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FEDERATION OF NIGERIA

MINISTRY OF COMMUNICATIONS AND AVIATION

**Report by Board of Investigation
into
Accident to West African Airways
Corporation Aircraft
BRISTOL 170 VR-NAD**

Held in February and March 1955

NINEPENCE NETT

LAGOS: FEDERAL GOVERNMENT PRINTER

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In writing a foreword to this Report with the accident would act as a background document.

On 5th February, 1955, West African on a flight to Calabar with nine passengers before the expected time of arrival of this aircraft for details of weather conditions at the airport. The communication system for the aircraft was not in operation and the acknowledgement appeared to be interrupted and there was no further contact with the plane. Enquiries were instituted to every aerodrome in the vicinity of the aircraft's last known movement and within 30 minutes, the full scale search and search measures were started by land and air.

Eventually, some eight hours later, the wreckage was found north of Calabar and some 4 miles from the main road. The aircraft had been found by the headman of the village. He visited the scene and walked back to the main road. It was found that the incident was very rapid and instantaneous.

Members of the Department of Civil Aviation visited the scene of the accident and on receipt of their report, the Director of Transport and Civil Aviation, London, who was in charge of the investigation.

On the 10th of February, I convened a Board of Enquiry. The members were Commander Coleman, A.F.C., Director of Civil Aviation; B. A. Morris, Esq., Inspector of Accidents, Department of Transport and Civil Aviation, London; and S. H. Nicholson, Esq., Director of Civil Aviation, Nigeria. Members of this Board took part in the investigation of the accident.

The conditions under which the board of enquiry was set up and the problems of reaching the wreckage and the problems of re-constructing the story of the accident were factors which had to be taken into account.

Examination showed that various parts of the aircraft were missing. The commendable co-operation by the various agencies and the assistance of the Shell D'Arcy Petroleum Company in the recovery of missing parts were discovered. The likelihood of the aircraft being hidden in thick undergrowth and tall trees into which it had fallen from the main wreckage.

It was only by the most strenuous efforts of the various agencies and other essential parts were removed from the wreckage through the jungle to the main road and the wreckage was taken by sea to Lagos for further examination.

On their arrival in Lagos, they were met by the Director of Civil Aviation, Farnborough, England, who as

Foreword

I feel that a brief resumé of the events connected with the report which, to a large extent, is a technical

Airways Bristol aircraft 170 VR-NAD left Enugu on 15th August 1946 with five passengers and four crew on board. Twenty-four minutes after leaving Enugu the aircraft crashed in Calabar, a request was made by the aircraft pilot for a landing at Calabar. This information was passed but the acknowledgment was not received. Despite repeated calls from the Control Tower, the aircraft did not land. Immediately after the aircraft was due at Calabar, the pilot requested a landing. Some time for any information concerning its possible position. An aircraft distress procedure was put into operation and the aircraft was located in thick jungle some 60 miles from Calabar-Arochuku road. The wreckage of the aircraft was found near Ubo Village who had seen and heard the crash, had been on the road and sent his report to Calabar. He reported that the aircraft had crashed. Further evidence shows that the crash was almost

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I must here pay tribute not only to the Chairman and members of the board of investigation together with their assistants for producing such a conclusive report, but also to all those members of Government departments who, by their devotion to duty both at the time of the accident and during the investigation, made it possible for the report to be prepared. My thanks also are due to the Ministry of Transport and Civil Aviation, London, and to the Royal Aircraft Establishment, Farnborough, who gave such timely assistance. I would also mention the help of the Shell D'Arcy Petroleum Company for the use of their helicopter and Messrs Costain Limited, West Africa, whose staff were of such assistance near the site of the accident.

It is invidious to single out any particular names for high commendation but I feel it is right to pick out two particular officers for mention. The first is Captain A. D. M. Walter, a Development Officer in Calabar who was largely instrumental in organising the recovery of the wreckage. Secondly, Mr Fabian Obi Azike, the Air Traffic Control Assistant in the Calabar Control Tower, the initiative and rapid action taken by this officer when he first received the impression that the aircraft had not been receiving his signals was such that in happier circumstances, the search and rescue services might have reached any survivor in the accident in the shortest possible time. The attention to duty of this officer is a tribute to the devotion to duty of all the staff connected with Civil Aviation in Nigeria.

I would mention that owing to the difficulty in communication between Calabar and the scene of the accident, it was not possible to hold a funeral service in Calabar for all the victims. For those not buried in Calabar, a service was held on the site of the accident and a memorial service was also held in Calabar. At a later date a national service of remembrance was performed in the Anglican Cathedral in Lagos.

Nigeria and the West African Airways Corporation have received a severe blow from this tragic accident but the fact that this report has come to some definite conclusions, which will be of value throughout the aircraft industries of the world, is some slight compensation for the tragic disaster which it covers.

As a final word, I wish to state that Bristol aircraft have as good a record of safety as almost any aircraft throughout the world and that the West African Airways Corporation's record of safety is also very excellent. In a new country faced with vast development in the future, air travel is bound to increase substantially and this accident will spur my Ministry and the Department of Civil Aviation to ensure that every human device for the safety of life shall be developed simultaneously with the increase in our air services.

K. OZUOMBA MBADIWE,
Minister of Communications and Aviation

30th April, 1955.

DEPARTMENT OF CIVIL AVIATION, NIGERIA

Accident Report

Aircraft.—Bristol 170 Mk 21E VR-NAD

Engines.—Two Bristol Hercules 672

Port serial number 167301

Starboard serial number 167424.

Registered Owner and Operator.—West African Airways Corporation, P.O. Box 136, Airways House, Ikeja, Lagos.

Names of Crew.—(i) Pilot : Derrick William Cox

(ii) First Officer : Alan Gardiner-Atkinson

(iii) Radio Officer : Donald McAlister Stott

(iv) Flight Clerk : Godswill Dan Jumbo

} Killed

Number of Passengers.—Nine—all killed.

Place of Accident.—Three miles NNE of IKOT OKPORA and forty miles NNW of CALABAR in the Eastern Region of Nigeria.

Date and Time.—5th February, 1955, at 1004 hrs.

ALL TIMES IN THIS REPORT ARE GMT (Greenwich Mean Time)

1.—NOTIFICATION

The Department of Civil Aviation was notified by the Air Traffic Control Centre, Lagos, at 1100 hrs. on the 5th February, 1955, that aircraft VR-NAD was forty-one minutes overdue on a flight from ENUGU to CALABAR. Confirmation of the finding of the wreckage was received from the Air Traffic Control Centre, Lagos, at 0025 hrs. on the 6th February, 1955. An investigating party left Lagos for Calabar by air on the 6th February, 1955, and visited the scene of the accident on the following day.

2.—BRIEF CIRCUMSTANCES

The aircraft, under the command of Captain D. W. Cox, was on a scheduled flight from Enugu to Calabar. At 1004 hrs. radio communication between VR-NAD and Calabar Tower appeared to be interrupted and the aircraft crashed, out of control, on a densely wooded hillside. The aircraft had struck the ground after descending almost vertically from a height estimated to be in the region of 4,000 feet. The force of the resulting impact had been such as to cause extensive disintegration of the aircraft's structure. The port mainplane was eventually found approximately three quarters of a mile from the main wreckage. There was no fire.

3.—FURTHER DETAILS

(a) THE AIRCRAFT

(i) *The Airframe.*—The aircraft was manufactured by the Bristol Aeroplane Company in 1948. It was first registered as VP-YHW and was operated by Central African Airways for approximately one year, during which time it had flown 1,070 hours. It was re-registered as VR-NAD in November 1949 and has since been operated by the West African Airways Corporation. It had flown a total of 7,044 hours since manufacture. The Certificate of Airworthiness was last renewed on the 29th October, 1954. It had been maintained in accordance with the

approved Maintenance Schedule. At the time of take off from Enugu the All up Weight of the aircraft was 35,442 lbs and the Centre of Gravity position was 87 inches Aft of Datum. The maximum permissible AWW is 40,000 lbs and the permitted Centre of Gravity range is from 83 inches to 88.5 inches AOD.

(ii) *The Engines.*—Port Engine No. 167301 was installed on the 4th August, 1954, after complete overhaul by the British Overseas Airways Corporation, Treforest. It had run a total of 3,251 hours since new and 757 hours since overhaul.

Starboard Engine No. 167424 was installed on the 9th January, 1955, after complete overhaul by the Bristol Aeroplane Company. It had run a total of 6,392 hours since new and 95 hours since overhaul.

(iii) *Propellers.*—Type : Four-bladed De Havilland Hydromatic No. PD96/446/1

Port No. 4A49898 was fitted on the 17th January, 1955. It had flown a total of 3,661 hours since new and 96 hours since overhaul by De Havilland Propellers Limited.

Starboard No. 4A421672 was fitted on the 17th January, 1955. It had flown a total of 2,753 hours since new and 1,566 hours since overhaul by De Havilland Propellers Limited.

(b) THE CREW

(i) *The Captain.*—Mr Derrick William Cox, aged 35 years, the holder of United Kingdom Airline Transport Pilot's Licence No. 25793, which was last renewed on the 30th September, 1954, following medical examination on the same day, and was valid until the 30th March, 1955.

Mr Cox also held United Kingdom Flight Navigator's Licence No. 1625, which was last renewed on the 1st April, 1954, and was valid until the 30th March, 1955.

His total flying time as pilot was 6,928 hours, of which 1,671 hours had been on Bristol 170 aircraft.

(ii) *The First Officer.*—Mr Alan Gardiner-Atkinson, aged 30 years, held Nigerian Senior Commercial Pilot's Licence No. 1 which was valid until the 9th May, 1955. His total flying time as pilot was 2,204 hours of which 700 hours had been on Bristol 170 aircraft.

(iii) *The Radio Officer.*—Mr Donald McAlister Stott, held United Kingdom First Class Flight Radio Telegraphy Operator's Licence No. 2494, which was valid until the 6th May, 1955.

(iv) *The Flight Clerk.*—Mr Godswill Dan Jumbo joined the West African Airways Corporation in June, 1952, and commenced the duties of a Flight Clerk in February, 1954.

(c) METEOROLOGICAL DATA

The Flight Forecast, which was issued to the Pilot before departure from Lagos, forecast the weather to be fair over the sector concerned.

Although, of course, no weather observation was made at the time and place of the accident from the interrogation of witnesses who were in the area at the time, it is considered that the Flight Forecast was accurate and that the weather was generally fair.

(d) THE FLIGHT

VR-NAD departed from Enugu at 0934 hrs. on the 5th February, 1955, for Calabar on the second leg of a scheduled flight from Lagos to Tiko via Enugu and Calabar. The flight plan filed by the pilot at Enugu showed an estimated flight time of 45 minutes to Calabar at a flight level of 5,500 feet. The endurance of the aircraft was 4 hours and there was a total of thirteen persons on board.

At 0937 hrs., shortly after take off, the aircraft passed a radio message informing Port Harcourt that it had departed Enugu at 0934 hrs., Estimated Time of Arrival Calabar 1025 hrs. and was climbing to 5,500 feet. The next communication from the aircraft was when Calabar Tower was called on radio telephony at 1001 hrs. and a request made for details of the weather

conditions at Calabar, which information was passed immediately. The aircraft did not pass position, height or ETA Calabar. The acknowledgment by the aircraft of the weather report appeared to be interrupted and despite repeated calls from Calabar Tower there was no further contact with the aircraft.

(e) DETAILS OF EVIDENCE

- (i) Report of Preliminary Investigation.
- (ii) Summary of Search and Rescue Ground Search action at Calabar.
- (iii) Statement by Mr FABIAN OBI AZIKE, duty Controller at Calabar Aerodrome.
- (iv) Statement by Chief FRANK NWANJI, of Ubo Village, a witness near the scene of the accident.
- (v) Statements from other inhabitants of Ubo Village.
- (vi) Statement by Mr C. H. M. LIMB, Assistant Superintendent of Police, Calabar, with regard to the ground search from Calabar.
- (vii) Relevant Log Books, Lagos, Enugu, Calabar and Port Harcourt.
- (viii) Cargo Manifest and Aircraft Load Sheet.
- (ix) Relevant Maintenance Documents of VR-NAD.
- (x) Flight Plan, Enugu to Calabar.

