

Department of Trade

ACCIDENTS INVESTIGATION BRANCH

**Piper PA 31-350 Navajo Chieftain G-BBJG  
Report on the accident at Horsforth  
near Leeds, Yorkshire,  
on 6 December 1974**

## List of Aircraft Accident Reports issued by AIB in 1975

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10/75	Piper Twin Comanche PA30 G-ATYR at Saulmore Bay, near North Connel aerodrome, Argyll October 1974	November 1975
11/75	Vickers Vanguard 952, G-AXOP at Hochwald/Solothurn, Switzerland April 1973	September 1975
12/75	Douglas DC7C/L E1-AWG at Luton Airport, Beds March 1974	October 1975
13/75	Boeing 727 Series 46 G-BAEF at Luton Airport, Beds June 1974	October 1975
14/75	Boeing 747 136 G-AWNJ near Nairobi Airport, Kenya September 1974	(forthcoming)

Department of Trade  
Accidents Investigation Branch  
Shell Mex House  
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London WC2R ODP  
14 November 1975

*The Rt Honourable Peter Shore MP*  
*Secretary of State for Trade*

Sir,

I have the honour to submit the report by Mr R D Westlake, an Inspector of Accidents, on the circumstances of the accident to Piper PA 31-350 Navajo Chieftain G-BBJG which occurred at Horsforth near Leeds, Yorkshire, on 6 December 1974.

I have the honour to be  
Sir  
Your obedient Servant

W H Tench  
*Chief Inspector of Accidents*



**Accidents Investigation Branch**  
**Aircraft Accident Report No. 15/75**  
**(EW/C505)**

**Aircraft:** Piper PA 31-350 Navajo Chieftain G-BBJG

**Engines:** 2 (right) LT10-540-J2BD  
(left) T10-540-J2BD

**Owner and Operator:** McAlpine Aviation Limited

**Pilot:** Killed

**Passengers:** Seven - Killed

**Place of Accident:** Horsforth near Leeds, Yorkshire  
53° 50' 14" N 01° 39' 49" W

**Date and Time:** 6 December 1974 at 1721 hrs approximately

All times in this report are GMT

## Summary

The aircraft took off from Leeds/Bradford Airport with one pilot and seven passengers on a charter air taxi flight to Staverton, Gloucestershire. About three minutes later the aircraft was heard and seen flying in and out of low cloud in the area south of the airport and following an apparently random flight path. This pattern terminated when it crashed in a field about two miles south of the airport approximately six minutes after take-off; there were no survivors.

Post-mortem examination of the pilot revealed that he had been suffering from coronary artery disease and the report concludes that it appears probable that he became incapacitated following an acute coronary episode in the air and was unable to maintain control of the aircraft.

## 1. Investigation

### 1.1 History of flight

The aircraft was on charter to ICI Fibres, Harrogate and was making an air taxi flight from Leeds/Bradford Airport to Staverton, Gloucestershire. The service was operated between Leeds/Bradford and Staverton twice daily, morning and evening from Monday to Thursday, with an evening service only on Fridays. This charter had been operating for about five years and for over a year it had been flown with Piper Navajo Chieftain type aircraft.

The seven passengers, all employees of ICI Fibres, boarded the aircraft with the commander and at 1710 hrs the aircraft was cleared to taxi to Runway 28. The aircraft commenced its take-off run at 1715 hrs and after becoming airborne and climbing away normally it disappeared into cloud at about 200 feet. At about this time the operator's manager pilot, who lived about 1½ miles west of the end of the runway, heard an aircraft depart. He assumed, from the time factor and the sound of the engines, that it was his company's Navajo and noticed what he believed to be the engines being reduced to climbing power; he thought all sounded normal. Shortly before 1718 hrs the pilot was asked by Air Traffic Control (ATC) to report passing 3,500 feet; there was no reply to this transmission, nor to all subsequent attempts to contact the aircraft.

