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DENMARK

DIRECTORATE OF CIVIL AVIATION

AIRCRAFT ACCIDENT REPORT

STERLING AIRWAYS INC.
CARAVELLE SE-210-10B3, OY-STL
FUJAYRAH, 50 NM EAST OF DUBAI AIRPORT
14. MARCH 1972

R E P O R T

of the Investigation into the Accident involving Sterling Airway's Caravelle Aircraft OY-STL in the Emirate Fujayrah on the 14th.March 1972.

All the times in this report are GMT unless otherwise stated.

Aircraft type:	Caravelle SE-210-10B3	
Registration:	OY-STL	
Owner and User:	Sterling Airways A/S.	
Cockpit crew:	Captain Ole Jørgensen	- killed
	First officer Jørgen Petersen	- killed
Cabin crew:	Stewardess Lone Bernth	- killed
	Stewardess Karin Sonja Troelstrup	- killed
	Stewardess Edith Johanne Wøhlk	- killed
Other crew members:	Aircraft engineer Poul Erik Johansen	- killed
Passengers:	106 - killed	
Location:	$56^{o}13'48''E$ - $25^{o}04'06''N$ elevation 1600 ft. MSL	
Date and time:	14th. March 1972 at 1804 hours.	

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Information of the Accident.

Information that a Sterling aircraft OY-STL had been lost during the approach to Dubai airport was received by the accident investigation section of the Directorate of Civil Aviation from the air traffic control centre at Copenhagen Airport, Kastrup, at 2200 hours on the 14th. March 1972. They had been informed by a telex which had been sent from Bahrain at 2015 hours.

The Directorate of Civil Aviation immediately began arranging the composition of a group which could participate in and assist the local authorities in their investigation.

On the morning of the 15th. March the Directorate of Civil Aviation received a message that OY-STL had been found crashed on the eastern side of the Oman peninsula in the Emirate Fujayrah. At 1600 hours on the same day a representative group departed for Dubai. The group consisted of representatives of the Directorate of Civil Aviation, the technical department and the identification branch of the State Police including forensic pathologists and odontologists as well as Sterling Airways Aircrew Association.

The group arrived in Dubai at 0230 hours on the 16th. March 1972 and were immediately briefed by the local authorities.

The local authorities of Dubai and Fujayrah were unable to conduct an accident investigation because of a lack of capacity but offered to assist with transport, men and material as far as was possible.

In view of this situation the Danish group then took over the responsibility for the investigation of the accident including the salvage and identification of the bodies.

Police technicians, forensic pathologists and odontologists from Sweden and Norway joined the Danish group on the 17th. March 1972.

Representatives of the French authorities and of Sud Aviation were also present in Dubai.

Summary.

A Caravelle SE-210-10B3 of Sterling Airways, registered as OY-STL and operating flight NB 296 crashed at night during an approach to Dubai international airport at 1804 hours on the 14th. March 1972.

Flight NB 296 was cleared for a straight in approach and landing on runway 30 and had reported passing FL 135 and had been requested to report at 2000 ft. or when he had the airport in sight.

or 3 minutes before the time estimated at SEAHORSE, but 6 minutes earlier than had been calculated in Bombay.

At 1714 hours, via another aircraft, NB 296 reported over DOLPHIN, it was 4 minutes earlier than had been calculated at BLUE WHALE, but the aircraft was now 10 minutes ahead of the time originally calculated at take-off from Bombay at 1520.

At 1725 hours the same aircraft also relayed a message from the Dubai tower to NB 296 giving the actual Dubai airport weather at 1700, *"040/08 10 km., no weather, 5/8 2000' estimated 5/8 8000' QNH 1016 temperature 20° dewpoint 18°"*.

At 1742 hours NB 296 was in VHF contact with ATC in Dubai on 124.9 Mcs. and reported SPEARFISH at 1742 hours, FL 310, estimating landing in Dubai at 1810 hours.

At this time control of NB 296 was passed from Bahrain centre to Dubai approach.

Dubai asked for his radial to "DO" (Dubai VOR), this was reported as 084° and at the same time the aircraft said that descent from FL 310 would be started at 1755 hours.

However, just after 1749 hours NB 296 reported that there were 95 n.m. to go and that he wished to begin descent immediately.

Permission to descend to FL 40 was given. ATC then asked if NB 296 would be following radial 084 to "DO". This was confirmed and a clearance for this was transmitted.

At approximately 1750 hours NB 296 reported, *"We are out of 310 for 40, what is your runway in use"*. Dubai ATC answered that the wind was 045/6 kts. and that NB 296 could use either runway 30 or 12 as he wished. The aircraft answered, *"We will see if we can make this a straight in on 30"*. NB 296 was then cleared for this.

In response to a request the aircraft stated at about 1756 hours that he was passing through FL 135. ATC then answered, *"Recleared "DO" 2000' on Dubai 1016 mb. report 2000' or field in sight"*. This message was confirmed by NB 296.

With the object of obtaining better communication the ATC had changed to the reserve transmitter, this meant however that what was received was very poorly recorded or not recorded at all because of the low volume.

At approximately 1801^{30} hours NB 296 called Dubai, but nothing can be heard of the remainder of the communication on the recorder. However, the ATC controller who was communicating with NB 296 is of

The inhabitants of the village of Hayl, close to the site of the accident, have said that they heard a crash but did not connect this with an air crash. It was dark, they had retired, it was raining heavily and the crash was put down to the weather conditions.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	6	106	-
Non-fatal	-	-	-
None	-	-	

1.3. Damage to aircraft.

The aircraft was destroyed in the collision with the mountain. Isolated fires broke out in the area of the accident.

1.4. Other damage.

None.

1.5. Crew information.

1.5.1. Captain Ole Jørgensen born 9th. April 1936, possessed an ATPL No. 6932 originally issued 23rd. Oct. 1968, renewed 10th. Jan. 1972 and valid until 17th. July 1972.

Ole Jørgensen began his career as a pilot in 1957 when he was issued with a Private Pilot's licence on the 1st. Oct.. A Commercial Pilot's licence was gained on 28th. Sept. 1959 at a flight time of 281 hours. When Ole Jørgensen was employed by Sterling in February 1966 he had acquired about 1400 hours of flight time on single and twin engine small aircraft with a maximum permitted weight of up to 3000 kg. Furthermore, he had gained an instrument rating and an instructor's licence.

These flight hours had been acquired as a free lance pilot in taxi and training flights to some extent.

Ole Jørgensen's flight training on the DC-6B began on the 14th. March 1966 after having completed the theoretical training at "Flight Training Centre". A DC-6B rating was issued on 29th. April 1966. The ensuing PFT's on the DC-6B were satisfactory.

Caravelle flight training began on the 30th. Jan. 1968, at which time Ole Jørgensen had 3000 hours' flight experience. The Directorate of Civil Aviation included a Caravelle SE-210-10B rating in his licence

Dubai) is as follows, but it should be noted that Ole Jørgensen flew as co-pilot on all these flights.

Outbound	6th. Feb. 1970	intermediate stop at Sharjah	04.30
Outbound	27th. March 1970	intermediate stop at Sharjah	03.14
Homebound	1st. April 1970	intermediate stop at Sharjah	05.00
Outbound	17th. Feb. 1971	intermediate stop at Dubai	03.15
Outbound	2nd. April 1971	intermediate stop at Dubai	05.00
Homebound	9th. April 1971	intermediate stop at Dubai	20.30

Landing and take-off have been about half an hour on each side of the times given above.

In addition, Ole Jørgensen had been on a number of flights in which Dubai had been overflown. It should also be mentioned that he had been on a round the world flight as well as some flights to the East and Africa - all as co-pilot on DC-6B.

According to Flight Operation Manual p.p.4.6.1. and 4.6.2. dealing with "Route and Aerodrome Qualification", the flights in April 1971 to Colombo qualified Ole Jørgensen to fly the same flight in March 1972 without any special briefing or check.

1.5.1.3. Medical history.

Ole Jørgensen's last medical examination was at the Clinic of Aviation Medicine on the 5th. Jan. 1972.

Nothing in his medical journal has given any basis for supposing that Ole Jørgensen was not medically qualified to act as a pilot in command.

A post mortem examination was performed on Ole Jørgensen but only a limited examination could be made because of the circumstances, and the result did not lead to any belief that Ole Jørgensen was medically unfit in any way.

1.5.2. First officer Jørgen Petersen born 26th. May 1941, possessed an ATPL No. 7739 issued 13th. Oct. 1969, last renewed the 13th. Oct. 1971 and valid until 13th. April 1972.

Jørgen Petersen learned to fly in the Air Force, where he gained the rank of pilot on 8th. July 1963. In the summer of 1968 he left the Air Force following 6 years service with approximately 1300 hours experience and was employed in Cimber Air where he flew Heron and Nord 262 aircraft.

Jørgen Petersen was employed by Sterling on the 15th. April 1970 and at that time had accumulated about 2400 hours.

On the 19th. June 1970, Caravelle SE-210-10B was entered in

1.5.3. Cabin Crew.

1.5.3. 1. Karin Troelstrup, born 13th. Aug. 1948. Cabin crew member licence No. 2181 issued 4th. March 1970, renewed January 1972 and valid until 20th. Jan. 1974.

Karin Troelstrup was employed by Sterling Airways on 1st. May 1970.

She had completed emergency training 25th. March 1971. 31st. Oct. 1971, emergency training item 7 25th. March 1971 and evacuation slide training on the Caravelle 12 on the 4th. March 1971.

1.5.3. 2. Lone Bernth, born 15th. March 1949. Cabin crew member licence No. 2304 issued 4th. June 1970 valid until 6th. May 1972.

Lone Bernth was employed by Sterling Airways on 1st. May 1970.

She had completed emergency training 12th. May 1971, 16th. Sept. 1971 and evacuation slide training on the Caravelle 12 on the 4th. March 1971.

1.5.3. 3. Ditte Wøhlk, born 25th. April 1947, cabin crew member licence No. 2308 issued 4th. June 1970 valid until 20th. April 1972.

Ditte Wøhlk was employed by Sterling Airways on 15th. May 1971.

She had completed emergency training on the 20th. Sept. 1971.

1.5.4. Other Crewmembers.

Poul Erik Johansen, born 23rd. Feb. 1944. Ground engineer licence No. 637 issued 26th. Sept. 1968, renewed 26th. Sept. 1970 and valid until 26th. Sept. 1972.

Poul Erik Johansen was employed by Sterling Airways on the 1st. April 1966.

The licence permitted him to do maintenance work on the Caravelle SE-210-6R, 10B3, and 10R.

Poul Erik Johansen had no duties on board during the flight and was only carried so that he could perform maintenance of the aircraft during the en route stops.

1.6. Aircraft Information.

1.6.1. Airframe.

The Caravelle aircraft SE-210-10B3 manufacturer's No. 267 was built at Sud Aviation in France in May 1970. The aircraft was registered as OY-STL according to registration certificate No. 2395 issued on 22nd. May 1970.

load sheet is given as 31123 kg. without any indication of the basic index used. The difference of 39 kg. is explained in a modification which requires an alteration of the equipment onboard among which is included the installation of two "Maxon" ovens. This modification gives the alteration of weight as plus 39 kg. and an index alteration of minus 2.5 units.

The total traffic load was 8891 kg. and the operating weight was 43919 kg. including 11750 kg. fuel, 4 crewmembers (2 of the total of 6 crewmembers onboard were included in the aircraft basic weight) pantry and which all together gave a take-off weight of 52810 kg. With an estimated fuel consumption of 8150 kg. for the flight Bombay - Dubai as stated on the load sheet, the landing weight would have been 44660 kg. The maximum take-off weight is 56000 kg. and the maximum landing weight 49500 kg. Therefore these figures are within the limitations.

The load sheet gives the centre of gravity for take-off as 28.2% MAC and 29.7% MAC for landing. A reconstruction resulted in figures of approximately 27.3% MAC and 29.0% MAC respectively, that is, with the centre of gravity slightly more forward. However, all the figures were within the permitted limits.

According to Esso Eastern Inc. (Bombay) the left tank was refueled with 4580 litres of JP-1 fuel and the right tank with 4540 litres which equals 3618 kg. and 3587 kg. respectively, calculated at a sp. gr. of 0.79. It should be noted that the specific gravity of the fuel had not been entered in the appropriate column of the fueling order.

The total fuel quantity according to the fuel order at departure from Bombay was 12,000 kg. This was distributed between the tanks so that 5000 kg. was in each main tank and 1000 kg. in each auxiliary tank.

In the "Remarks" column on the load sheet a note "centre tanks not to be used" had been entered. This implies that both centre tanks, which are an integral part of the main tanks, had been approximately full and that therefore it can be supposed that the remaining part of the main tanks had contained approximately 4000 kg. each.

1.7. Meteorological information.

1.7.1. At the time of the accident the general weather situation in the Dubai area, i.e. the Gulf of Oman, the southern part of the Persian Gulf and the coastal areas, was that a low pressure at the surface was centred about 500 n.m. WNW of Dubai. The upper air low was situa-

As regards the descent to Dubai, it was stated that NB 296 could expect 3/8 Cb. locally, base at 3000' and tops at 30.000' and 6/8 As. with a base of 8000'. There were no clouds of note on the rest of the route.

After landing in Bombay one of the pilots went to the weather office and a briefing was given in accordance with the weather folder and the 1200z weather chart. Disregarding the fact that the flight had been reported by Sterling the weather service were not prepared for it, and as the pilot did not have time to wait, the original TAF chart was handed over. These were as follows:

Bombay 06-24 300/10 - 15 8 km. gradually 16 - 18 300/10 6 km. gradually 22 - 24 360/8 6 km. 3/8 Ci. 25000'.

Dhahran 06 - 24 160/10 - 20 more than 10 km. 4/8 Sc. 3000' 6/8 Ac. As. 9000' intermittently 8 km. rain. 20% probability of temporary thunderstorms 2/8 Cb. 3000' gradually 18 - 21 290/15 more than 10 km. 3/8 Sc. 3500' 4/8 Ac. 10000'.

Doha 06 - 06 140/15 more than 10 km. 3/8 Sc. 2500' 3/8 Ac. As. 8000' temporary 06 - 03 8 km. rain 20% probability temporary 06 - 03 5 km. thunderstorms 3/8 Cb. 2500' gradually 03 - 06 330/10 CAVOK.

Abu Dhabi/ Dubai/ Sharjah 06 - 06 VAR/10 - 20 3/8 Sc. Cu. 3000' 6/8 Ac. As. 8000' temporary 06 - 06 8 km. rain 20% probability of temporary 5 km. thunderstorms 3/8 Cb. 3000'.

The winds and temperatures for take-off from Bombay and landing in Dubai were:

	Bombay		Dubai	
1500'	340/15	20°C	230/15	13°C
3000'	230/10	9°C	240/15	2°C
4500'	VAR/10	1°C	250/25	-9°C

During flight, at 1726, NB 296 received from another aircraft the following actual weather at Dubai: 040/08 10 kms. no weather 5/2000' estimated 5/8000' estimated QNH 1016 temp. 20°C dewpoint 18°C.

1.7.3. The actual weather at Dubai International Airport was:

1700 040/08 10 km. 5/8 Cu. Sc. 2000' 5/8 Ac. As. 8000' temperature 20°C dewpoint 18°C QNH 1016 m.b.

1800 040/09 10 km. 2/8 Cu. Sc. 2000' 5/8 Ac. As. 8000' temperature 19°C dewpoint 18°C QNH 1016 m.b.

as far as they remember the weather was good up to FL 350.

Lufthansa 693 took off from Bombay at 1955 hours for Athens via R 19. According to the log of that particular flight nothing of note was observed en route except for an isolated row of thunderstorms between Rafha, Saudi Arabia, and Tanf, Syria. (Both of these places are much further west than Dubai, beyond Kuwait).

A Cessna 182 search aeroplane from the Dubai Police Air Wing took off at 1935 hours. The pilot said that the clouds west of the mountains were 5/8 - 6/8 at 3500 ft. and about 500 ft. thick. East of the mountains relatively thick clouds were seen over the coast and the sea. Large cloud formations were seen to the north. From the position where the radial 084 of "DO" VOR crosses the coast, the aircraft flew along the coast towards the south. Shortly after 2000 hours in the area where NB 296 had passed the coast, there were 8/8 cloud with tops at 2500 ft. - 3000 ft. and a broken layer above that. The glow from the lights on the ground could be seen now and again. From the same position there was very good visibility towards the SW and the glow from Dubai and Sharjah could be seen. Thunderclouds were seen 40 - 50 n.m. towards the south. The Cessna landed at 2100 hours after having flown at heights between 5 - 9000 ft. without having been through any heavy rain.

The captain of another search aeroplane, an Islander from Abu Dhabi Air Force, which flew over the coast during the period between 0001 - 0035 at heights between 7 - 9000 ft., said that he was at no time VMC and therefore had not seen either the coast or the mountains.

Eyewitnesses on the ground have stated that it was raining heavily when NB 296 passed the coast.

1.8. Aids to navigation.

1.8.1. Aircraft.

The aircraft was equipped with: 2 Collins 51 RV-1 VOR/LOC/GS receivers, 2 Collins 51 Y-4 ADF receivers, 1 Collins 51 Z-4 75 MHz Marker receiver, 1 Collins 621 A-3 ATC transponder, 1 Collins 860 E-2 DME, 1 TRT AHV 3 radio altimeter, 1 RCA AVQ-20 weather radar, and e EDO 800 loran sets.

A navigation kit was carried containing a Jeppesen Manual covering the Middle East and all (pre-printed) company flight plans for the route Copenhagen - Ceylon and back.

1.8.3. On the 21st. March 1972 a test was made by a Cessna 182 of the Dubai Police Air Wing in order to establish at which heights it was possible to receive stable signals from "DO" VOR 115.7 Mc. and the locator "DO" NDB 265 kHz.

From the east coast radial 095 was followed to the site of the accident and it was shown that the indication of the VOR instruments began to be unstable at 3200 ft. The instruments "OFF" flag became "STEADY ON" at 3000 ft.

As regards the ADF, no signals were received from the locator "DO".

1.8.4. Appendix K. Fragments of an abbreviated company flight plan for the route Bombay - Dubai were found at the accident site. The flight plan was found in an aluminium holder of the type normally used by aircrew. The flight plan holder was severely deformed and crumpled together with parts of the aircraft structure. This flight plan was the top one of a pile of unused flight plans for the route Copenhagen - Ceylon and vice versa, including one for the leg Bombay - Dubai. These flight plans were all torn to pieces.

The times and other hand written notes on the flight plan are in exact agreement with the times and information obtained from other sources regarding the flight of NB 296 from Bombay to Dubai.

As the flight plan was very torn and missing in part it was compared with another Sterling Airways flight plan for this leg which had a date of printing of 5.1.72. These two flight plans were not identical.

Comparison with a further flight plan for the same leg dated Oct./71 and which was in force prior to the flight plan dated 5.1.72 still showed disagreement.

However, further investigation showed that there were two different editions of the flight plan dated Oct./71 and that the one found at the site of the accident was one of these two. The difference between the two editions was the use of the ground navigation facility for determining the check point SEAHORSE and the bearings used for determining check points SALMON, BLUE WHALE, and DOLPHIN.

As these 4 points are transferred unchanged to the edition of 5.1.72 it can be established that the flight plan found at the accident site belonged to the first of the 2 editions dated Oct./71.

The revision of the flight plan which gave rise to the issue of the flight plan edition of 5.1.72 was caused by a revision to Jeppe-

and for removing what may remain of the previous edition. It is also the responsibility of this office to ensure that any navigation kits taken en route include only the latest revised materials, including flight plans.

1.9. Communication.

1.9.1. The aircraft was equipped with the following means of communication: 2 Collins 618M-1 (1A) VHF transceivers, 1 Collins 618M-2B VHF transceiver (reserve), 2 Collins 618S-4 H/F transceivers, and 1 Collins 456C-1 H/F Selcall unit.

1.9.2. A recording was made of the communication with Bombay on VHF 118.1 Mcs., 127.9 Mcs. and 126.9 Mcs.

The H/F communication en route was on frequencies 3446 Kcs. and 6624 Kcs.

The communication with Dubai approach was on 124.9 Mcs. and the ground station had a transmitting power of 80 watts. Because the antenna of the reserve transmitter was in a more favourable position, this transmitter had a greater range (200 n.m.) than that of the normal transmitter. Because of these circumstances, ATC changed over to the reserve transmitter at one time in order to improve communications with NB 296. The communication between Dubai approach and the aircraft was made only on 124.9 Mcs.

As far as is known, no communication with NB 296 took place in the period 1614 and 1714 hours. In the period between 1647 and 1706 a vain attempt was made to establish contact on H/F 3446 Kcs. and 6624 Kcs. using Selcall. Between 1714 and 1742 hours VHF contact was established between Dubai and NB 296 on 124.9 Mcs. via another aircraft. A copy of the record of the communication is given in appendix B.

Appendix B.

1.10. Aerodrome and ground facilities.

Dubai international airport, official height 25 ft., is surrounded by a flat landscape consisting of desert and, to the west, Dubai city and the Persian Gulf. To the east stretches a north-south chain of mountains at a distance of 30 n.m. from the airport.

At the time of the accident the airport had only one runway, 12/30, which was 3800 metres by 46 metres with magnetic headings of $122^{\circ}/302^{\circ}$.

The height of the threshold of runway 30 is 25 ft. and this

giving the actual values, the values obtained are therefore liable to errors of the following order:

G-load	± 0.2 G
Heading	± 2.0°
IAS	± 10 kts.
Altitude 0 - 2000 ft.	± 100 ft.
3000 ft.	± 125 ft.
4-10,000 ft.	± 150 ft.
12,000 ft.	± 180 ft.
14,000 ft.	± 210 ft.
16,000 ft.	± 240 ft.
18,000 ft.	± 270 ft.
20,000 ft.	± 300 ft.
22,000 ft.	± 335 ft.
25,000 ft.	± 375 ft.
30,000 ft.	± 450 ft.

Three readings of the tape were made: First, the final 4.30 min. were read at intervals of 5 seconds. Second, the last 38 min. were read at intervals of 30 seconds. Third, the whole flight from Bombay was read with a reading being made every time one of the five parametres changed value. These read-outs are shown graphically.

Appendix C 1, 2, 3.

No irregularities of the registrations made by the scriber, or other indications that the flight recorder was not functioning properly prior to the accident, have been found. Therefore, the read-out values must be assumed to be correct within the tolerances given above.

1.11.2. As regards the five parametres which are recorded it could be concluded from the flight recorder read-out that:

1.11.2. 1. Time.

The elapsed time from take-off in Bombay until the collision was 2 hours 45 minutes 31 seconds.

1.11.2. 2. Height.

After take-off NB 296 climbed to 30,600 ft. in 30 minutes, this height was kept constant for 1 hour 29 minutes. Following a further 12 minutes flight at 30,400 ft. descent was begun which, on the whole, was constant with an average rate of descent of 2600 ft/min. down to a height of 9400 ft. At this point NB 296 flattened out somewhat so that after almost a minute the height was 9000 ft. Then a rapid descent was initiated at a rate of approximately 4000 ft/min. down to

left on to 240°. 2½ minutes before the collision the aircraft began a turn on to 290° and this heading was held until the collision occurred.

1.11.2. 5. Vertical acceleration.

Some small variations in "G" (vertical acceleration) were recorded during flight at cruising level.

During the descent "G" loads were recorded in the period from about 5½ minutes before the collision until a little more than 3 minutes before the collision.

Test flights with an aircraft similar to OY-STL, made under the same conditions, have resulted in comparable flight recorder "G" curves when the speed brakes were used, as those mentioned above in the 5½ minutes to 3 minutes prior to the collision.

1.12. Wreckage.

1.12.1. The aircraft hit the tops of 2 ridges of equal height in the Sharqiyin mountains 1 n.m. from the village of Hayl. The collision was at a height of 1600 ft. on a heading of approximately 285°, 50 n.m. from Dubai airport and 21 n.m. from the extended centre line of runway 30.

The initial collision was with the left wing and this was broken off the aircraft in the area around the wheelwell. The wing was crushed and pieces were spread on both the easterly and westerly sides of the ridge.

265 m. further on from this first point of collision the aircraft then hit the next ridge just below the top and was demolished completely. The main part of the wreckage, including all the heavier parts, were then spread out fanwise in the direction of flight down the side of the ridge in an area 200 m. by 400 m. while the remainder of the aircraft fell backwards down the eastern slope against the direction of flight.

The western ridge was formed as a row of transverse folds, so that the valleys and ridges led from the top of the mountain down to the bottom of the main valley and thus formed side valleys. The difference in height from the top to the bottom was approximately 300 m. The majority of the pieces of wreckage were found at the bottom in four of these side valleys.

The aircraft was demolished so completely that there was no question about any "main" wreckage, but after a wreckage distribution

wing were found to be locked in the same position. This corresponds to the position in which the spoilers were found when the right wing was inspected visually.

Some spindle parts from the flap system for extending the flaps were found. At a preliminary examination, part of the one flap spindle was estimated to have been broken in a position corresponding to flaps 0°, while another part was found in a position indicating that the flaps had been extended 5°. A laboratory examination showed that the parts were from the same spindle and that at the moment of collision the spindle had been in a position corresponding to flaps 0°.

Although one of the actuating cylinders for the main wheels was slightly bent, both were found in the fully extended position, corresponding to "Up". Both uplock latches were found bent forward in the direction of flight. The damage to the main undercarriage, including the wheels and brakes, was very slight.

The artificial feel selector handle was found in the "Neutral" position. This indicates that both artificial feel systems were operating normally.

1.12.3. The left engine was found lying about 60 m. from the second impact point, but in several pieces and severely deformed. The right engine was also found in several pieces from about 150 m. to 225 m. from the impact point.

All rotor blades were torn off, severely damaged and spread over a large area. The mechanism of the right and left reverse control box was found in the forward thrust position. No visible signs of in-flight fire were found on the pieces of engine wreckage. Both high pressure fuel levers were found in the "On" position.

The generator from the auxiliary power unit was found broken off and showed no signs of having been in rotation at the time of collision, which means that the APU was not operating at this time. There were no signs of fire in the auxiliary power unit compartment.

A number of fuel gauges from the cockpit and wing section were found, some of these were read on the site and others were salvaged for closer examination in Denmark.

The following instruments were found:

The main indicators in the wing RH centre tank
RH main tank
RH aux. tank showed 830 kg.

the goniometer and all three motors were torn out of the gear assembly.

Comparison with an intact receiver showed that the band mode switch was in band 1, equivalent to 190 - 400 KHz and ADF mode.

An examination of the tuning synchro showed damage from which it was possible to presume that the position of the synchro was equivalent to the position it was in at the moment of collision. The position was equivalent to 306 KHz.

ADF receiver. Identified as No. 1 (left). It was found in the same condition as ADF receiver No. 2. Both synchros for bearing and tuning, the goniometer and all 3 motors were also torn from the gear assembly. Since none of the synchros had been damaged to such an extent that it was possible to determine the position at impact nor any course information obtained from the goniometer or associated synchro transmitter, it was not possible to determine the ADF indications at the moment of collision.

An examination showed that the band mode switch was in band 1, equivalent to 190 - 400 KHz and ADF mode.

The tuning condensor and the coil assembly were severely compressed. As the tuning systems control transformer was torn off without the instrument indications being determined, it was attempted to establish the frequency tuned by means of the movable condensor and the associated gear. The immediate position of the condensor which had been torn off the gear was equivalent to approximately 225 KHz. As it was obvious that the condensor had been turned during the deformations, this finding was unreliable. The gearwheel of the condensor axle had been pulled from the axle and lay loose in the gearbox. An examination of the gearwheel showed that this had been turned during the initial deformations by an amount equivalent to 6-7 teeth, before the axle had been pulled off. 6 and 7 teeth are equivalent to an angular movement of 25.7° and 30° respectively. Starting from the position of the condensor being equivalent to approximately 225 KHz, a turn through 30° would be equal to an original tuning position of 268.8 KHz. As it was determined that the turn was between 25.7° and 30°, the frequency tuned could well have been 265 KHz, which is the frequency of the Dubai locator. These conclusions presuppose that the condensor was not moved by the blow that drew the axle out of the gearwheel and squeezed the condensor firmly into position.

VOR/LOC/GS receiver. Identified as having been mounted in posi-

1.15.2. Examination of the salvaged fuel gauges.

A number of fuel gauges were salvaged with a view to closer examination in order that the indication of the instruments at the time of the accident could be established.

The examination results were as follows, but it should be remembered that individual figures taken by themselves, must be regarded as unreliable:

Main indicators	RH centre tank	1025 kg.
	RH main tank	0 kg.
Cockpit repeaters	LH main tank	100 kg.
	RH main tank	150 kg.

1.15.3. An examination of what the salvaged engine instruments indicators showed at the moment of collision.

Examination of the 2 Engine Pressure Ratio (EPR) indications showed, as regards the right engine, a comparatively reliable index adjustment of 1.98 and a gauge position which is thought to be unreliable, while the left instrument showed a doubtful index adjustment of 1.9, while the gauge position could not be determined.

The examination of the 4 RPM indicators showed for the right N 1 indicator a position at the time of the crash of 80-90%, but the position must be regarded as unreliable, the left N 1 indicator showed 30%, this position also must be regarded as unreliable. The right N 2 indicator showed also 30%, this position is thought to be very unreliable. The left N 2 indicator showed 90-92%, and this position is thought to be comparatively reliable.

The examination of the right Exhaust gas temperature (EGT) showed that at the moment of collision this had been at least 370°C while the right indicator, with good reliability, had shown 380°C.

1.15.4. The examination of the weather radar RCA AVQ 20.

Part of the components of the weather radar were found and brought to Denmark for closer examination.

Reflexklystron was found in two parts. The exit from the klystron and the wave guide flange were found still mounted on the radar's duplex system while the actual klystron was found by itself. The base for the klystron was partly missing.

An examination of the socket terminals under the microscope showed no signs of burning which could indicate whether or not hot filament wires had been pressed on them at the moment of collision.

and the glass and the indicator were lacking. An examination of the instrument's potentiometer together with marks in its windings showed with comparatively good certainty that at the moment of impact the indication was less than 13°.

The examination of the Hz 4 Horizon Flight Director indicator which was severely deformed but showed by means of impact marks on the instrument that the aircraft, at the time of the second collision, had 23° of bank to the left. This indication is almost certain. Pitch indication, also based on impact marks, showed 10-15° climb. This indication is relatively certain.

An equivalent examination of the other Horizon Flight Director indicator of Hz 4 type, which was also severely deformed, showed a 30° bank to the left and a pitch of 20° climb, both of these indications are almost certain.

An examination of the Airspeed indicator, Machmeter indicator and Altimeter scales gave no result.

An examination of the bulbs and switches from the warning system, or the remains of these, from UC 3 panel gave only a few results, but it was determined though that the warning lamp for split flap had been illuminated at the moment of collision.

This split flap indicator must be considered a natural consequence of the first collision where the left wing was partly torn off.

The indication however also shows that electricity was connected to the emergency bus VP-11 (115 v 400 Hz) which supplies this system's synchro transformer in the left wing at rib 31, and that there was 28 v electricity on the essential bus PP-11, at the moment of collision. The electrical connections to rib 31 have remained intact after the first point of collision, disregardless of the fact that a bevel gear was found at this place which had apparently come from rib 38.

R 19. By comparing the Magnetic Headings from the flight recorder read-out with these Magnetic Tracks it can be seen that the actual wind correction angle varies between -2° to -4°.

The flight of NB 296 has been reconstructed backwards from the site of the accident, using information from the flight recorder and a wind velocity of zero.

Appendix F.

This shows that the aircraft passed over the coast at 1801^{30} (0 - 2½ min.) at 2000 ft. on a heading of 240° immediately south of the villages of Kalba, Ghuryafah and Fujayrah and in addition, that at the time of passing the coast had turned about 50° to the right and then flown towards the accident site at heights down to a little above 1400 ft. over an area where the surrounding countryside consists of higher terrain on both sides. By working backwards to the top of descent (0 - 14 min.) it is seen that NB 296 was about 6 n.m. south of radial 084 of "DO" VOR. If the flight is moved a further 8 minutes backwards (0 - 22 min.) to the point where the captain said that he was on radial 084 it can be seen that he was actually on radial 084.

This must mean that on the average there was no drift, but it should be pointed out that the surface wind at Dubai was from 40° and that the Magnetic Heading on the last part of the flight was 265° and 240° respectively, which means that on this last part of the flight on the average the aircraft could easily have had a drift either to the left or to the right.

On the other hand, if the flight from Bombay is plotted with zero wind, still on the basis of the flight recorder read-out, so that the conditions for passing overhead SALMON are fulfilled at 0 - 2 hours 24 min. then the aircraft will be at a position at 0 - 14 min. which is 220° and 150 n.m. away from where it actually was. This is equivalent to an average wind from SALMON to top of descent of 220°/68 kts. With this wind as the starting point it can be determined that at 1714 hours (0 - 50 min.) the time at which the captain reported DOLPHIN, the aircraft had been somewhere around 90 n.m. north of the intended track.

A wind of 220°/68 kts. would have given the aircraft a drift of -9° and a headwind component of about 30 kts.

If a plot is continued back from radial 084 at 0 - 22 min. towards DOLPHIN at 0 - 50 min. on the basis of this wind, it is seen that the aircraft has been 80 n.m. north of track on radial 199 from Jiwani.

Lufthansa LH 693, which took off from Bombay at 1955 hours for

From the same chart it is also seen that the wind over Bombay was 270° - 280° at 50 kts. and over Sharjah 240° - 250° at 90 kts.

As mentioned previously this confirms that the drift was greater the further west they proceeded on the route Bombay - Dubai and at the same time it can be established that the crew had material which led to the expectation of such an increase in drift.

For instance if the crew had utilized the wind given in the forecast for the leg Bombay - Dubai the WCA would have been -4, -6 and -7 and the head wind component about 30 kts.

2.1.1. 5. Recognition of drift.

One can then determine that NB 296 for about 1 hour 40 min. maintained a heading which, apart from some small corrections, was constant.

As it must be taken for granted that NB 296 would have corrected for an established drift this implies that NB 296 has not had any indication of its drift before the final stages.

The navigation from Bombay to Dubai, apart from departure from Bombay and approach to Dubai where navigation aids have been respectively to the rear and in front, takes place by means of bearings to navigation aids to the side of the track. Furthermore weather-radar can be used as a secondary aid.

Because of the distance from the airway to the navigation aids on land and the navigation equipment with which OY-STL was equipped it must be realized that for the centre section of the route which is over 600 n.m., the pilots must mainly be content with calculating how much one advances and thereby calculate ground speed, but it is not certain that a possible drift can be established.

Among navigation aids covering the above mentioned 600 n.m. by which the drift could possibly be determined Karachi and Jiwani VOR should be mentioned. A series of NDB's on the coast which in the actual case, with thunderstorms in the vicinity, must be expected to be unreliable.