(f) EXAMINATION OF THE WRECKAGE

Approach to the wreckage was made difficult by the fact that it was in extremely dense bush and could only be reached on foot by a single-line track, which involved crossing a number of small streams. This track had to be negotiated after a journey of 54 miles along the road from Calabar to Ikot Okpora. The road is as yet unsurfaced and the last few miles are only a pilot road. The foot journey to the wreckage took about 1½ hours and was of an exhausting nature.

Inspection showed that the aircraft had struck the side of a 500 feet high hill with a 45° slope, covered with dense undergrowth and tall trees. The aircraft's attitude at the moment of impact was almost vertically nose-down with evidence of side-slipping to port (Appendix 1). The speed of impact was high and all components of the airframe which were visible were very badly broken up (Appendix 2). This coupled with the density of the bush, the general condition of the wreckage in which thirteen people had met violent deaths, and the difficulty of maintaining a foothold on the 45° slope, rendered inspection under tropical conditions both arduous and unpleasant. Identification of some components of the airframe proved difficult (Exhibit A) and no evidence was seen of the port mainplane. In view of the fact that none of the eyewitnesses had seen any portion of the aircraft become detached in the air, however, it was thought that possibly the port mainplane was buried under other components. It was decided, therefore, that the wreckage would have to be dragged, piece by piece to, the top of the slope where there would be a better chance of inspecting it. This would also enable those parts which were underneath to be exposed and examined.

Both engines were completely buried in the ground and approximately 18 inches only of one blade of each propeller were visible above the surface. As it was necessary to determine whether these engines were rotating and whether they were delivering power at the moment of impact, it was decided that they must be dug out. When this had been done the appearance of the propeller blades indicated that the starboard engine was rotating and delivering power and that the port was rotating but that no significant degree of power was being developed. This port engine was examined therefore for evidence of pre-crash mechanical defect or failure. No such evidence was found and the filters were clean and free from metal or extraneous matter. The throttle barrels were found broken off from the engine by force of the impact and the throttle valves were found to be in the closed position (Exhibit B). Impact marks on the barrels showed that the valves were in this position at the moment of impact and it is considered therefore that the pilot had closed the port throttle before the aircraft struck the ground. Under these circumstances the existence of pre-crash engine failure was dismissed.

Meanwhile the work of bringing the airframe components to the top of the slope and of examining them was proceeding, and on the 23rd February it was established that the major portion of the port mainplane could not be in the main wreckage. It was decided therefore to institute a search and parties were provided by the Survey Department, assisted by the Forestry Department, to do this. They were advised that the parts required would most probably be in an area somewhere between a quarter of a mile and $1\frac{1}{2}$ miles back along the aircraft's track and that the area might be some half a mile in width. The search should be conducted using 340° Magnetic (the reciprocal of the aircraft's track) as the centre-line. The result of this search was the finding of the port mainplane in five main portions distributed as shown at Appendix 3. These were in dense, untracked bush, in an area stretching from approximately 900 yards to approximately 1,500 yards from the main wreckage (Exhibit C).

Examination showed that in order to establish the mode and sequence of failures it would be necessary for these parts to be transported from the bush to some place where they could be laid out in their correct relation and examined under the best conditions available.

(g) RECOVERY AND SUBSEQUENT EXAMINATION OF CERTAIN PARTS OF WRECKAGE

To cut tracks through the bush and manhandle the parts to the roadhead was the only solution. After discussions it was decided that the relevant parts would have to be transported to Lagos for the examination, which would be conducted in co-operation with a representative of the Structures Department (Accidents Section) of the Royal Aircraft Establishment, Farnborough, England, and a member of the Design staff of the Bristol Aeroplane Company.

The manhandling of the parts through the bush and the transport by road to Calabar was placed under the direction and organisation of the Development Officer, Calabar, who, with local labour recruited from Calabar, accomplished this difficult task to such effect (Exhibit D) that by the 15th March all the relevant wreckage from the dispersed area and from the main wreckage site was safely in the Marine Dockyard at Calabar. The speed with which this operation was accomplished was of vital importance as it is considered that had the rains set in before it was finished, recovery of the remainder might well have proved impossible and thus the entire investigation might have been jeopardised.

From Calabar this wreckage was shipped to Lagos, arriving on Sunday, 20th March. It was laid out in its correct relation and examined in co-operation with representatives of the Royal Aircraft Establishment and of the Bristol Aeroplane Company, as previously decided. This examination was made at Lagos Airport where suitable accommodation had been provided under guard. The wreckage comprised the entire port mainplane from root joint fitting to tip, but did not include certain portions of spar which were never found in spite of every effort having been made to locate them. In fact, however, failure to recover these parts has not prevented the investigation from being concluded successfully. They form only a small proportion of the wing structure and it is far more remarkable that so great a proportion was found and recovered than that these few parts were not. It is correct to record here, however, that despite the best efforts of all concerned, these parts eluded discovery. They are :—

A length of rear spar top boom inboard of Station 144 and some portions of web inboard of this station, but not including the butt joint, both halves of which were recovered.

The rear spar bottom boom outboard of Station 126.

Two lengths of front spar web inboard of Station 150.

In addition to the wing outboard of the main attachments, lengths of centre-plane spar to which these attachments are assembled were also transported to Lagos airport.

Examination of this wreckage showed the following evidence :—

(h) PORT MAINPLANE FRONT SPAR (APPENDIX 4)

Bottom boom.—Found detached, 900 yards from main wreckage.

Fractured in upward bending at outboard bolt-hole of root joint fitting.

All rivets attaching boom to web sheared spanwise in the sense of boom moving inboard, web moving outboard. This pattern was continued across the upward bending failure (Exhibit E).

There was considerable evidence of fretting on the boom face over a length of more than two feet, commencing approximately one foot outboard of the root joint fitting (Exhibit E).

The root joint itself was in good condition and the joint pin extracted normally, without use of excessive force.

The skin angle was fractured at the same point as the boom, through the outboard bolt-hole of the root joint fitting and this fracture showed evidence of fatigue on both sides of the bolt-hole (Exhibit F).

Top boom.—Found in main wreckage. Fractured in backward bending 21½" outboard of root joint and again in backward bending 122" inboard of the tip. These fractures are considered to be due to ground impact.

All rivets attaching boom to web sheared spanwise in the sense of boom moving inboard, web moving outboard.

Web.—There was a shear failure at the root gusset plate position.

(i) PORT MAINPLANE REAR SPAR (APPENDIX 5)

Top boom.—75" inboard of Station 150 not recovered. 75" from root joint found in main wreckage. Remainder of boom outboard of Station 150 still assembled in mainplane.

Rivets attaching boom to web inboard of Station 150 all sheared spanwise. This pattern was consistent across the boom fractures and was in the sense of boom moving outboard and web inboard.

A fracture at Station 49 was in backward bending and is considered to be due to ground impact.

The Web, from Station 144 outboard was still assembled in the mainplane and the butt joint of the web at this station was separated, the rivets on the inboard side of the joint having sheared in the sense of outboard side moving upwards and inboard side downwards.

Bottom boom.—That portion outboard of Station 140 was not recovered. The rivet holes and markings on the corresponding piece of web indicated spanwise failures, showing boom moving inboard and web outboard.

The boom inboard of Station 140 was found in the main wreckage in three pieces and the two fractures are considered to be due to ground impact.

(j) BETWEEN SPARS STRUCTURE FROM ROOT TO STATION 144 (EXHIBIT G)

Found separate, approximately 1,200 yards from main wreckage. This portion is considered to have become separated in the air at the time when the spars pulled out. There were some diagonal shear wrinkles in the top surface running from outboard trailing to inboard leading.

(k) LEADING EDGE FROM ROOT TO STATION 144

Found separate, approximately 1,500 yards from main wreckage. Considered to have become separated in the air, when the front spar booms pulled out.

There was a heavy spanwise score on the inside of the lower surface at the root end made by the front spar bottom boom as it pulled out (Exhibit H).

(l) TRAILING EDGE FROM ROOT TO STATION 144—COMPLETE WITH FLAP

Found approximately 1,100 yards from main wreckage. Considered to have become detached in the air when the rear spar booms pulled out.

(m) PORT AILERON

Found approximately 1,150 yards from main wreckage. Considered to have become detached in the air due to break up and separation of the wing structure from the remainder of the aircraft.

4.—OBSERVATIONS

There was no evidence of general overstressing of the aircraft's structure.

The direction of the shear wrinkles in the top surface of the between spars structure from root to Station 144 indicates a failure of the front spar near the root at a time when the rear spar was virtually intact.

The finding of the front spar top boom in the main wreckage indicates that it did not fail in the air. The finding of the front spar bottom boom 900 yards from the main wreckage indicates that it failed in the air.

The consistency of direction of shear across the bottom boom fracture of rivets attaching boom to web indicates that these rivet failures preceded the boom fracture. This is further confirmed by fretting on the boom face which indicates that some rivets had failed over a period of time.

There was a shear failure of the front spar web at the root end gusset plate. The point at which this fits into the sequence has not been determined and must await more detailed examination at the Royal Aircraft Establishment.

The consistency of direction of shear across the Station 144 butt joint of rivets attaching boom to web of the rear spar indicates that detachment of boom from web preceded failure of the butt joint, but this was secondary to failure of the front spar.

5.—CONCLUSIONS

(i) The documentation of the aircraft was in order. The All Up Weight of the aircraft was less than the maximum permitted and the Centre of Gravity was within the prescribed limits.

(ii) The crew was competent and properly licensed.

(iii) Weather conditions had no bearing on the accident.

(iv) There was no evidence of bad maintenance. There is evidence of failure, over a period of time, of rivets attaching the front spar bottom boom to web, but this is not visible on inspection.

(v) There was no contravention of regulations.

(vi) No blame attaches to the Pilot, members of the Crew, or the West African Airways Corporation.

6.—OPINION

The accident was caused by the structural failure of the port mainplane.

7.—RECOMMENDATIONS

The significant parts of the wreckage have been forwarded to the Royal Aircraft Establishment, Farnborough, England, where they should be subjected to a detailed examination to determine the reason for the structural failure.

E. H. COLEMAN,

(Chairman)

Director of Civil Aviation, West Africa

B. A. MORRIS,

Inspector of Accidents, Ministry of Transport
and Civil Aviation, London

C. SUNDERLAND,

Senior Surveyor, Air Registration Board

S. H. NICHOLSON,

Operation Officer, Department of Civil Aviation

Department of Civil Aviation,
Lagos, Nigeria, 29th March, 1955.