About this time the aircraft was seen (with its navigation lights and anti-collision beacons on) and heard flying in the general area where it finally crashed. It was first seen at a position about 3½ miles south-southwest of the airport just below the low cloudbase and flying on a north-easterly heading, as if returning to the airport. However the evidence indicates that it subsequently followed a very random course, continually turning and flying in and out of the cloud-base. This pattern terminated in a sustained, descending, steep turn to the right from which it struck the ground at very high speed on a southerly heading. Shortly before the crash the engines were heard to cough or splutter, however this was followed by the sound of the engines at very high power, many witnesses described the noise as similar to a dive bomber; the noise continued to the point of impact about two miles south of the airport, in a ploughed field at an elevation of about 280 feet. A plot of the aircraft's probable ground track based on information obtained from witnesses is at the Appendix to this report.

## 1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	7	-
Non-fatal	-	-	-
None	-	-	-

## 1.3 Damage to aircraft

The aircraft was destroyed by impact and ground fire.

## 1.4 Other damage

There was some minor damage to stone walls, hedges and foliage in the fields where the aircraft crashed.

## 1.5 Crew information

Commander:	Aged 51 years.
Licence:	Commercial Pilot's Licence, valid to 7 July 1978.
Ratings:	Aircraft, Part 1; PA22, Cessna 150/210, BN2 Islander, PA23, HS104-Riley 400, PA34, PA31. Instrument rating valid to 25 February 1975.
Last medical examination:	6 November 1974, assessed fit. This examination included a routine electrocardiograph which was reported as showing no abnormalities.
Last certificate of test:	On PA31 aircraft, 25 November 1974.

Last route check:	4 May 1974.
Total pilot hours:	6,784 hours.
Total flying hours in command of PA31 aircraft:	390 hours.
Total flying hours in last 28 days:	31 hours 35 minutes.
Rest period	21 hours.

The pilot had been in the Royal Air Force from 1942 to 1966 and obtained a Commercial Pilot's Licence in July 1968; he joined McAlpine Aviation Limited in May 1971. He commenced flying the PA31 aircraft in November 1973 since when he had flown it extensively on the route between Leeds/Bradford and Staverton.

## 1.6 Aircraft information

The Piper PA31-350 Navajo Chieftain is a multi-purpose, twin engine, low wing monoplane. Each Avco Lycoming T10-540-J2BD turbocharged engine drives a three bladed, constant speed, fully feathering metal propeller. The aircraft was fitted with dual full instrument flying panels, an Altimatec autopilot, full night flying equipment and upper and lower anti-collision beacons; full dual controls were fitted. It was also equipped with ten seats, including the two side by side pilots seats.

Manufacture:	Piper Aircraft Corporation, USA.
Date of manufacture:	1973.
Certificate of Registration:	The aircraft was registered in the name of McAlpine Aviation Limited on 18 September 1973.
Certificate of Airworthiness:	Transport Category (Passengers) valid until 27 September 1975. The aircraft had been maintained in accordance with an aircraft maintenance schedule approved by the Civil Aviation Authority (CAA).
Total hours since built:	692 hours.
Hours since last check:	44 hours.
Total engine hours:	692 hours (left) 692 hours (right).
Hours since last inspection:	44 hours (left) 44 hours (right).

The exact weights of the pilot, the passengers and their baggage are known but it was not possible to determine which of the available seats were occupied by the seven passengers. The calculated take-off weight was 95 kg below the maximum certificated take-off weight of 3,175 kg and it has been calculated that the Centre of Gravity would have been within the prescribed limits of 126.6 inches to 135 inches aft of datum, irrespective of which seats were occupied by the passengers. It was customary for one of the passengers to occupy the right hand pilot's seat.

Prior to its departure from Leeds/Bradford on the accident flight the inboard tanks of the aircraft were refuelled with Avgas 100 to their maximum capacity of 93 imperial gallons, the outboard tanks were empty.