Karachi VOR is situated at a distance of 210 n.m. from airway RED 19 and is used by Sterling for determining the position of checkpoint BLUE WHALE which is situated 240 n.m. from the VOR. The range of the VOR must be calculated to be about 200 n.m. at flight level 310 to ensure reliable reception. The radio horizon at this altitude would be at a distance from Karachi VOR of about 225 n.m. Therefore it must be established that the use of Karachi VOR aid for determination of checkpoint BLUE WHALE was marginal if not impossible.

that NB 296 must have appreciated that the aircraft was not where it should have been. At this time NB 296 was about 200 n.m. from Dubai.

NB 296 turned left to a heading of 262°. As this heading was kept, even when NB 296 reported radial 084 "DO" VOR, the aircraft was on, or close to radial 084 when the alteration of course took place, and from this time steered inbound to "DO" VOR. It can also be concluded that the change of course has been made on the basis of bearings to "DO" VOR.

NB 296 has, as mentioned above, at 1734 appreciated its northerly position, which was even north of airway A 1 (Karachi - Dubai). As far as can be judged from the copy of the correspondance or from the other facts at hand, NB 296 has not at this time attempted to give its position neither has it requested a clearance direct to Dubai from this position.

At 1742 NB 296 reported SPEARFISH, well knowing that in fact they were at some considerable distance from this reporting point. Neither at this time did they ask for permission to continue on radial 084.

When the deviation from track was appreciated NB 296 should have requested a new clearance for the continuation of the flight without delay.

2.1.1. 6. 58 E/SPEARFISH.

The next and the last checkpoint after abeam Jiwani was SPEARFISH. NB 296 knew that the checkpoint was no longer 58 E but SPEARFISH as this had been entered in the 58 E column on the flight plan, although no alteration of the distance or of the time had been made other than that required by the calculated headwind component for the last two sections of the route. As SPEARFISH had been entered this could lead to the assumption that this information had been taken from the Jeppesen route chart and that this chart therefore had been a revised edition.

That the crew was not quite conversant with the alteration of the checkpoint can be seen from the fact that the captain spoke of the checkpoint as 58 E when contact was first established with Dubai via another aircraft.

It is not known exactly when NB 296 became aware that 58 E had been altered to SPEARFISH but at 1742 hours when SPEARFISH was reported the pilot used the word SPEARFISH.

for the last section to Dubai when RETO Dubai 1810 hours was reported at 1742 hours.

It can also be that the time 1742 hours is only arrived at as a consequence of an expected gain in time corresponding to a similar gain on the section BLUE WHALE - DOLPHIN.

Even if it could easily be a coincidence, it should be mentioned that at 1742 hours NB 296 had a MH of 262° on radial 360 from Azaiba TWO NDB, equivalent to an abeam position on the whole when consideration is given to the WCA, for such was also the situation when passing SPEARFISH on R 19 but on QDR 020°. The conditions for this to be relevant are of course that NB 296 has been within range of Azaiba TWO NDB and that the captain has accepted an abeam position as SPEARFISH.

The captain had flown the route several times, as mentioned in the first section of the report, and it must therefore be considered probable that he knew of Azaiba TWO's performance and it can therefore be thought that, as regards the assumed RETO 1742, that at DOLPHIN the time for the next checkpoint has just been estimated with the assurance that in any case a positive ADF indication would not be obtainable especially not with thunder in the area so the checkpoint has been reported at the estimated time.

It has not been possible on the basis of what is known to decide whether or not NB 296 was aware that the two last distances had been officially changed as compared with those given on the flight plan. Neither has it been possible to decide whether NB 296 has fixed his position at SPEARFISH by bearings from Azaiba TWO NDB or simply reported this at a suitable time.

2.1.1. 7. Top of descent.

When asked by Dubai, NB 296 said at 1743 hours that he wanted to begin descent at 1755 hours. About 6.5 mins. later however NB 296 reported that it was now 95 n.m. out and that permission to descend was required.

It must be supposed that the time 1755 hours has been calculated by use of a rule of thumb in relation to the ETA Dubai of 1810 hours. The distance to Dubai has been about 165 n.m. at 1742 hours.

According to paragraph 4.6 of the AFM regarding descent, 12.3 mins. will be used while descending from FL 310 to 2000 ft. while travelling a distance of 70 n.m. with an average headwind of 30 kts. In the 13 mins. at cruise level from 1742 hours until 1755 hours the

gave no result or else could not be found.

The radar was apparently serviceable at departure from Bombay, since no defects were noted in the technical log prior to take-off from here. However, it is not unusual that pilots do not write down the technical defects until the end of the flight. In this case this would have been at Ankara.

2.1.1. 8.2. The crew's use of the radar.

If it is assumed that the radar has been "ON" and usable, there is the possibility that although the equipment has been used or attempted to be used for navigation.

On the other hand, in the circumstances, it seems that the possibility that radar, at least occasionally, would have not been desired to be used, to be minimal. After a long, over water flight, where it has apparently not been possible to determine the exact position of the aircraft, it must be taken for granted that the pilots, when they thought that they were within range of the coast, have tried to use this to determine their position.

2.1.1. 8.3. "False" radar picture.

When flying westwards over the Muscat peninsular the phenomenon quite frequently occurs, that the desert to the rear of the mountains does not produce an echo on the weather radar and thus no contours of the west coast of the peninsular are produced where the desert gives way to the sea.

In this way the western edge of the mountains, considered uncritically, can appear to be the west coast of the peninsular and thus if the navigation is based solely on radar, lead to planning the flight incorrectly.

This phenomenon has been experienced and is known by several Sterling pilot's who have flown over the area and is also confirmed by the captain of LH 693 mentioned in section 2.1.1.3. During a test-flight where the last part of the reconstructed route was flown, the radar screen was photographed whilst it was tried in different positions and also here it was quite evident that the desert could not be distinguished from the sea areas lying to the rear particularly during certain adjustments of the equipment. The echoes from the western edge of the mountains when viewed uncritically appeared as the western coast of the peninsular.

weather and the radar picture has therefore appeared otherwise than it would have done for NB 296. There were at that time clouds in the area which contained large amounts of water and this could have altered the picture.

If the radar was used for judging distance, this must mean that the crew did not compare their impression of the width of the peninsular with that indicated in the Jeppesen chart. They could thus have found that the radar picture was not a true picture of the peninsular. Clouds on the east coast and eastwards could however have blurred the outlines of the coast so that only the contours of the western edge of the chain of mountains could be seen. Cloud formations, storm clouds, have as far as it has been possible to find out, covered the east coast area.

The captain of BA 833 which overflew the area about 2 hours later than NB 296, has stated that the east coast was not easily visible on the radar because of clouds. The co-pilot of BA 833 was able to determine his position by a VOR radial and distance to the east coast by weather radar.

If, at $17^{49}{}^{21}$, NB 296 had a usable radar picture on which the descent could be based it should also have been possible for him to get a usable picture at 1742 when Dubai requested the time for top of descent. However, the radar can have been tilted for weather at that time or they can have had trouble with the adjustment.

Also, if NB 296 has begun to use the weather radar for navigation after descent had begun, the radar picture must have been distorted without the pilot's appreciating this, furthermore, the contours of the east coast must have been blurred as otherwise there is no explanation of why NB 296 as far away as 40 n.m. from the point where Dubai was thought to be was down to FL 94 and even accelerated its descent immediately afterwards, so that at 2000 ft. it was 30 n.m. from where Dubai was thought to be. Even in this situation it can be imagined that the radar has been tilted for use in looking at the weather, this giving a changed radar picture. It is just during descent through an area that has been forecasted as having thunderstorm activity, that it would be natural to keep an eye on where this activity was.

2.1.1. 8.7. Use of radar before 1742 hours.

As mentioned earlier, it must be taken for granted that NB 296 as it approached land wished to determine its position with the help

2.1.1. 8.9. Conclusion.

It has therefore not been possible to determine with certainty whether the weather radar has been attempted to be used for navigation or not, or whether the advancement of the time for descent was the result of information from the weather radar.

If the radar has been used about 1749 hours, then the conditions, as regards "false" radar picture and distance were such as could have caused the pilots to advance the time of descent.

At the same time it can be concluded that if the time for descent was advanced solely as a result of information from the weather radar, then this has been used as a primary navigational aid, and furthermore that the captain could not have known of the radar phenomenon when flying over the Muscat peninsular.

2.1.1. 9. Use of flight plan.

The flight plan used showed the distances DOLPHIN - 58 E, 58 E - Dubai to be 189 n.m. and 150 n.m. respectively.

The crew of NB 296 reported at 1742 hours that the RETO Dubai was 1810 hours, and shortly afterwards requested to begin descent at 1755 hours. The calculations on which the time of 1810 was based are not known, but if the same procedures were used as had been used for the other RETO's on the flight plan then the RETO Dubai should have been 1813 hours when passing abeam Jiwani and 1808 hours when passing 58 E.

If the time was based on the time the aircraft was abeam Jiwani, it can be thought that a gain of 3 mins. was reckoned with for the last two sections of the flight. When abeam Jiwani the flight had had a gain of 10 mins. If the RETO Dubai was based on the time abeam Jiwani it also means that no importance had been placed on the checkpoint 58 E/SPEARFISH. There is no immediate explanation for the time of 1810 hours, it seems, if this is based on the ATO 58 E/SPEARFISH.

At 1749^{21} NB 296 reported 95 n.m. from Dubai. If this report was based on a speed calculation from abeam Jiwani, a groundspeed of 415 kts. would have been used, which the pilots may have considered to be realistic.

If it is assumed that NB 296 was aware that the distance from SPEARFISH to Dubai was 191 n.m. and that this was the distance from Dubai at 1742 hours then the groundspeed would have been 750 kts. for 7.5 mins. Equally, if NB 296 had calculated with a position abeam Azaiba TWO at 1742 hours and a remaining distance to Dubai of 165 n.m.,

Jeppesen route chart, unless certain conditions were fulfilled as stated in the Flight Operation Manual. It was only when other circumstances occurred during descent that the time of descent became of importance.

2.1.1.10. Visual contact.

NB 296 received permission for descent and was cleared down to FL 40.

Just after descent was initiated the captain said that he would try a "straight in" to runway 30.

The first part of the descent here was made with a rate of descent of about 3000 ft./min., and after a couple of minutes the heading was altered from 255° to 265°. At FL 135 NB 296 was cleared further down to 2000 ft. by Dubai ATC.

At FL 94 NB 296 reduced his rate of descent and at the same time turned 25° to the left while the IAS decreased from 295 kts. to 250 kts. After almost a minute the rate of descent was increased to 4000 ft./min. at the same time as the speed brakes were extended.

The extension of the speed brakes with the consequent rapid rate of descent together with the change of heading to 240°, i.e. 60° to the extended centre line of runway 30, suggests that NB 296 at that time had got the impression that they were very close to Dubai.

The VOR equipment could not, under the prevailing circumstances, have given an indication that the aircraft was close to the VOR station, neither does it seem reasonable to suppose that the weather radar could have indicated that they were close to Dubai - indications, which could have formed the basis on which the pilots regarded it as feasible to descend at 4000 ft./min. down to less than 3000 ft. with the speed brakes extended. In the light of this it does seem probable to suppose that NB 296 has had visual contact when the pilots were given the impression that they were close to Dubai.

Appendix G.

The towns of Kalba, Ghurayfah and Fujayrah are situated on the east coast of the Muscat peninsular in the Emirat of Fujayrah. Fujayrah and Ghurayfah are almost amalgamated while Kalba lies some kilometres to the south.

Appendix H.

The towns extend some 7 km in a north-south direction. A part of Fujayrah town consists of two rows of houses placed apart from the rest of the town, south of this, and northwest of Ghurayfah.

Between these two rows of houses, 19 masts are placed 40

"Let down and Approach during VMC at Night and Contact" states that if it is positively determined that the aircraft is within the sector distance a visual approach can be made without following the instrument procedure. The aircraft position during this approach shall continuously be checked by using the available radio aids to ensure the necessary terrain clearance.

After NB 296 has become VMC and has caught sight of the towns which were thought to be Dubai, the captain has felt convinced that he was within the sector limits and continued his approach visually below the minimum flight altitude down to the 2000 ft. to which he was cleared. It seems that the captain cannot have positively determined his position as being within the sector limits as this can only be determined with the help of a radio navigation aid. It should be noted that the regulation in FOM does not specify exactly what is understood by "positively determined".

The same paragraph in the Flight Operation Manual, item 1.C, regarding "Rate of descent" states that the rate of descent at heights below minimum basic altitude +2000 ft. shall not be above 2000 ft./min. That is to say in this case minimum sector altitude 2000 ft. +2000 ft. = 4000 ft.

If the pilots had thought that they were within the sector limits as they obviously did, then the rate of descent when passing 4000 ft. should have been reduced from 4000 ft./min. to the above mentioned 2000 ft./min.

2.1.1. 12. Final Phase.

Whether NB 296 has been able to maintain visual contact with the towns during the whole descent from FL 90 is not known, but the aircraft was seen passing the coast at 2000 ft. by witnesses on the ground who were able to follow it until the accident.

If the pilots had thought that the towns were Dubai and the row of lights was the airport, then they must have been aware by the time that they passed the coast of their mistake, amongst other things, they were immediately over the coast when they called up about "DO" NDB, which could indicate that they tried to find out by means of the ADF how close they were to the airport.

That NB 296 remained at its height indicates that at no time before the very last moments was trouble suspected as regards their belief that they were close to Dubai.

After passing the coast the speed has slowly decreased to 160 kts.

difficulties obviously lies in the fact that the aircraft at that height, in that area, was out of range of the NDB.

b. Use of VOR.

On the basis of the investigation results given in section 1.15 it can be established that both VOR units have been tuned to a VOR station.

In the period from 1803^{15} hours to 1803^{30} hours - 30 to 60 seconds before impact - the aircraft reported, as stated in the transcript of the R/T communication, that the VOR indications were unreliable. It is taken for granted that the VOR has been tuned to "DO" 115.7 Mc up to this point. It was suggested that a change to the ILS localizer be made which, as stated above, had not been made at the time of the accident. As there are no grounds for believing that instead of changing to the localizer the aircraft should have changed to e.g. Sharjah VOR, it is assumed that both VOR's were tuned to "DO" 115.7 Mc at the time of the accident.

The manufacturer of the VOR equipment states that a $3\mu V$ input signal will give satisfactory VOR navigation performance, but that the automatic VOR channel will, in practice, often function quite well with a $0.5\mu V$ antenna signal.

Due to the receiver's own noise the RMI servo will move haphazardly if no antenna signal is received.

As the RMI servos indicated radial 115 and 117 respectively it is most probable that both navigation receivers have received a usable VOR signal as otherwise it is thought to be most improbable that their indications should be so alike.

As regards the statement in section 1.8.3 that is not possible to receive VOR signals below 3000 ft. and that the aircraft crashed on radial 100 at a height of 1600 ft. and without a line of sight to the VOR station, it must be thought probable that the VOR signal is due to reflections from the mountains further inland. The height of the mountains inland is about twice that of the actual height where the aircraft was flying at the time of the accident.

It is not known which radials the RMI's showed when NB 296 passed the coast at 2000 ft. at 1801^{30} hours, but it was at that time that the aircraft asked about "DO" NDB and if problems with the VOR had been observed at this time it is obvious that this would have been reported.

The aircraft passed the coast on a heading of about 240° but then

This energy curve runs smoothly without any definite movements indicating that at no time immediately prior to the accident has there been any abrupt changes in the power of the engines.

The examinations performed shows that the engines have been operating normally at the moment of collision and in the time immediately preceding, and that nothing has been found to indicate that the engines have not operated normally for the whole flight.

It can be mentioned that the emergency checklist was found unopened in the metal pocket where it is normally kept, indicating that they have not been engaged in any emergency procedure at the time of the accident at least.

It can also be mentioned that the rudder and elevator trim were found in positions which were normal for that speed on a normal aircraft.

It is evident from section 1.15.6 that the two horizon flight directors at the moment of collision (2nd. collision) indicated 23° and 30° banking to the left and 10° or 20° degrees of climb. It is also evident that the angle of attack indicator was below 13°.

Large parts of the left wing were torn off when the aircraft hit first time, and it must have begun to turn left and a left turn of 23°-30° at the time of the 2nd. collision is absolutely probable and matches the distribution of the wreckage which shows that, as opposed to the rest of the aircraft, the right wing has cleared the mountain ridge.

As regards climb, the 10°-20° indicated on the horizon must be put down to attitude. Just before the crash the aircraft had initiated a climb of 600-700 ft./min., which, at that speed is equivalent to between 1° and 2° angle of attack.

By and large the differences between the height of the first and second collisions was zero, this means that the aircraft has moved horizontally, on an average, between the two collision points.

As soon as part of the left wing was torn off the lift of the aircraft was reduced and it has not been possible to maintain the rate of climb. A slight rate of descent was evident at the second point of collision.

From section 1.12.2 it is evident that the aircraft had an indication of full right aileron and part right rudder. These positions can well be thought to have been imparted by the pilots who can instinctively have sought to counteract the asymmetrical balance in the aircraft brought about by the loss of part of the left wing.

for R 19 from SPEARFISH - Dubai is FL 100.

Flight control for Dubai airport is administered by INTERNATIONAL AERADIO Ltd. England (IAL). Air Traffic control is performed in accordance with ICAO Annex 11, International Standards and Recommended Practices AIR TRAFFIC SERVICES, ICAO DOC 4444, Procedures for Air Navigation Services RULES OF THE AIR and AIR TRAFFIC SERVICES, ICAO DOC 7030, Regional Supplementary Procedures, the Bahrain AIP and IAL Company Air Traffic Control Services.

The Department of Civil Aviation, Dubai, has stated that at the time of the accident the IAL Manual of Air Traffic Control specifically excluded para. 6.3 part IV of ICAO DOC 4444 (ref. p. 56). The reason being that whereas such a paragraph could be utilized satisfactorily in an area which was liberally sprinkled with navigational aids, it cannot be utilized in an area which is relatively short of navigational facilities due to traffic saturation.

It shall be mentioned that on the 14th. March 1972 Dubai was not a member of ICAO.

The air traffic controller's disposition as regards first clearing the aircraft down to FL 40 and later down to 2000 ft. was in accordance with usual practice based on the contents of the documents mentioned previously.

Briefly speaking, this practice amounts to clearing aircraft down to 2000 ft. or minimum sector altitude and allowing the responsibility for the navigation of the aircraft and therefore for knowing when the aircraft is within the sector boundaries and also for maintaining terrain clearance until then, to rest on the pilot.

The pilot's responsibility, as regards navigation and terrain clearance, is incontestable.

Page 3.2 paragraph 4.1 of ICAO DOC 4444 states regarding ACC's (Area Control Centre) assignment of cruising levels:

"4.1. Except when specifically authorized by the appropriate authority, cruising levels below the minimum flight altitudes established by the State shall not be assigned."

Dubai APP (Approach) took over control of NB 296 from ACC Bahrain when the aircraft was 165 n.m. from Dubai. This was a natural arrangement as the aircraft did not have contact with Bahrain centre.

A definite limitation of the areas of responsibility between ACC and APP is not set in the ICAO publications. In DOC 4444's VII section item 3.3.1 is stated that APP can give permission to fly to all aircraft that are transferred from ACC and from the II section, item

as ICAO's Annexes, which contain standards and recommended practices, but complement these, and so member countries do not have a duty to follow directions or to report differences. As regards the importance of knowing of any differences to those recommended by ICAO, it is suggested that member countries should report any difference anyway.

If APP had cleared NB 296 to not lower than 4400 ft. and then waited until the aircraft had reported over the VOR, or reported the airfield in sight, it does not necessarily mean that the accident would not have happened.

Under the circumstances it can not be excluded that NB 296 would have reported the airfield in sight when he saw the towns Fujayrah, Ghurayfah and Kalba and possibly the illuminated road. In this way APP would have been entitled to let the aircraft descend through 4400 ft. and then he could have continued his approach with the object of making a "straight in" landing, just as actually happened.

In connection with the investigation of this question, various interpretations have been put forward as to how the documents in question shall be interpreted. This led to ICAO being approached on the question. ICAO put forward the interpretation given here in the report.

It should also be mentioned that it has come to light during the course of the investigation that the procedures used by Dubai airport are possibly used in certain other places, e.g. in Europe.

The fact that these vital regulations can be interpreted in different ways and the uncertainty as to the meaning of the terms used indicates that the contents, formulation and readability of the regulations is faulty.

2.1.3. The origin of the flight plan.

It must be concluded from the evidence under para. 1.8.3. that the flight plan found at the accident site was the one used by the crew for the flight from Bombay to Dubai.

The only contents of the navigation kit found at the accident site were a Jeppesen Route Manual, parts of flight plans for other route sectors and remains of the navigation bag in which navigation equipment is stored. It has therefore not been possible to discover the actual dates or editions of the flight plans in the navigation kit.

2.1.4. Fuel Consumption.

As shown on the loadsheet, para. 1.6.3. NB 296 did not intend to use fuel from the centre tanks, that is to say that this fuel would not be transferred to the main tanks.

The reason for not using the fuel in the centre tanks was that it takes a relatively long time to fill them again. This would increase the ground stop time during an intermediate landing made solely for tanking.

As shown in para. 1.12 and 1.15.2. there were 2 indications of 1025 kg. in the RH centre tank, 3 indications of from 0 to 150 kg. for the 2 main tanks, and 1 indication of 830 kg. in the RH auxiliary tank. This indicates that NB 296, as intended, did not use the fuel in the centre tanks.

In the column on the flight plan for actual fuel consumption is noted 8000 kg. when passing 58°E (SPEARFISH) at 1742 GMT, together with a note 4.T. This note could indicate 4000 kg. fuel remaining.

Since in the 2 main tanks there had been fueled a total of 8000 kg. according to the fueling order, then the main tanks would have been empty at approximately 1742 GMT and the auxiliary tanks would then have been used, an operation which is normally automatic.

From 1742z until "top of descent" at 1749z 330 kg. would have been used, and during descent to 2000 ft. a further 275 kg. would have been consumed. These figures have been calculated from the tables in the AFM. This would mean that there remained approximately 730 kg. in each auxiliary tank assuming there had been an equal consumption from each side.

This deviation from the indicated 830 kg. in the RH auxiliary tank lies well within the tolerances of the fuel gauges and fuel flow meters.

Due to instrument tolerances the time of change-over to the auxiliary tanks can have been some minutes later than the time where the pilots indicated having used 8000 kg. since this figure was probably estimated with reference to the RH fuel totalizer indication. It should be noted that the LH fuel totalizer was unserviceable.

In AFM 1.7.2. para. 03 "Operational Limitations" is stated: *"The main tanks must be emptied first. When using fuel from auxiliary tanks reduce V_{MO} to 290 kts IAS"*, and on page 1.7.3. para. 03 regarding "Fuel tank selection" is stated: *"The centre and main tanks must always be emptied first."*

As regards the NDB stations in the area, a number are found whose official range, according to ICAO's Air Navigation Plan, cover some of the area which is flown through, but owing to the tolerances of the NDB's and ADF's the range will be limited depending upon which degree of accuracy the navigation is to be executed. Then the possibility of unreliability in connection with thunder, night effect and coastal refraction is added.

On the chosen routing the navigational equipment used must therefore be considered marginal if it is assumed that the operational regulations should be followed so that the aircraft is able to navigate according to the flight plan and in accordance with ATC instructions.

The very northerly routing, which OY-STL followed, should however have given rather good navigational possibilities for most of the flight, especially the final third.

2.1.6. Qualifications.

According to para. 1.5.2.2. of the report Jørgen Petersen was not qualified to perform the flight in agreement with the regulations of FOM.

The FOM regulations concerning "Pilots' Route Qualifications" state that both captain and co-pilot shall, before a flight within the area of the Middle East, have received a complete route briefing and at least one "two way route training flight". In addition they shall also comply with the regulations concerning "Aerodrome Qualifications" for destination and alternate airport.

Provided a pilot has flown within the area, as active pilot, within a period of 12 months the above mentioned requirement can be disregarded.

The instruction regarding a pilot's aerodrome qualifications states that a captain is only allowed to use regular weather minima applicable to airports approved by Sterling Airways, provided he has, within the last 12 months, fulfilled the training requirements as specified for the group to which the aerodrome concerned (destination and alternate) belongs, or has landed at the airport as active pilot during the last 12 months.

As far as a co-pilot is concerned he shall have completed a link/simulator program covering all pertinent destinations and alternate airports. A special link session shall be given for any airport not covered by this simulator program.

they considered that provided one pilot had been to an airport within 12 months then the crew was qualified. If these qualification requirements were fulfilled, then it was delegated to the crew assignment office to make dispensations from the regulations in FOM previously mentioned.

Since the regulations of FOM are approved by the Directorate of Civil Aviation - and therefore also the rules stated above - the procedures used in practice should have been forwarded to the Directorate of Civil Aviation for approval before actually being put into effect.

It is possible that the regulations in FOM are too restrictive for actual use, when considering the operations in which the company is involved. On the other hand the line of action used is considered not sufficiently restrictive, since it could happen, as it possibly did in this case with the combination of Ole Jørgensen and Jørgen Petersen as crew, that before a flight, pilot A, either captain or co-pilot, had neither flown the route nor received a briefing, while pilot B only needed to have flown the route once before within a period of 12 months. Pilot B did not require a briefing before his earlier flight (precisely as was the case with pilot A since the pilot he then flew with had flown the route before. Pilot B's knowledge of the route in question could thus simply consist of what he himself learned together with what information the other pilot chanced to tell him, and this other pilot's knowledge again is dependant on etc., etc., etc. The system gives no guarantee that a pilot will ever be introduced to the total route information accumulated by the company.

The Ministry of Public Works regulations regarding crew members qualifications require special knowledge of the route from the captains but not from the other crew members.

As regards these regulations an aircraft operating company must ensure that the captain has the knowledge necessary for the route and that this knowledge is obtained by flying the route and that such knowledge shall not be older than 12 months.

Ole Jørgensen had flown the route 6 times within 10 months without accident and the crew were qualified according to the understanding of the Directorate of Civil Aviation, according to the Ministry of Public Works regulations.

Ole Jørgensen had been operating as captain for only nine months. He had earlier been in the Middle East and Far East, but always as co-pilot, and on a few of these flights a navigator had been carried.

of airports and routes accumulated by the company.

4. The combination of Ole Jørgensen and Jørgen Petersen as crew members with their background of experience could have been more suitably chosen to perform the flight in question.
5. None of the pilots employed by the company had received any special training in the use of the weather radar.
6. There has been found nothing during the inquiry to suggest that the pilots were not both mentally and physically fit.
7. Regulations regarding working times were observed until the time of the accident. The total crew duty could have been completed within the limits of the working regulations.
8. OY-STL was properly certified and had a valid airworthiness certificate.
9. The aircraft centre of gravity and weight was within the established limits at take-off from Bombay and there is nothing to suggest that such was not also the case at the time of the accident.
10. The inquiry disclosed no malfunction of the aircraft that could have taken place before the crash.
11. It has not been possible to ascertain whether the radar was able to function when switched to "ON".
12. Both motors were giving considerable power at the moment of impact and there is nothing to suggest that the motors had not operated normally during the flight.
13. OY-STL was in a "clean" configuration at the time of impact and had both AC and DC power available until the second impact.
14. NB 296's fuel management was not in accordance with the FOM regulations, but in accordance with Cockpit Info No. 111.
15. The crew of NB 296 had been provided with adequate meteorological information before departing from Colombo and Bombay.
16. The weather in the approach area had no direct influence on the accident, since the weather was similar to that which the pilots would normally expect and in which they should have been able to operate. On the other hand the weather was a factor in the chain of circumstances and this together with the fact that it was dark added to the circumstances necessary for the accident to have occurred.
17. NB 296 drifted 80-90 n.m. north of the planned route R. 19. With the weather information available the crew should have foreseen a larger wind drift correction than that used on the flight plan and together with a better use of the navigational

26. The actual area has only partly been covered by clouds which meant that the crew was able to get contact with the ground. During this time the villages mentioned in 25. have probably been taken for Dubai.

27. Without having determined his position definitely descent was continued through Minimum Flight Altitude (4400 ft.) and through the cleared altitude of 2000 ft. down to 1800 ft. which was reached after a gradual change to level flight.
By this time speed had been reduced to 200 kts. and the coastline was passed just south of the towns of Kalba, Ghurayfah and Fujayrah. After crossing the coastline the aircraft descended to 1420 ft. and the speed was reduced to 155 kts. During the last minute of the flight (that is approximately 1 min. 30 sec. after passing the coastline) speed increased to 190 kts. IAS and the aircraft climbed to 1600 ft.
This last manoeuvre could indicate an overshoot, but could equally well be a wish to return to 2000 ft.

28. The warning system of the radio altimeter has not been used so that it was capable of giving a warning in the prevailing circumstances.

2.2.2. <u>The reason for the accident.</u>

The reason for the accident was that the aircraft was flown below the prescribed minimum altitude, probably because:

1. The pilots thought that they were closer to their destination than they actually were, supposedly due to the incorrect information on the outdated flight plan in use or due to a misreading of the weather radar, or a combination of both.
2. The pilots thought they had their position confirmed when they got visual contact with the towns of Fujayrah, Ghurayfah and Kalba, mistaking these for Dubai.

come under the jurisdiction of the chief pilot who is responsible to the authorities for the carrying out of the operations in accordance with the given regulations.

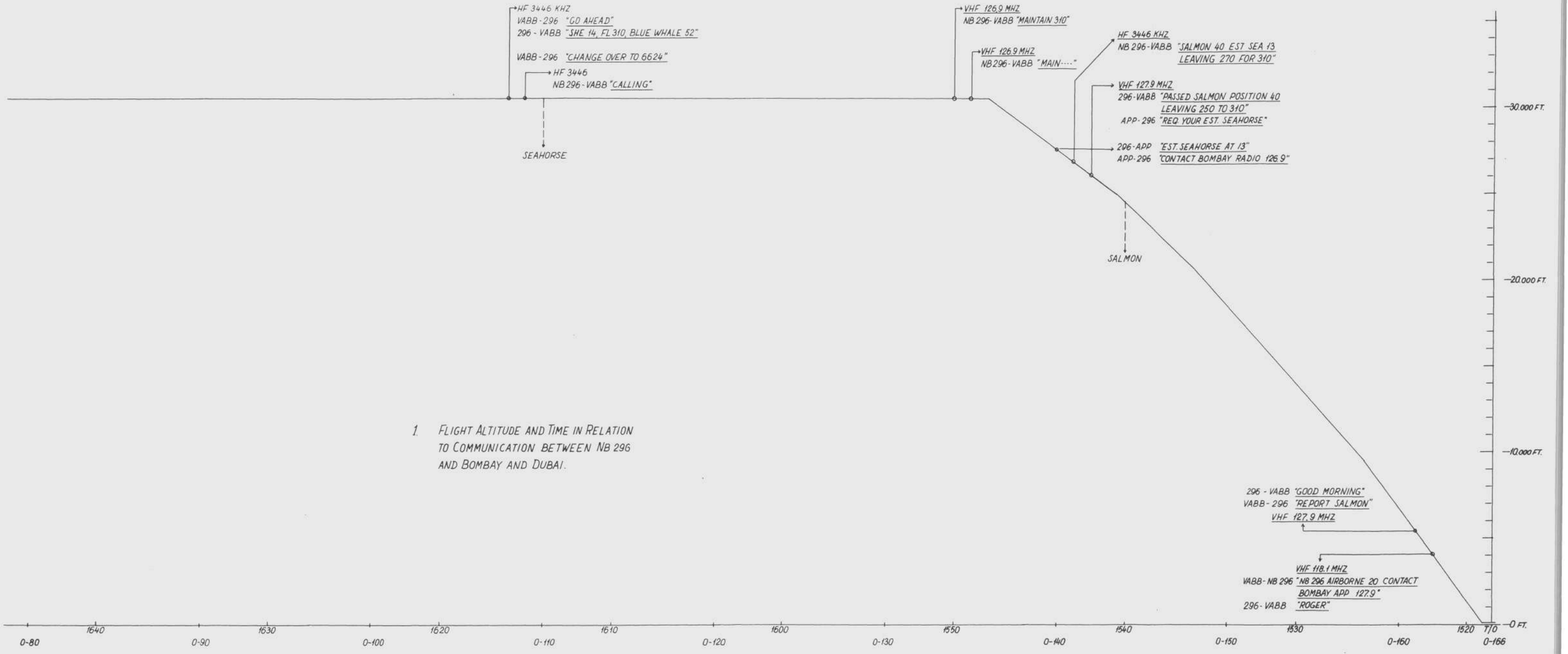
3.7. It appears that the company used fuel consumption tables based on their own experience. This has caused the Directorate of Civil Aviation to investigate the criteria used by other Danish companies in the calculation of their flight plans. With one exception all companies used only the performance data recommended by the aircraft manufacturer.
The company mentioned uses a fully acceptable method based on EDP.
It is recommended that the authorities produce rules stipulating when it is permitted to use other criteria for calculation of the flight plans than those produced by the manufacturer.

3.8. It is recommended that the procedures for the production and use of pre-calculated flight plans is such as to give the greatest possible guarantee that the flight plan will contain the latest essential information before starting a flight.
This can be done for instance by:
a) accurate dating and an indication of which previous flight plans are no longer valid, b) lists of the latest issued flight plans, c) collecting all relevant flight plans only where autorized before each flight, and by the destruction of unused flight plans when the flight is completed, d) annulment of the remaining flight plans as soon as essential changes are made, even if a new edition has not been produced.
It is also recommended that, on those flight plans or route charts used on routes requiring more than the normal degree of pilot navigation, space should be made available for a form of NAV log so that it is apparent how the actual navigation has been made.