EXHIBIT 'A'

The following five photographs show main wreckage as found at the scene of the accident





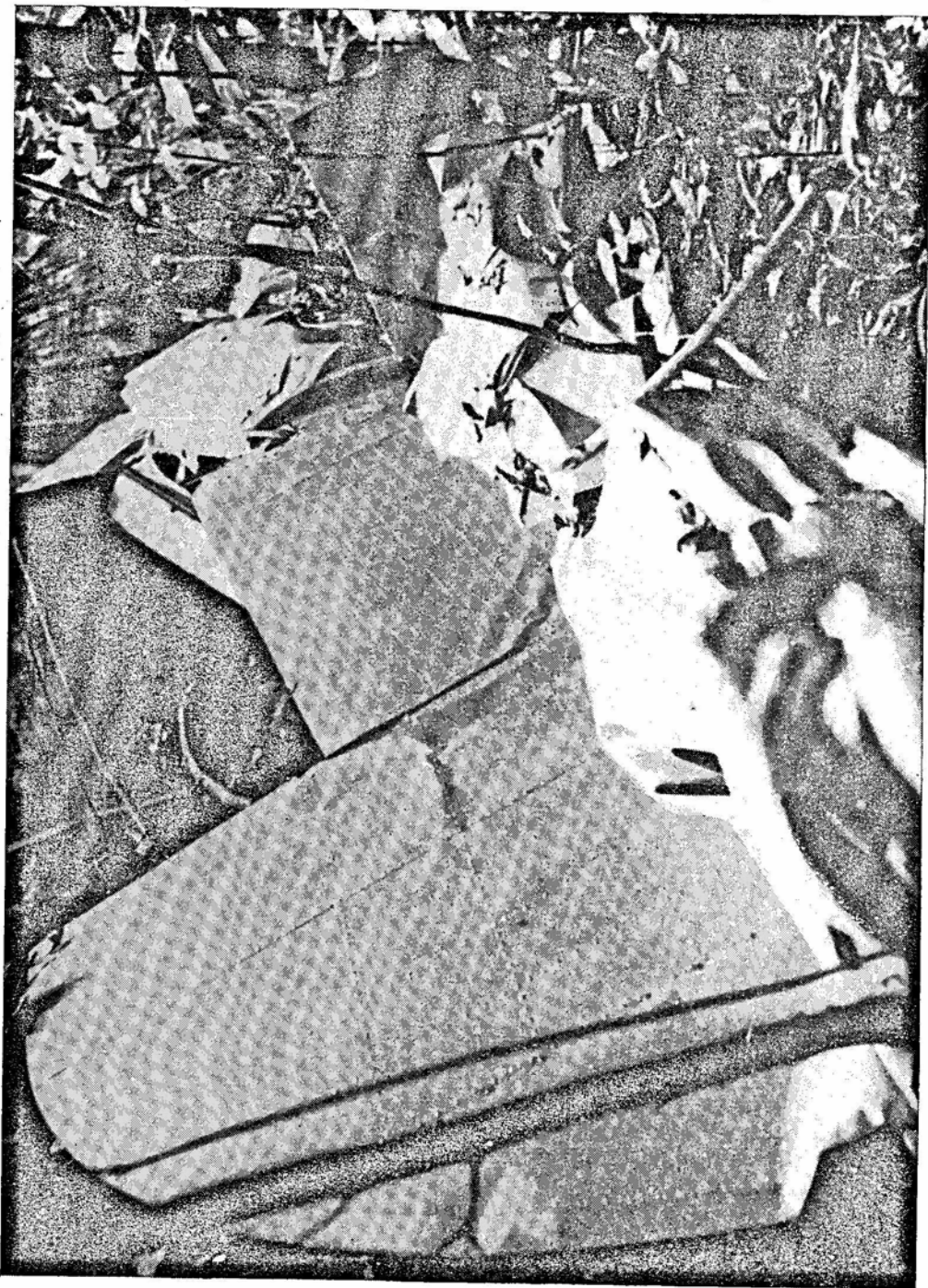
Wreckage as found at the scene of accident



Wreckage as found at the scene of the accident

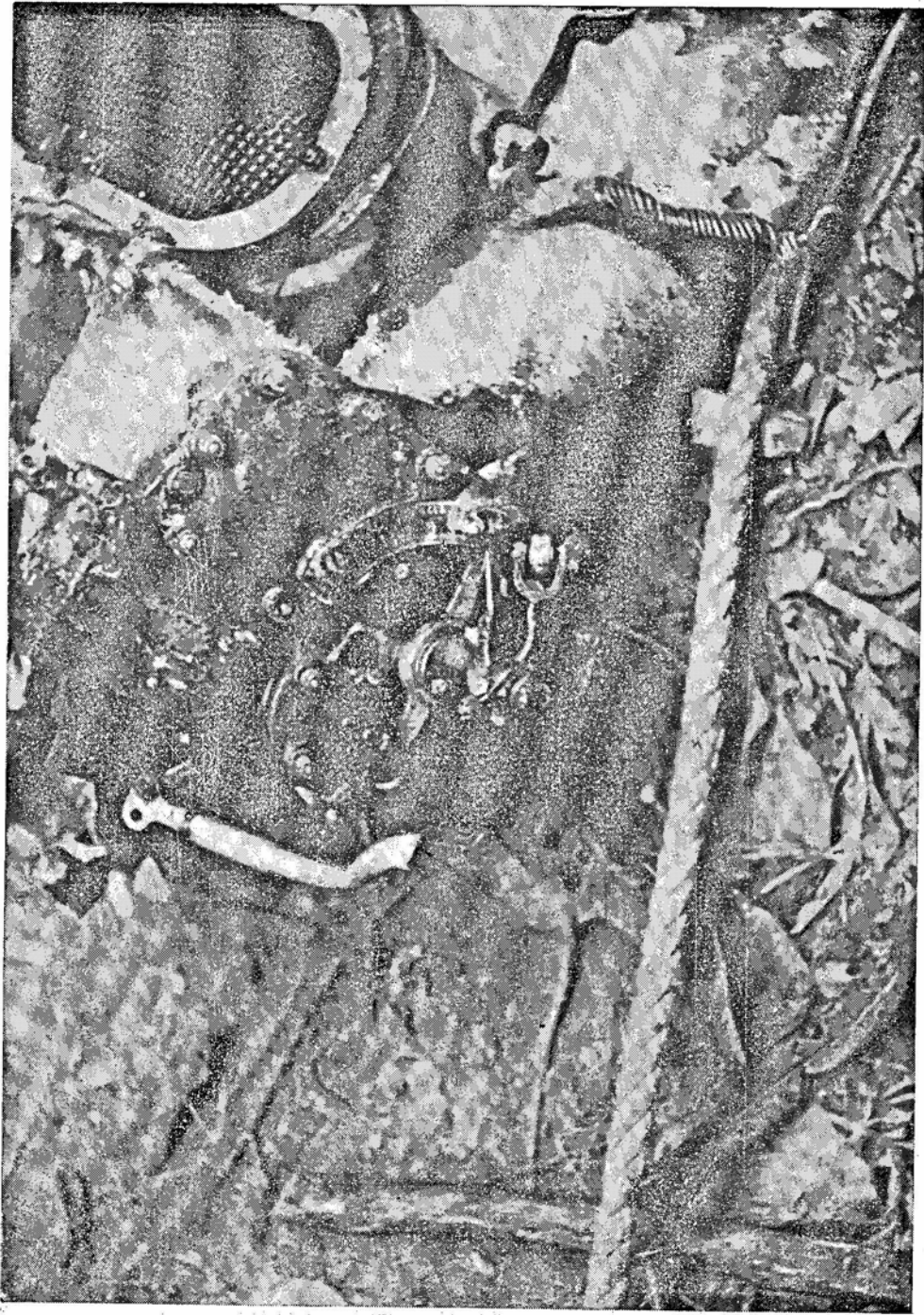


Wreckage as found at the scene of the accident



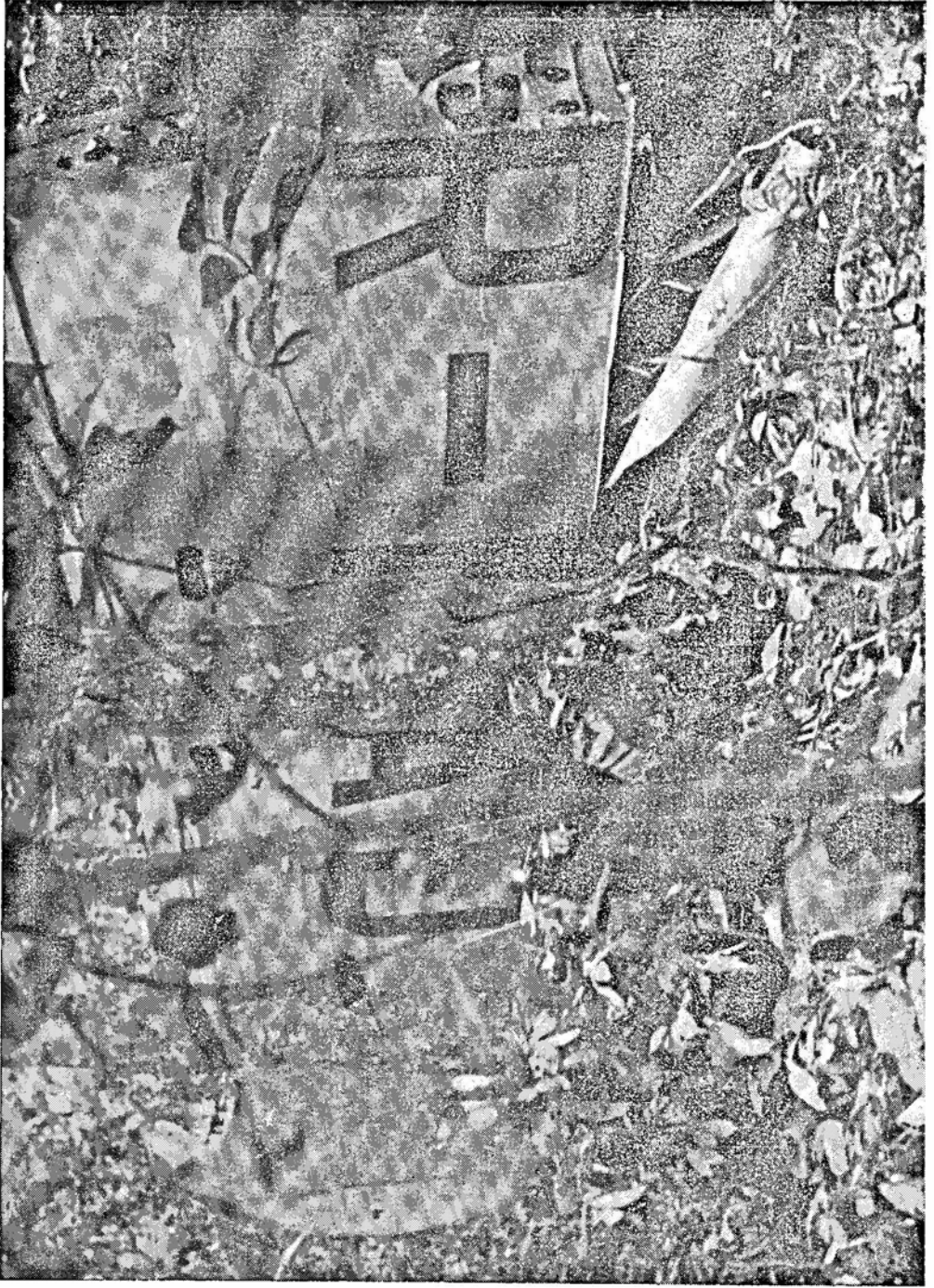
Wreckage as found at the scene of the accident

EXHIBIT 'B'



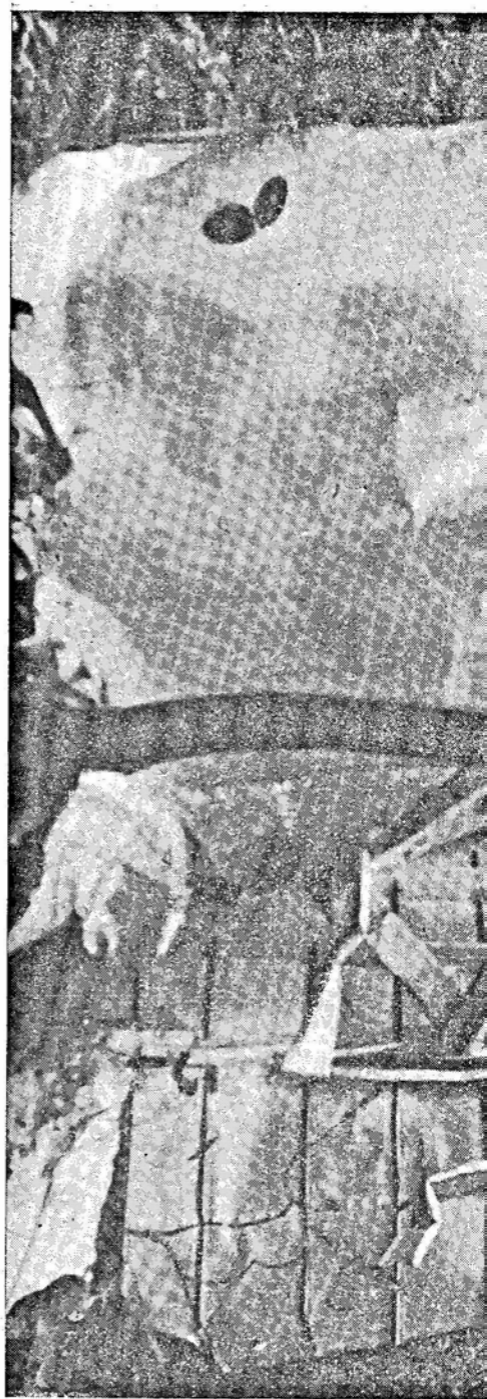
Port engine throttle barrels with valve shaft indicator in "closed" position