The aircraft's records show that the left density controller of the right engine was reported as defective on a flight the previous day. On the morning of the day of the accident a new density controller was fitted and the Commander was present when a satisfactory ground run was carried out. On completion, an entry was made in the engine log book by a qualified licenced aircraft inspector, and the Commander also signed an acceptance of the aircraft before starting the accident flight. The unserviceable controller was subsequently given a test rig check to determine whether any other part of the turbocharger system could have been at fault. The test proved that the density controller itself was unserviceable and a diaphragm failure was suspected as the cause.

## 1.7 Meteorological information

The following weather observation was recorded at Leeds/Bradford Airport at 1716 hrs ie just after take-off:

Surface wind:	270 <sup>0</sup> /14 knots.
Cloud:	5/8 stratus at 200 feet, 7/8 stratus at 300 feet.
Visibility:	2,500 metres.
Weather:	Continuous slight drizzle.
Temperature:	+ 8 <sup>0</sup> centigrade.
QNH:	1020.2.

A pilot who landed at Leeds/Bradford Airport shortly before the departure of G-BBJG reported the cloudbase as 300 feet. After a quick turnaround he departed again at 1728 hrs, and reported the cloudbase then to be slightly higher at approximately 400 to 500 feet.

Leeds/Bradford Airport has a Flight Planning Office where facilities are available for pilot self-service meteorological briefing. During the afternoon the pilot of G-BBJG made several calls at this office checking on the weather conditions at Leeds/Bradford and his destination and alternates. On one visit he collected a route forecast and aerodrome forecasts for Staverton and its alternate aerodromes.

The forecast for Staverton was:

Period:	1800 hrs to 2100 hrs.
Surface wind:	240 <sup>0</sup> /15 knots.
Cloud:	5/8 stratus at 700 feet. 8/8 stratocumulus at 1,200 feet.
Visibility:	8 kilometres.
Weather:	Drizzle.
Intermittently:	
Cloud:	7/8 stratus at 400 feet.
Visibility:	3,000 metres.

On his final call at the Flight Planning Office he collected copies of all the major United Kingdom aerodrome forecasts.



About an hour before departure the pilot spoke by telephone with his company's manager pilot, discussed the weather situation with him and said that he thought there was a good possibility of the weather on his return to Leeds/Bradford being below company limits and that in this event he would divert to Tees-side for which the relevant forecast was a minimum of 8 kilometres visibility and a 1,000 feet cloudbase.

The accident occurred at night.

## **1.8 Aids to navigation**

### **1.8.1 *On the ground***

At Leeds/Bradford Airport all the relevant radio navigational aids were serviceable. These aids consisted of the Instrument Landing System (ILS) for Runway 33, the non-directional radio beacon (NDB) 'LBA' situated 4 nm from the threshold of Runway 33, Leeds radar and the very high frequency direction finding (VDF) facility.

Except when there was a separation problem with other aircraft (not so in this case) it was not normal for Leeds radar to monitor departing traffic, so the radar was not manned. A few minutes after take-off, when it became apparent that radio contact had been lost, the radar display was checked but the operator was unable to identify any blip that could have been the departing aircraft. A similar check made by Preston Air Traffic Control Centre (ATCC) also failed to locate the aircraft but Preston ATCC does not normally pick up a radar return from an aircraft departing Leeds/Bradford Airport until it is at a height of about 3,000 feet.

### **1.8.2 *In the aircraft***

The aircraft was equipped with two VHF communication transceivers, two VHF navigation receivers, a single ADF receiver, a single DME and a Radar Transponder; no unserviceabilities had been recorded in the technical log.

## **1.9 Communications**

A transcript of the messages between ATC and the pilot shows that normal VHF communication was established on the frequency of 123.75 MHz; this was the only frequency used throughout the entire departure sequence. The ATC clearance given to the pilot at 1714 hrs, just before take-off, was 'Macline 537 is clear to Staverton via Oldham, Amber 1, climb to maintain flight level 50, request level change en route, flight level 70, flight level 90 not available.' The last communication from the pilot was at 1715.00 hrs when, after receiving clearance for take-off, he replied 'five three seven rolling'. At 1717.48 hrs the pilot was called by ATC to 'report passing 3,500 feet'; there was no reply to this transmission nor to all subsequent attempts to contact him.