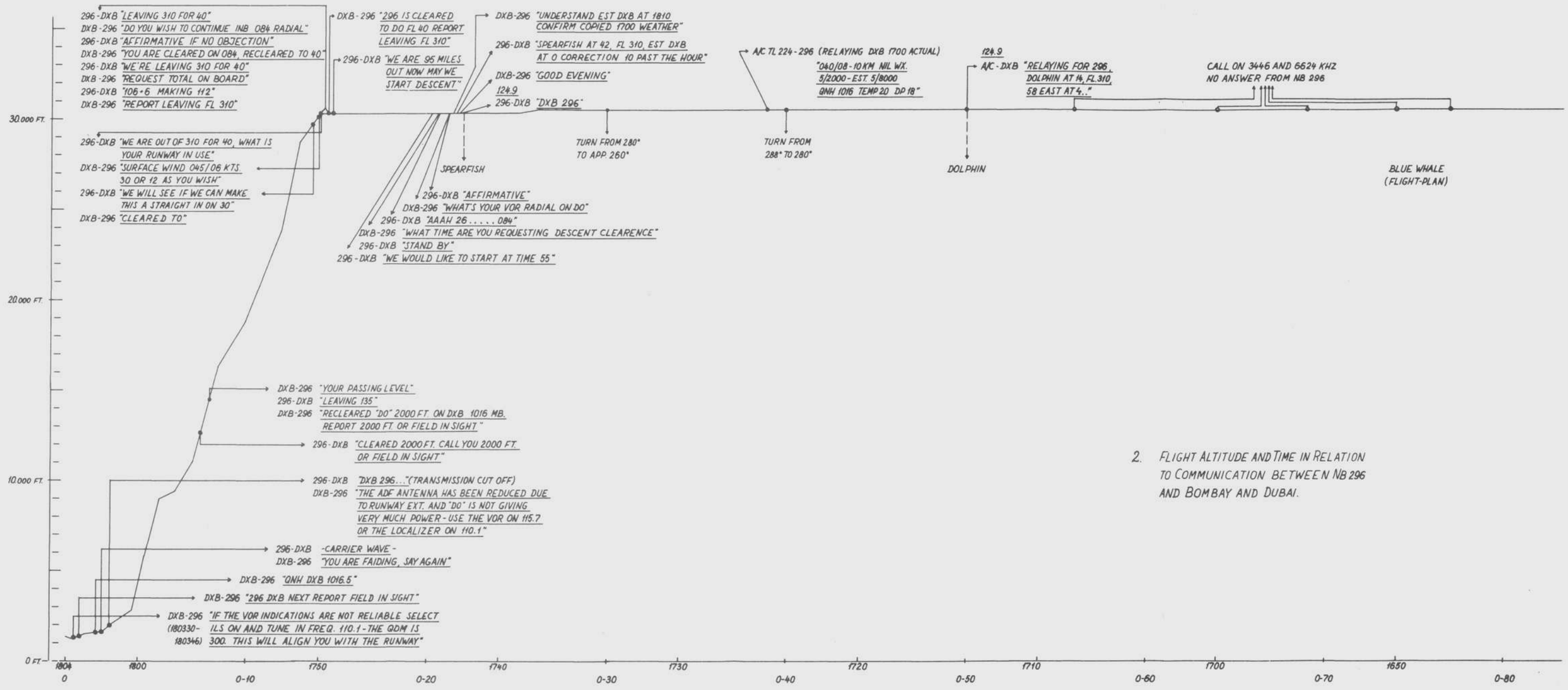
3.9. It is recommended that when companies calibrate flight recorders the results shall be recorded and filed. This would make possible a more accurate read-out.
Flight recorder cases are painted orange to make them easier to find.
At the accident of OY-STL the flight recorder case was broken and the tape cassette was thrown clear of the case.
It is recommended that the recorder cassette is also painted in an easily distinguishable colour.

above mentioned resolutions be made ICAO standards and be so formulated that ATC can never give a clearance to an altitude lower than the minimum safety altitude pertaining to the route sector in which the aircraft is flying, unless the aircraft's position is positively determined by means of radio navigation equipment or its equivalent.

The Directorate of Civil Aviation Denmark November 1973.



1. FLIGHT ALTITUDE AND TIME IN RELATION TO COMMUNICATION BETWEEN NB 296 AND BOMBAY AND DUBAI.



2. FLIGHT ALTITUDE AND TIME IN RELATION TO COMMUNICATION BETWEEN NB 296 AND BOMBAY AND DUBAI.

APPENDIX B

Tape transcript

carried out by Mr. K. Gopal, Senior Air Safety Officer, Civil Aviation Department, Government of India, Bombay, of Channel 118.1 MHZ regarding flight NB 296 from Bombay to Dubai on 14.3.1972.

Time (GMT)	From	To	Text
1506	296	TWR	Bombay Sterling 296 start up clearance?
	TWR	296	Standby one please.
	TWR	296	Sterling 296, we have'nt received your general declaration yet.

	TWR	296	Sterling 296, we have not received general declaration yet.

07	TWR	296	296, we have'nt received your general declaration yet.
	296	TWR	Bombay Sterling 296.
	TWR	296	Sterling 296, we have'nt received your customs clearance yet.
	296	TWR	We have a copy also on to the aircraft telling the clearance should be OK. Will you please check up?
	TWR	296	We are supposed to get a copy of it, I think we have'nt received it yet.
	296	TWR	OK and they should have delivered one copy to you.
11	296	TWR	Bombay Sterling 296.
	TWR	296	Standby sir, I have'nt received the clearance yet.
	296	TWR	We have just been in contact with the Air India and they say they have delivered the clearance.
	TWR	296	OK, we are just receiving it, you are cleared to start.
12	TWR	296	Sterling 296 RWY 27 wind 230°/8K Temp.29 QNH 1011.5 mbs.
	296	TWR	Roger.
14	296	TWR	296 RQ taxi clearance?
	TWR	296	Sterling 296, turn left and taxi round the CL-44 on your left for RWY 27.
15	TWR	296	Sterling 296, hold your position there a minute please till arriving caravelle clears the RWY.
	296	TWR	Roger, we are holding.
16	TWR	296	Sterling 296 cleared to enter runway, runway is clear, other caravelle is on the taxiway.
	296	TWR	Roger cleared to enter and back track.
18	TWR	296	296 ATC clearance.
	296	TWR	Go-ahead.
	TWR	296	ATC clears Sterling 296 to Dubai via Red-19 to cruise FL 310, after take off straight ahead to 1500 ft. right turn climb on track.

continue-

continued

Tape transcript

Time (GMT)	From	To	Text
18	296	TWR	Roger, cleared to Dubai, Red-19, level 310, straight ahead to 1500' then right turn and climb on track.
	TWR	296	That is affirmative.
1519	TWR	296	Sterling 296 is cleared for take off.
	296	TWR	Roger, cleared for take off.
22	TWR	296	296 airborne at 20 contact Bombay Approach 127.9.
	296	TWR	Roger will do.
			Channel 127.9 MHZ.
1523	296	APP	Bombay Sterling 296 good morning.
	APP	296	296, report Solman.
	296	APP	296 Roger.
42	296	APP	Bombay Sterling 296, passed Solman position 40 leaving 250 to 310.
	APP	296	REQ your estimate Seahorse?
	296	APP	Standby.
44	296	APP	Estimating Seahorse at 13.
	APP	296	Roger, contact Bombay Radio on 126.9.
	296	APP	Roger 126.9.

- -

En route VHF RTF 126.9 MHZ on 14.3.1972.

Time (GMT)	From	To	Text
1549	AIR INDIA	VABB	Calling NB 296
	AIR INDIA	VABB	184 on 126.9 MHZ
	NB 296		Main .....
	AIR INDIA 184		On 126.9 MHZ
1550	STERLING 296	VABB	Maintaining 310.
1551/59			(No reply from VABB - TX not modulating - TX checking)

- -

En route HF RTF 3446 KHZ on 14.3.1972.

1543	VABB	NB 296	Go ahead - SELCALLS
	NB 296	VABB	VABB Go ahead
	NB Sterling 296		Salmon 40 EST SHE 13 Leaving 270 for 310
	VABB	NB 296	Repeated
1544	NB 296		This is correct
1615	296	VABB	Calling

continue-

continued Tape transcript

Time (GMT)	From	To	Text
1616	VABB	296	Go ahead
	296		SHE 14 FL 310 BLUE WHALE 52
	VABB	296	Say again
	296	VABB	SHE 14 310 BLW 52
	VABB	296	CFM SHE 14 310 BLW 52
	296	VABB	That is correct
	VABB	296	Change over to 6624
	VABB	296	CALLS/SELCALLS (NO ANSWER)

- -

SELCALLS GIVEN TO NB 296 ON .....

3446 KHZ	6624 KHZ
1647	1650
1650	1700
1655	1708

No answer from NB 296.

- -

Tape transcript on 3.4 on 14.3.1972.

1726	VABB	OPKC	On 3.4
	OPKC		Go ahead
	VABB	OPKC	Can you raise Bahrain and Request position on NB 296 Sterling 296 GLBC departed Bombay to Dubai
	OPKC	VABB	PSE stand B1
	VABB		Go ahead
	OPKC		Did you copy
	VABB		Negative
	OPKC		DOLPHIN 1714 in contact with Dubai NB 296 DPH 1714 in contact with Dubai
	VABB	OPKC	What is the reporting position 1714
	OPKC		DOLPHIN, BOMBAY/BAHRAIN FIR Delta papa hotel
	VABB	OPKC	Thank you DOLPHIN 1714 in contact with Dubai.

- -

For afskriftens rigtighed

H Paulsen

assistent

Tape transcript

Date: 14th March 1972.

Time: 1713-1820 GMT.

Frequencies: 124.90 and 118.30 mc.

Dubai - NB296.

124.90 mc

1713	224	Dubai this is two two four are you calling
	dub	..... two two four Dubai negative call
1714	224	.....
	224	aircraft calling two two four you are coming in rather distorted say again
	224	Dubai ..... two two four is relaying for sterling two nine six he has Dolphin at one four level three one zero estimating fiftyeight east at four two
	dub	oscar maxfeldt two two four Dubai copied I request sterling two nine six to call you at five eight east
	224	sterling two nine six this is two two four Dubai copied O K and he has no information about you what is your destination
	224	sterling two nine six this is two two four
	dub	two two four Dubai ..... he is coming from Bombay to Dubai
	224	O K sir .....
	dub	O K thank you
	224	copied O K sir
	dub	thank you
1715	224	Dubai kilo lima two two four ..... maintaining one four zero
	dub	two two four
1725	dub	sterling two nine six Dubai how do you read now
	224	sterling two nine six this is kilo lima two two four
	224	Dubai ask you to listen in he is calling you
	224	Dubai sterling two nine six is not reading you
1726	dub	roger and are you ready to give him the weather please
	224	go ahead
	dub	zero four zero diagonal zero eight ten kilometres no weather five at two thousand estimated five at eight thousand estimated Q N H one zero one six millibars temperature two zero the dew point one eight
	224	sterling two nine six this is ..... two two four relaying Dubai actual the wind zero four zero at zero eight knots visibility ten kilometres the weather no five eights estimated two thousand feet and five eights eight thousand feet altimeter one zero one six temperature two zero dew point one eight

Underlined text means: Interpretation doubtful

..... means: Interpretation impossible

1727	224	Dubai sterling two nine six copied O K
	dub	turn right before zero eight
	g337	Dubai this is golf three three seven we copied the weather also one zero one six we are coming to seven zero estimating you four nine
	dub	three three seven call again when ready for descent
	337	three seven thank you
1731	337	Dubai three three seven is level seven zero
	dub	three three seven
1734	dub	three three seven Dubai the surface wind is at present zero six zero eight knots but call on final runway one two
1735	dub	golf three three seven Dubai surface wind zero six zero at eight knots call final runway one two
	dub	kilo lima two two four Dubai
	224	two four
	dub	roger ..... Bahrain ..... call at one two six decimal seven at position quebec if no contact return to this frequency
	224	..... estimating that position at three seven
	dub	roger roger
1736	dub	golf three three seven Dubai
	337	roger three seven
	dub	surface wind is now zero six zero at eight knots landing runway one two at what time further descent
	337	descent at four two please
1737	dub	roger then you will be recleared to the delta oscar at two thousand check Dubai Q N H one zero one six millibars report leaving seven zero
	337	I will call you in seven zero two thousand one zero one six thank you
	224	Dubai kilo lima two two four
	dub	kilo lima two two four Dubai here
	224	we are in contact now with Bahrain we checked quebec at three six estimating ..... at zero one past the hour
	dub	roger two two four continue to Bahrain good night and thank you for co-operating
	224	roger thank you sir good night
1739	337	Dubai three three seven is leaving seven zero this time three nine
	dub	golf three three seven report two thousand and our field in sigt

Underlined text means: Interpretation doubtful
..... means: Interpretation impossible

1739	337	three three seven roger
1742.16	nb296	Dubai sterling two nine six
1742.19	dub	sterling two nine six Dubai good evening sir
1742.22	nb296	Spearfish four two flight level three one zero we will be estimate Dubai at zero correction one zero past the hour
1742.36	dub	roger roger understand estimate Dubai at one eight one zero and confirm you copied the seventeen hundred weather
1742.42	nb296	that's affirmative
1742.45	dub	sterling two nine six Dubai what is your V O R radial on the Delta Oscar
1742.49	nb296	ah two six ah it is zero eight four
1743.00	dub	that is correct
	dub	three seven Dubai do you have the field in sight
	337	three three seven we have the general area in sight we can't pick up the localizer
1743.18	dub	sterling two nine six Dubai at what time are you requesting descent clearance
1743.24	nb296	.....
	337	three three seven we have the runway lights in sight now
	dub	three three seven is cleared to final ..... approach to land the surface wind zero six zero at eight knots and negative traffic on the one two approach
	337	three three seven roger
1743.42	nb296	sterling two nine six Dubai request descent at five five
1743.47	dub	roger two nine six
	337	three three seven on final
	dub	roger cleared to land zero six zero eight knots
1743	337	O K sir
1745	dub	three seven correct wind check to zero five zero and six knots and we have ten thousand and seven hundred fifty kilos .....
	337	O K sir thank you
1747	dub	three three seven landed four seven turn right .....
	337	very well sir
	337	do you have any Muscat weather or information of that kind up there go
	dub	not at the moment
	dub	..... the Muscat weather ..... after he stay up in the morning which is ..... between five and six A M

Underlined text means: Interpretation doubtful
..... means: Interpretation impossible

1747	337	thank you
	dub	..... tomorrow
	337	that's another crew but .....
	dub	I am sorry there is no ..... the Muscat weather
	337	do you have to start this it has been rather bad to-day for some reason is that correct
	dub	we had to carry on at about between six and eight local time here and ..... about three six thousand ah I can't help you .....
1749	337	about six to eight this morning roger
	dub	six to eight this morning we got a great deal in
	337	ah roger ..... are not better good luck
	dub	.....
	337	O K thank you
1749.16	nb296	Dubai sterling two nine six
1749.19	dub	two nine six Dubai
1749.21	nb296	we are nine five miles out may we start descent
1749.25	dub	roger sterling two nine six you are cleared to delta oscar at flight level four zero report leaving flight level three one zero
1749.30	nb296	leaving three one zero this time for four zero
1749.34	dub	roger two nine six do you wish to continue inbound on the zero eight four radial
1749.39	nb296	affirmative no objection from you
1749.42	dub	you are cleared to continue on the zero eight four you are recleared in at flight level four zero
1749.46	nb296	roger continue descending to four zero
1749.49	dub	two nine six request the total on board
1749.53	nb296	hundred and six we are six crew that makes hundred and twelve
1749.57	dub	roger thank you report leaving flight level three one zero
1750.05	nb296	we are out of three one zero what is the runway in use
1750.09	dub	roger at the moment the surface wind is zero four five at six knots three zero or one two as you wish
1750.15	nb296	thank you very much
1750.24	nb296	we will see if we can be able to make a straight in runway three zero
1750.28	dub	roger roger cleared to
1750.30	nb296	thank you

Underlined text means: Interpretation doubtful
..... means: Interpretation impossible

1756.03	dub	sterling two nine six Dubai your present level
1756.07	nb296	we got one three five sterling two nine six
1756.09	dub	roger two nine six recleared at delta oscar two thousand on Dubai Q N H one zero one six millibars to report two thousand or field in sight
1756.17	nb296	roger cleared two thousand call you two thousand or field in sight one zero one six
1801.31	nb296	Dubai two nine six (transmission cut off)
1801.36	dub	the ADF aerial had to be reduced in length because of the runway extension and therefore is not giving so much power which just tune in the V O R on one one five decimal seven or use the I L S localizer one one zero decimal one
1801.55	??	thank you
1802.04	dub	two nine six Dubai you are fading say again please
1802.12	dub	two nine six Dubai Q N H Dubai one zero one six decimal five
1803.15	dub	two nine six next report field in sight
1803.30	dub	ah two nine six Dubai if the V O R indications are not reliable select I L S ..... and tune the frequency one one zero decimal one the Q D M is three zero zero this will aligne you with the runway
1808	dub	sterling two nine six Dubai how do you read me
	dub	sterling two nine six Dubai if you are reading me suggest you try your number one V H F your number two or the box you are using appears to be unserviceable
1809	dub	sterling two nine six this is Dubai transmitting blind if you see the runway you are cleared to land
1810	dub	sterling two nine six Dubai how do you read
	dub	sterling two nine six Dubai how do you read
1811	dub	sterling two nine six Dubai if you read me and you see the airfield you are cleared for a visual approach
1815	dub	sterling two nine six Dubai do you read
1817	dub	sterling two nine six this is Dubai if you are reading me and if you can see the runway you are cleared to land
1819	dub	sterling two nine six Dubai if you read me when you can see Dubai you will be cleared to land no reported traffic

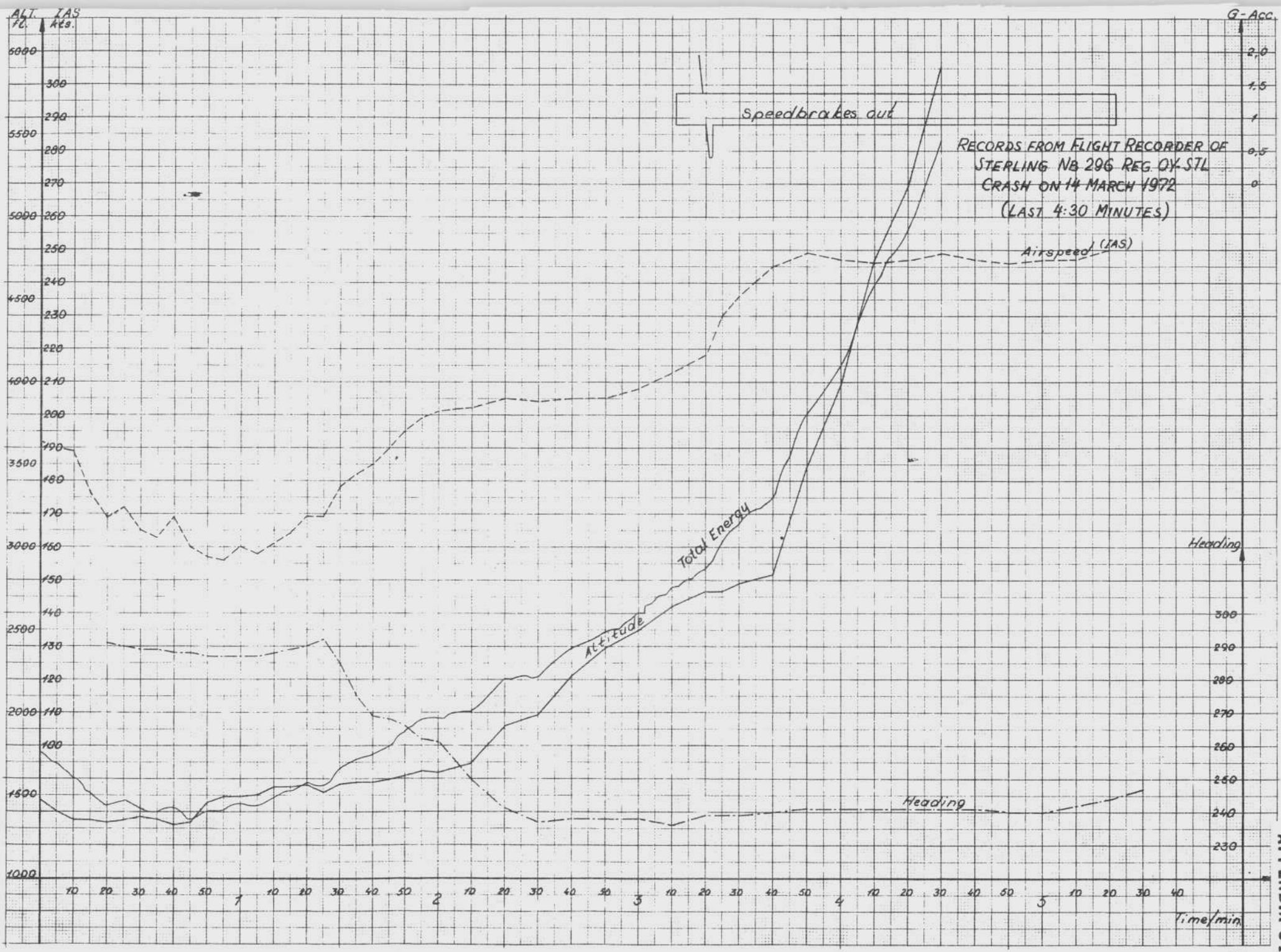
Underlined text means: Interpretation doubtful

..... means: Interpretation impossible

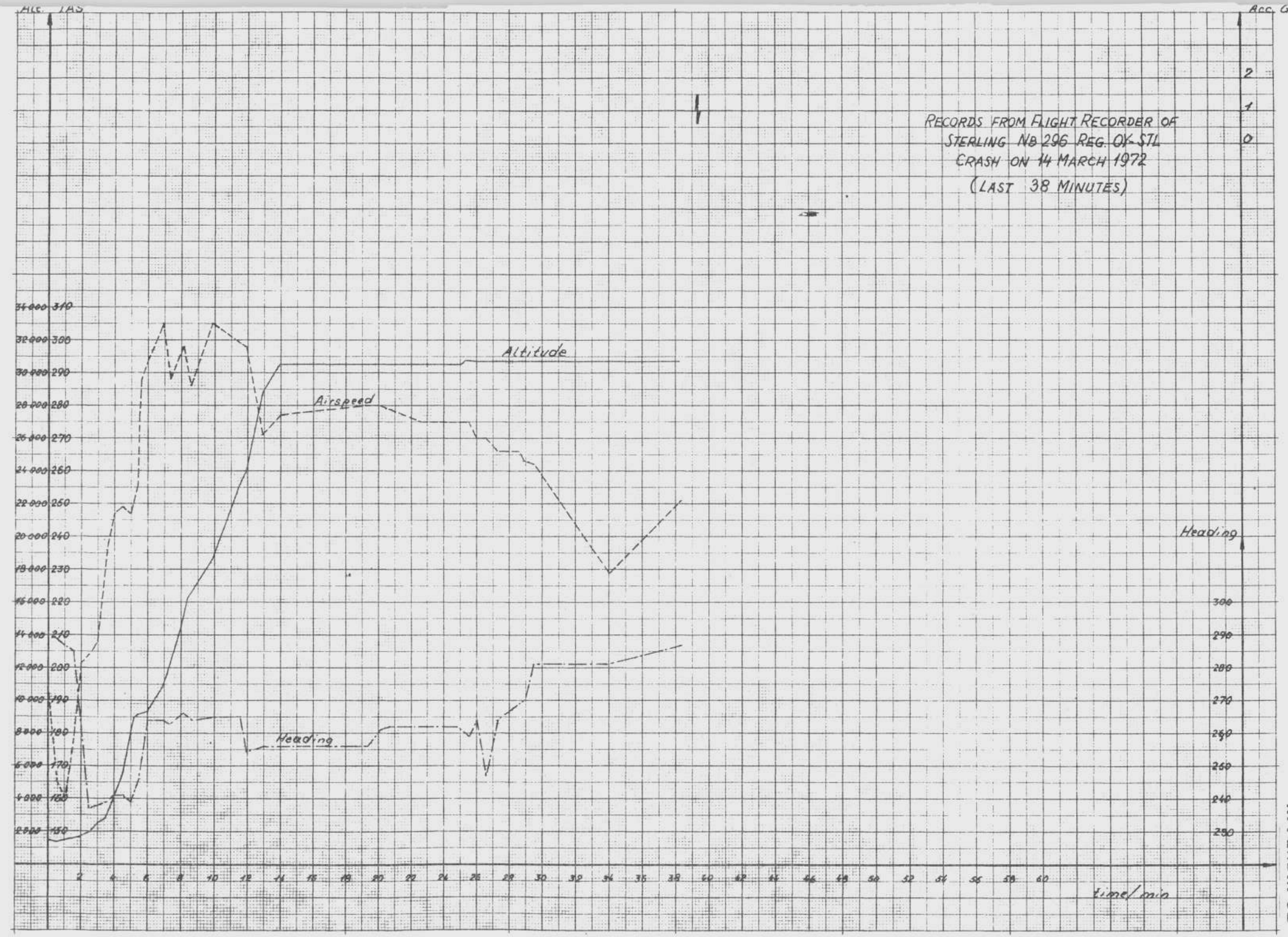
118.30 mc

1811	dub	sterling two nine six Dubai on one one eight three do you read
1812		
1813		
1814		
1815	dub	sterling two nine six Dubai do you read
1816		
1817	dub	sterling two nine six this is Dubai if you are reading me and if you can see Dubai you are cleared to land
1818		
1819		
1820	dub	sterling two nine six this is Dubai if you read me when you can see the runway you will be cleared to land as no other reported traffic

For afskriftens rigtighed
H. Paulsen
assistent


ALT. ft.
IAS kts.
G-Acc.
Speedbrakes out
RECORDS FROM FLIGHT RECORDER OF STERLING NB 296 REG. OY-STL
CRASH ON 14 MARCH 1972
(LAST 4:30 MINUTES)
Airspeed (IAS)
Total Energy
Attitude
Heading
Heading
Time/min
1
2
3
4
5

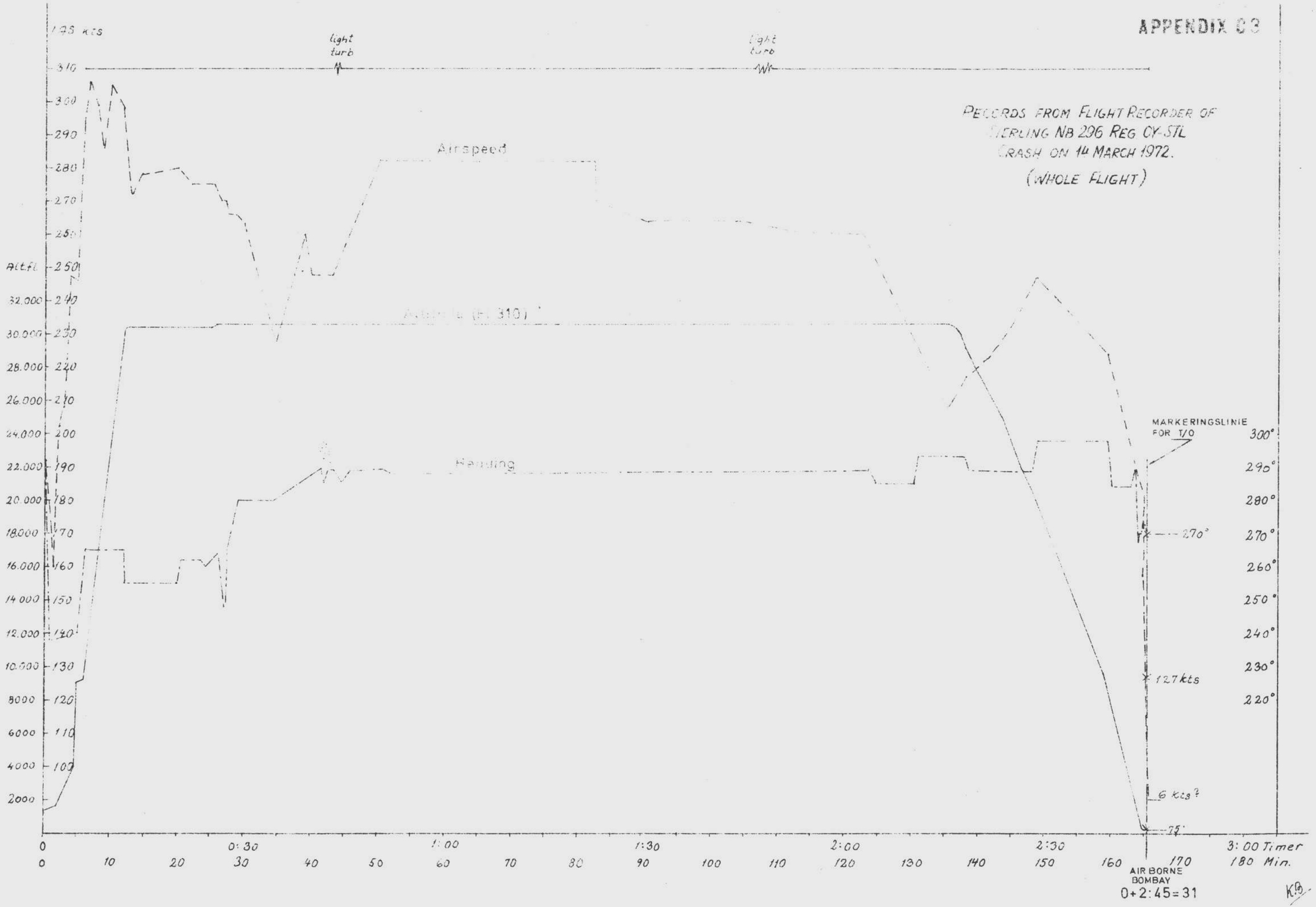
APPENDIX C1


Alt. IAS
Acc. G.
RECORDS FROM FLIGHT RECORDER OF
STERLING NB 296 REG. OK-STL
CRASH ON 14 MARCH 1972
(LAST 38 MINUTES)
Altitude
Airspeed
Heading
Heading
time/min

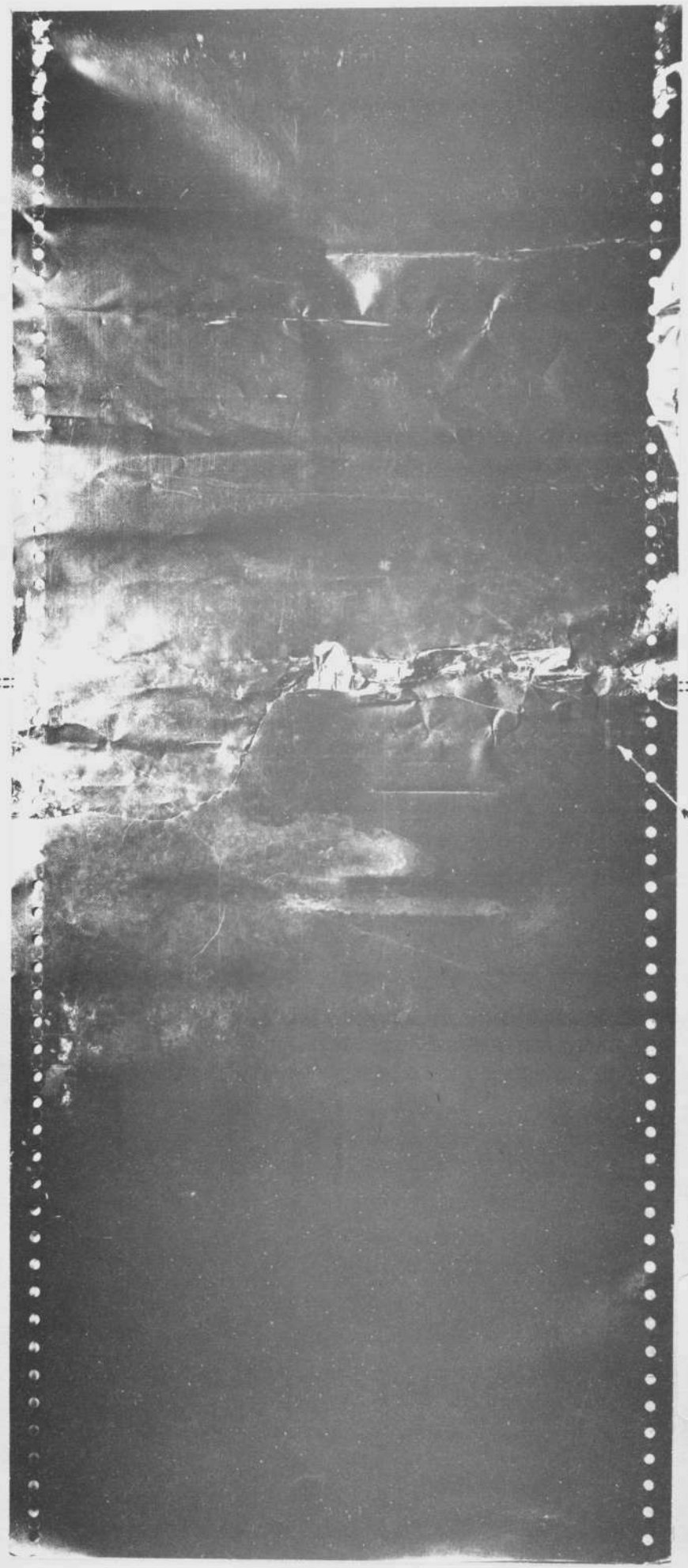
APPENDIX C2

APPENDIX C 3

RECORDS FROM FLIGHT RECORDER OF
STERLING NB 296 REG OY-STL
CRASH ON 14 MARCH 1972.
(WHOLE FLIGHT)



APPENDIX C4



STERLING NB 296
ACCIDENT
14TH OF MARCH 1972

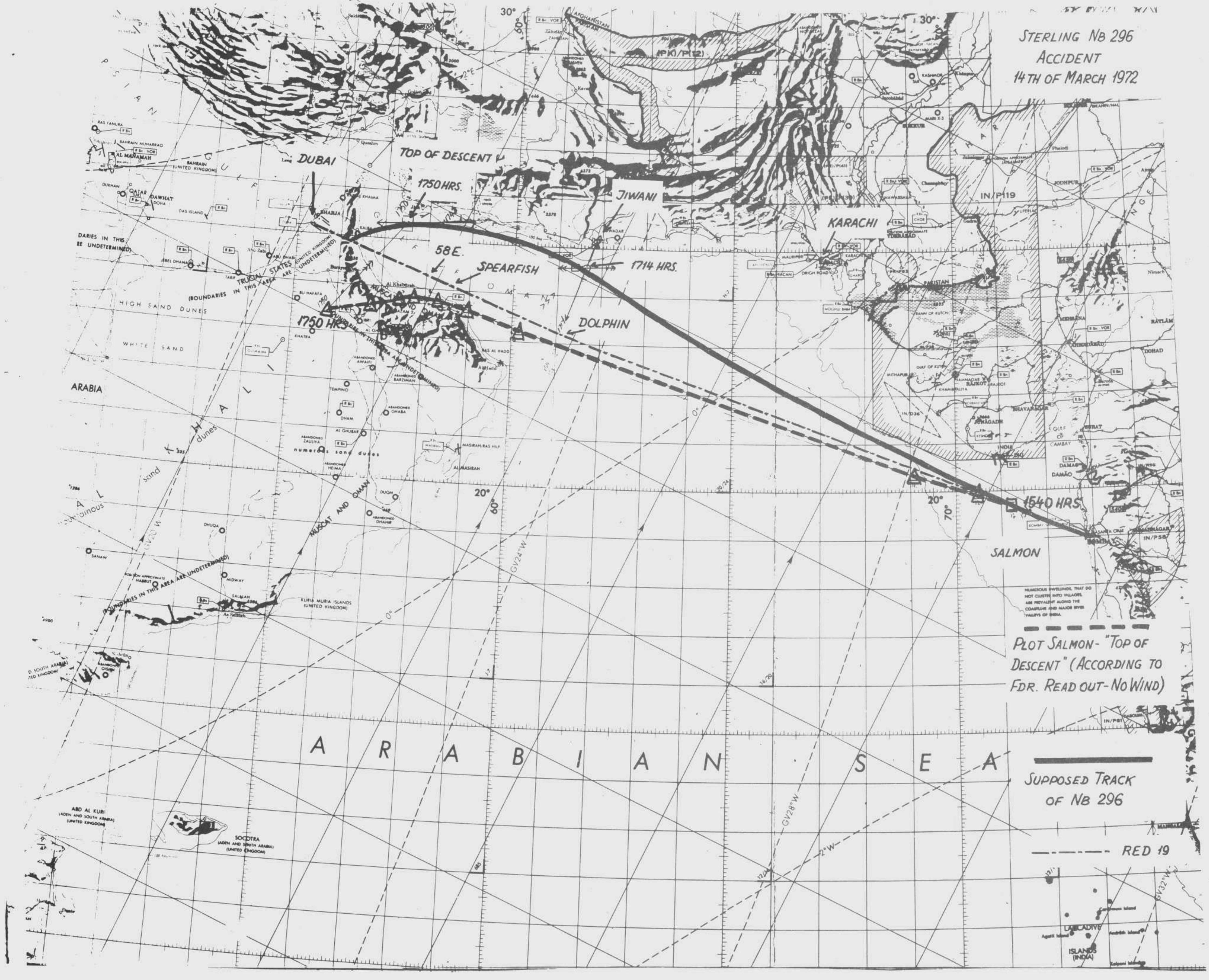
POSITION OF
SCRIBER ROLLER

SPEED BRAKE.