EXHIBIT 'C'
The following four photographs show parts of port mainplane detached in air





Part of port mainplane detached in the air





Parts of port mainplane detached in the air

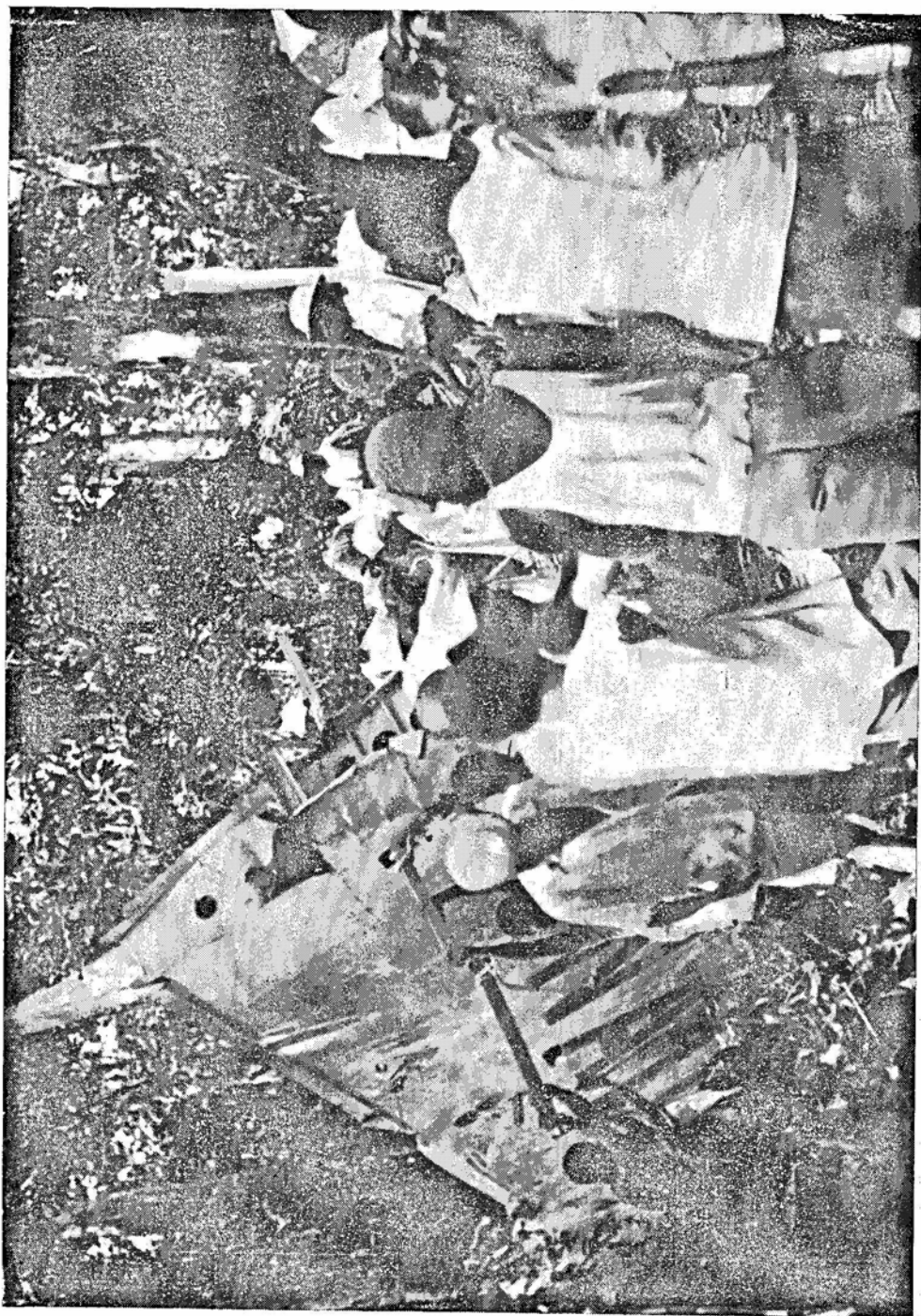


Parts of port main plane detached in the air

EXHIBIT 'D'

The following four photographs show scenes during the recovery of the port mainplane

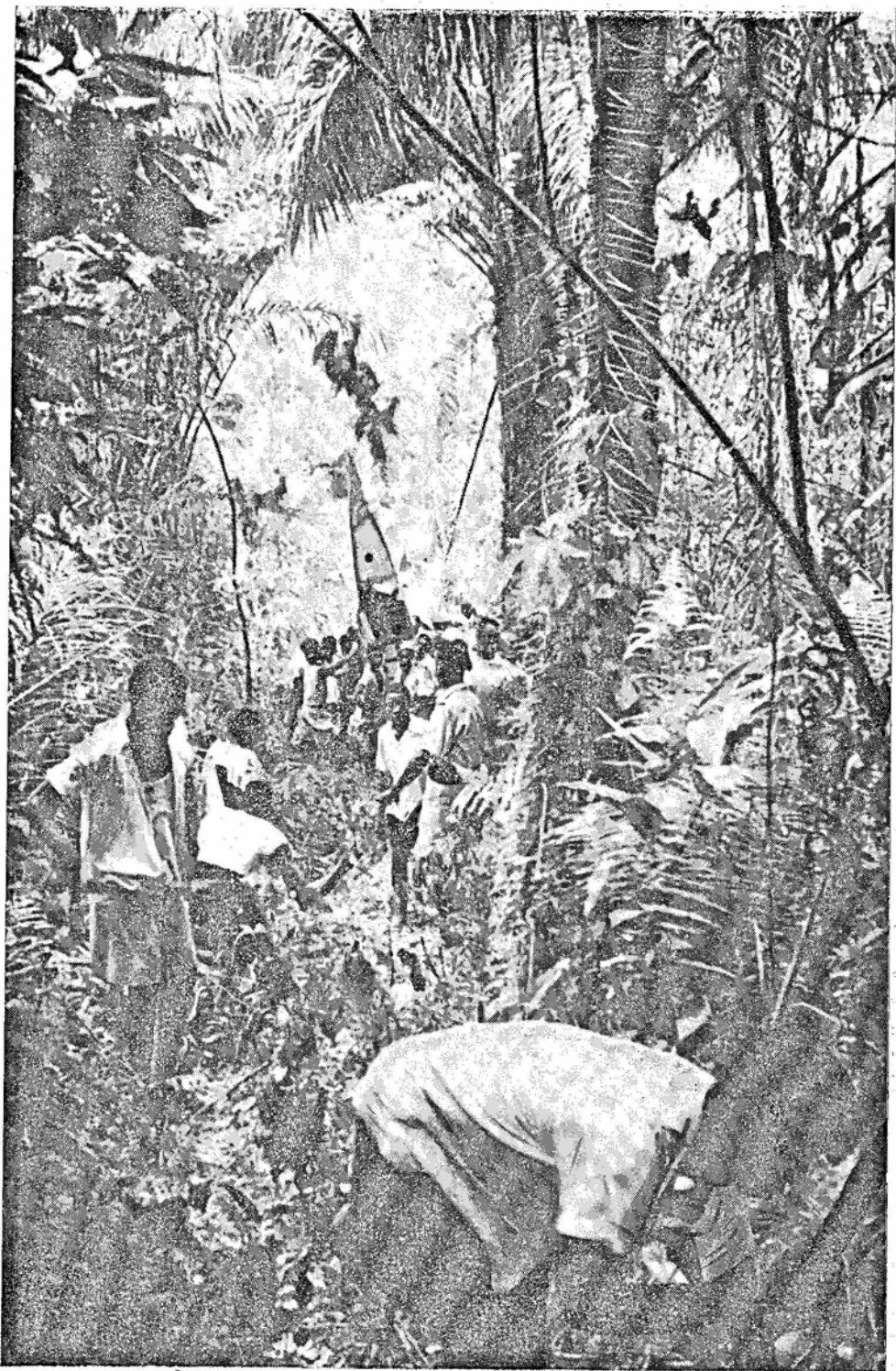




Scenes during the recovery of the port mainplane

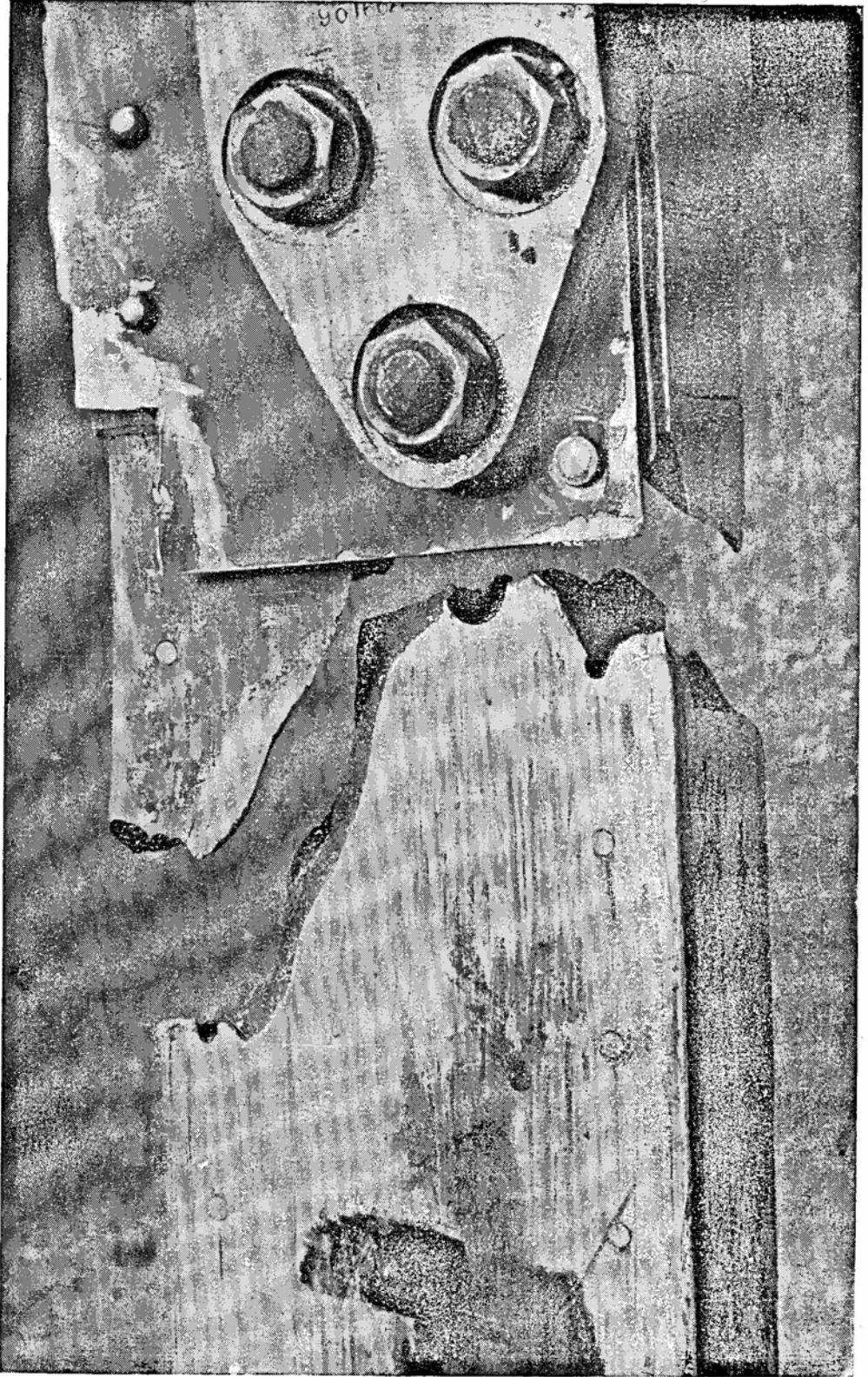


Recovery of the port mainplane



Recovery of the port mainplane

EXHIBIT 'E'

