J. Koekemoer, Marine Signalman, S.A.R. (on barometer readings East London).

6. T.P. Kelly, “New Hope", Kayser's Beach.

7. Mrs. C V. Kelly, "New Hope”, Kayser ‘s Beach.

8 Sub-Lieut. H.J.M. Trainor, S.A. Navy.

9. N.C. Strudwick, Technical Assistant, S.A. Airways (on wreckage)

10. J.W. Verster, (wreckage found at Plettenberg Bay).

11. G.M. Leslie, Senior Air Traffic Controller, Dept. of Transport, East London

12. J.R. Mowatt, Manager, Fliqht Administration, S.A. Airways.

13. Dr. T.S. McDonald, Military Medical & Personnel Selection Centre.

14. J. Knight, Assistant Safety Officer, British Aircraft Corporation.

15. H.W. Clarkson, Department of Transport (let-down procedures).

16. J. Adam, Deputy Chief Executive, S.A. Airways.

17 Capt. F.A. Roux, N.C. Strudwick and V.J.P. Adlard, S.A. Airways Board of Inquiry into "Rietbok" Accident.

18. S.H. Frank1in, Port Captain, East London.

19. Comdt. A.P. Rich, 0.C. Flying, AFS Ysterplaat, S.A.A.F.

20. Dr. H. Penn, Ear, Nose and Throat Specialist.

21. Dr.O.P. Charlton, Radiologist.

22. Dr. M.A. van der Spuy, Asst. Chief Medical officer, S.A. Airways.

23. Sister A E. van der Merwe, radiographer.

24 J. Germishuys, Chief Inspector of Flying, Division of Civil Aviation.

25. Capt. J.R. Trotter, S.A. Airways pilot.

26. J.A. Smuts, S.A. Lugdiens Eerste Offisier.

27. J.J. Hoffman, S.A. Lugdiens Eerste Offisier.

28. M.M. McLean, S.A. Lugdiens Eerste Offisier.

29. D S. Fourie, S A. Lugdiens Eerste Offisier.

30. D.A. Knudsen, S.A. Lugdiens Eerste otfisier.

31. D G. Tainton, S.A. Lugdiens Eerste offisier.

32. A.W. Halliday, S.A. Lugdiens Eerste offisier

33. G D. Ferguson, S.A. Lugdiens Eerste Offisier.

34. M.D. Kemp, S.A. Lugdiens Eerste Offisier.

35. J.P. Ho1liday, S.A. Lugdiens Eerste Offisier

36. B.K. Hayward, S.A. Lugdiens Eerste offisier.

37. F.J. le Roux, S.A. Lugdiens Eerste Offisier.

38. W.F. Coetzer, S.A. Lugdiens Eerste offisier.

39. J.M. Armstrong, S.A. Lugdiens Eerste offisier.

40. J.P. Louw, S.A. Lugdiens Eerste Offisier.

41. H.H. Pieterse, S A. Lugdiens Eerste offisier.

42. H.F.C. Herrmann, S A. Lugdiens Eerste Offisier.

43. Capt. JG. Newton, S.A. Airways pilot.

44. Capt. D.W Scott, S.A. Airways pilot.

45. Capt. B. Wilson, S.A. Airways pilot.

46. H.J.R. Tindall, S A. Airways pilot.

47. D. L.S. Smith, Senior Government Pathologist, East London.

48. T.B. Phillips, Production Manager, S.A. Airways (fuel tests and analysis).

49. F.O. Russell, Production Foreman, Viscount Section, S.A Airways (fuel tests and analysis)

50. D.G. Anderson, Technical Assistant, Fuel Quality Control, S.A Airways (fuel tests and analysis)

51 V.C. Lewis, S.A. Airways (fuel tests and analysis).

52. Col. K. Matheson, S.A.R. & H. Police (items of wreckage recovered).

53. Capt. Forsyth, S.A. Airways Operations (answering allegations of excessive flying by S.A. Airways pilots).

III. LIST OF WITNESSES INTERVIEWED BY BOARD

1. B. Aston, Chief Test Pilot, British Aircraft corporation.

2. G.M. Leslie, Senior Air Traffic Controller, Dept. of Transport, East London.

3. Capt. K. Wyness, S A Airways pilot.

4. Dr. B. van Lingen, specialist Physician & Cardiologist.

4. Prof. G. Lauf, Professor of Land Survey, University of Witwatersrand.

6. A.M. Conradie, Q.C. , Chief Executive, S.A. Airways.

7. J. Adam, Deputy Chief Executive, S.A Airways.

8. Capt. J.A.G. Rademan, Fleet captain, S.A. Airways.

9. Capt. S. Pienaar, Chief Instructor, S.A. Airways.

10. L.C. du Toit, Director of Civil Aviation.

IV. PARTIES REPRESENTED AT THE HEARING

PARTY:	REPRESENTED BY:
S.A. Airways	Adv. L. Le Grange
Insurance Underwriters of passenger liability	Attorney D. Munro
British Aircraft corporation Ltd.	Adv. P. Peart
Estate late V D. Atkins	Attorney G N. Orsmond
Estate late V.E.P. Wood	Attorney G N. Orsmond
Estate late E.D.L. Wood	Attorney G N. Orsmond
Estate late P.L. Bezuidenhout	Attorney G N. Orsmond
Estate late J. Blankfield	Attorney L. Kaplan
Dependants of late L.W. Lawe	Attorney J.A. Chubb
S.A. Airways Pilots Association	Capt. A. Rous.