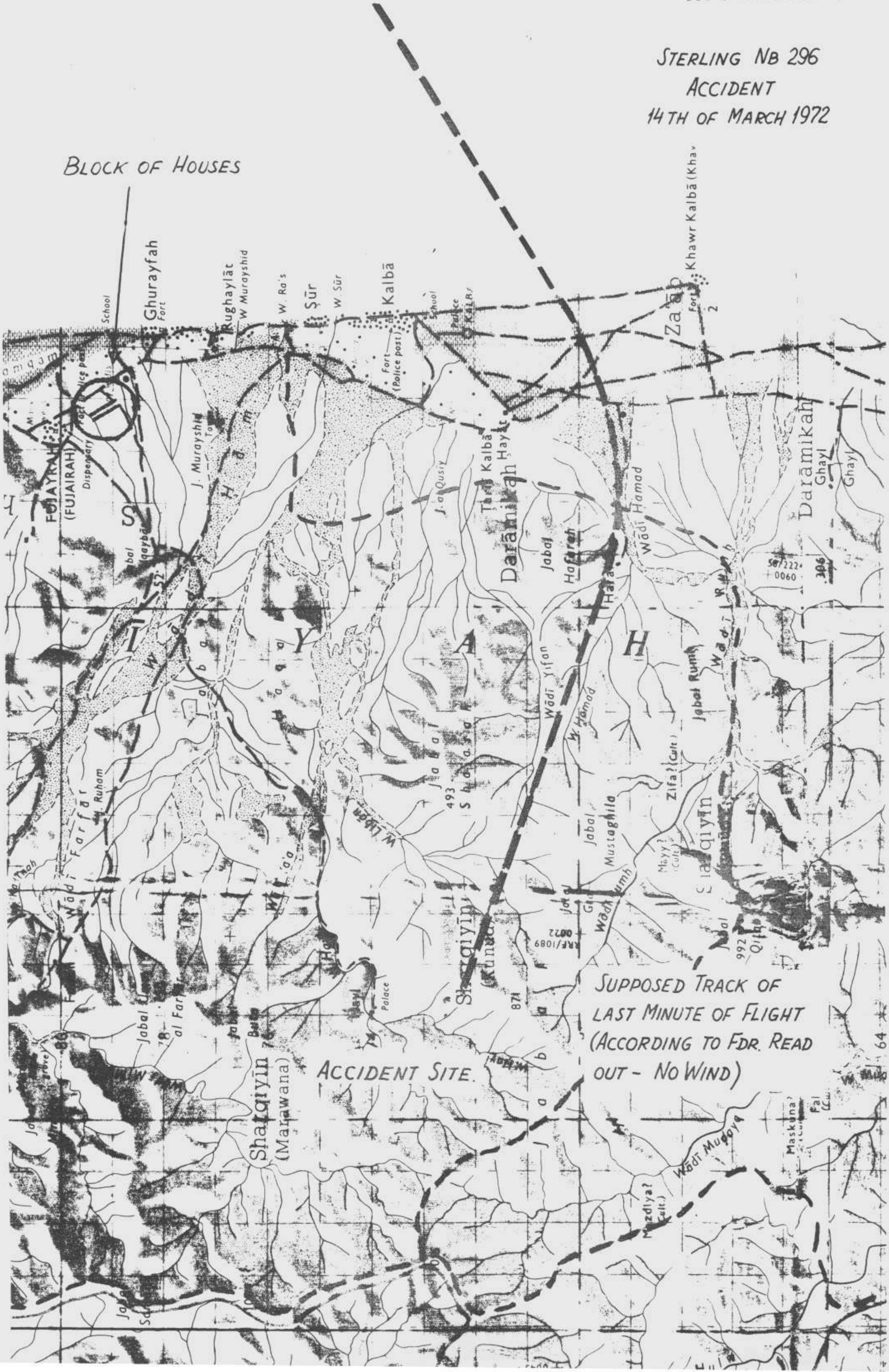
STEEL TAPE
FROM FLIGHT RECORDER
WITH DAMAGE.

APPENDIX D


JEPPESEN AIRWAY MANUAL
MIDDLE EAST
HIGH/LOW ALTITUDE EN-ROUTE
CHART. SECTION OF 3ME (H/L)
(SCALED DOWN)
ARABIAN SEA
ALL DISTANCES ARE NAUTICAL
STERLING NB 296
ACCIDENT
14TH OF MARCH 1972

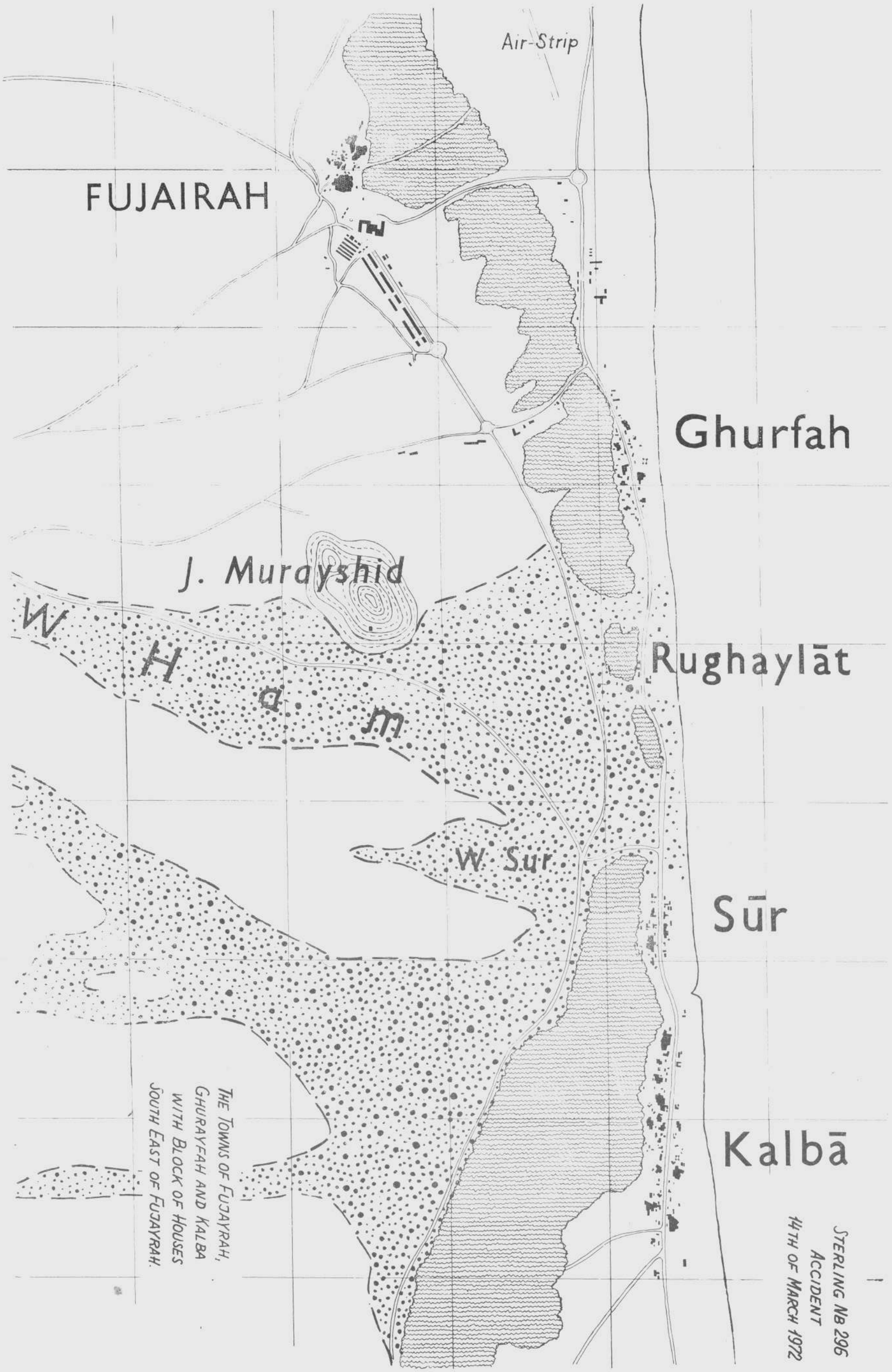

STERLING NB 296
ACCIDENT
14TH OF MARCH 1972
DUBAI
TOP OF DESCENT
1750 HRS.
JIWANI
KARACHI
58E.
SPEARFISH
1714 HRS.
1750 HRS
DOLPHIN
1540 HRS
SALMON
PLOT SALMON - "TOP OF DESCENT" (ACCORDING TO FDR. READ OUT - NO WIND)
SUPPOSED TRACK OF NB 296
RED 19
A R A B I A N S E A
ARABIA
SOCOTRA
LACCADIVE ISLANDS (INDIA)

APPENDIX F


STERLING NB 296
ACCIDENT
14TH OF MARCH 1972
BLOCK OF HOUSES
SUPPOSED TRACK OF LAST MINUTE OF FLIGHT (ACCORDING TO FDR. READ OUT - NO WIND)
ACCIDENT SITE.
Ghurayfah
Rughaylāt
Şūr
Kalbā
Khawr Kalbā
(FUJAIRAH)
Darāmikah
Shaqiyin
(Marawana)

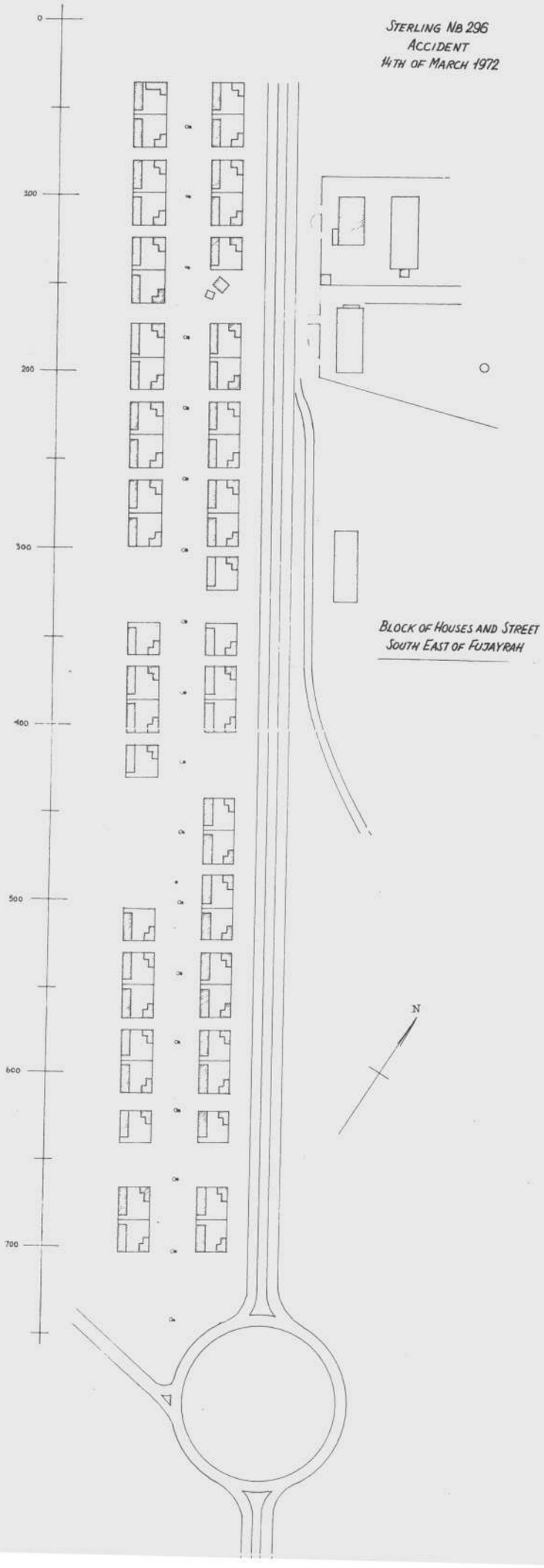
APPENDIX G

STERLING NB 296
ACCIDENT
14TH OF MARCH 1972



THE TOWNS OF FUJAYRAH,
GHURAYFAH AND KALBA
WITH BLOCK OF HOUSES
SOUTH EAST OF FUJAYRAH.

APPENDIX H



STERLING NB 296
ACCIDENT
14TH OF MARCH 1972

BLOCK OF HOUSES AND STREET
SOUTH EAST OF FUJAYRAH

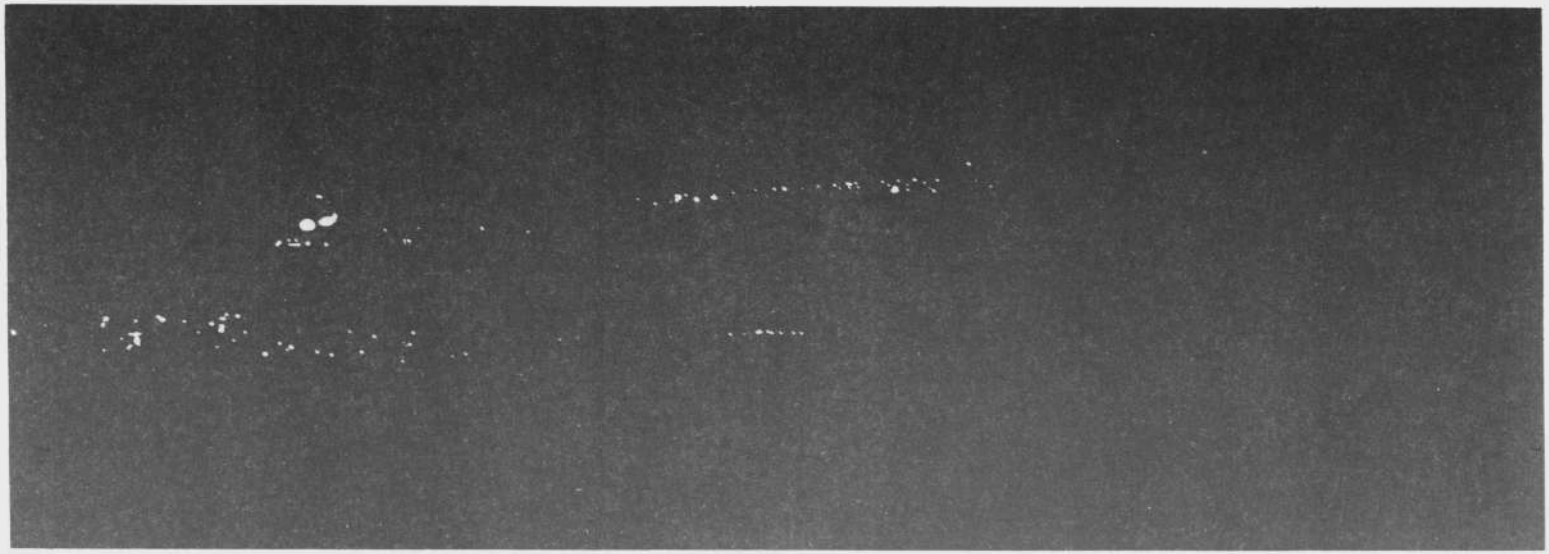


Photo of Ghurayfah and Fujayrah in a distance of approx. 3 NM altitude 3000 ft.

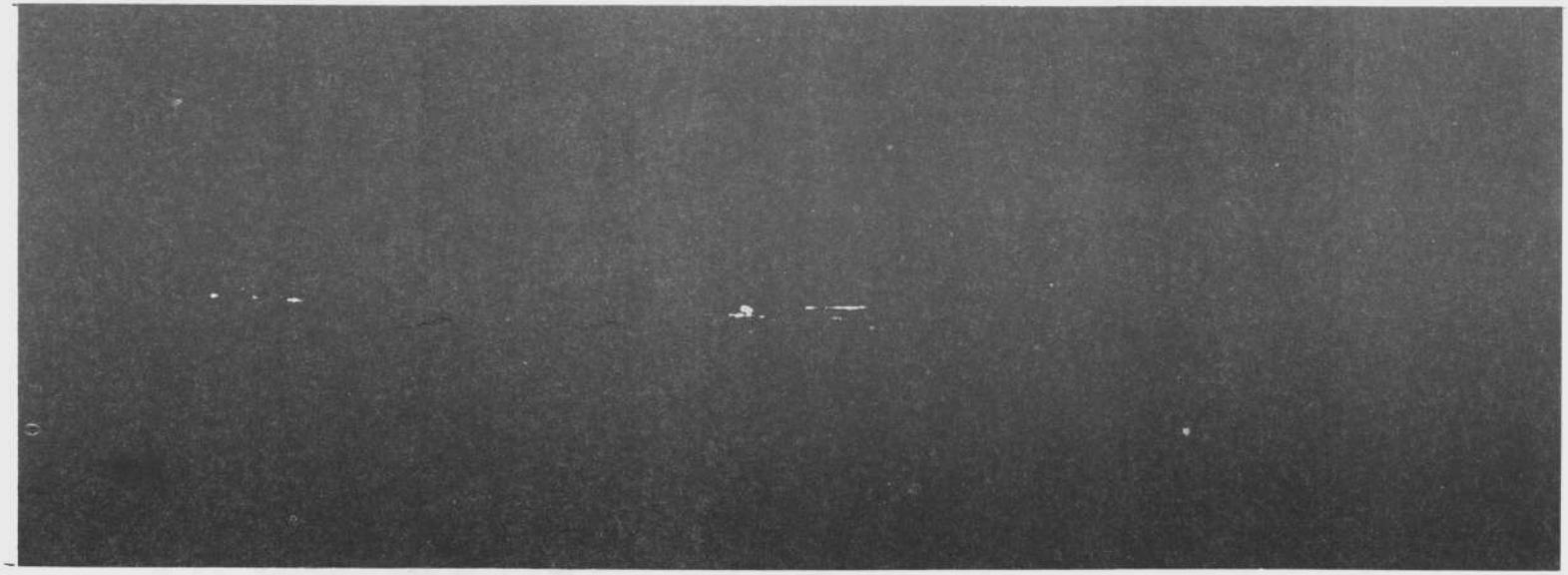
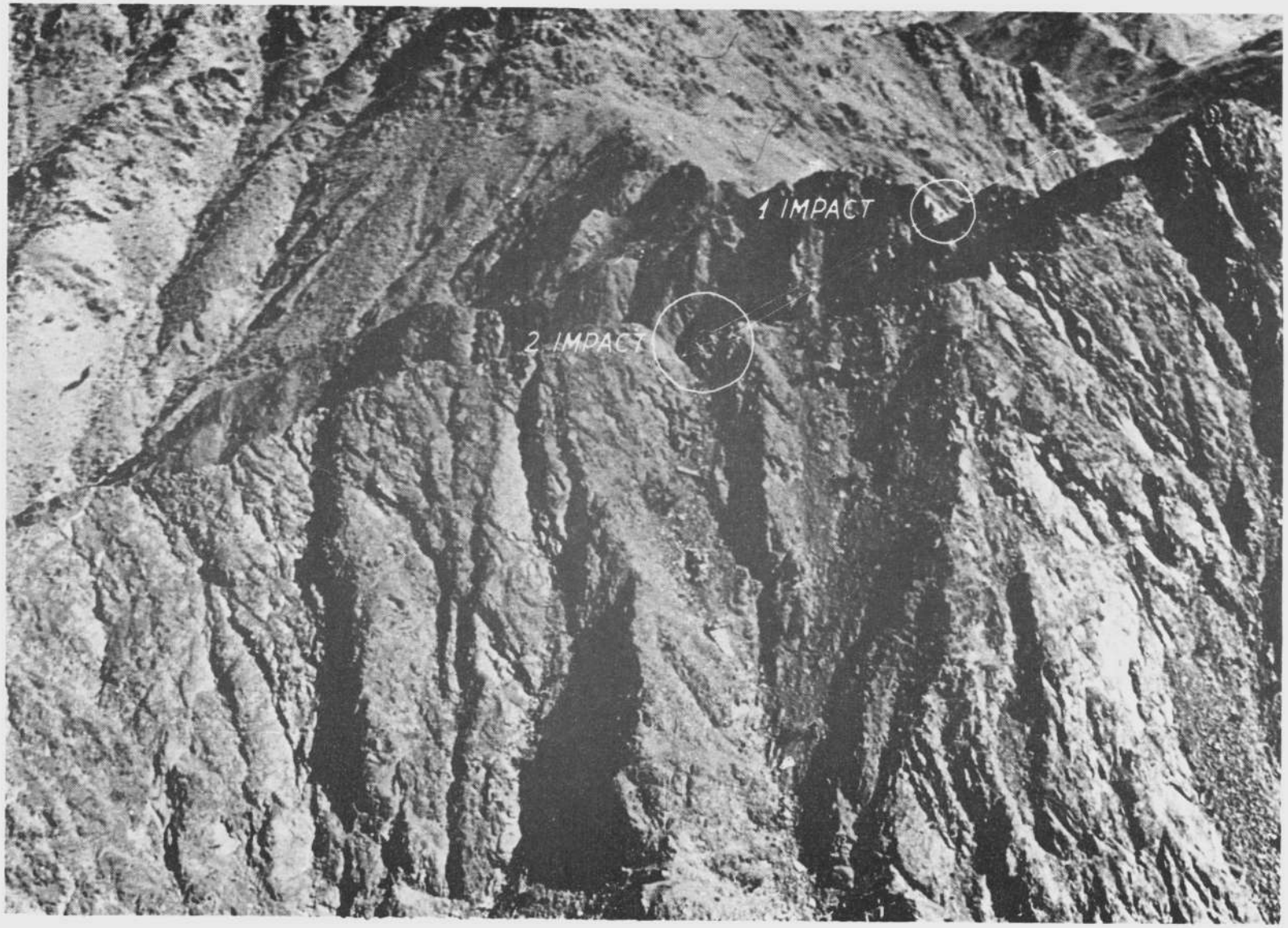


Photo of the towns Kalba, Ghurayfah and Fujayrah taken by night from east in a distance of approx. 15 NM altitude 7500 ft.



Accident site seen from west.

PICTURES AND PLOTTING.

Picture No.	Plotting No.	
1		Hayl
2		Helipad at the accident site
3		View from helicopter on the first arrival
4	A&B	A&B areas
5	A	A area
6	B	B area
7	C	C area
8	C4	View from C4 downwards in direction of the camp
9	C4	View from impact 2 to impact 1
10		View from northern side of C4 to impact 1
11	A1	RH outer wing section inverted
12	A1	"
13	A1	"
14	A1	"
15	A2	Crew O_2 bottle - outlet in direction south
16	A3	Pedestal - throttle section
17	A3	"
18	A3	"
19	A3	"
20	A3	"
21	A3	"
	A4	Front windshield panel centersection
	A5	Dynamotor for HF
22	A6	Flap vane - No. 20722 on the right endplate
	A7	Fuel tank unit capacitor gauge P/N 381063-01889 SN 1266D
	A8	Coffee heater element
23	A9	TADG spare SN 0000 125 VG 0000 285
24	A11	Flight recorder - separated
25	A11	"
26	A12	Flight recorder magazine - visible in left part of picture 24
27	A12	"
28	A13	VHF COM 618 M-2B - spare
29	A14	Slide- and side window LH side
30	A15	Airspeed indicator SN AA 8142
31	A15	"
	A16	Flight recorder front plate
32	A17	1st off. side window "D" - parts of window frames and one cabin window

Picture No.	Plotting No.	
33	A18	Fuel flow indicator
34	B1	Main battery
	B1	Crew O_2 regulator SN 2124
35	B2	Rate gyro
	B3	Cockpit window LH
36	B4	HZ 4 ball
37	B4	Sby. horizon
38	B5	Radar T/R unit
	B6	Sby. HZ (B4) frontplate
39	B7	HF unit
40	B7	AP amplifier
41	B8	TADG 0000 188 (89)
42	B9	HF unit
43	B10	Radio junction box
44	B11	Galley - brewmatic
	B11	Cabin attendants moneybox
45	B12	Turbine starter wheel
46	B12	Mach trim computer
	B13	Throttle knob and PA amplifier
47	B14	APU RPM- and EGT indicator, zero RPM - UA-6 panel
48	B15	Main battery
49	B15	VHF COM 618M-1 SN 94 co-pilot
50	B15	"
51	B15	VHF COM 618M-1 SN 3351 pos.1 capt.
52	B15	Hyd. panel UP-7
	B15	ADF control box SN 8596, HF control unit, selcall unit, water box, AWLS relay box, marker rx 51Z-4
53	B16	Engine burner section
	B16	Wheel column 40 cm. of- and MHR-4 SN 133E
54	B17	AC generator
55	B17	UC-3 panel (center panel eng. inst. etc.)
56	B17	Flap consol with screwjack (broken) SN 475
57	B17	Sby. compass
58	B17	"
59	B17	ADF receiver No. 1
60	B17	ADF receiver No. 2
	B17	ADF control box, fuel flow indicator SN DD 113 reads 4131 kg, loran ant. splitter, ADF- and radar rack
61	B18	Radio altimeter front section
62	B18	HZ4 housing(see under B4 picture 36)

Picture No.	Plotting No.	
63	B18	RH outer wing from aileron and 6m inwards. No damage from hail
64	B18	To leading edge. Traces of fire on the ground
65	B19	Aileron trim knob
66	B19	RH inner wing. Traces of fire on ground
67	B19	"
68	B19	"
69	B19	"
70	B19	"
71	B19	RH main tank fuel quantity masterindicator
72	B19	Speedbrake retracted (2 moving cylinders retracted)
73	B19	UA-2 panel AC voltm. 115V (emerg.bus?) DC loadmeter control Tr.rect. 0,5 - 50% load
74	B20	Spoiler-and wing parts. Spoilers retracted and locked
75	B21	Flap spindel broken, missing from assembly under B17
76	B21	Picture 56
77	B22	Overwing emerg.exit (big one) P/N 2102543 680 Fab. 43 03 70
78	B22	"
79	B23	The B23 area
80	B23	UP-3 panel - windshield wipers selector off
81	B23	Cabin attendants LH seat
82	B23	Turbine axle with 6th. stage bearing and turbine
83	B23	Throttle box
84	B23	Engineparts and RH main landing gear. MLG retracted, actu-
85	B23	ator fully extended, uplock hook bent in direction of flight
86	B23	MLG RH actuator cylinder
87	B23	Service door lock
88	B23	Main door and part of fuselage
89	B23	Part of flap
90	B23	Flightplan
91	B23	Jeppesen Manual
92	B23	Part of B23 area
93	B23	Center tank panel UA-5
94	B23	"
95	B23	Topfuselage viewed in direction of "C" area
96	B23	"
97	B23	"
98	B23	Bottom of "B" 23 area
	B23	RH thrust reverser, AHV-4 radio altimeter, angle of attack indicator rear section, turn and slip indicator, RMI indicator, fuel pressurising and dump valve and fuel control unit
	B24	RH altimeter scale

Picture No.	Plotting No.	
99	C1	The C1 area contains the following: LH engine and stub, RH
100	C1	stub, APU (not rotating at impact), Rudder servodyne (RH
101	C1	deflection ratio 1:2,25), elevation and rudder artificial
102	C1	feel system and
103	C1	
104	C1	artificial feel selector valve (position normal)
105	C1	"
106	C2	View from C1 to C2 area
107	C2	The C2 area contains the following: Tail section and rudder,
108	C2	RH elevator and tailplane, elevator servodyne, engine tur-
109	C2	bine parts, CSD. Elevator- surface and servodyne rods in
110	C2	neutral
111	C2	
112	C2	Elevator skin peforated by a wheel and tyre causing a fire
113	C2	supported by oxygen from 2 small bottles thrown through the
114	C2	same hole. Only the tyre steel wires were left.
115	C2	Refrigeration unit
116	C3	View from C2 to C3 area
117	C3	LH-MLG retracted. Actuator fully extended and bent. Uplock
118	C3	hook bent in direction of flight
119	C3	"
120	C4	View from C3 to C4 area
121	C4	The C4 area contains the following: LH elevator, LH reverser
122	C4	flap console and spindle with Hobson gear SN 375 L 96
123	C4	Flaps retracted
124	C4	
125	C4	
126	C4	
127	C4	
128	C5	LH tailplane
129	C5	C5 area
130	C5	Wing junction fitting
131	C6	Refrigeration unit
132	C7	LH and RH fuselage sections
133	C8	Fuselage topsections with dorsal fin. Traces of fire
134	C9	Topsection with dorsal fin
135	C10	Fuselage side and top
136	C11	Overwing exit small
137	C12	Maindoor

Picture No.	Plotting No.	
138	C12	Maindoor
139	C12	"
140	C13	Wing junction fitting
141	C13	Wing junction fitting
142	C14	Central wing section
143	C15	Wheel brake
144	C16	Burner section
145		Flying the approach to the scene at about double altitude
146		"
147		"
148		View from impact I to inpact II
	D1	Part of left inner aileron
	D2	Flap vane
	D3	Fueltank skin
	D4	LH spoiler
	D5	Fuselage lower part near cabin heater ground connection and LH innerwing
	D6	Inner part of LH outer flap and flap interconnection rod
	D7	Fueltank skin and speed brake
	D8	Fueltank skin
	D9	Stairway forward part
	D10	Speed brake
149	E	The scene of first impact. Principal parts: LH outer aile-
150	E	ron and outer trailing edge. LH outer wing with a large piece of fuel skin
151		The road to Hayl
152		"
153		Fujayrah.