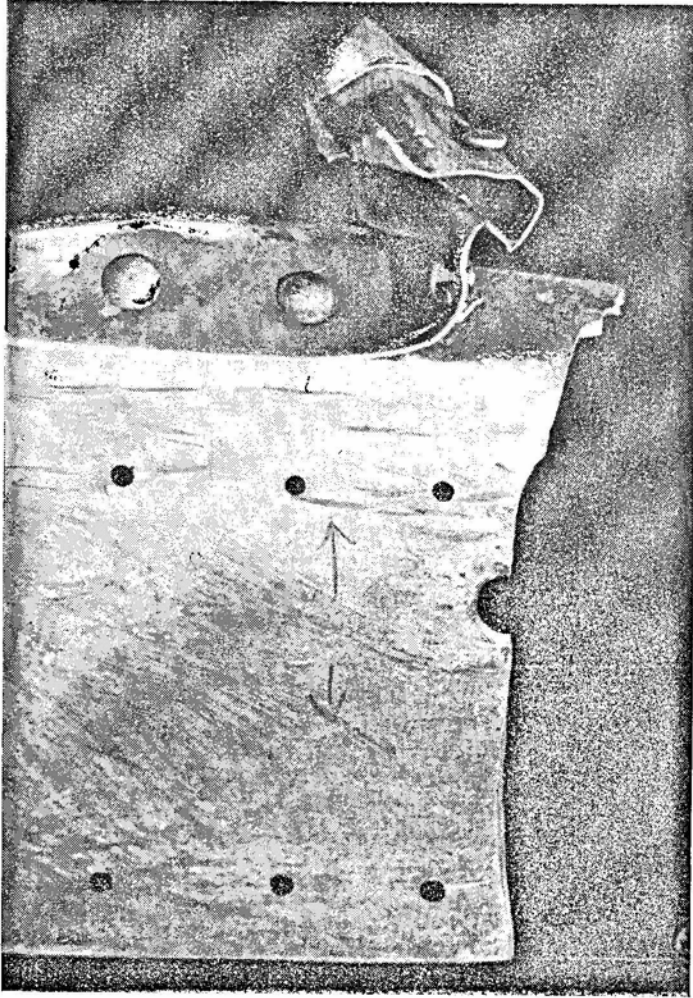


Port main front spar bottom boom fracture

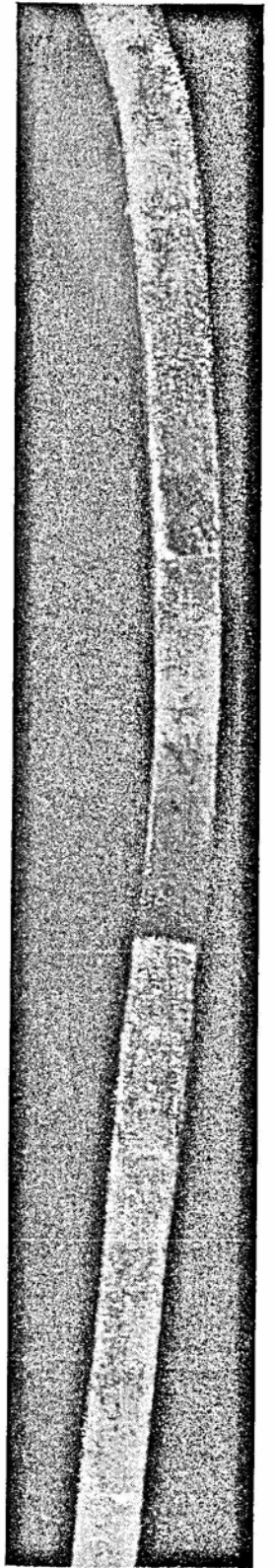


Front spar bottom boom fretting

EXHIBIT 'F' (i)

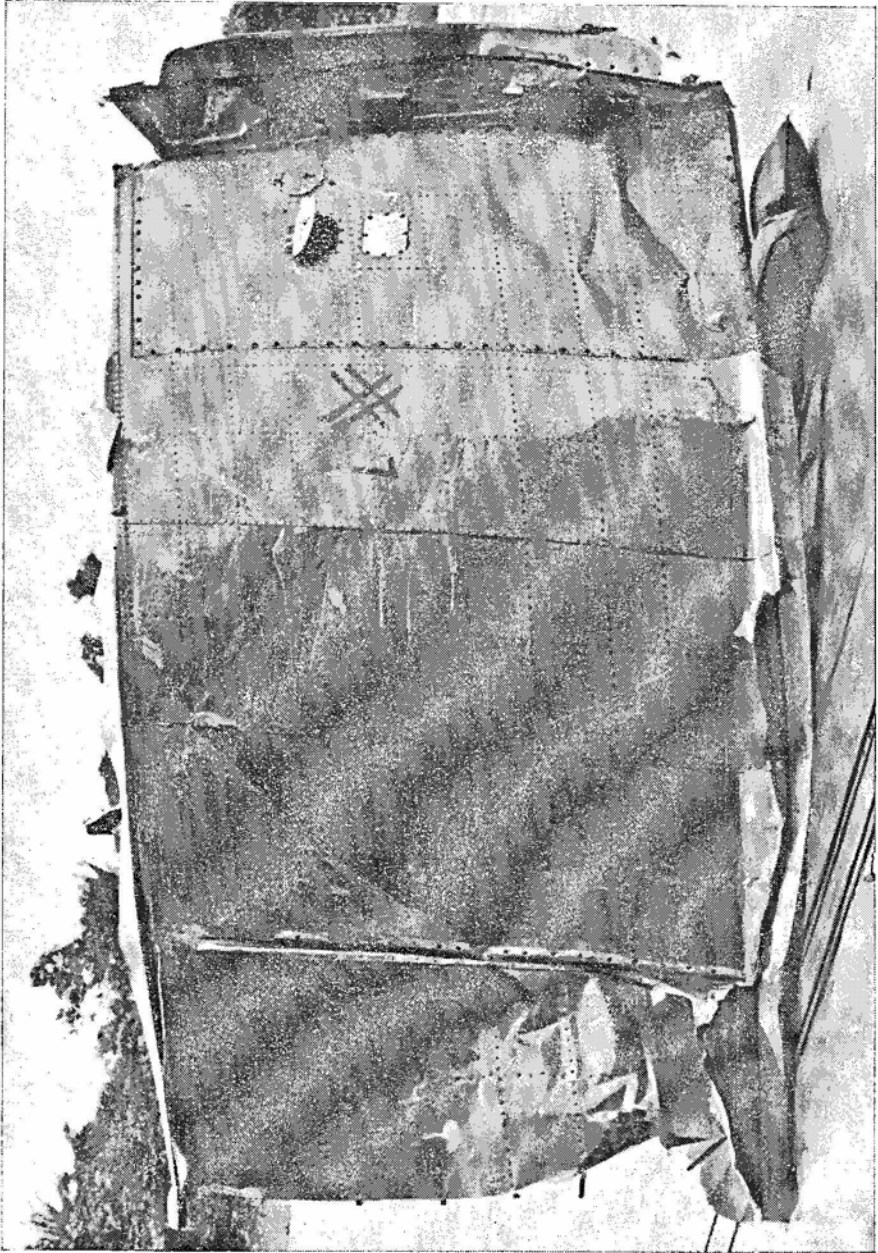


Front spar, bottom boom skin angle at root attachment fitting.
Fracture showing some fatigue



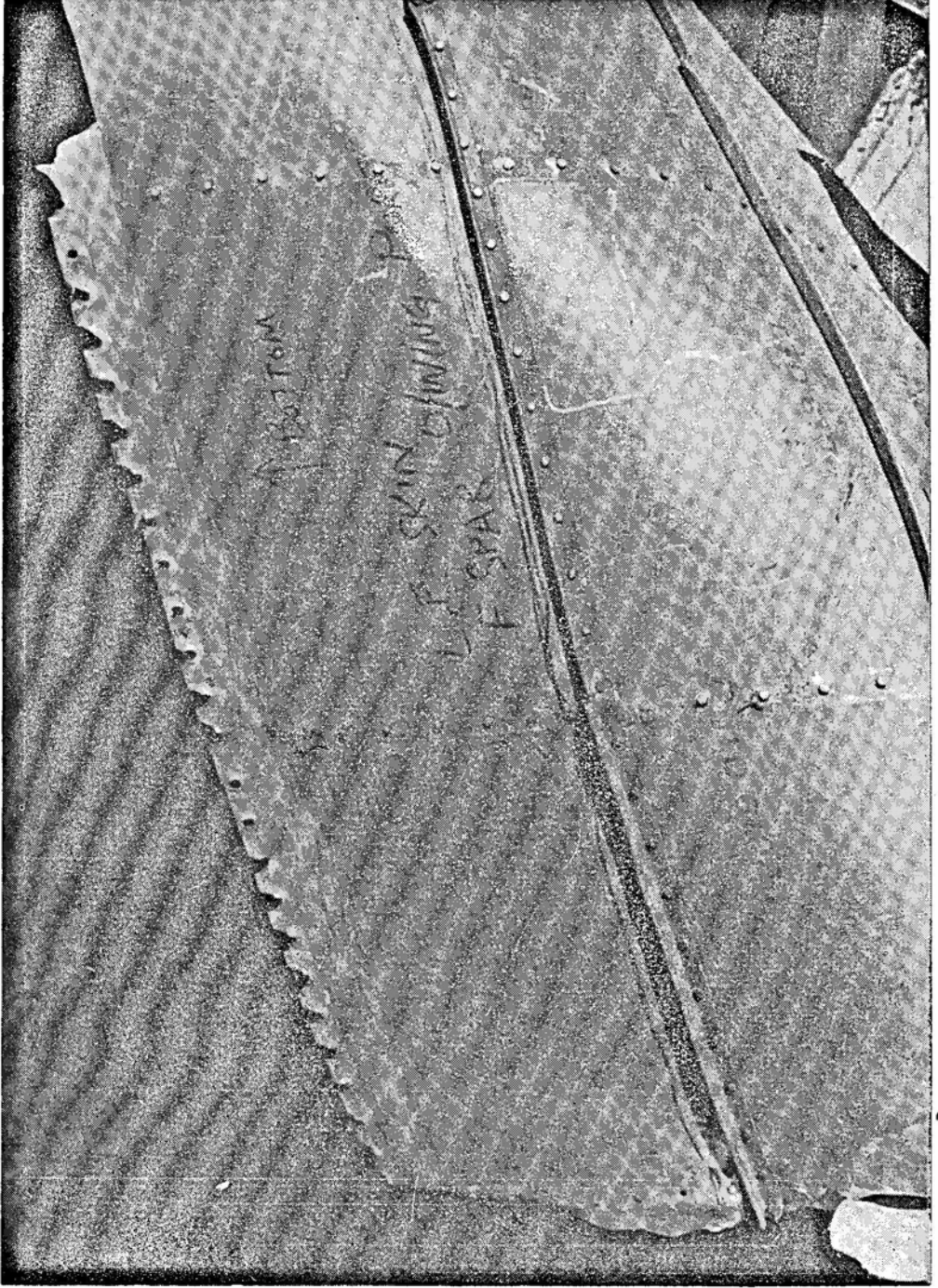
Cross section of piece
between rivets

EXHIBIT 'G'