## **1.10 Aerodrome and ground facilities**

Leeds/Bradford Airport is situated 6 nm northwest of the city of Leeds at an elevation of 681 feet. To the south, the area over which the aircraft was flying, the ground drops away to an elevation of about 200 feet into a valley towards the River Aire and then rises again south of the river.

## **1.11 Flight recorder**

There was no requirement for a flight recorder and none was fitted.

## **1.12 Wreckage**

Examination of the wreckage showed that the aircraft had struck the ground, right wing tip first, at high speed in a shallow nose down attitude with a high rate of sink

and on a heading of approximately 220°(M). From the point of first impact the wreckage trail extended for 260 metres in a direction of 176°(M) across ploughed and grass fields which were divided by dry stone walls.

The wreckage trail indicates that the aircraft had been turning at the moment of impact and that large side forces were involved during its break-up. Fire occurred on impact.

Detailed examination of the wreckage showed that the front and centre fuselage broke up during ground impact; the right wing had completely disintegrated and the left wing had also broken into small pieces. The complete tail unit received extensive crash damage which caused twisting of the tail structure; this was consistent with the impact attitude and the forces involved. There was no evidence of any pre-crash failure in any of the fractures or control connections.

The flying controls of the ailerons, elevator and rudder were reconstructed and examined. The examination showed no evidence of pre-crash mechanical failure or malfunction and all damage found was consistent with the crash. Evidence from the three trim tab systems indicated that all were at an approximate neutral setting.

The autopilot system was severely damaged; examination of the remains showed no evidence of any pre-crash failure nor was there any evidence to indicate whether or not it had been in use.

All crew and passenger seats had broken off at floor level, the damage being consistent with the aircraft's attitude and direction at ground impact.

Both engines received very extensive crash damage. Strip examination showed no evidence of malfunction or damage other than that consistent with the crash. Strip examination of portions of the broken hubs and blades from both propellers showed that they were operative at the time of impact. Examination of the fuel system showed no evidence of mechanical failure or malfunction and the filters showed no obstruction or dirt other than that caused by the crash. The left and right fuel selector valves were found set to their respective inner tanks. No fuel was obtainable from the crash but analysis of a fuel sample taken from the vehicle used for the last refuelling of the aircraft showed that it complied with specification requirements.

Examination of two pneumatic and two electrically driven gyroscopic flight instruments showed that they had been working at the time of impact. Examination of a number of light bulb filaments which survived the accident showed that they were illuminated when the aircraft crashed.

Both VHF communication transceivers were badly damaged. Both were selected 'on', the No. 1 set being selected to 127.45 MHz (Preston Airways and Radar frequency), and the No. 2 set being selected to 123.75 MHz (the frequency of Leeds/Bradford Approach Control, used for the departure sequence). The two VHF navigation receivers were also badly damaged; the No. 1 set was found selected to between 109.95 and 110.90 MHz and the No. 2 set to 110.90 to 110.95 MHz, (the frequency of the Leeds/Bradford ILS serving runway 33 is 110.90 MHz). The frequency found selected on the ADF receiver was 344 kHz; this corresponds to the frequency of the Oldham NDB.

According to the operator's manager pilot at Leeds/Bradford these selections on the radio equipment would have been normal pre-departure procedure, especially in the event of a take-off into poor weather conditions.

### 1.13 Medical and pathological information

Post mortem examination showed that all the occupants had died from severe multiple injuries. Tests of the pilot for alcohol were negative and there was no evidence of cockpit contamination by carbon monoxide.