For afskriftens rigtighed
H Pallesen
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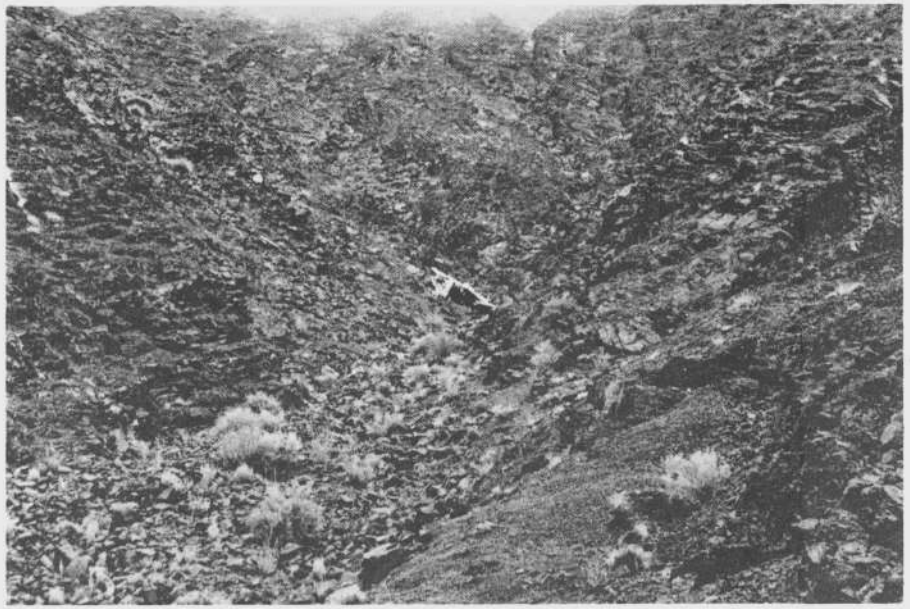

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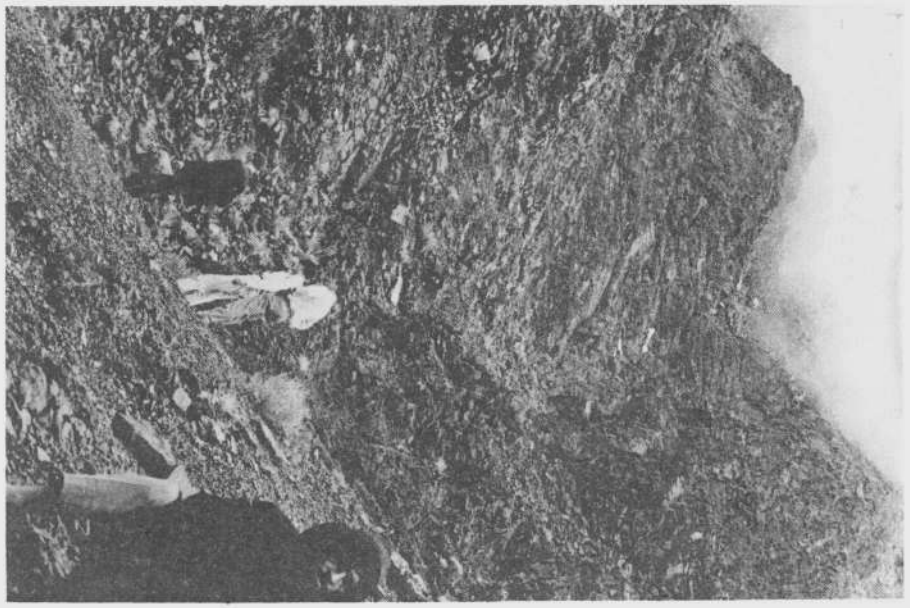

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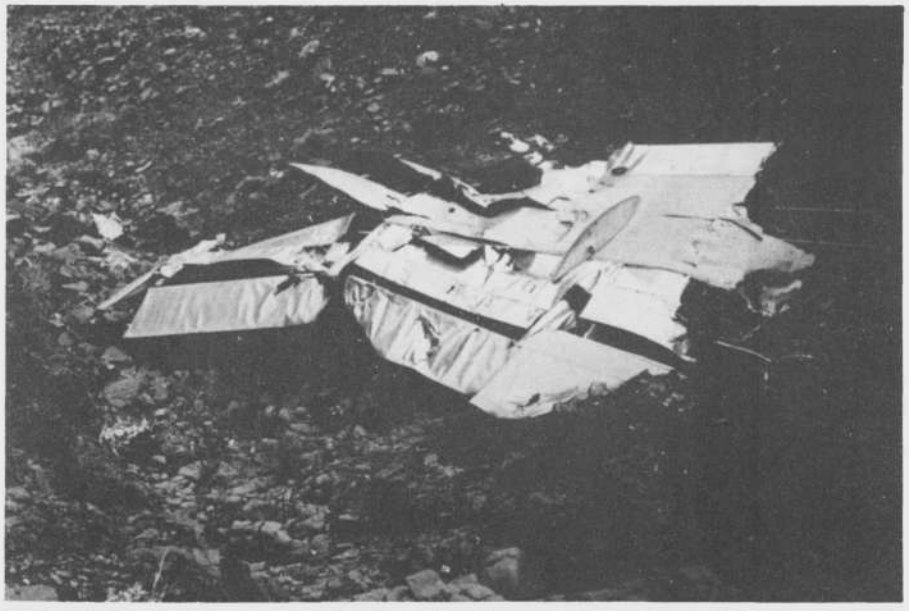

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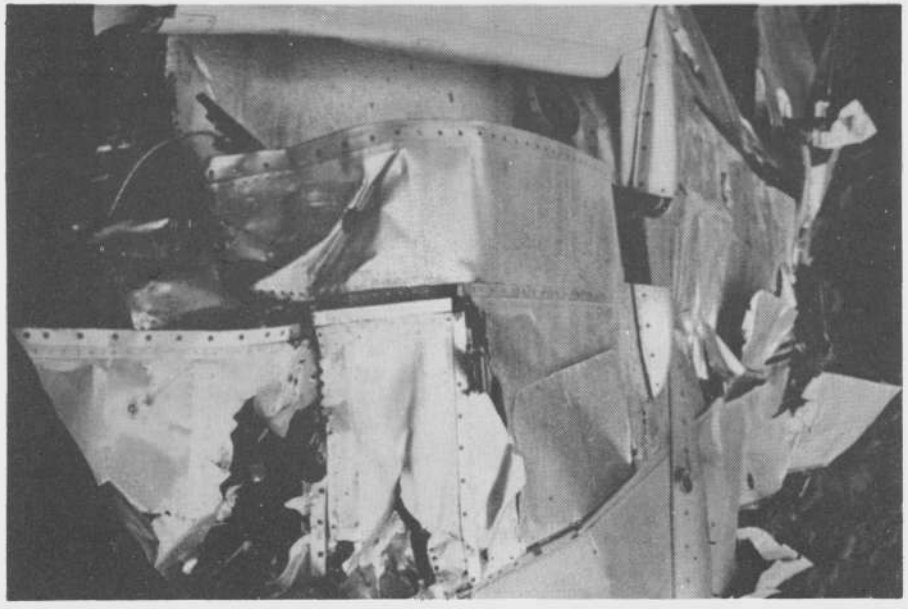

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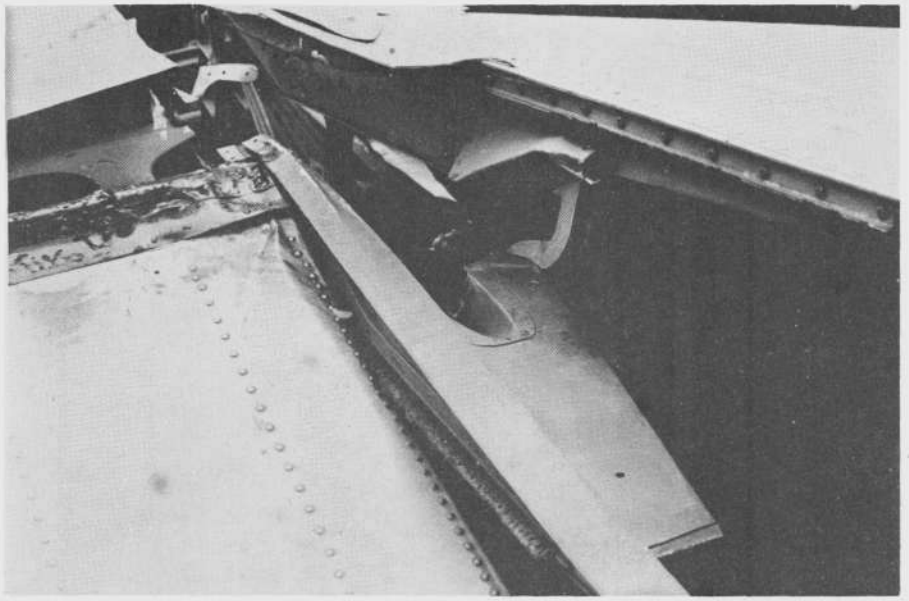

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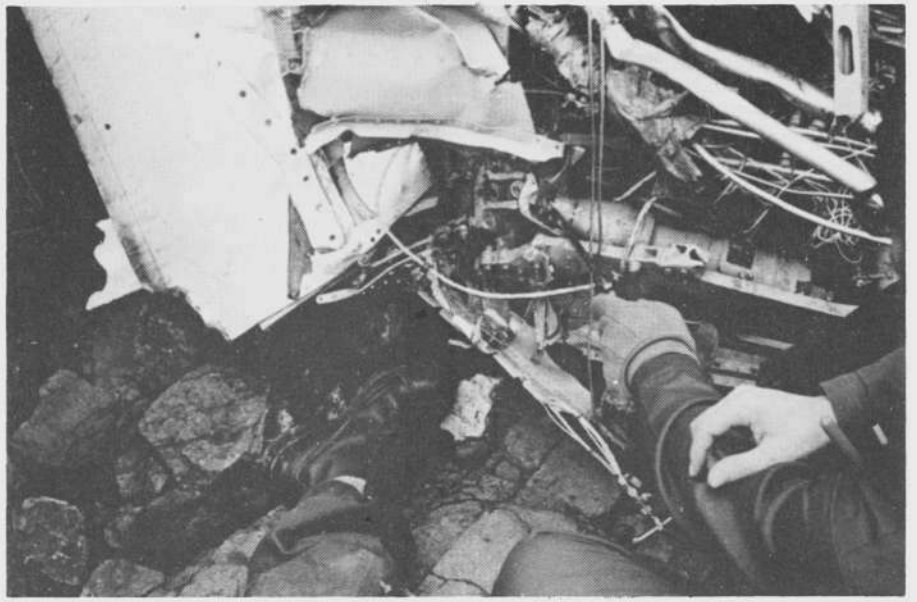

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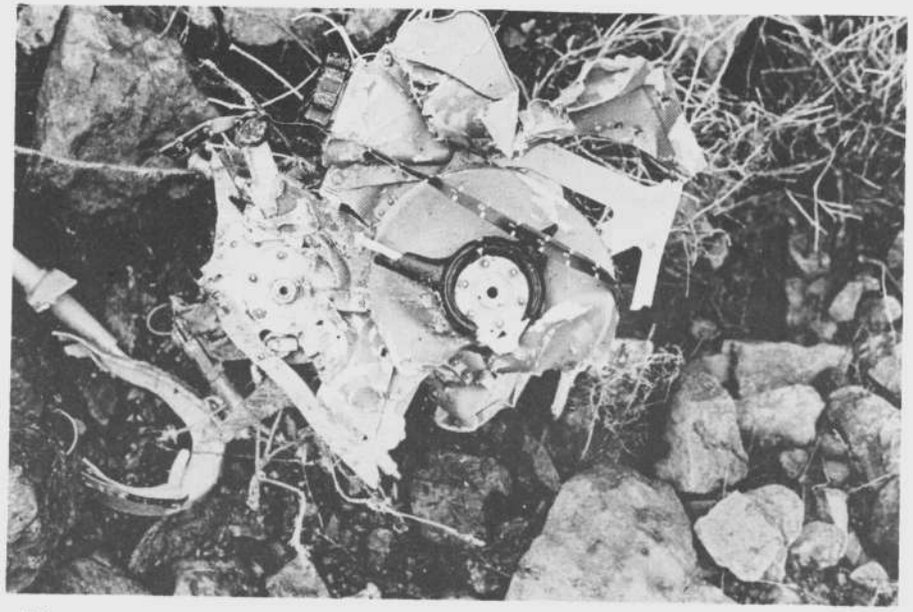

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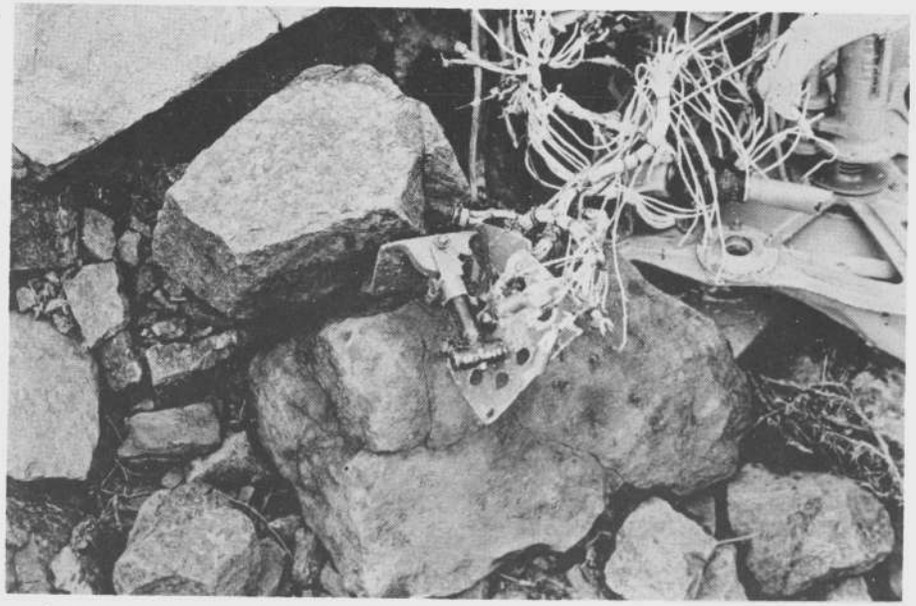

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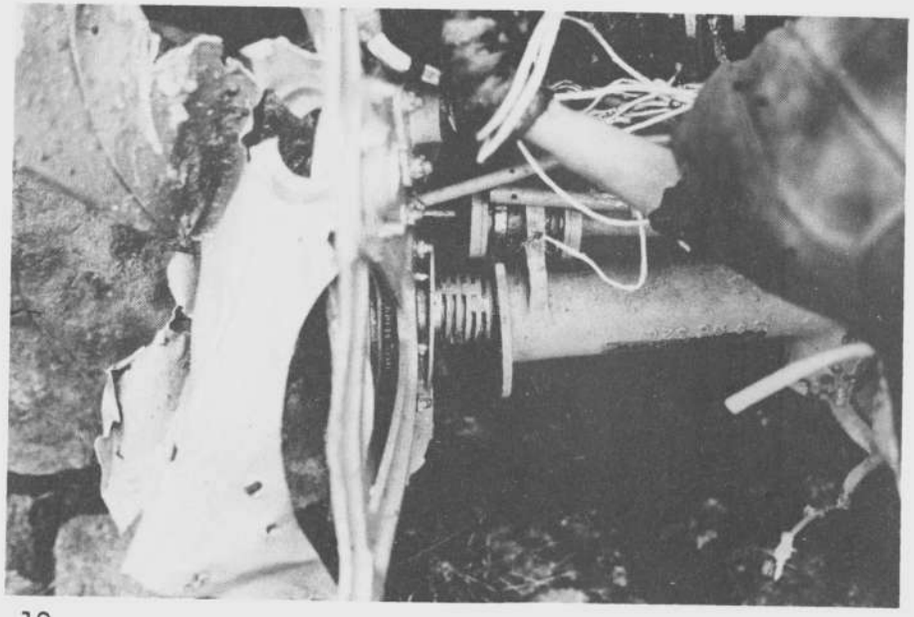

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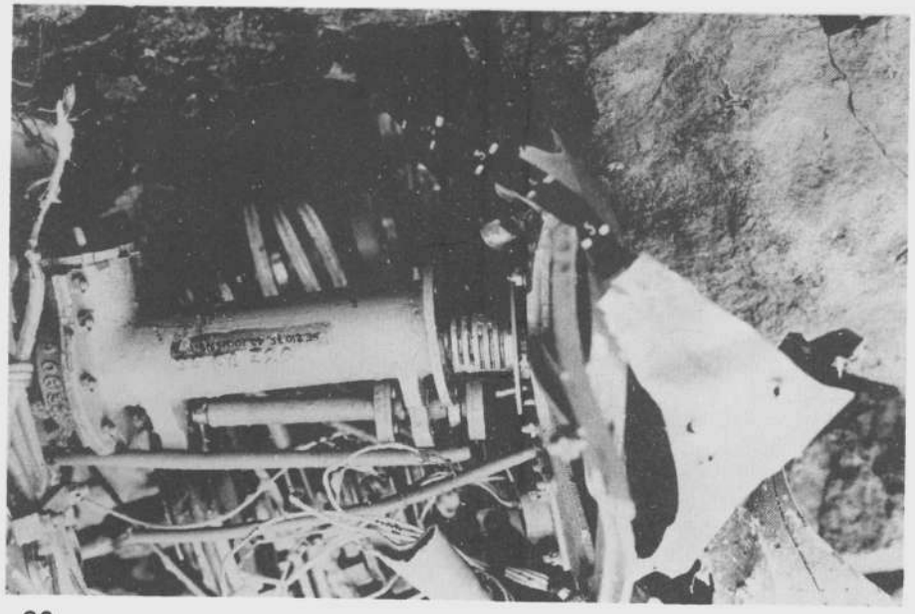

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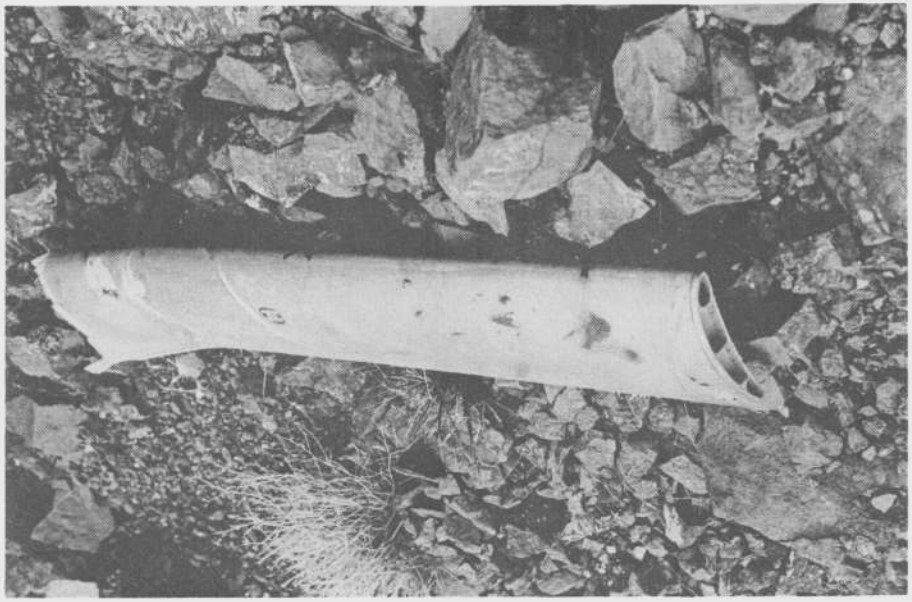

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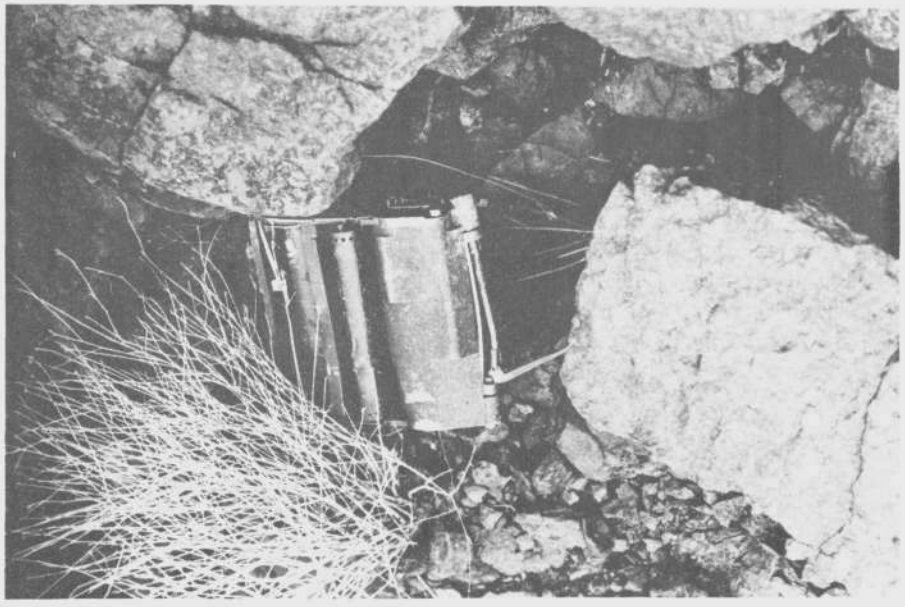

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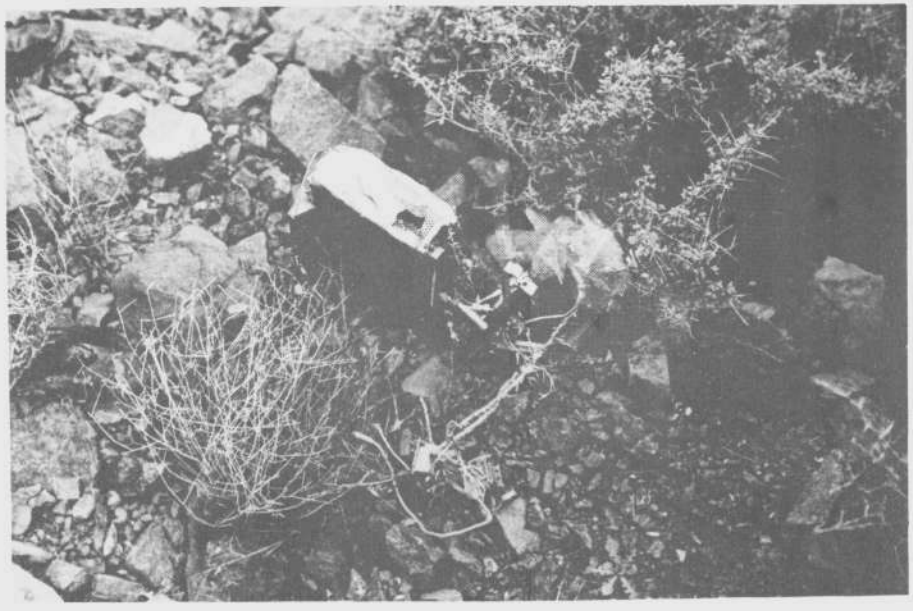

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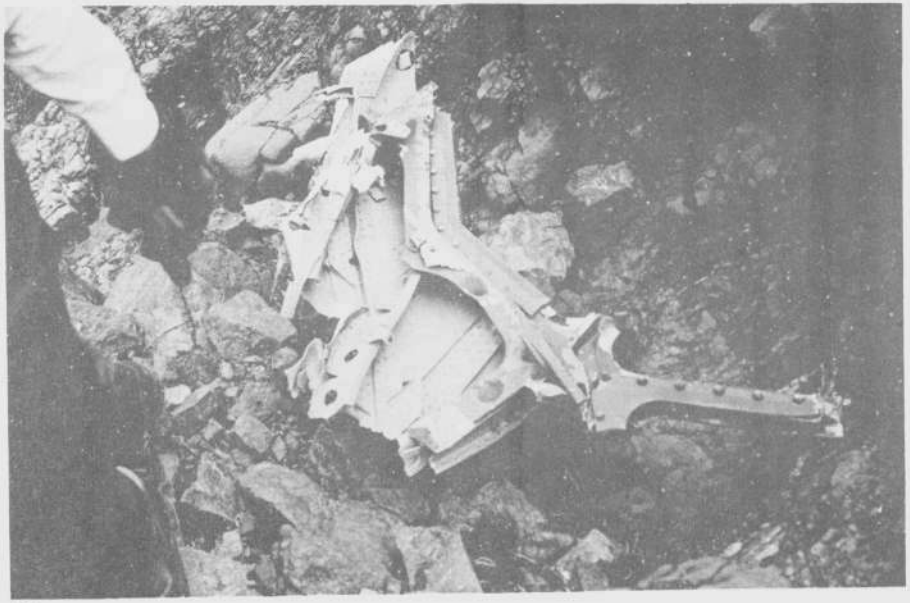

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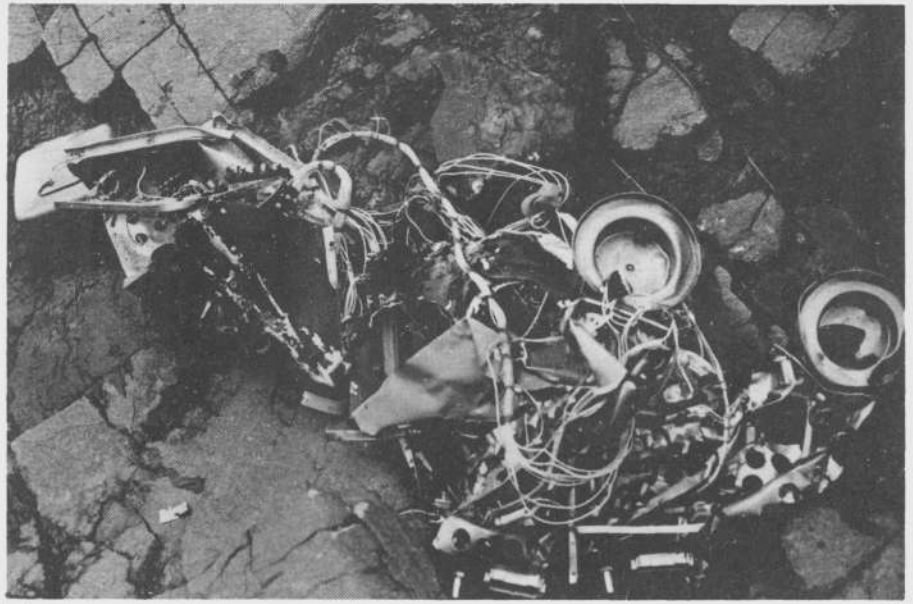

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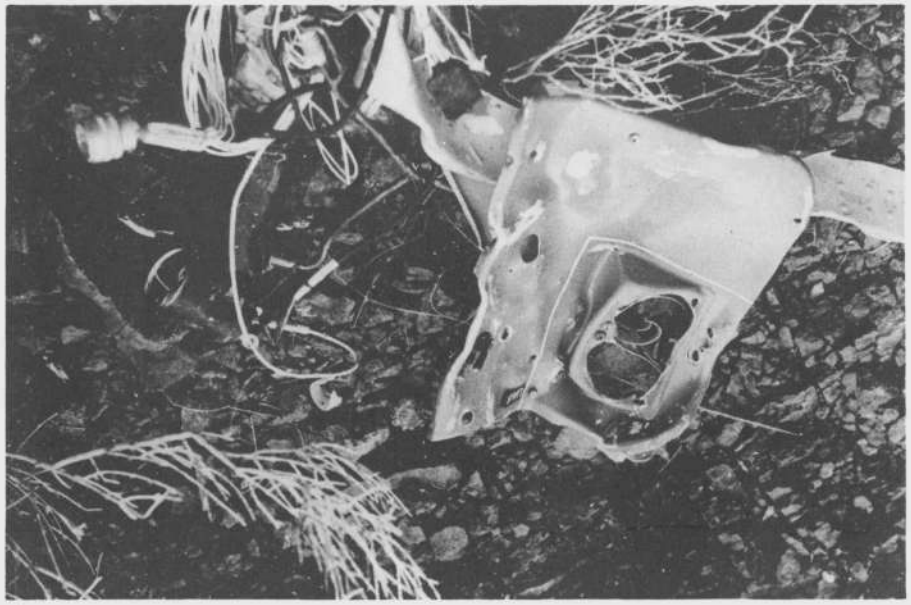

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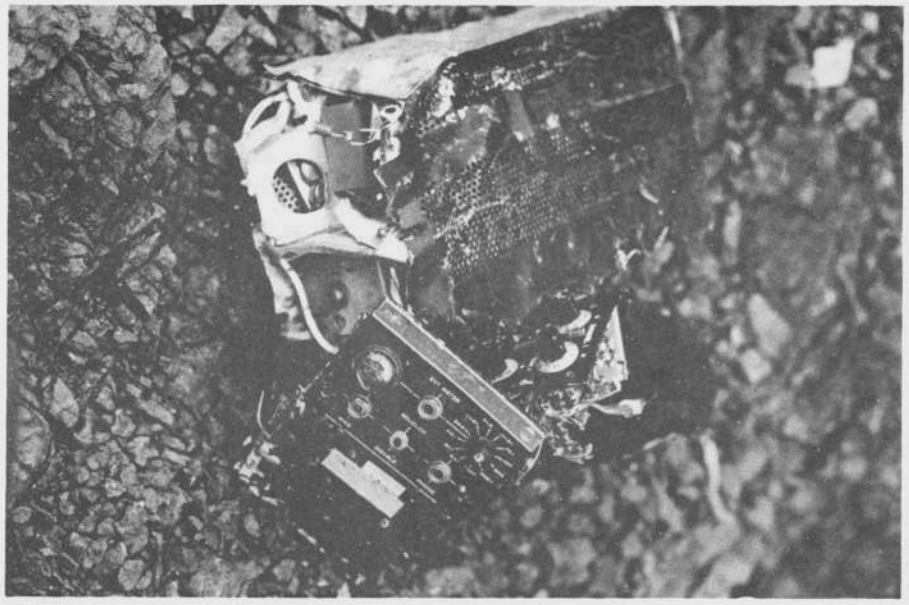

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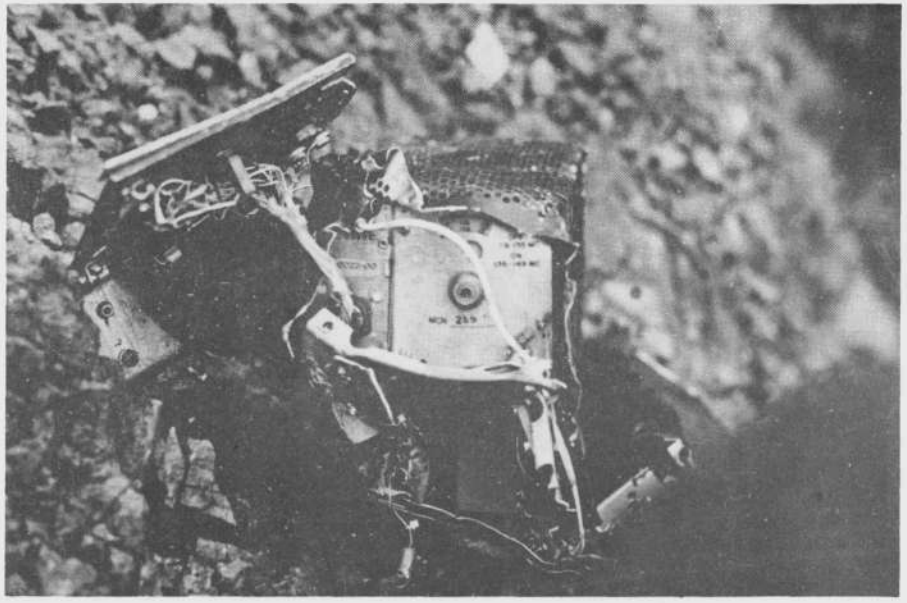

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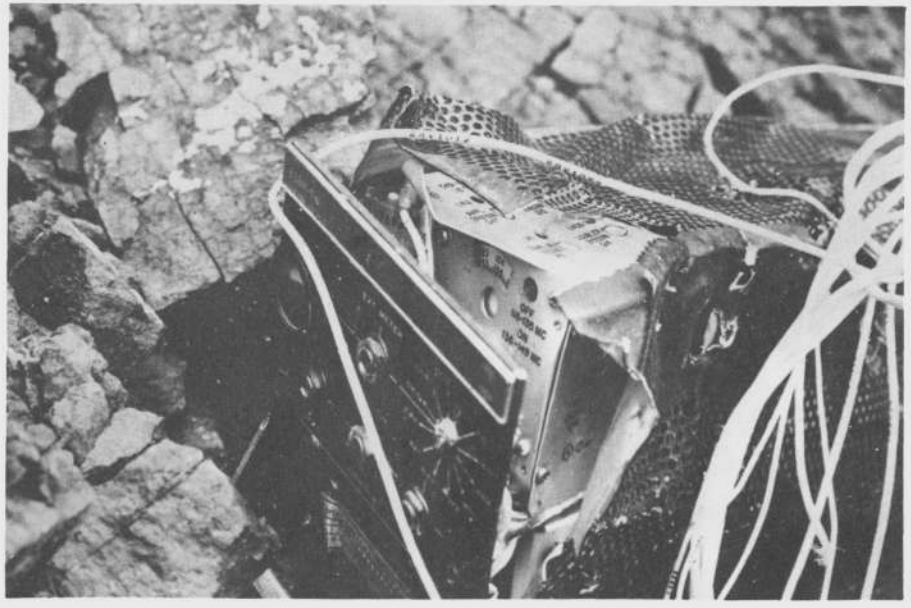

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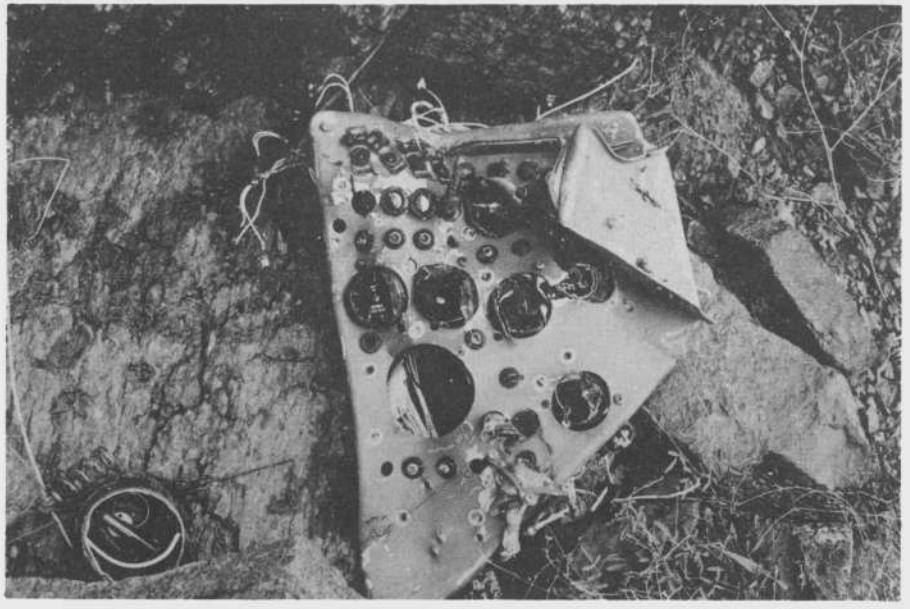

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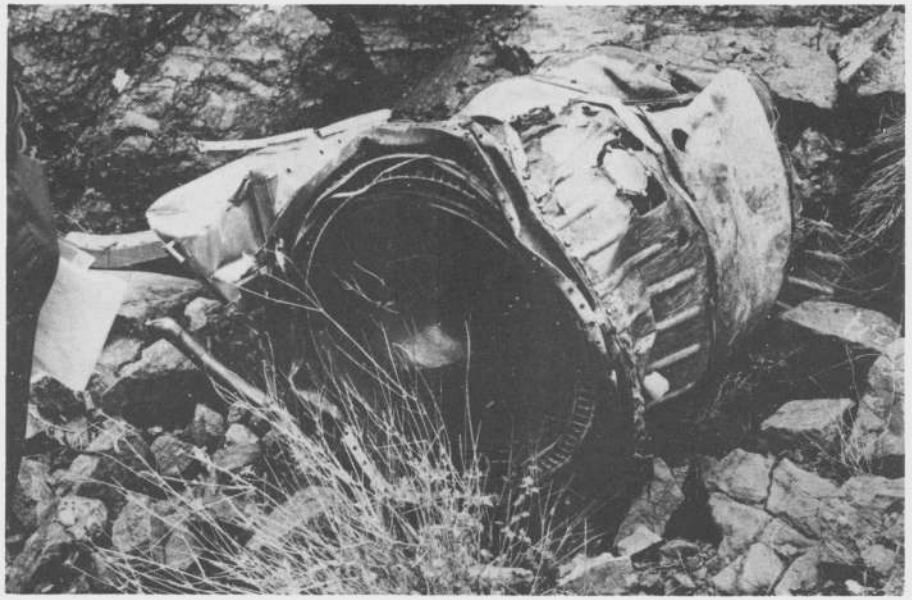

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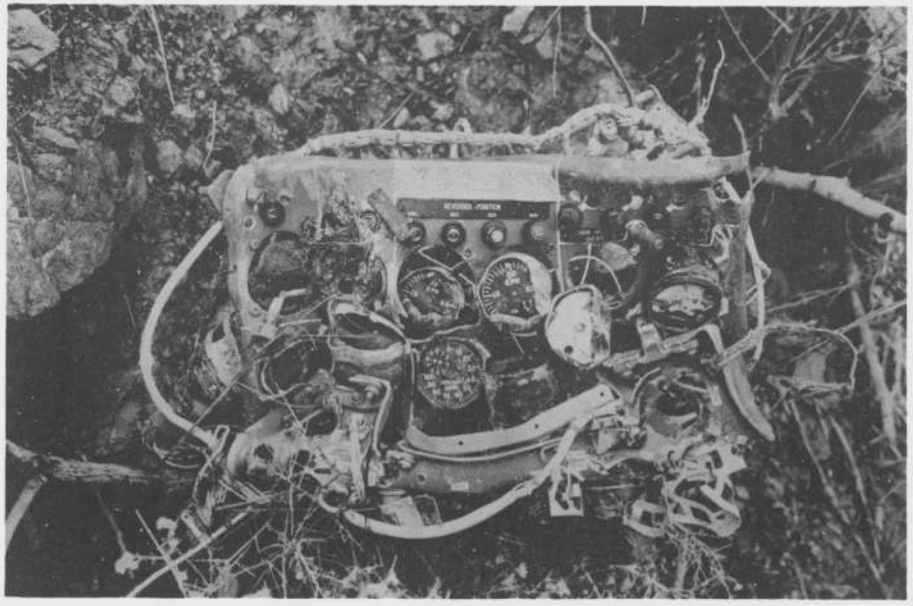