The evidence was led by Mr. Erasmus, legal adviser in the Department of Transport.

A witness, Mr J . Meiring, was represented by Attorney D. Curran.

V. LIST OF MAIN EXHIBITS

DOCUMENTS

1. Koerantberig “Die Landstem”.

2. Koerantberig “Dagbreek en Sondagnuus”.

3 Koerantberig "Dagbreek en Sondagnuus".

4. Map furnished by Underwater Technical Centre (Pty.) Ltd.

5. Registration of ZS-CVA.

6. Certificate of airworthiness of ZS-CVA.

7. Renewal of above.

8. Certificate of safety of above.

9. Plan of Viscount Aircraft.

10. Passenger manifest.

11. Passenger handling advice

12. Cargo manifest.

13. Capt. Lipawaky's logbook.

14. Airframe logbooks of ZS-CVA (two books)

15. Engine logbooks of ZS-CVA (four books).

16. Propeller log-books of ZS-CVA (four books).

17 Confidential file from Military, Medical and Personnel Selection Centre on Capt. Lipawsky's medical history (including ECGs).

18 Transcript of recorded conversation on tape at Port Elizabeth.

19. Report on weather information supplied and weather conditions in the East London area on 13th March, 1967.

20. Weather and aerodrome forecasts for East London.

21. Route forecast

22. Weather reports for East London airport.

23. Synoptic chart.

24 Aerad documents on East London airport.

25. Various maps and charts handed in by Commander Reaper.

26. Various maps and charts handed in by Underwater Technical Centre (Pty.) Ltd.

27. Surveyor's map of relevant datum points in regard to the accident.

28. Dr. H. Penn's report on Capt. Lipawsky.

29. Radiologist's report on Capt. Lipawsky.

30. Reports by First Officers who flew with Capt. Lipawsky (17 documents).

31. Reports by captains who flew with First Officer Trenwith (4 documents).

32. S.A. Airways Board of Investigation report.

33. Details of Capt. Lipawsky's leave.

34. Report on flying hours by S.A. Airways pilots (in answer to suggestions of fatigue).

35. Details of Capt. Lipawsky's flying history and flying hours.

36. Details of First Officer Trenwith's flying history and flying hours.

37. Corrected transcript of tape.

38. Post-mortem report.

39. Statement by G.M. Leslie.

40. Statement by T.B. Phillips.

41. Statement by F.O. Russell.

42. Statement by D.G. Anderson.

43. Statement by V.C. Lewis.

44. Correspondence between S.A. Airways and various fuel companies in regard to contamination of fuel and steps taken to prevent it in future.

45. Reports by S.A. Bureau of Standards on fuel analysis tests.

46. Report from Philippine Airlines to Flight Safety Foundation on fuel contamination.

47. Capt. Lipawsky's flight plan (two documents).

48. Anemogram at East London on 13th March, 1967.

49. Enlarged photographs of hydrolic accumulator recovered from ZS-CVA.

50 List furnished by Col. Matheson on finding items of wreckage and where each was found.

51. Map showing where body was discovered.

52. Numerous plots on probable flight path of ZS-CVA.

53. Reports on operational flight tests conducted on 14th March, 1967, on radio and visual navigation aids.

54. ICAO and other reports on air accidents.

55. Various publications on pilot disorientation.

ARTICLES :

1. Actual tape record at Port Elizabeth.

2. Cabin window.

3. Seat cushion.

4. Head-rest cushion.

5. Portion of door to hydrolic compartment.

6. Portion of ceiling.

7. Portion of rear cabin bulkhead.

8. Shelf .

9. Seat cushion.

10. Galley food container.

11. Pair of panties.

12. Seat cushion.

13. Head-rest pillow.

14. Portion of wall of hydro1ic compartment.

15. Pillow slip.

16. Galley food container.

17. Galley food container.

18. One packet of airmail letters.

19. Cabin window.

20. Two portions of panelling.

21. Seat cushion.

22. Portions of material, clothing and stockings

23. Food container.

24. Head-rest cushion.

25. Hydrolic accumulator.

26. Table attached to forward bulkhead.

27. Forward bulkhead.

28. Table attached to bulkhead.

29. Bulkhead.

30. Portion of bulkhead.

31. Portion of bulkhead.

32. Portion of bulkhead.

33. Portion of bulkhead.

34. Portion of bulkhead.

These various items were picked up at sea or were washed ashore at places near Hamburg, Fish River Mouth, Bighamond, Boesmansrivier Mouth, Port Alfred, Kasanga, Rietrivier and Plettenberg Bay.