Port wing, between spars structure root to Station 144

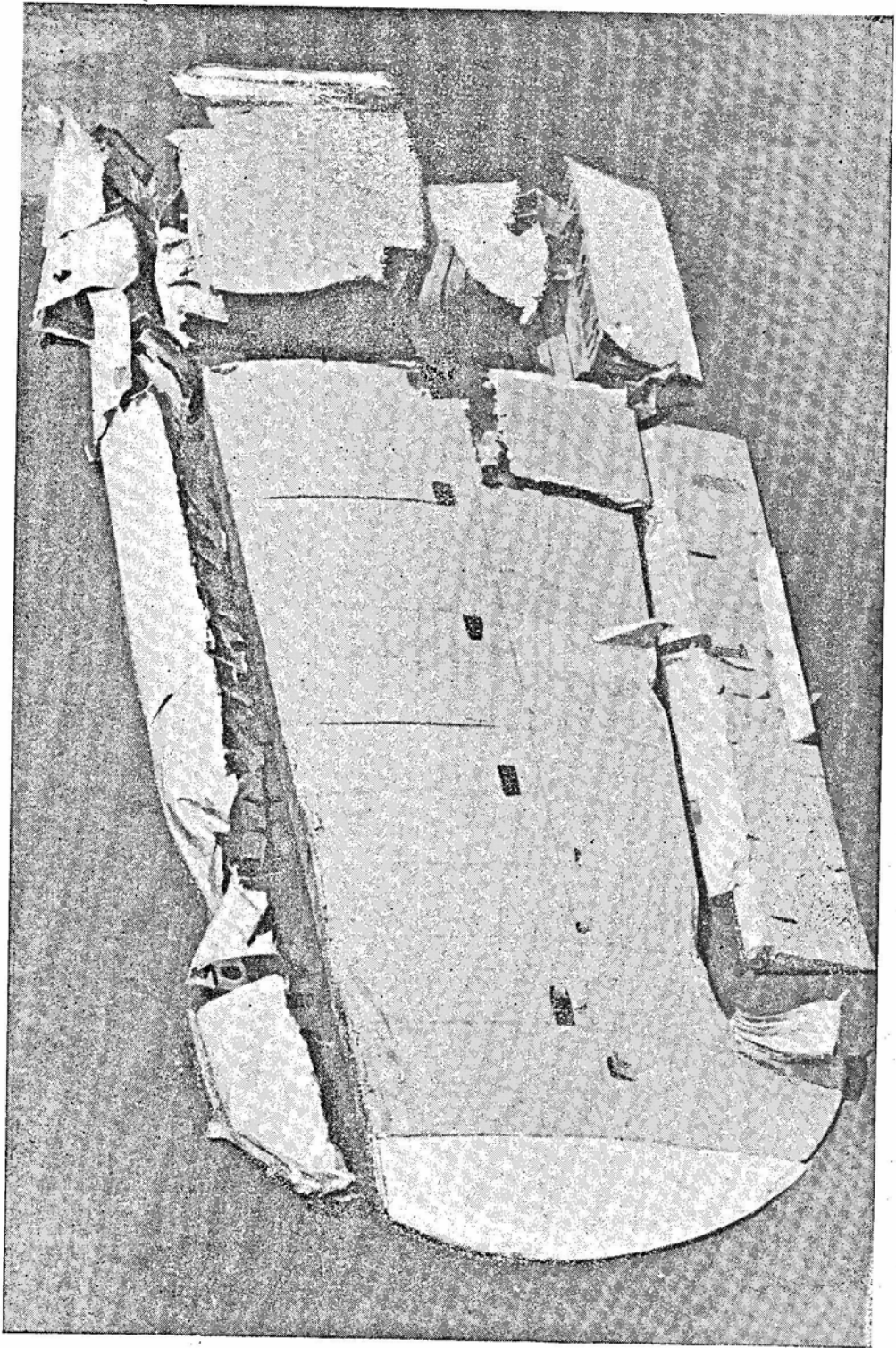
EXHIBIT 'H'



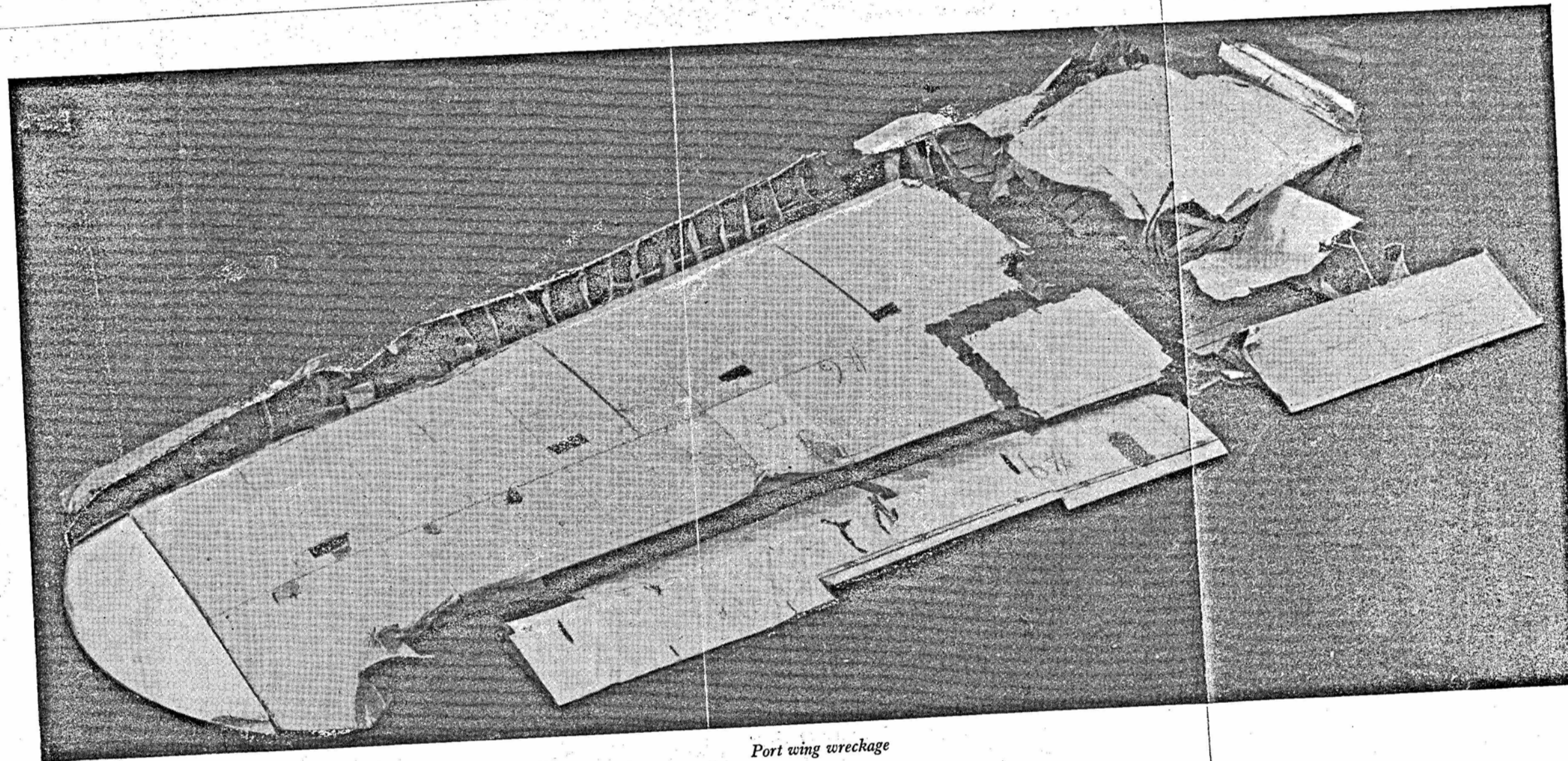
Leading edge, lower surface, Station 'O'

EXHIBIT 'I'

The following three photographs show the port wing wreckage, leading edge removed for ease of removal from bush

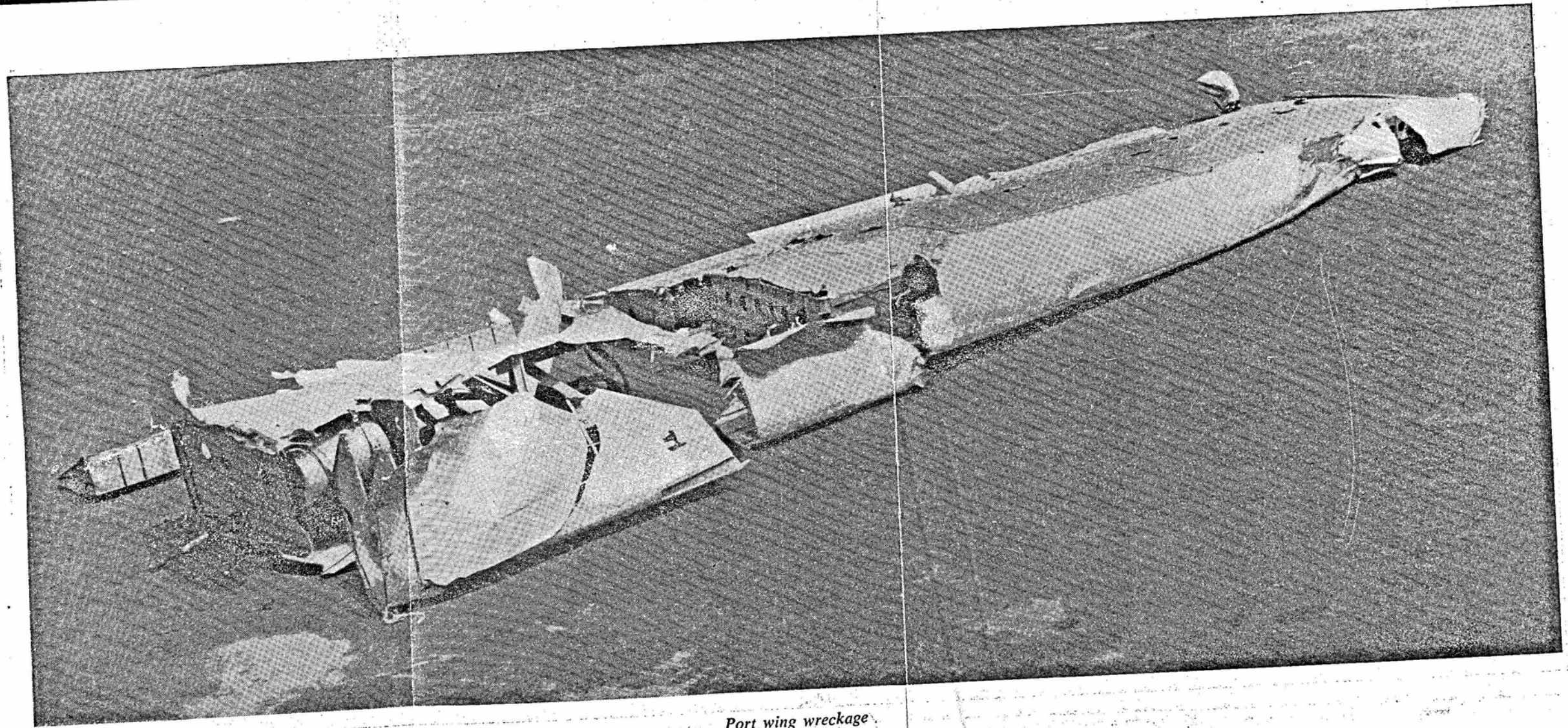


Port wing wreckage



Port wing wreckage

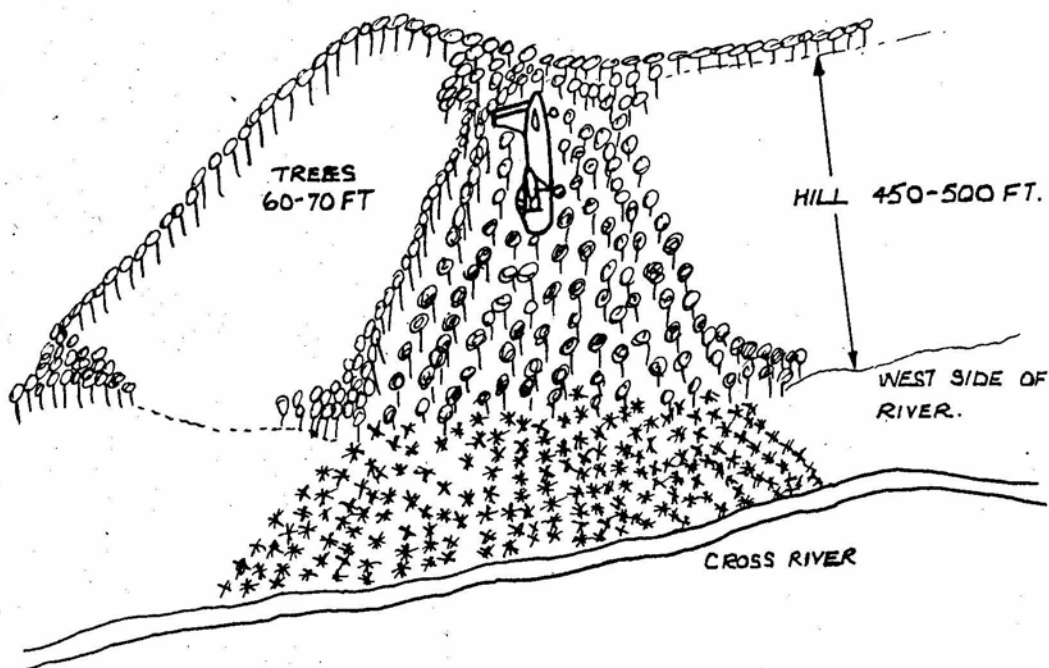
The following three photographs show the port wing wreckage, leading edge removed for ease of removal from bush



Port wing wreckage

SKETCH OF LOCALITY AND FREIGHTER

VR-NAD ABOUT TO PENETRATE FOREST.