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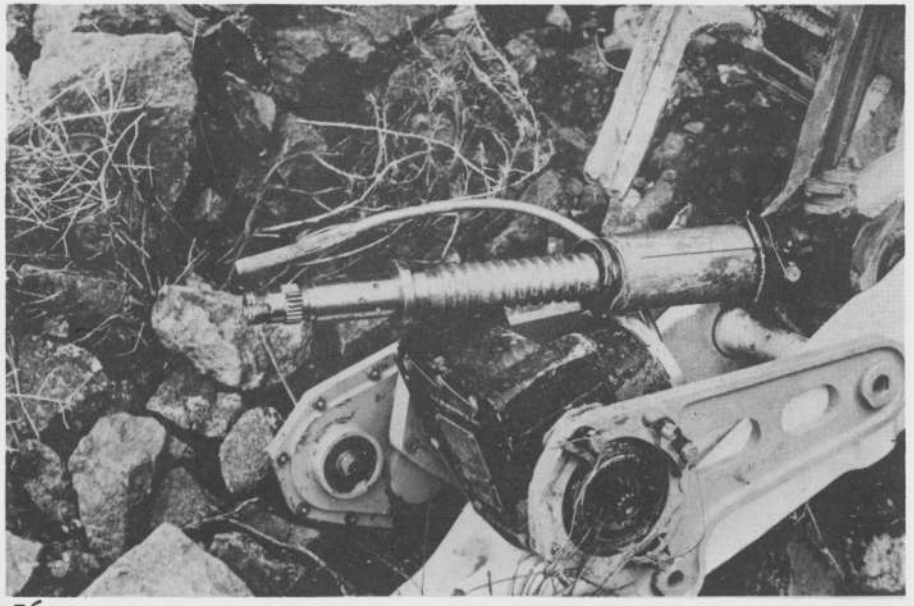

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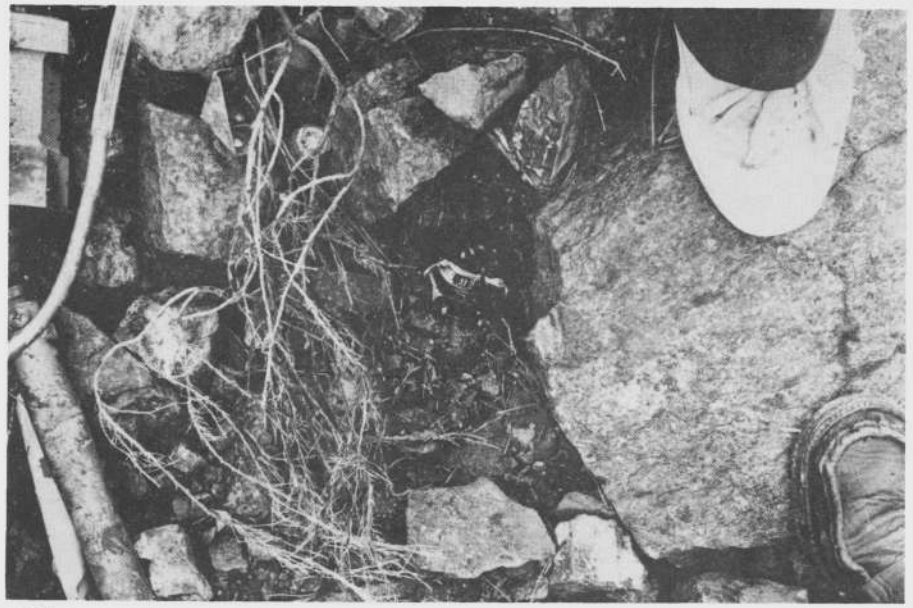

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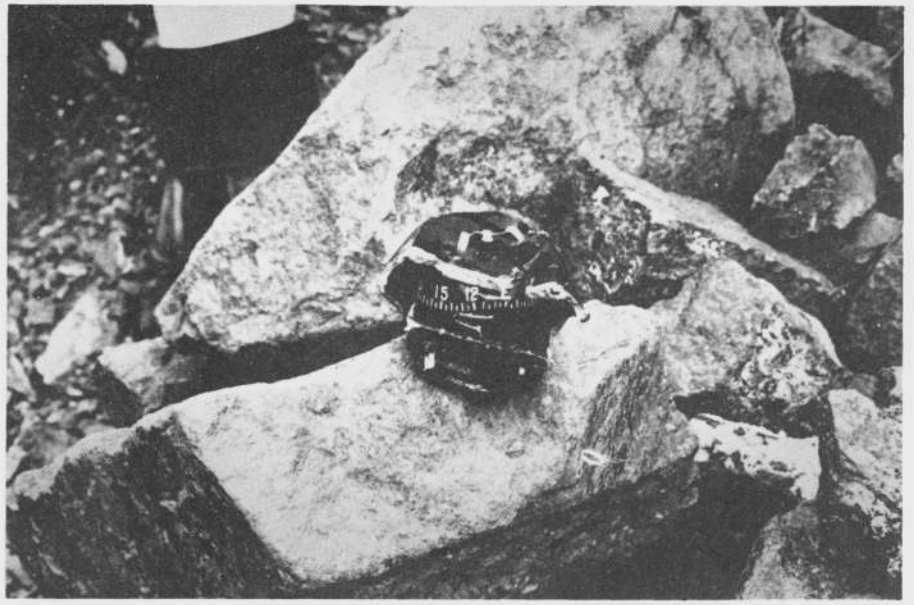

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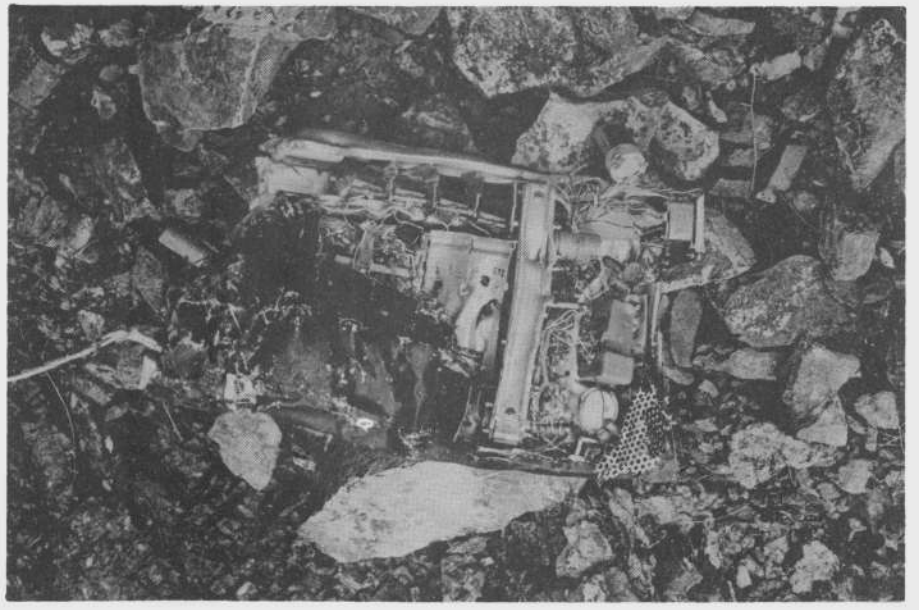

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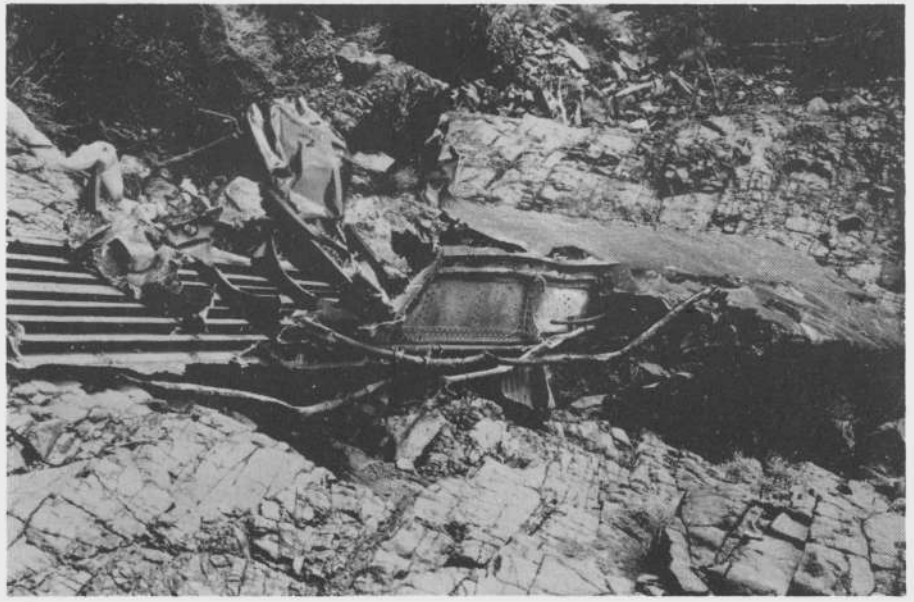

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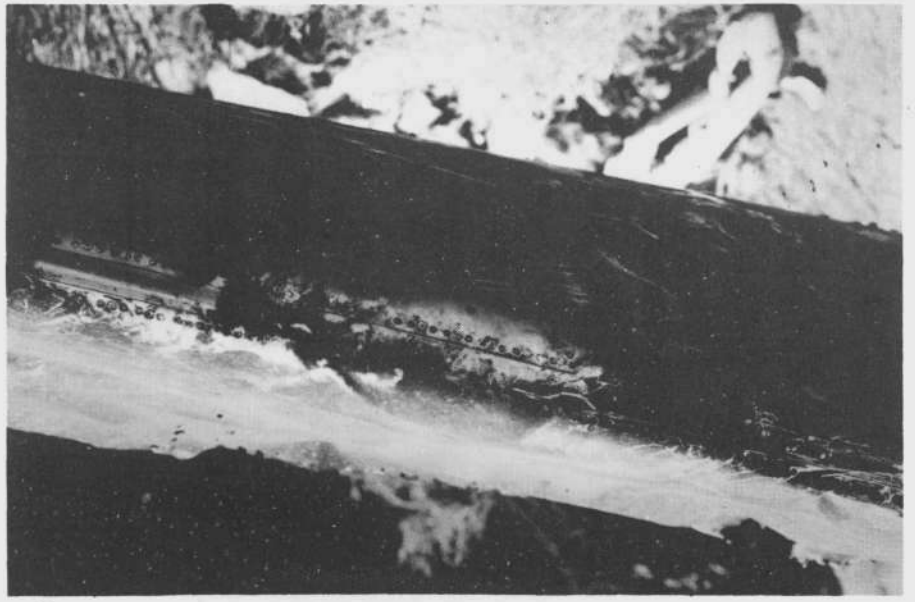

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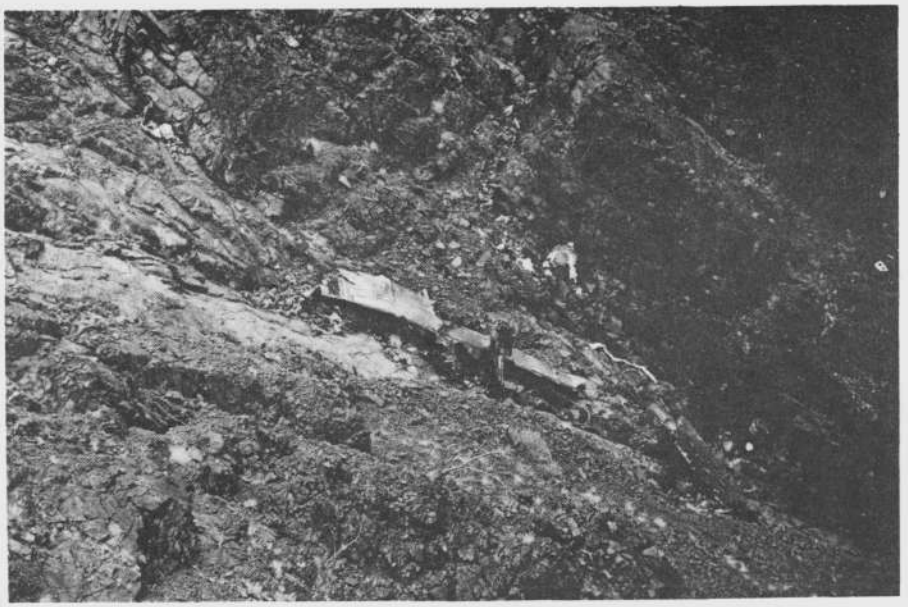

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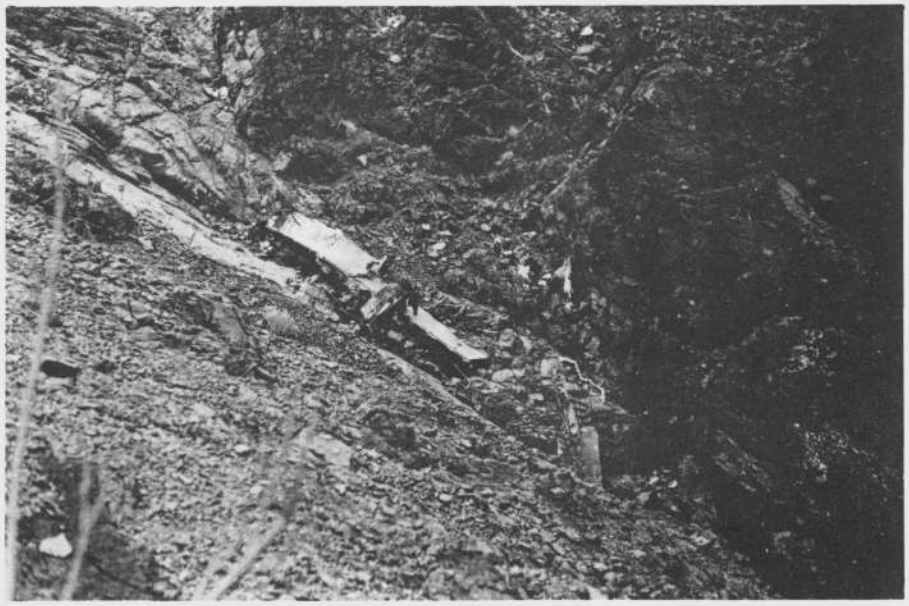

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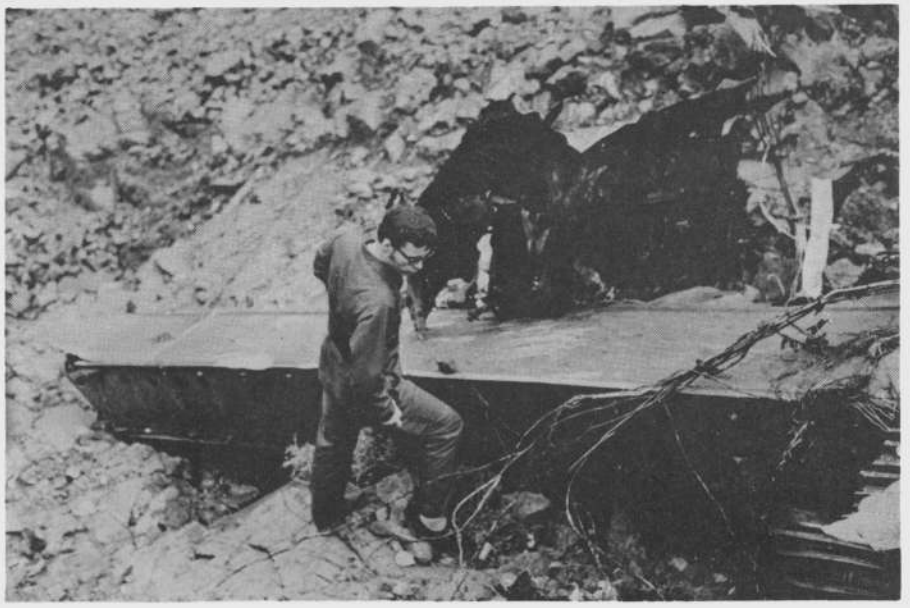

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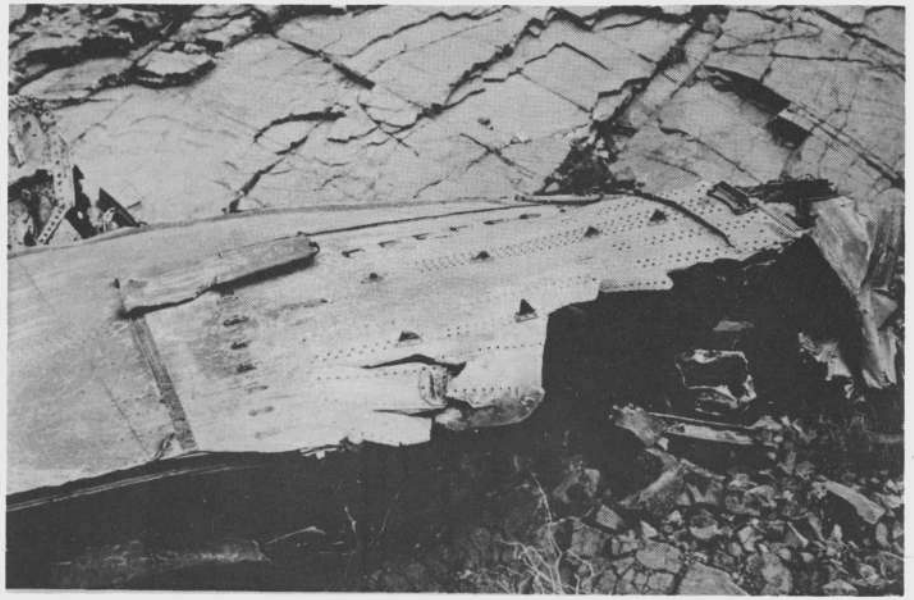

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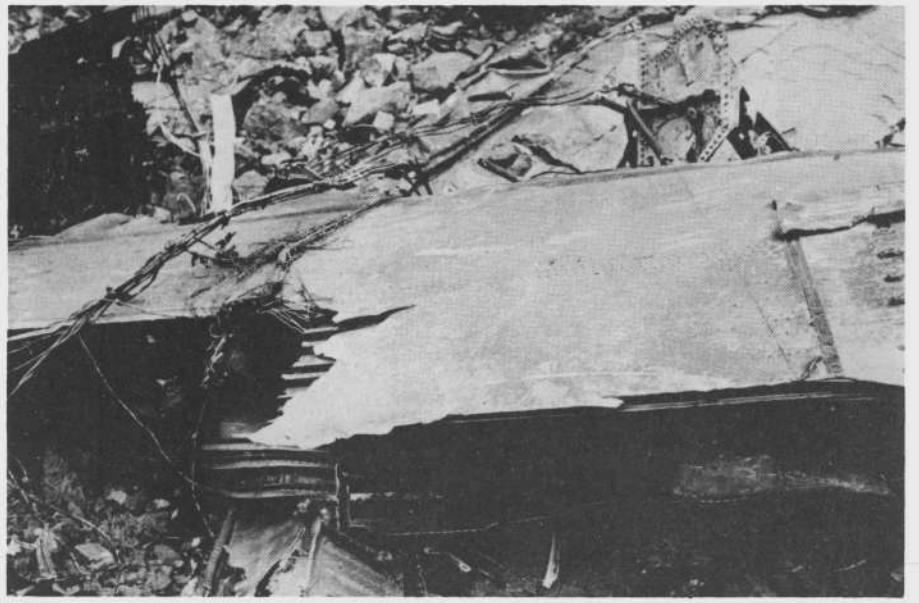

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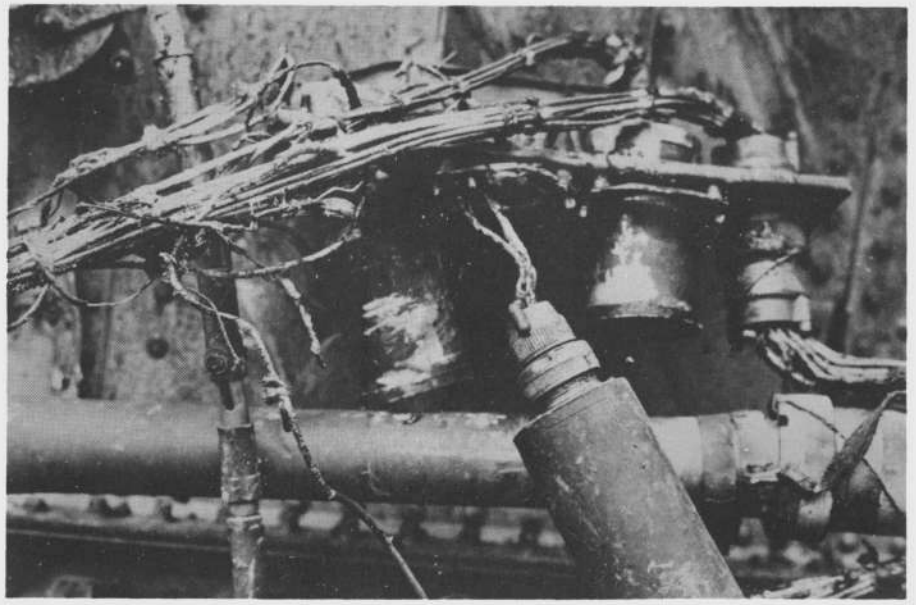

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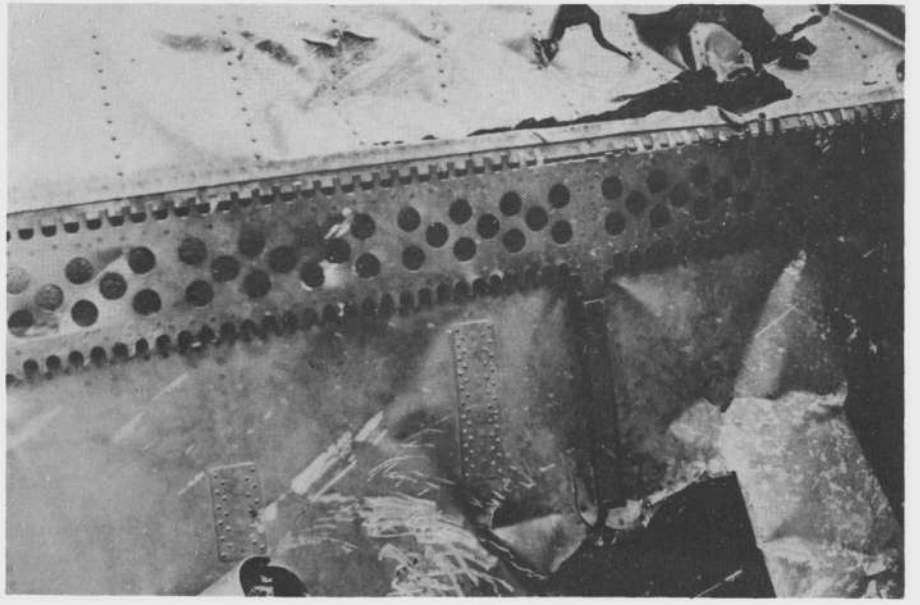

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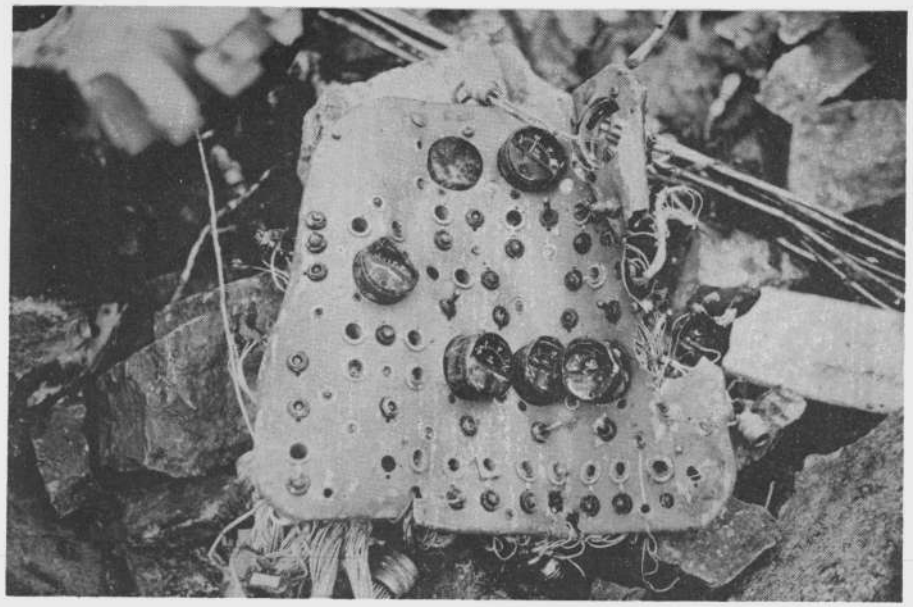

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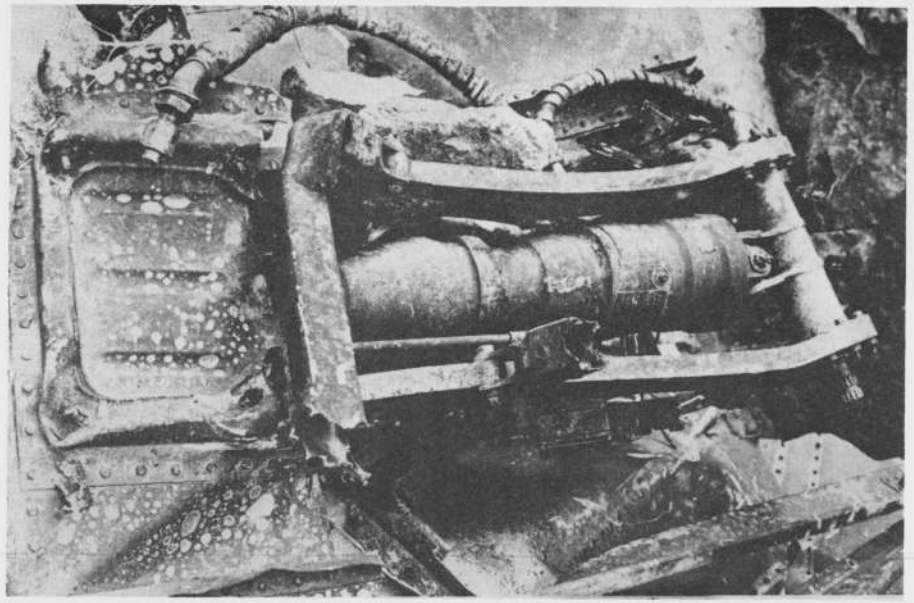

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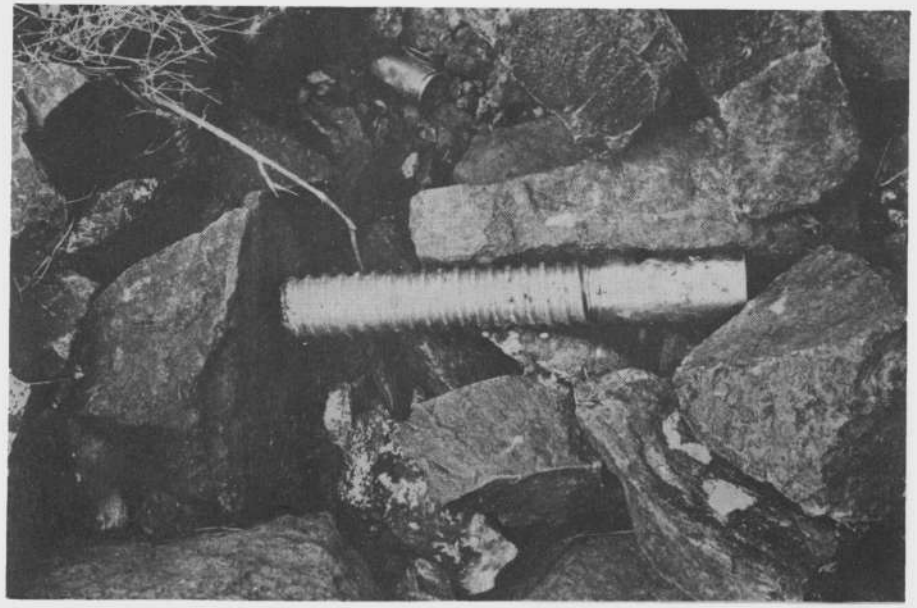

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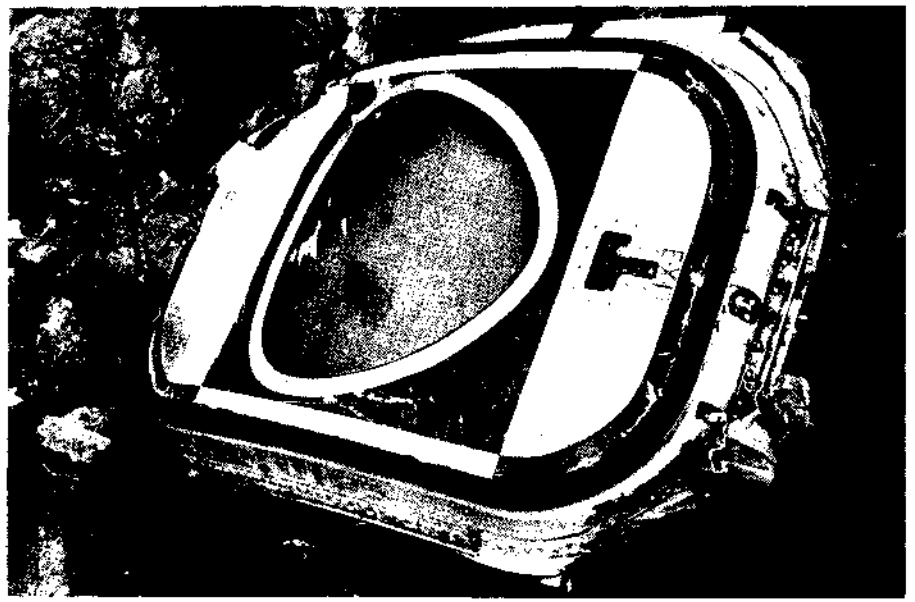

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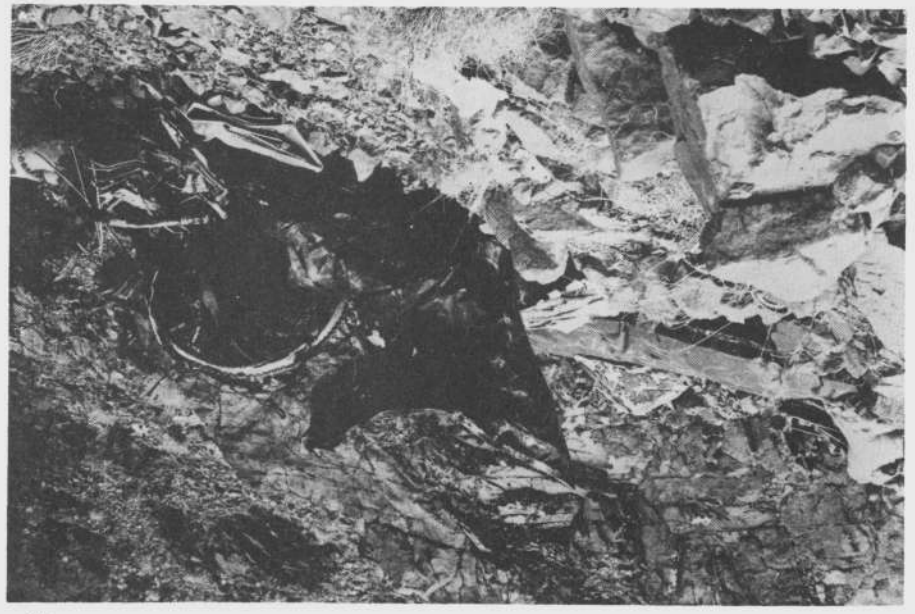

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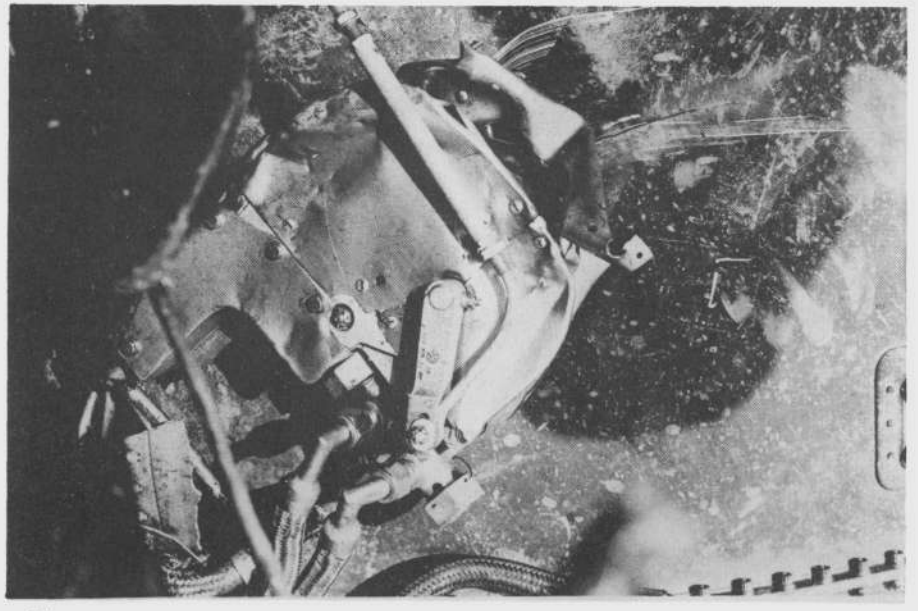

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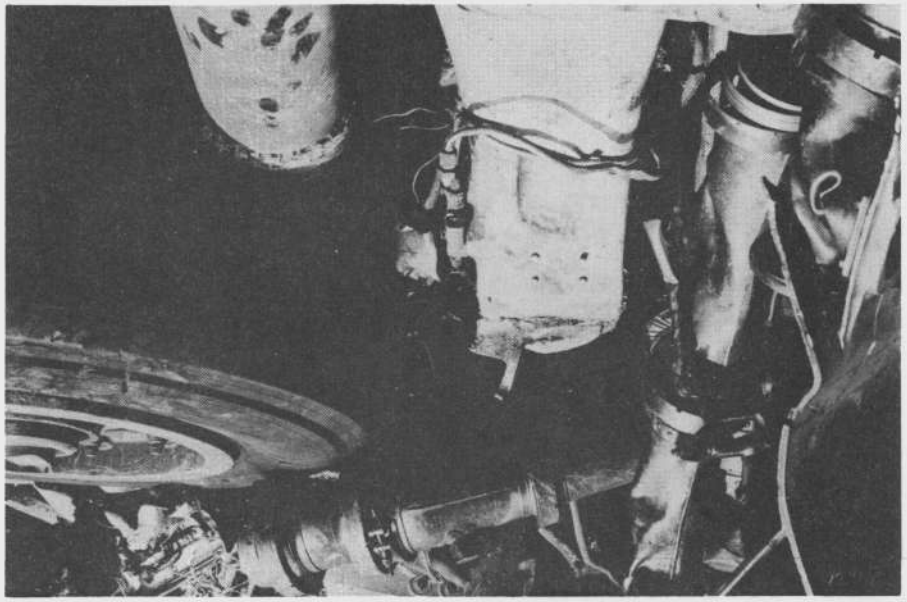

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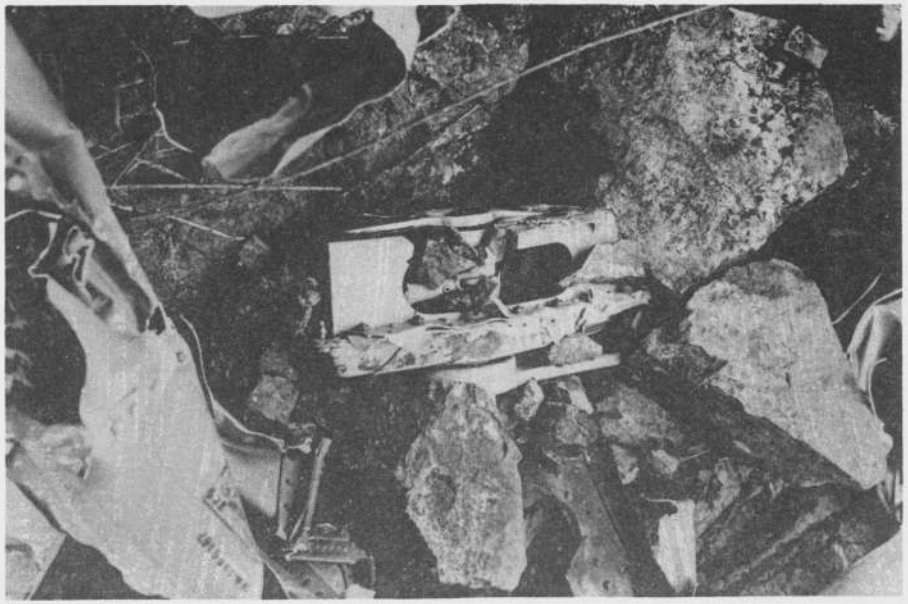

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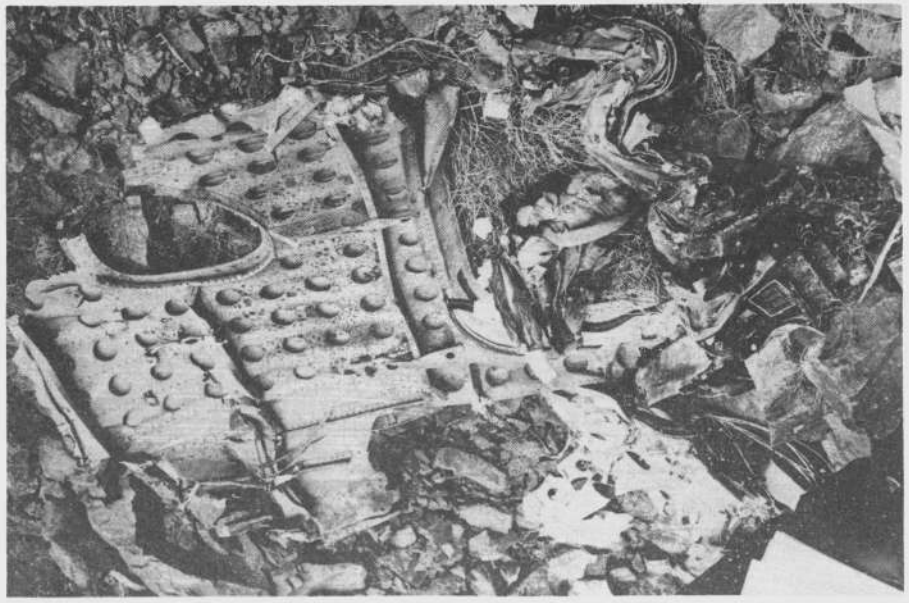

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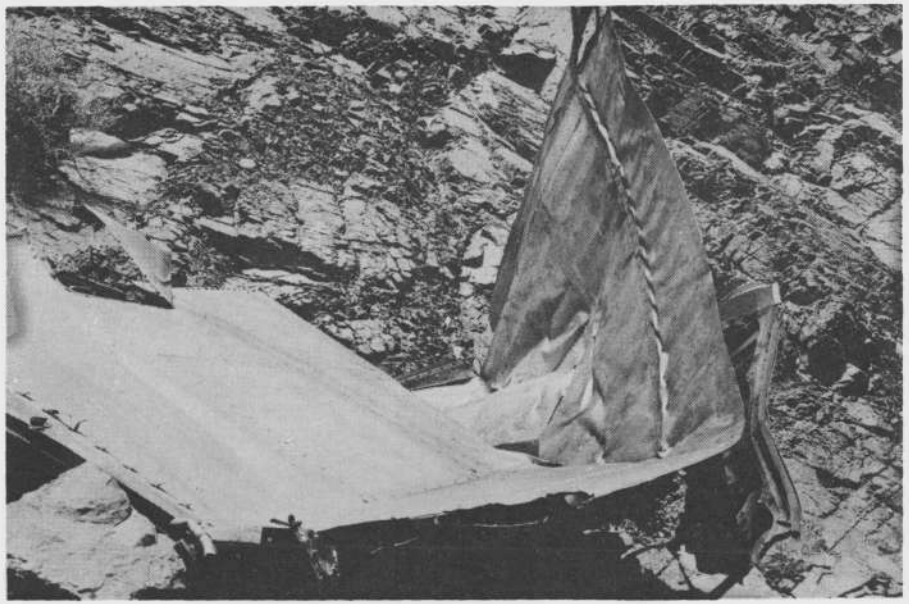

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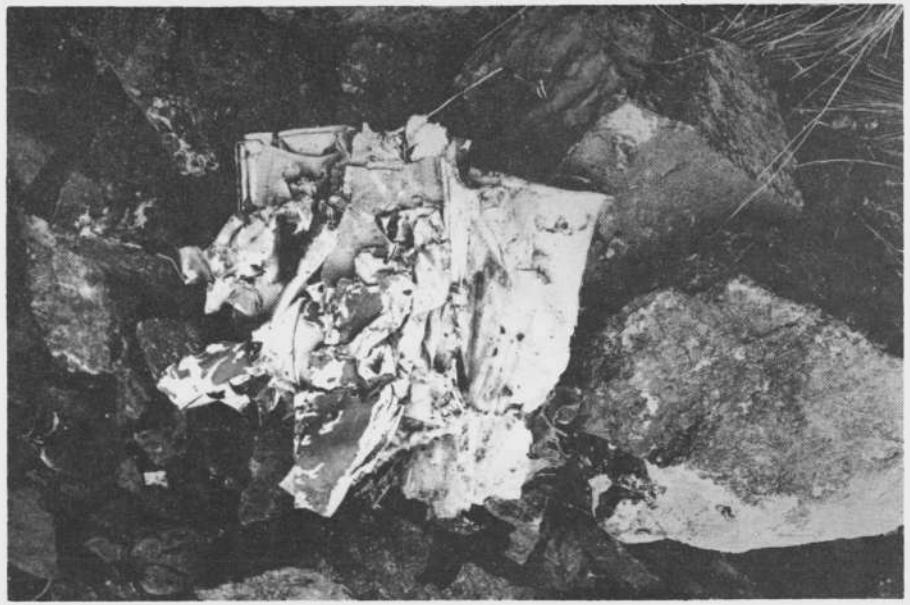

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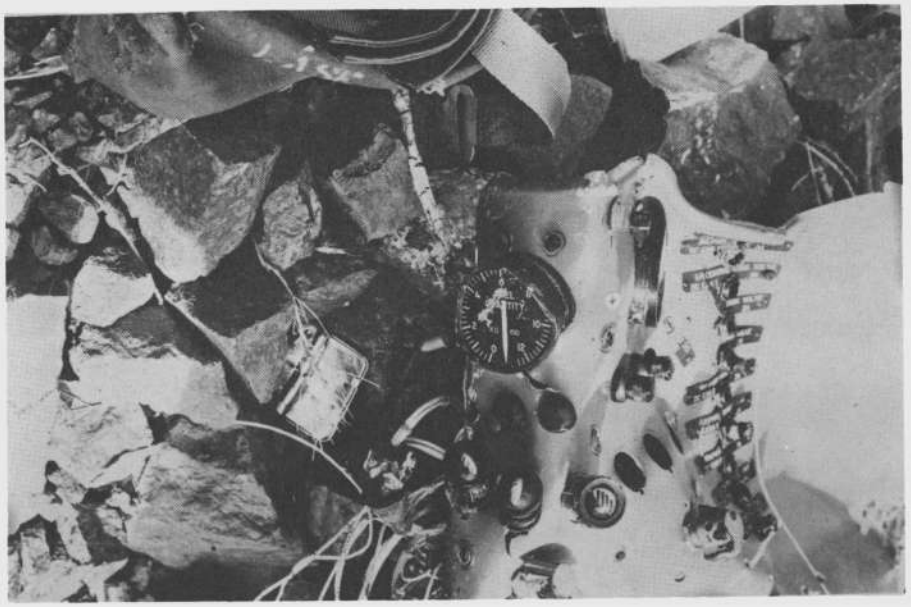

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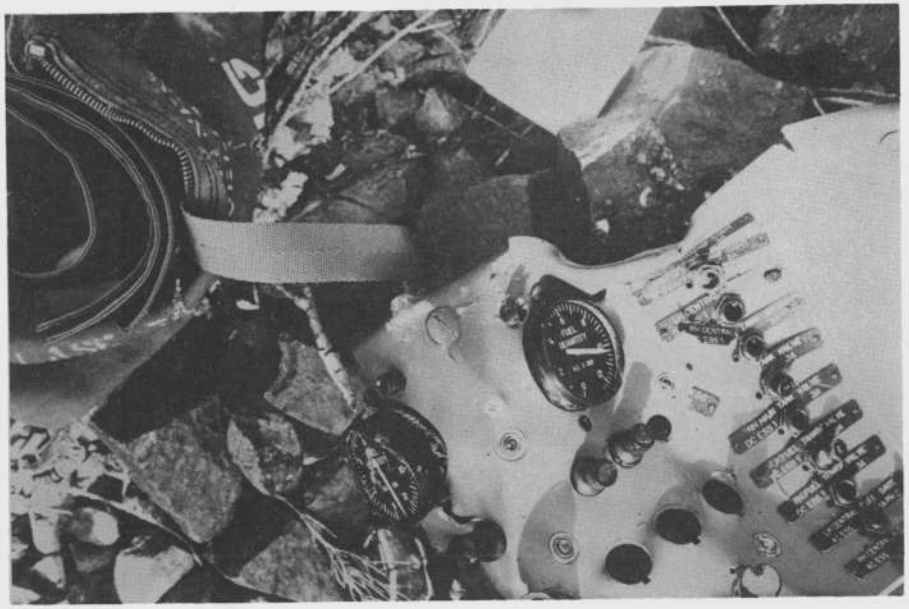

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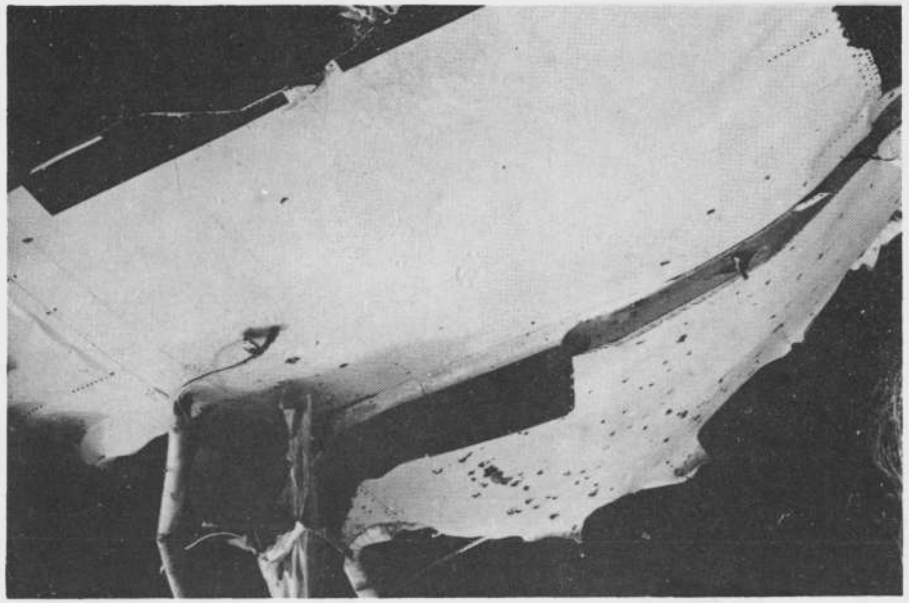

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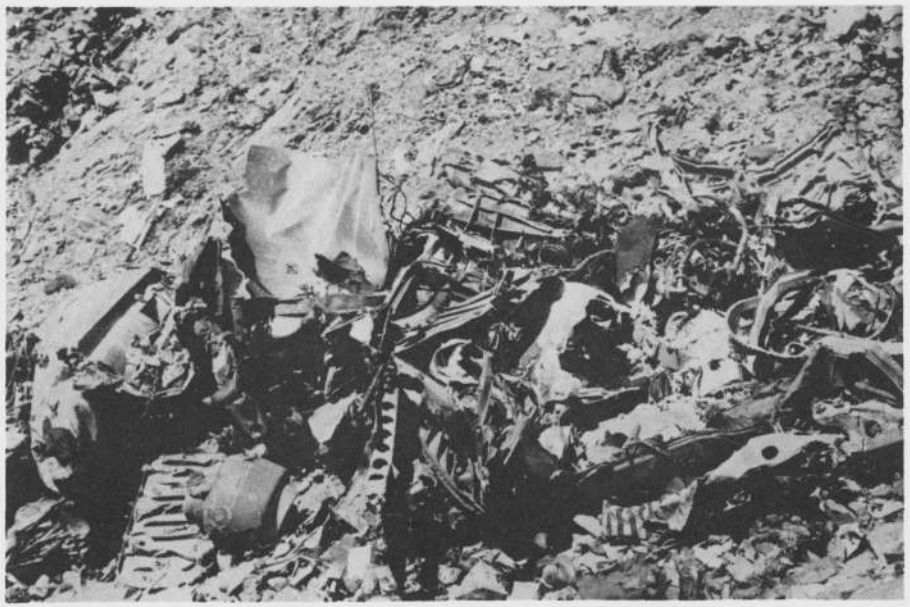

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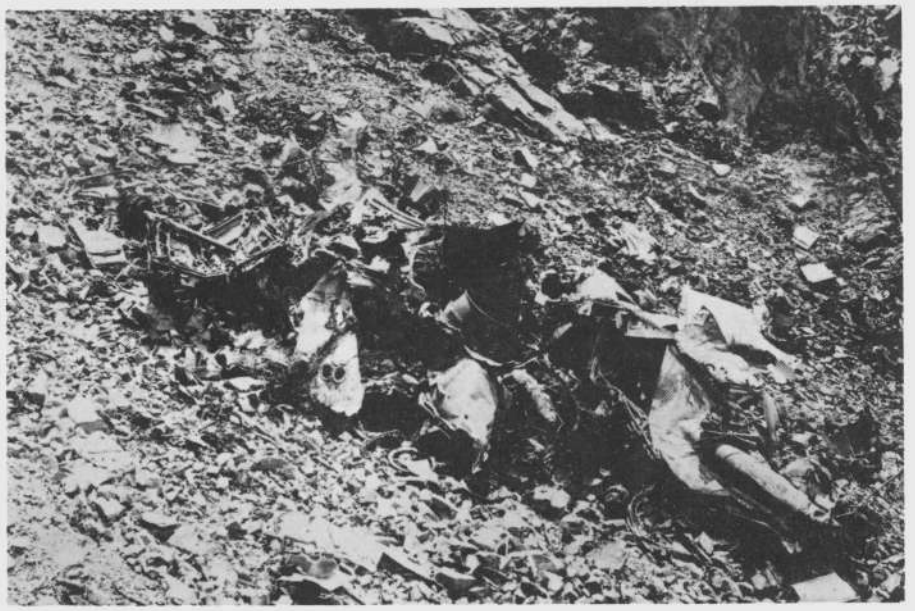

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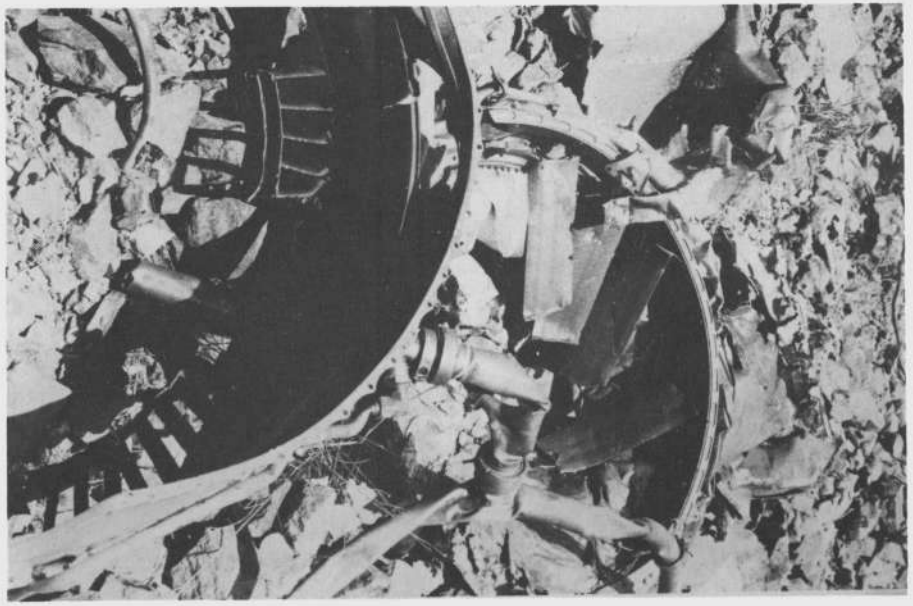

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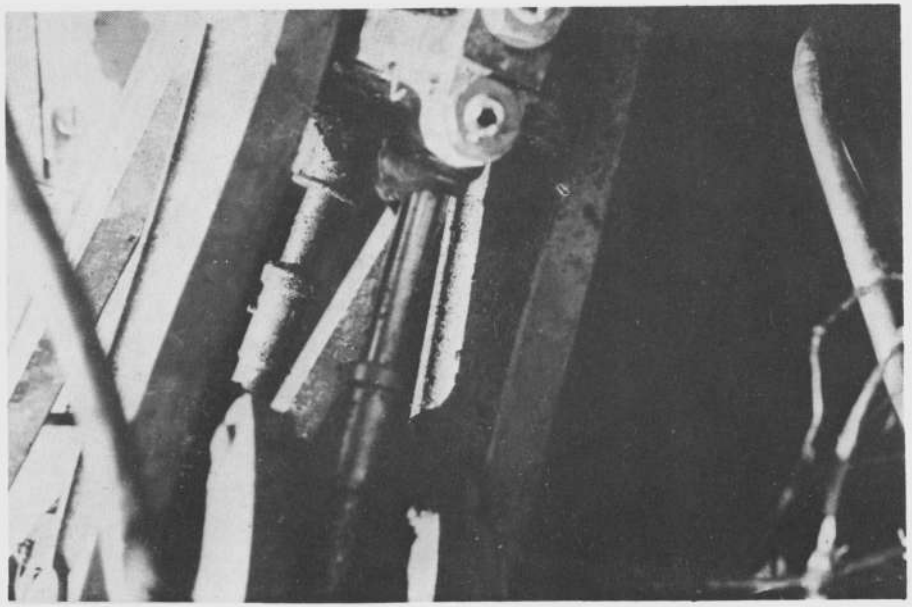

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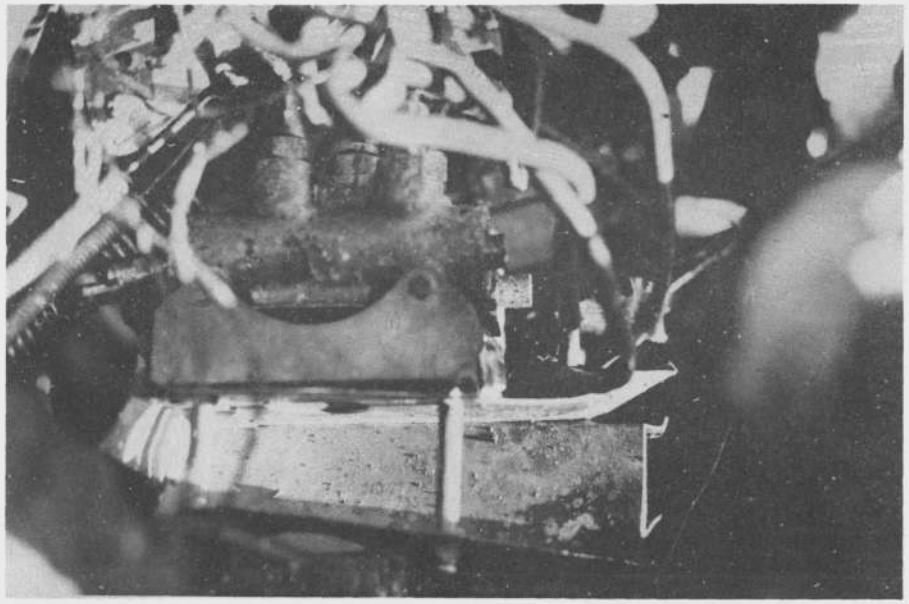

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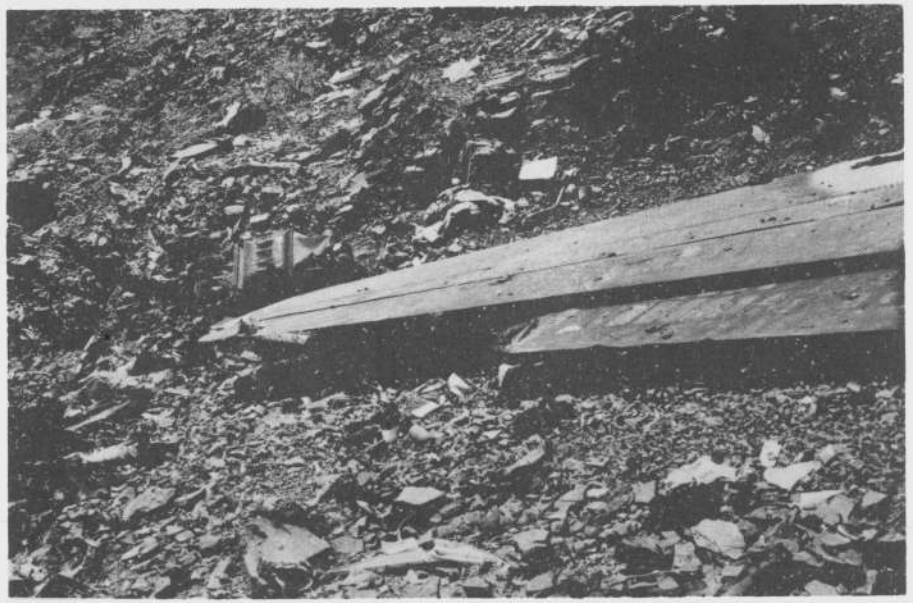

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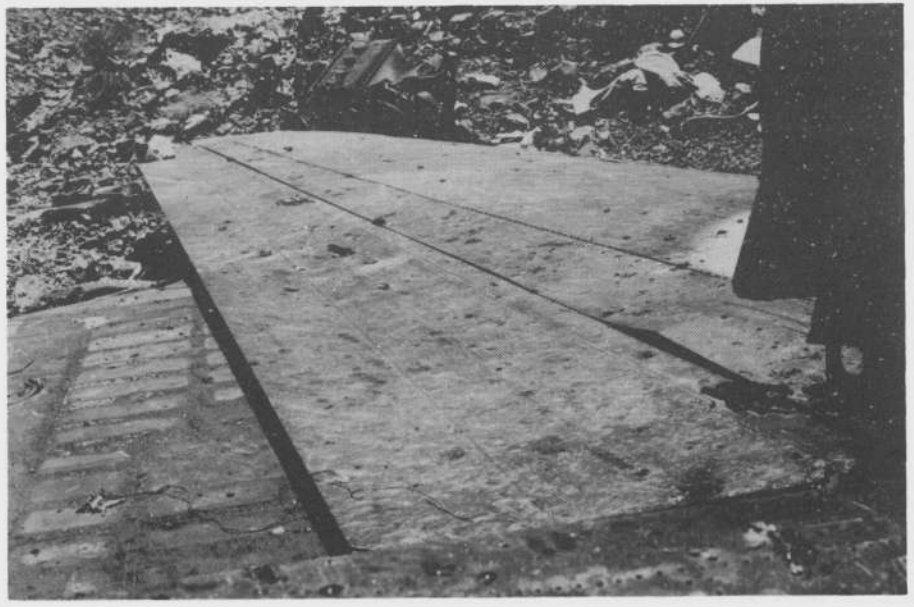

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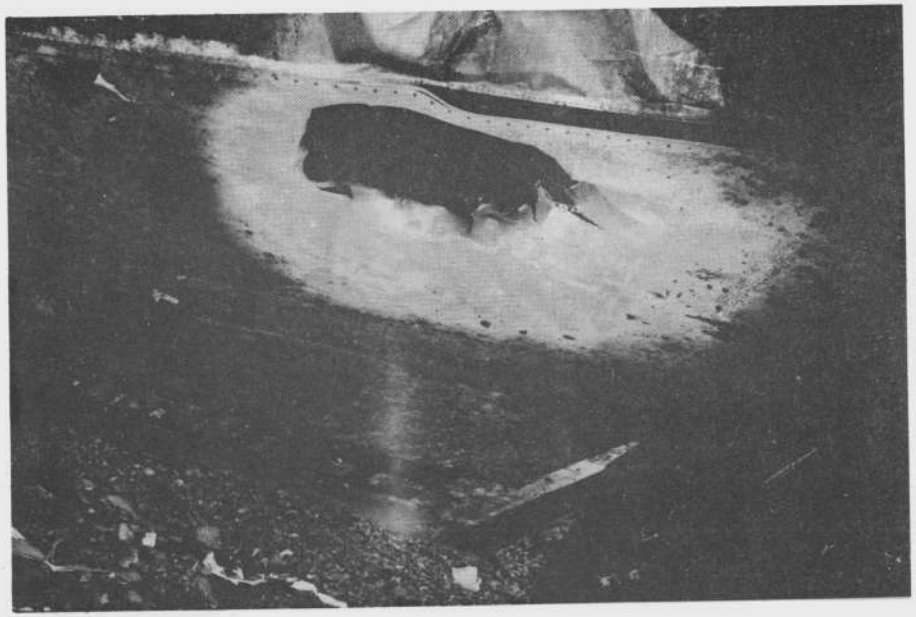

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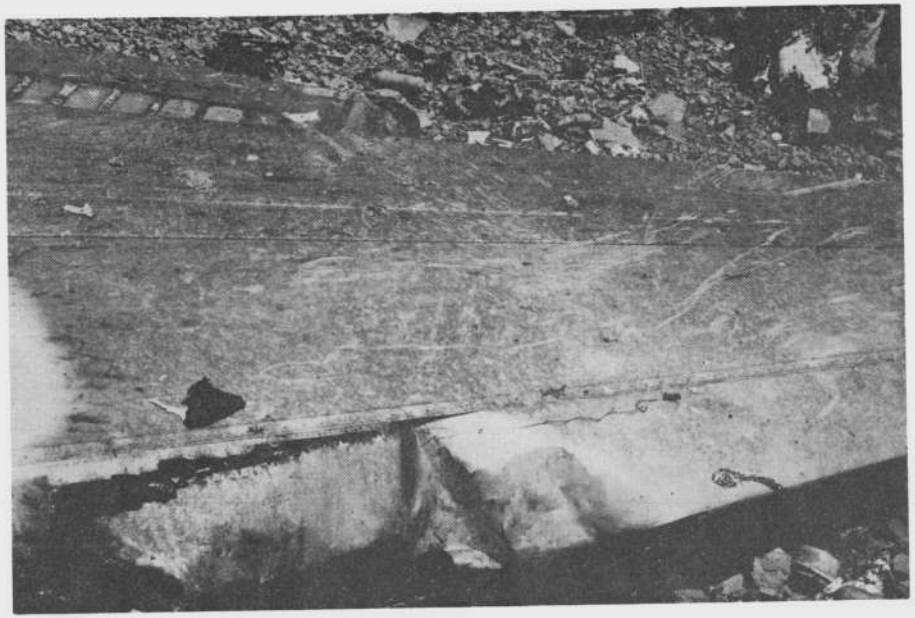

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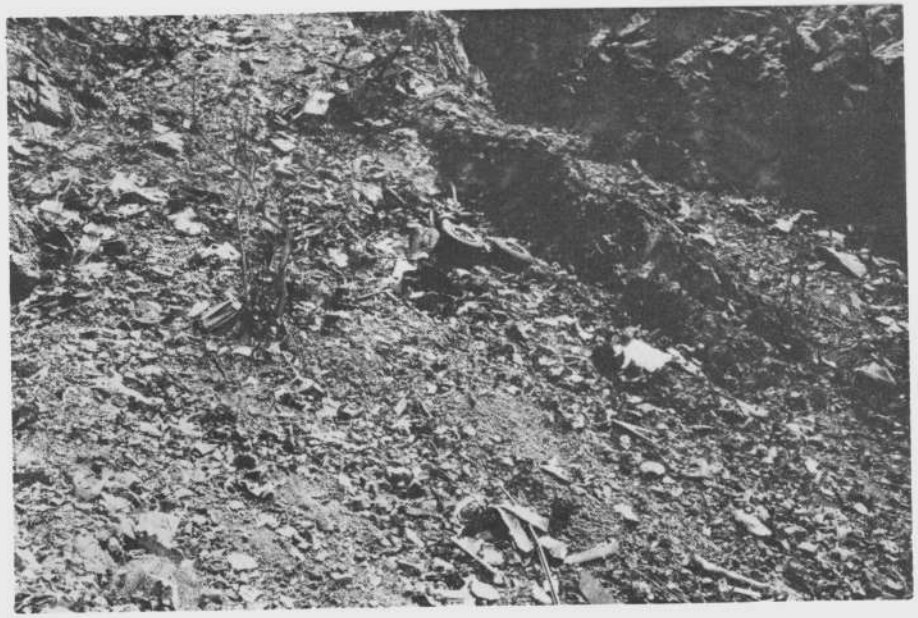

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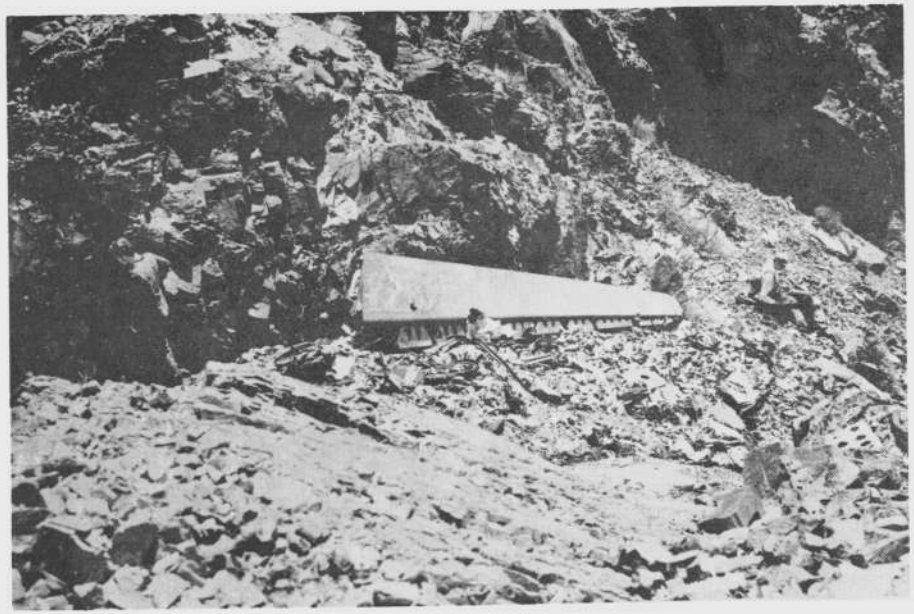

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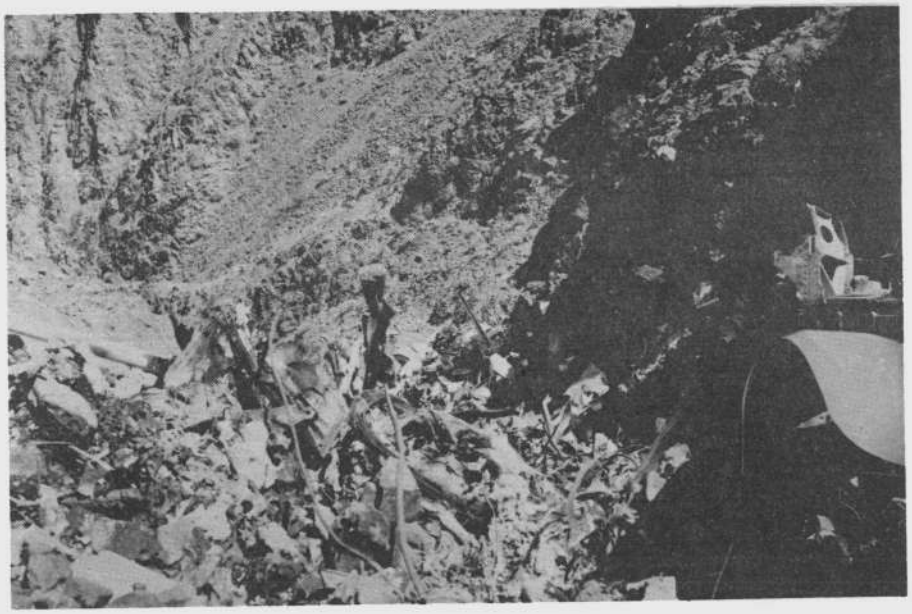