APPENDIX I

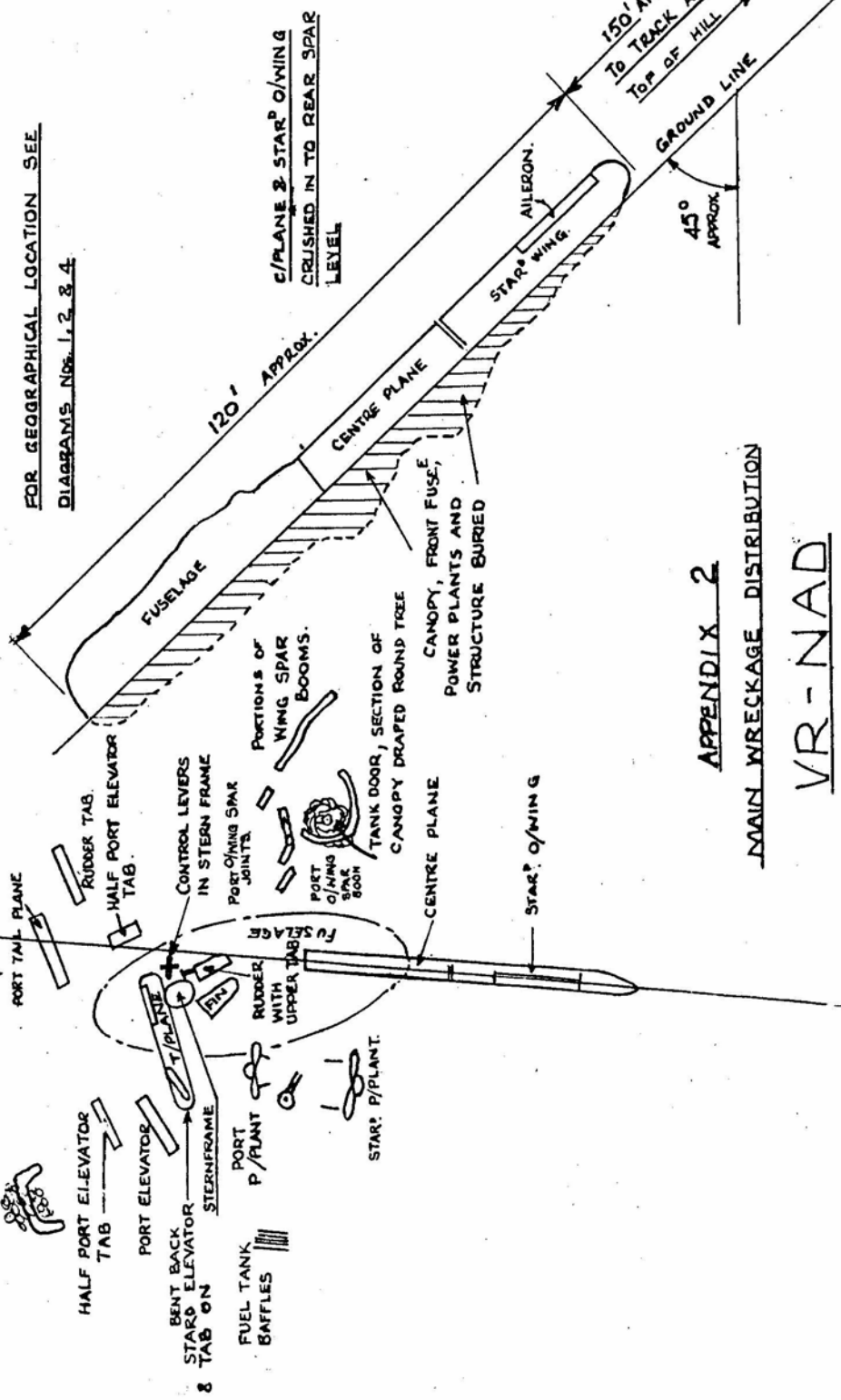
28° W of N.
332° ON TRACK.
(TRUE)

U/C LEG.

FUSELAGE CENTRE SECTION
FRAMES & FLOORING.

THE WHOLE WRECKAGE COMPLETELY
SURROUNDED BY 60' TO 70' FOREST TREES

FOR GEOGRAPHICAL LOCATION SEE
DIAGRAMS Nos. 1, 2, & 4

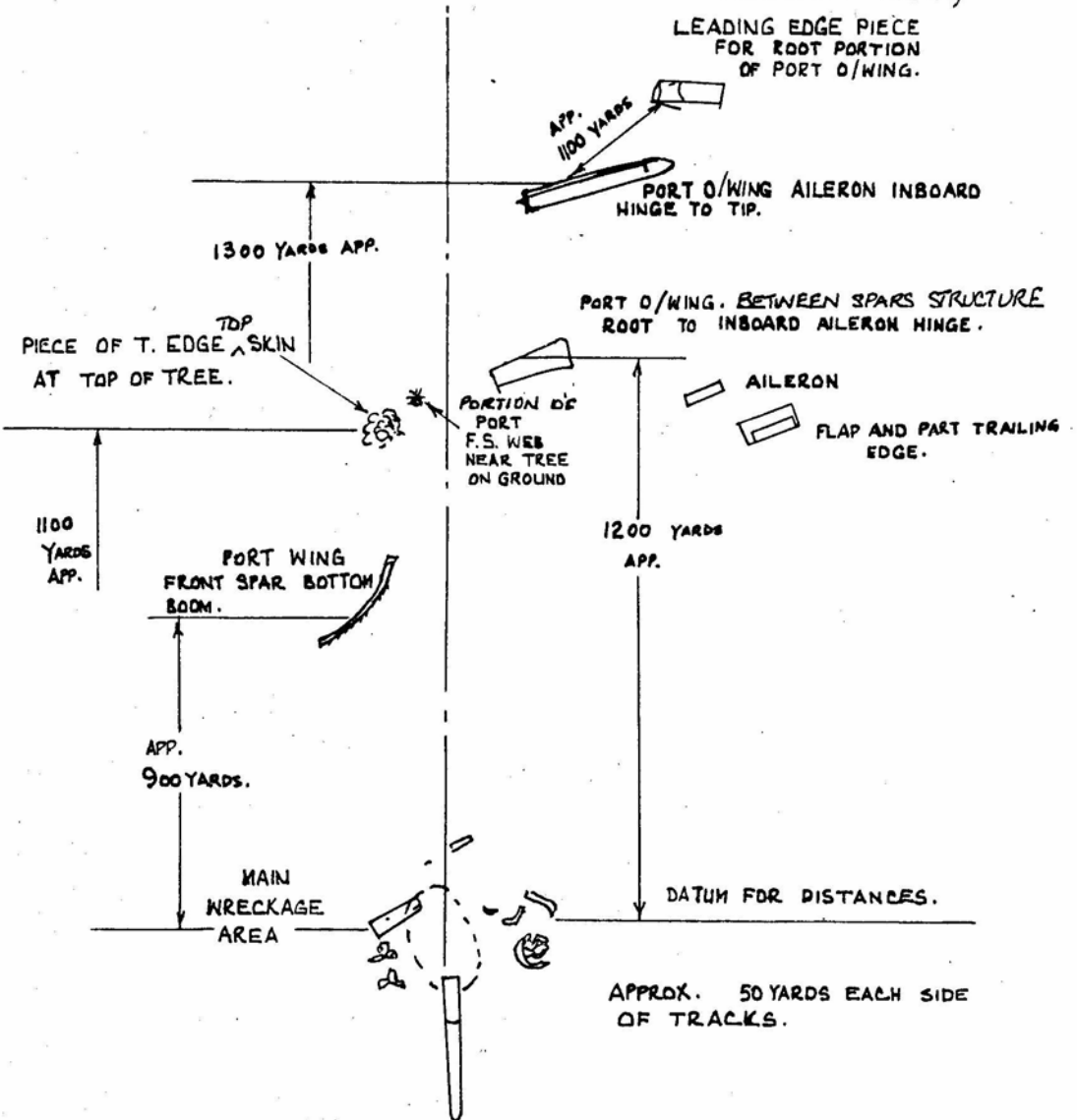


APPENDIX 2

MAIN WRECKAGE DISTRIBUTION

VR-NAD

TRACK 340° MAGNETIC. (RECIPROCAL OF AIRCRAFT'S TRACK)

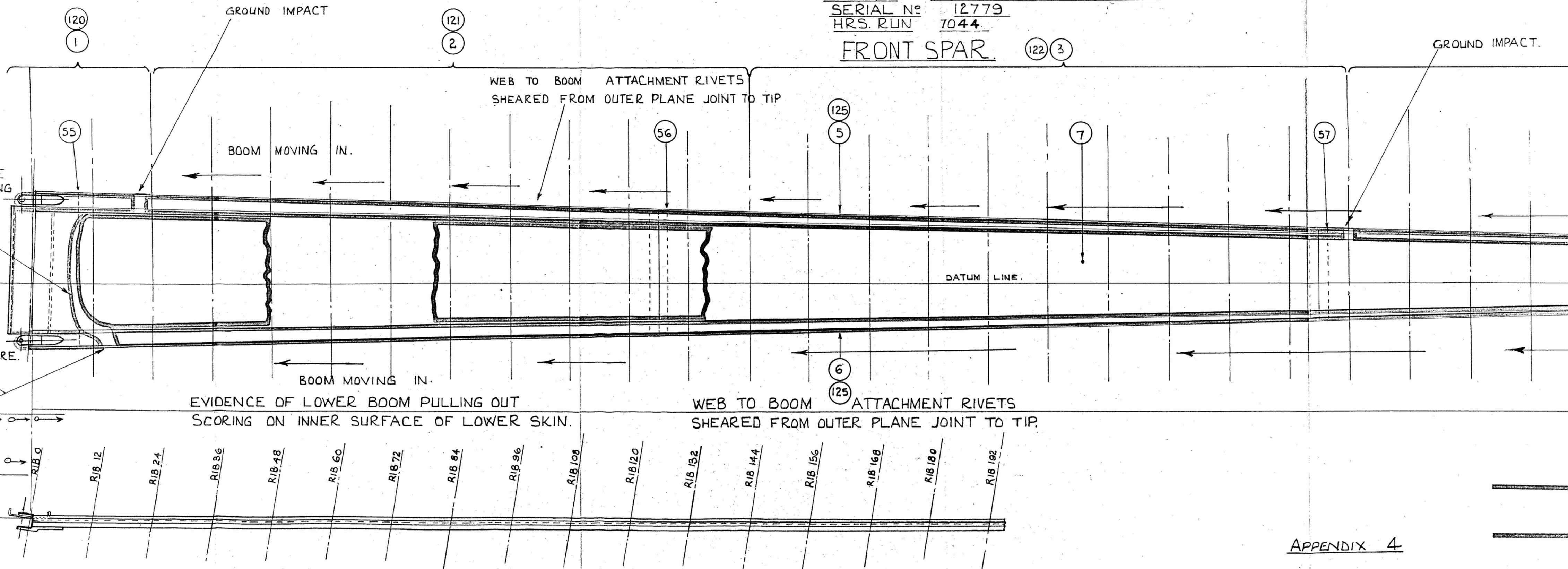


LOCATION OF PORT MAIN PLANE STRUCTURE AWAY FROM MAIN WRECKAGE. (READ IN CONJUNCTION WITH DIAGRAM NO. 2)

WRECKAGE PLOT
APPENDIX 3

B170 A/C VR-NAD PORT OUTER WING.
SERIAL No 12779
HRS. RUN 7044

FRONT SPAR



B170 A/C VR-NAD PORT OUTER WING.