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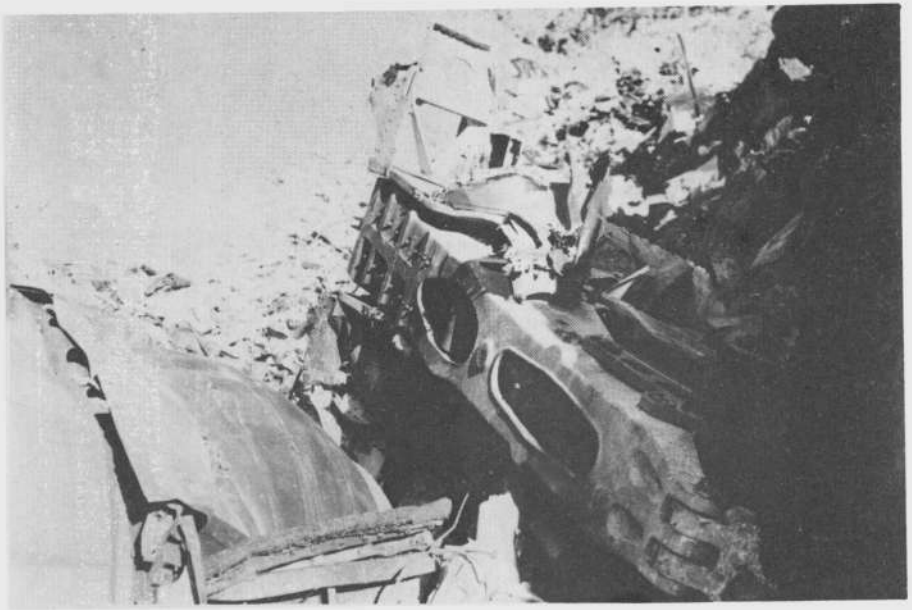

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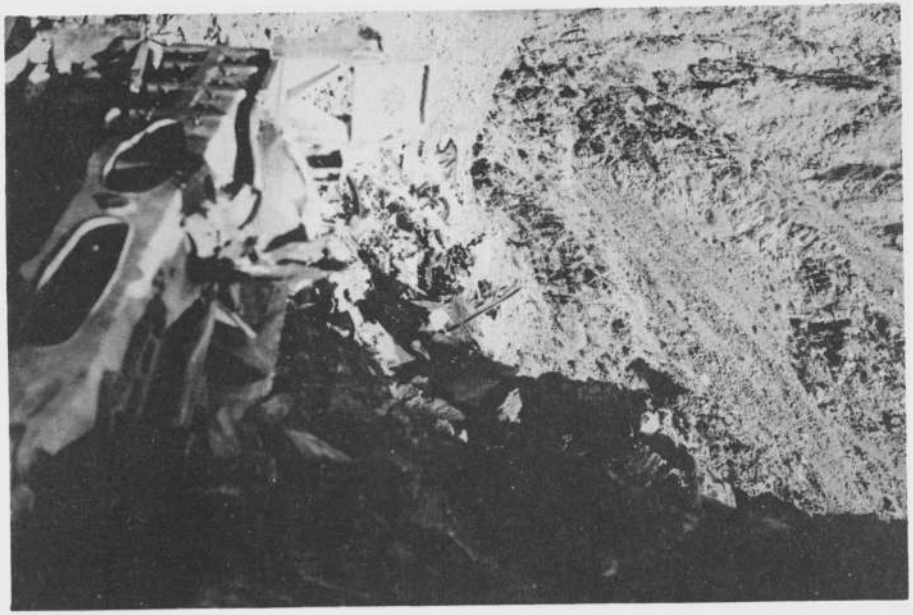

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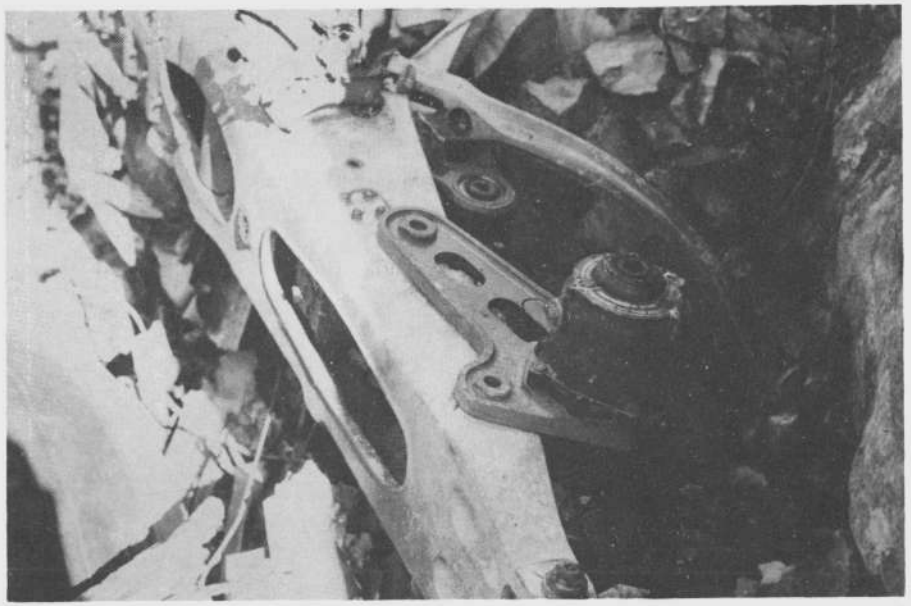

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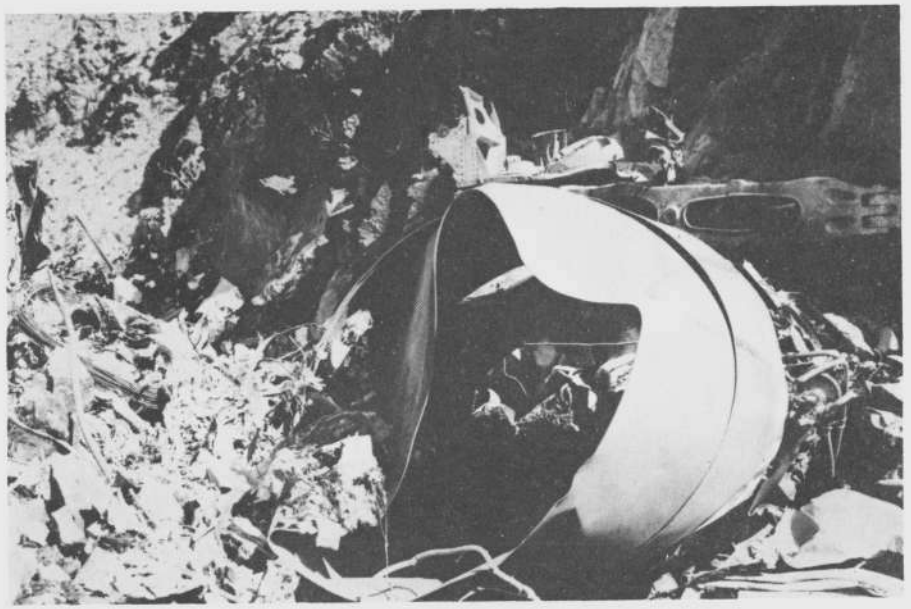

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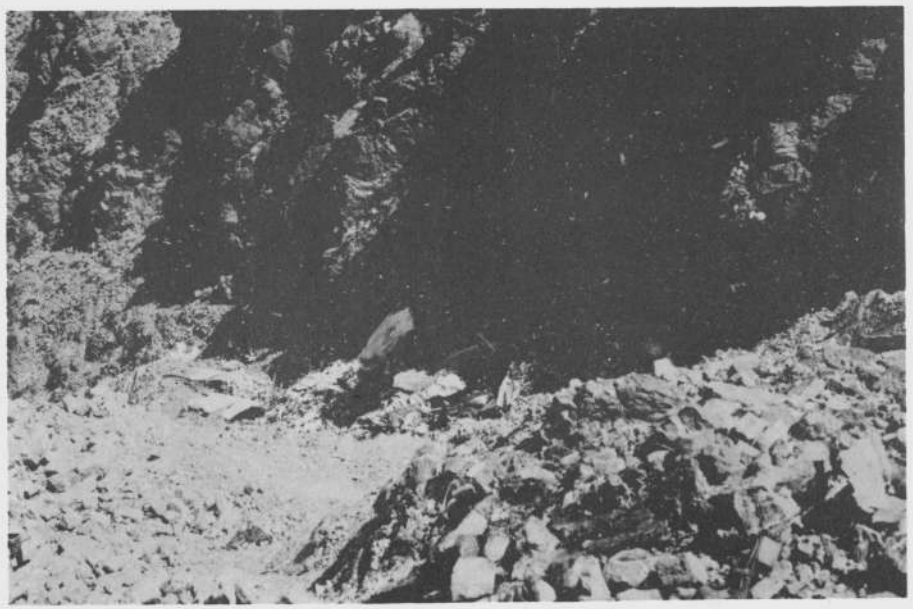

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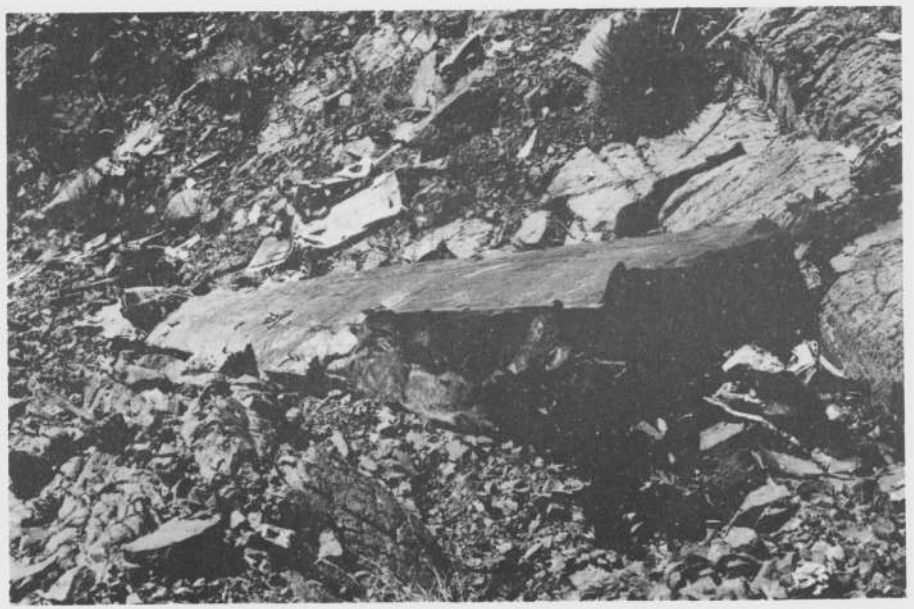

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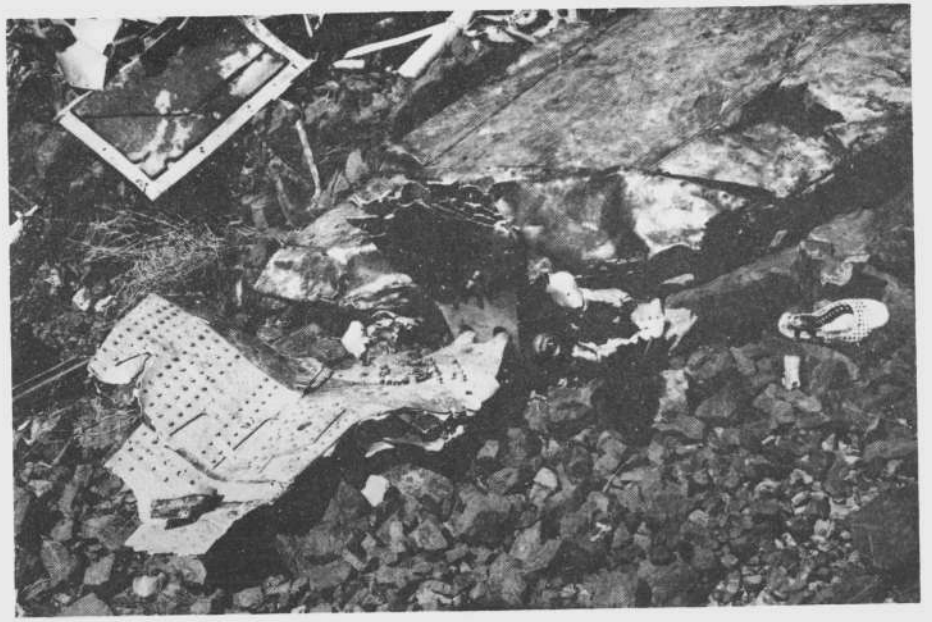

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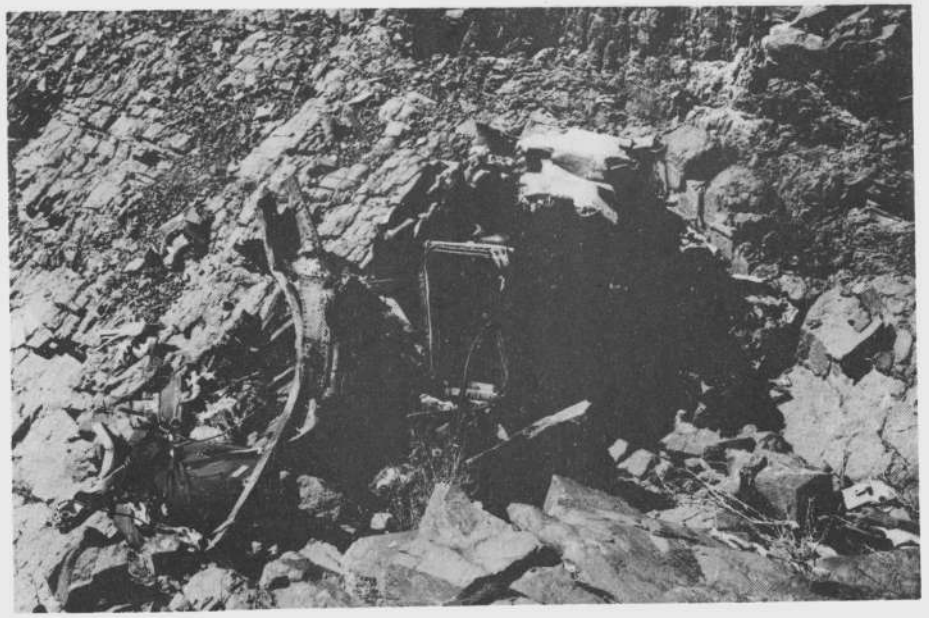

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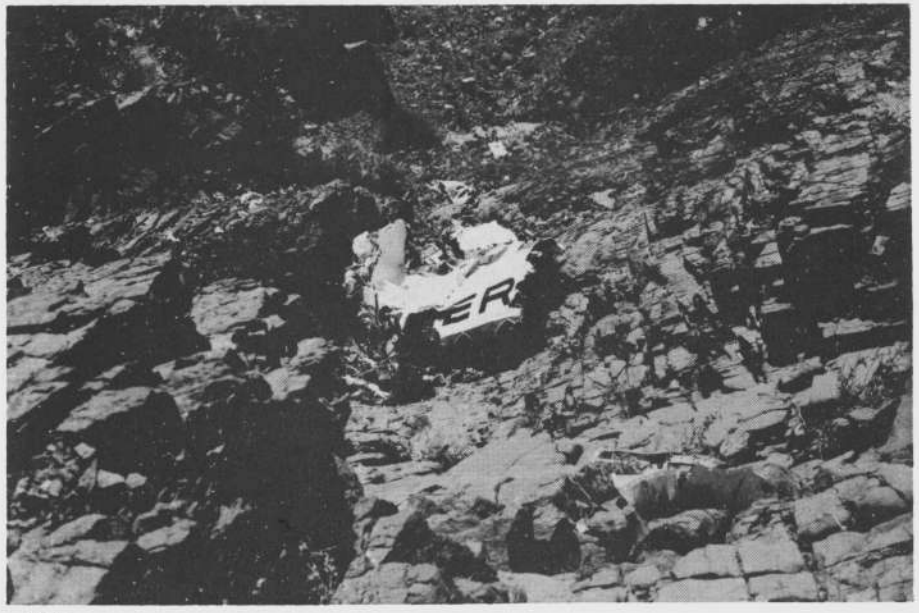

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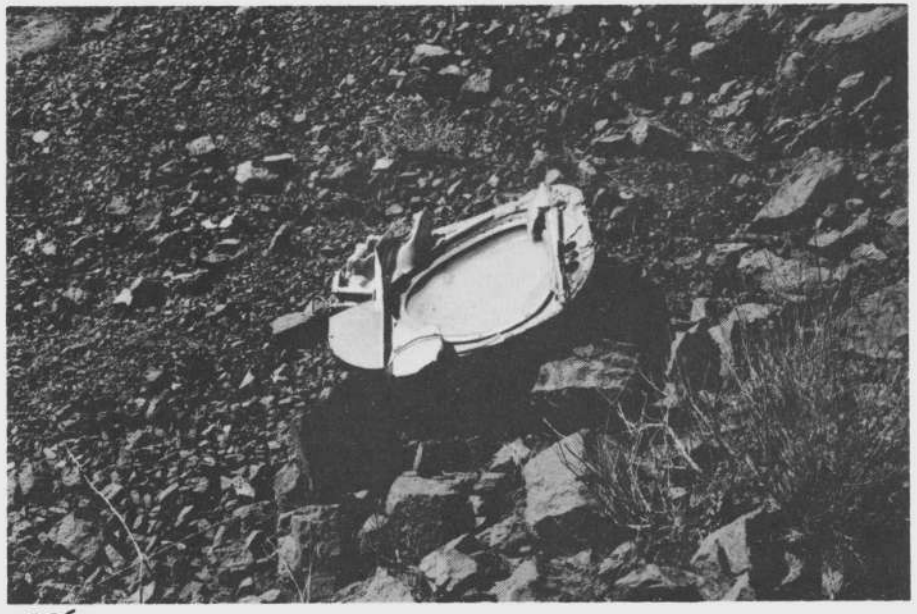

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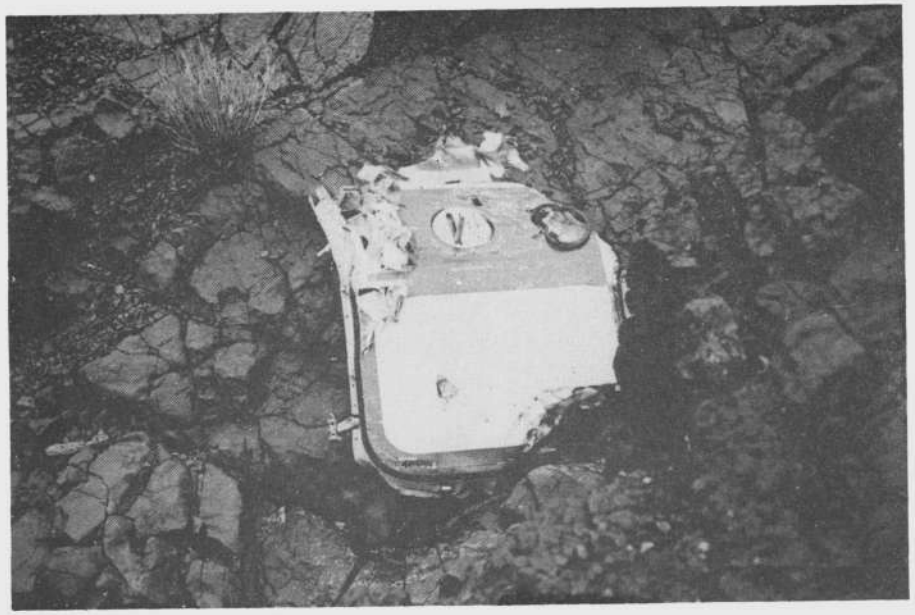

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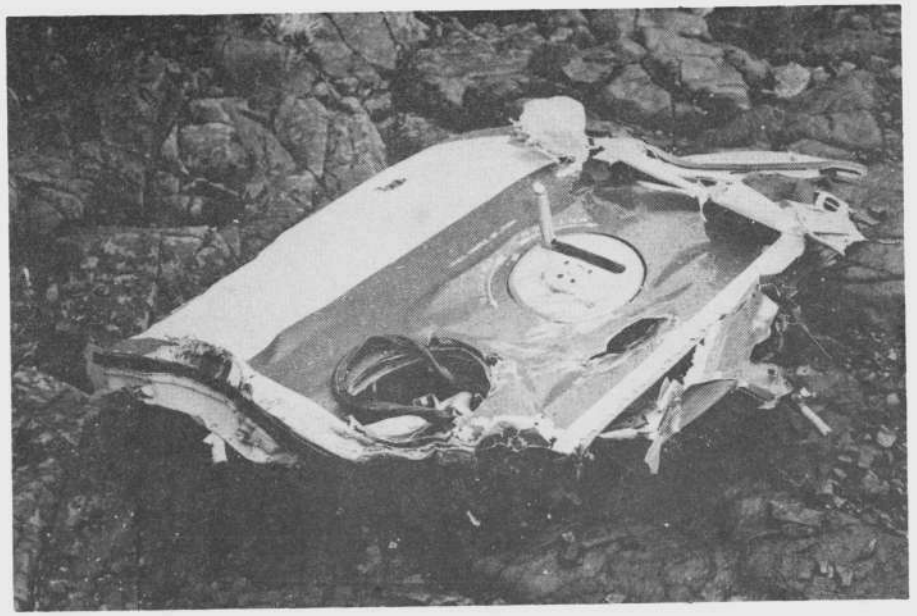

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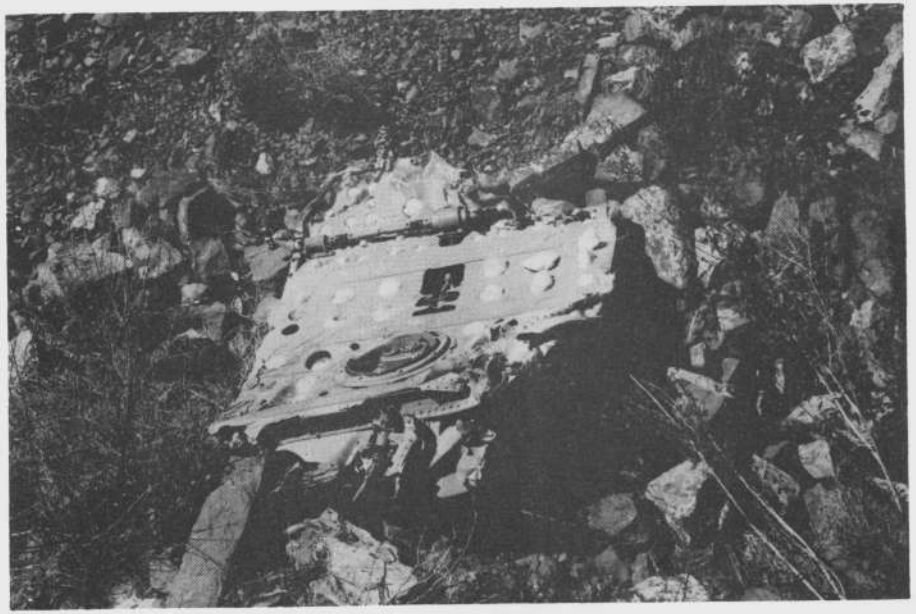

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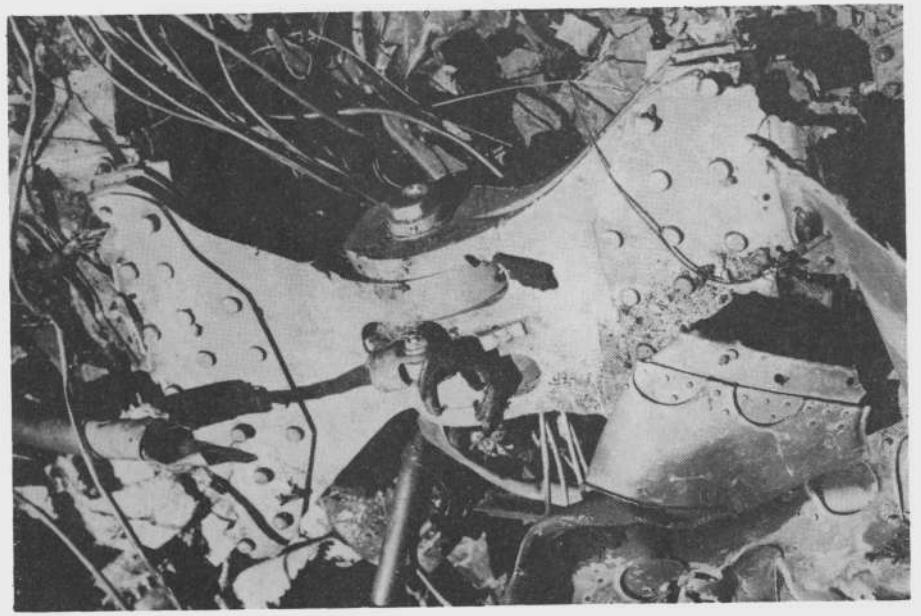

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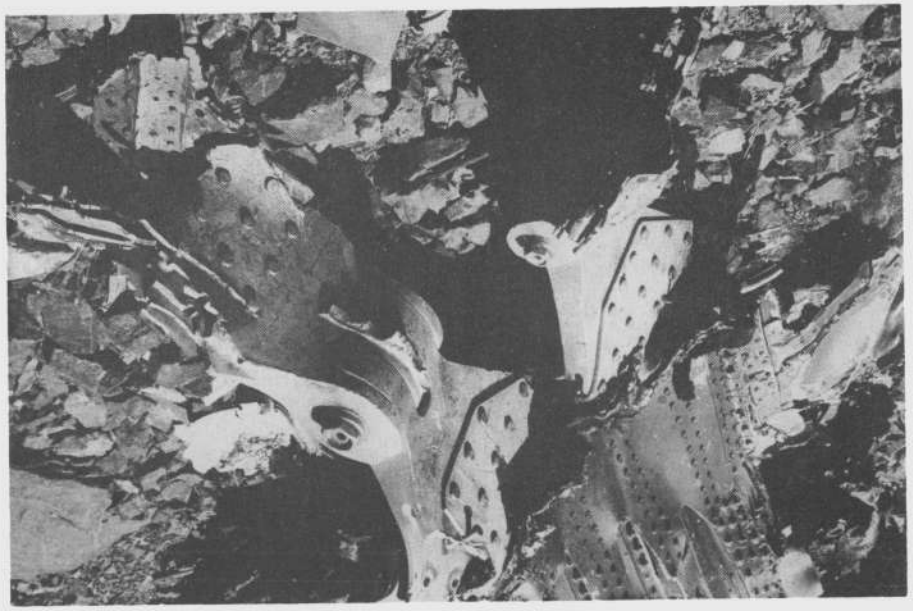

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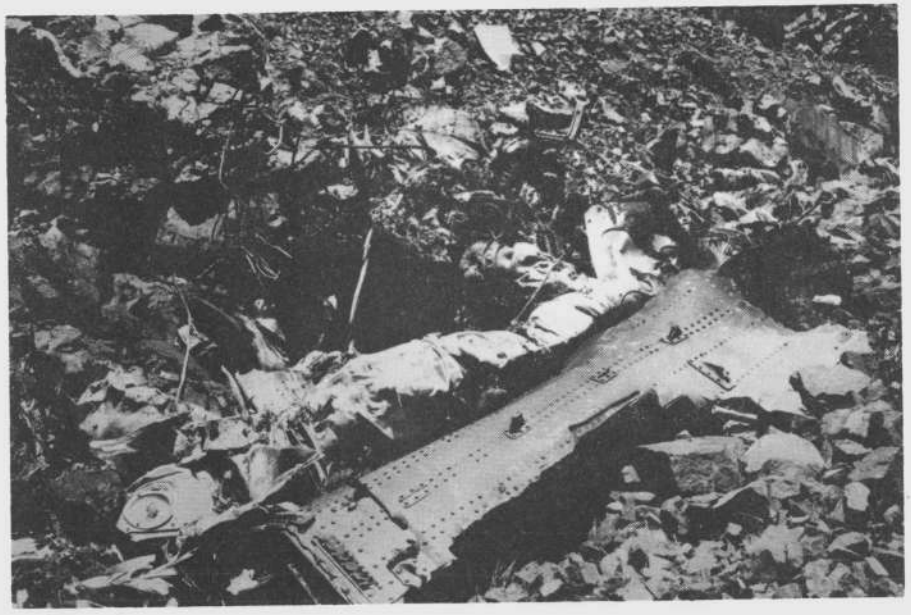

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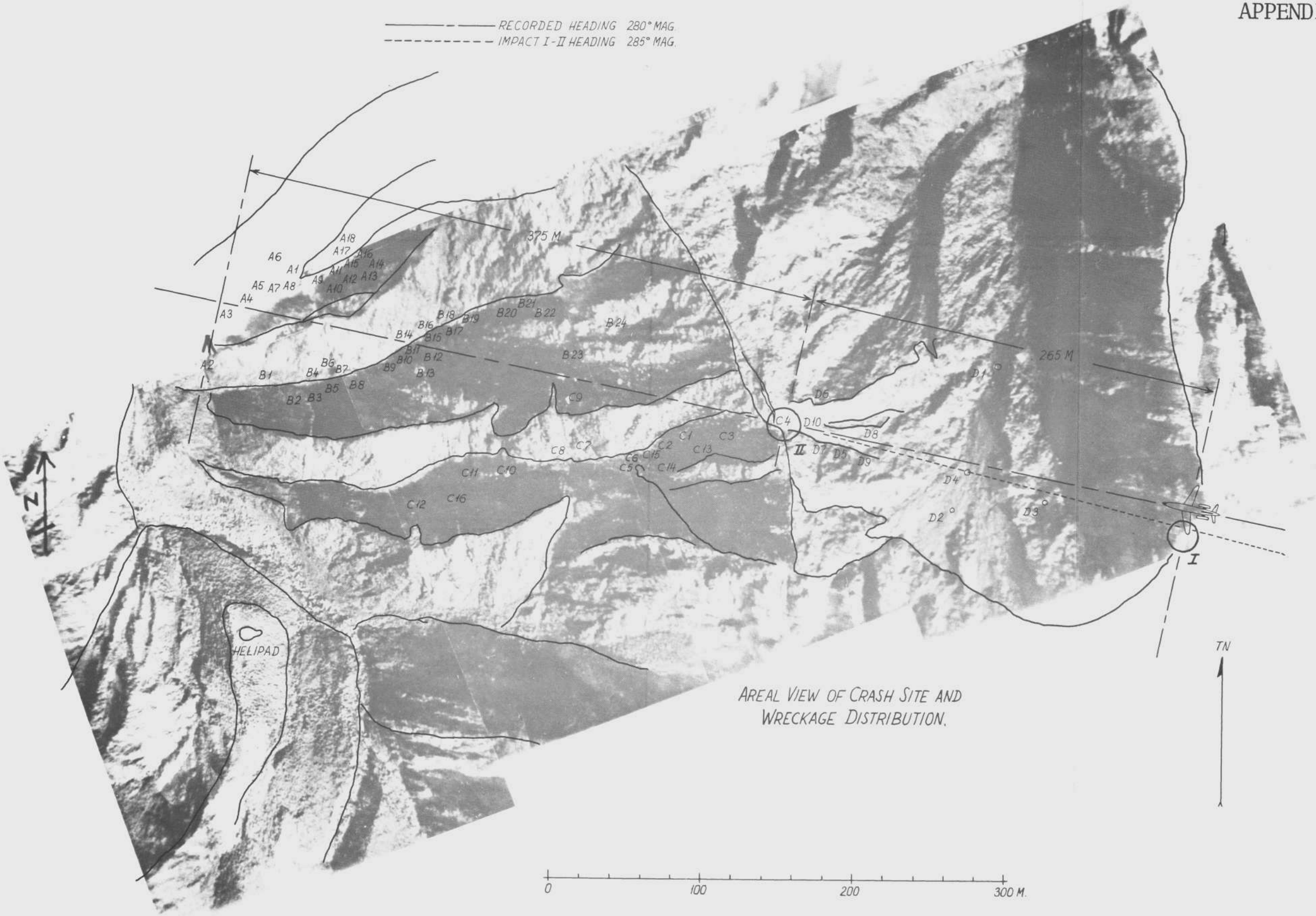

AREAL VIEW OF CRASH SITE AND WRECKAGE DISTRIBUTION.

STERLING
Flight
Date
Off
A/C Reg.
Selcal
Time
Fuel
Act
AWY
Min Alt
Dist.
ACC
Wind
ATO
FL
Remarks TAS/FE/FIR
STD
Temp
WC
ZERO
Alt.

APPENDIX K

TERLING

WEIGHTS IN: LBS: DC-6 B
LBS: F-27/L-188

FLIGHT PL

ht		Date		STD	Off Bl.	A/C Reg.		Selcal		Time		Fuel	
										STD	Corr	Est	Act
ry	Min Alt	Dist.	ACC	Wind	MT ▼	Off VABB	ATD	ETO/RETO	ATO	FL	Remarks TAS/FF/FIR				
9	27	1oo			293	Salmon/SLM (R 2o5 BV 243)		/				2o			
	1o	197			292	Seahorse/SHE (R 169 KC 112,1)		/		31o	428/263o	29		3250	
	1o	241			291	Bleuwhale (R 228 KC 112,1)		/				34		4700	
	1o	166			291	Dolphin/DPH (R 199 JI 113,9)		/		35o	4o1/224o/1:47	25			
	1o	189	OBBI		29o	58E (R 336 GA 318)		/				28		6700	
	43	15o			291	Dubai DO 115,7		/				22		7350	
								/							
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								/							
								/							
						COPY OF FLIGHT PLAN		/							
						DATED OCT. 71.		/							
						(2ND. EDITION)		/							
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	IAL	-			IAL	OG OMDB	ATA	ETA		ETE	2:44	6		765o	
	1o43	NM	Average			STA	On	Note:				Captains Sign.:			

Conditions		Corrections		
Standard	Act	Unit	Time	Fuel
TOW		+1	+1	+1oo
54T		-1	-1	-5o
FL				
STD		-4ooo	-7	+4oo
Temp		+1o	+7	-15o
STD		-1o	-5	+25o
WC		+2o	-6	-2oo
ZERO		-2o	+8	+3oo
Destination Correction:				

Fuel Calculations	Standard		Corrected	
	Time	Fuel	Time	Fuel
Dest. OMDB	2:44	765o		
Alt. OMSJ	Incl.in Hold.			
Res. 1o%	o:16	6oo		
Holding	1:oo	22oo		
Min. Bl. Fuel	4:oo	1o45o		
EXTRA				
Total Bl. fuel				

Dripped/Dipped: Gauges:

Burn off KGs:

Tankage KGs:

APPENDIX L

Oct/71