SERIAL No 12779

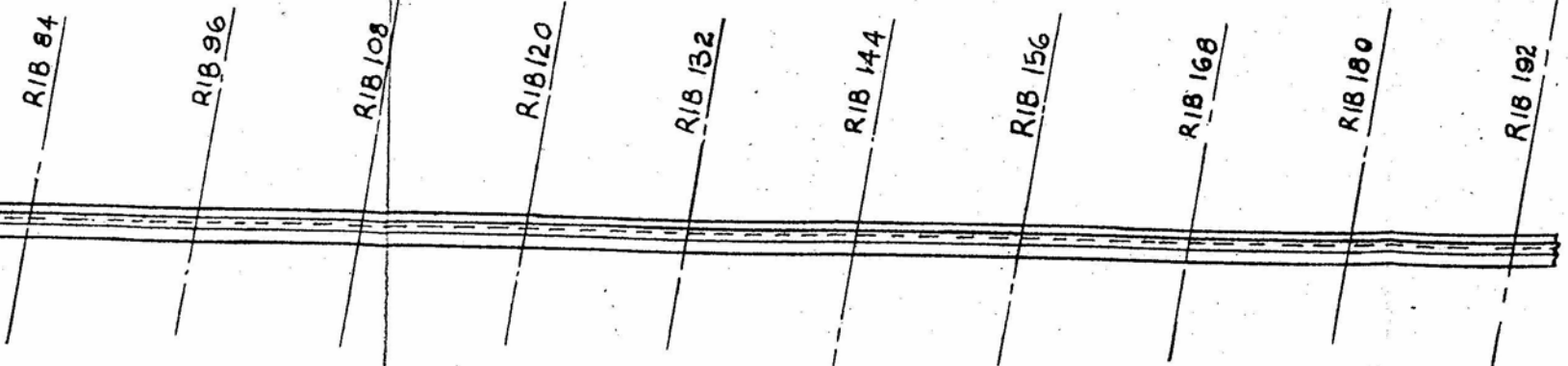
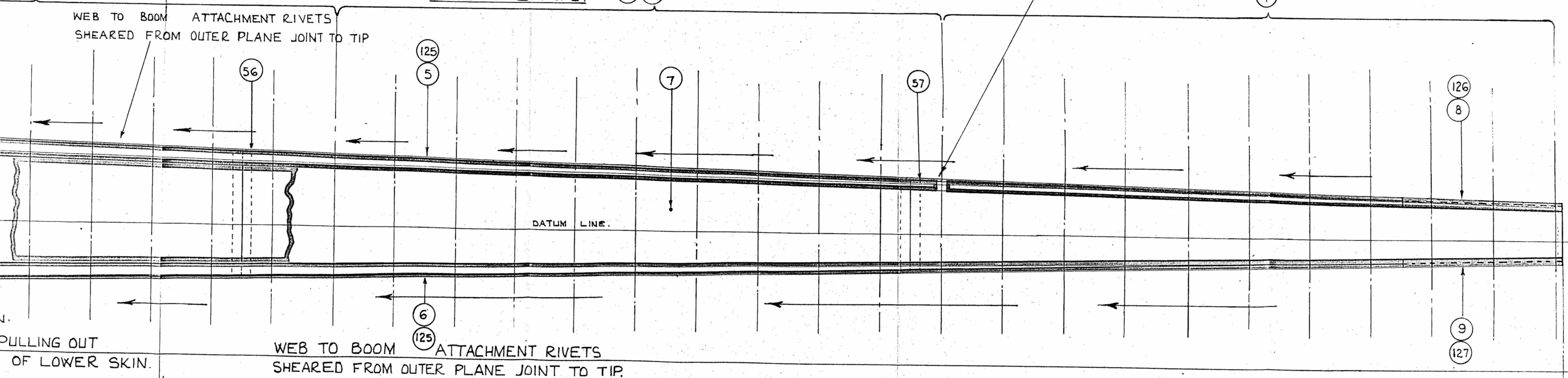
HRS. RUN 7044

FRONT SPAR

(121)
2

(122) 3

(123)
4

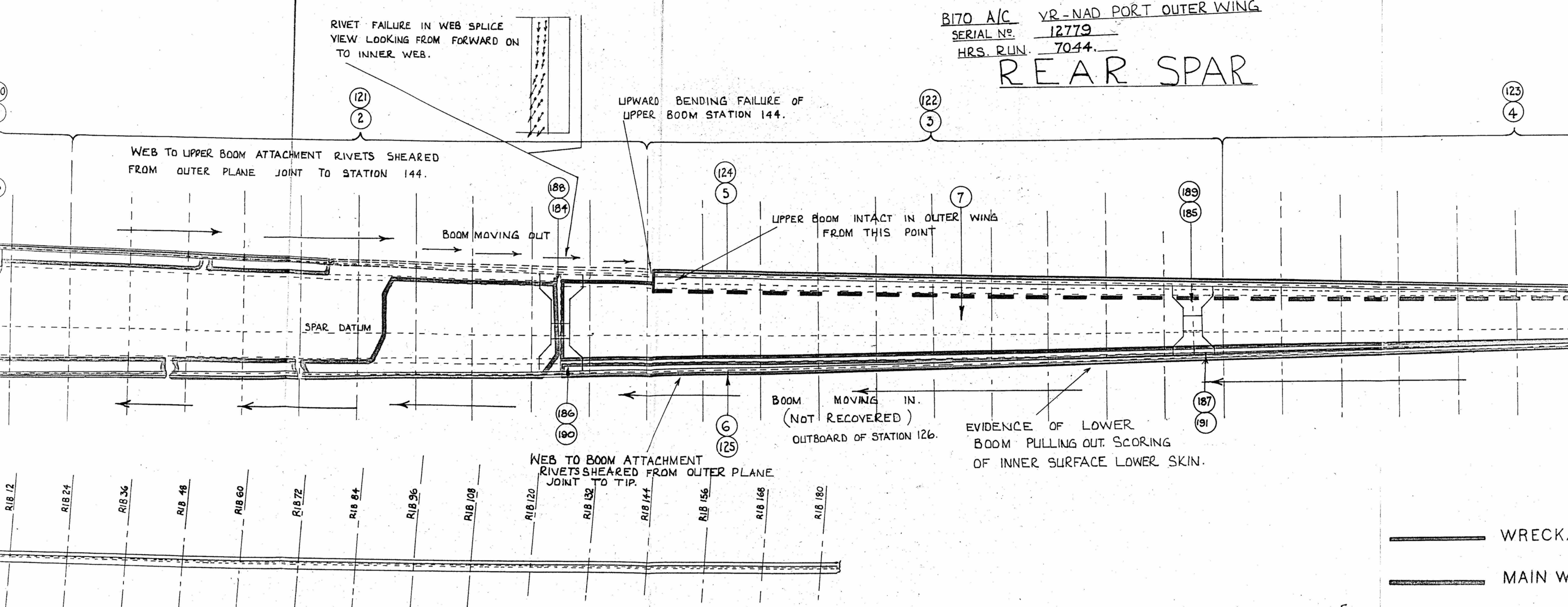


———— WRECKAGE DETACHED IN AIR

———— MAIN WRECKAGE

B170 A/C VR-NAD PORT OUTER WING
 SERIAL NO. 12779
 HRS. RUN. 7044.

REAR SPAR



RIVET FAILURE IN WEB SPLICE
 VIEW LOOKING FROM FORWARD ON
 TO INNER WEB.

LIPWARD BENDING FAILURE OF
 UPPER BOOM STATION 144.

WEB TO UPPER BOOM ATTACHMENT RIVETS SHEARED
 FROM OUTER PLANE JOINT TO STATION 144.

UPPER BOOM INTACT IN OUTER WING
 FROM THIS POINT

BOOM MOVING OUT

BOOM MOVING IN.
 (NOT RECOVERED)
 OUTBOARD OF STATION 126.

EVIDENCE OF LOWER
 BOOM PULLING OUT. SCORING
 OF INNER SURFACE LOWER SKIN.

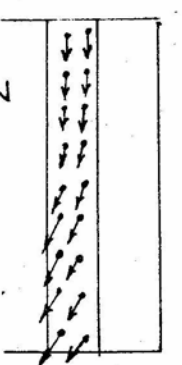
WEB TO BOOM ATTACHMENT
 RIVETS SHEARED FROM OUTER PLANE
 JOINT TO TIP.

- RIB 12
- RIB 24
- RIB 36
- RIB 48
- RIB 60
- RIB 72
- RIB 84
- RIB 96
- RIB 108
- RIB 120
- RIB 132
- RIB 144
- RIB 156
- RIB 168
- RIB 180

————— WRECK.
 ————— MAIN W.

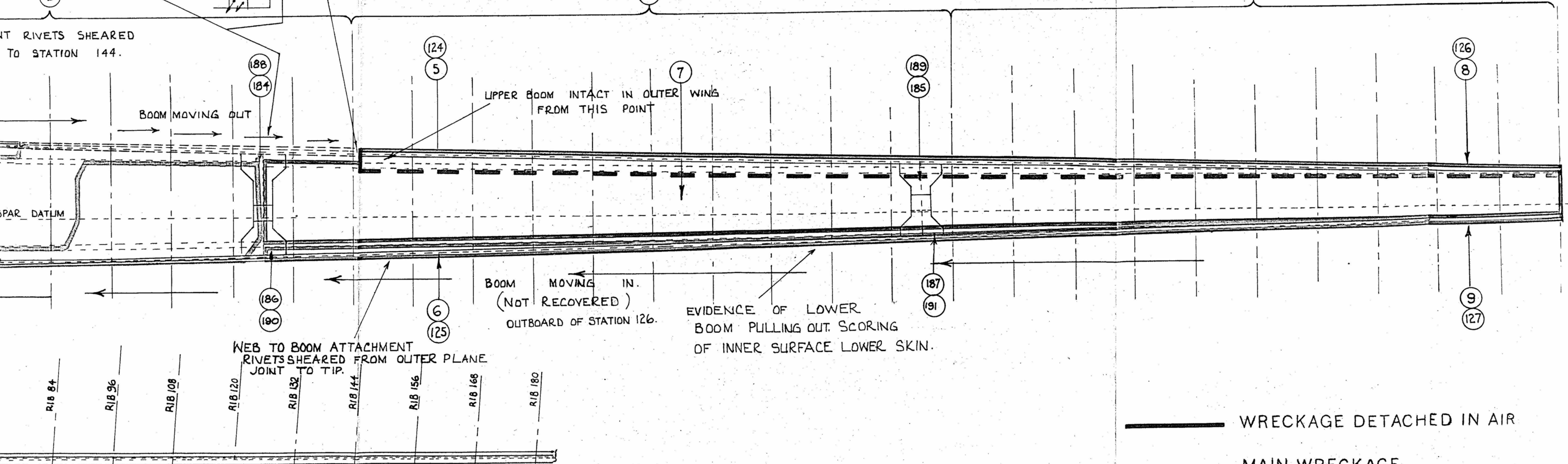
B170 A/C VR-NAD PORT OUTER WING
 SERIAL NO. 12779
 HRS. RUN. 7044.
REAR SPAR

RIVET FAILURE IN WEB SPLICE
 VIEW LOOKING FROM FORWARD ON
 TO INNER WEB.



LIPWARD BENDING FAILURE OF
 UPPER BOOM STATION 144.

ALL RIVETS SHEARED
 TO STATION 144.



BOOM MOVING IN.
 (NOT RECOVERED)
 OUTBOARD OF STATION 126.

EVIDENCE OF LOWER
 BOOM PULLING OUT SCORING
 OF INNER SURFACE LOWER SKIN.

WEB TO BOOM ATTACHMENT
 RIVETS SHEARED FROM OUTER PLANE
 JOINT TO TIP.

RIB 84 RIB 96 RIB 108 RIB 120 RIB 132 RIB 144 RIB 156 RIB 168 RIB 180

————— WRECKAGE DETACHED IN AIR
 - - - - - MAIN WRECKAGE