Histological examination of the pilot's heart revealed severe coronary artery disease. This was accompanied by a more recent change in the form of a haemorrhage into the wall of one of the coronary arteries and there was evidence to indicate that this haemorrhage had occurred during the lifetime of the pilot and was not attributable to injuries sustained during the crash.

It was concluded that this was a natural disease process which could have been occurring for a period of hours or even a few days prior to his death.

From the pathological evidence (and the supporting evidence from the accident reconstruction) it is believed that the pilot suffered an episode of acute myocardial ischaemia (heart attack) shortly before the crash. The symptoms and consequences of such an episode could vary from feeling ill with a pain in the lower chest or abdomen, resembling acute indigestion, to severe pains in the chest with the possibility of becoming unconscious or even dying during the attack. The available pathological evidence does not allow any useful assessment as to an order of probability or severity in this case.

Examination of the pilot's hands revealed injuries which could have been caused by gripping the control column of the aircraft at the time of impact. However these injuries were far from typical and, because of the extensive destruction involved in this accident, it is impossible to offer any positive opinion that these injuries were in fact caused in this manner. One of the passengers had similar hand injuries which, if anything, were more typical of the type to be expected from gripping a control column at the time of impact with the ground. There is also some evidence to suggest that this passenger may possibly have been in the right co-pilot seat (his body was found fairly close to that of the pilot) and this, in turn, suggests the possibility that this passenger had been attempting to control the aircraft following the pilot's incapacitation.

### 1.14 Fire

There was no evidence of in-flight fire. During the complete disintegration of the aircraft at ground impact, fuel was thrown over a considerable area and caught fire. In addition to parts of the aircraft wreckage the hedges and foliage of the fields into which the aircraft had crashed also caught fire.

Six appliances from the West Yorkshire Metropolitan Fire Service arrived at the scene at 1725 hrs and by 1747 hrs all fires had been extinguished using one hose reel jet from a water tender and 10 lb of dry powder extinguisher.

Twenty-two fire fighting personnel were in attendance. Prior to the arrival of the Fire Service two members of the public attempted to deal with the fires using two 2 gallon water expelling extinguishers.

### 1.15 Survival aspects

The accident was non-survivable

### 1.16 Tests and research

Nil

1.17 Other information

Although it was not possible to establish a passenger seating plan it is known that it was normal practice for one of them to sit in the right hand pilot's seat; it is assumed that this practice was followed on the accident flight. Inquiries have established that none of the seven passengers had any pilot training or experience.

## 2. Analysis and Conclusions

### 2.1 Analysis

The aircraft had been properly maintained and there were no outstanding 'carry-through' items in the maintenance log. The defective left density controller of the right engine, reported on a flight the previous day, had been replaced, signed out by a qualified licenced aircraft inspector and accepted by the pilot after a ground run of the engines.

The take-off on Runway 28, into a cloud base of about 200 to 300 feet, was apparently normal and there is no reason to suppose that it should have presented any significant problems to an experienced commercial pilot who was also very familiar with the route and the aircraft. Pre-take-off radio selections of communications and navigation equipment appear to have been made to the appropriate standards for such a departure and communications with Leeds/Bradford were entirely satisfactory up to and including the pilot's report 'five three seven rolling' at the start of the take-off.

It appears probable that the aircraft continued straight ahead after take-off for about one mile to the point where it was heard by the operator's manager pilot to whom it sounded normal at that time. However, about two minutes later, instead of having continued the climb to the cleared 50 flight level, the aircraft was seen and heard, south-west of the aerodrome, still with engine noise apparently normal, but flying at about 300 feet above ground level and on a heading of approximately north-east, ie towards the airport. Although it must be treated with some reserve the diagram at the Appendix to this report, which shows the aircraft's flight path during the remaining three minutes before the crash, is considered to be the best assessment of the evidence of a considerable number of ear and eye-witnesses. During this period the engines were heard at a constant power level except for a momentary reduction followed by a very considerable power increase during the final turn just before the crash. The navigation lights and anti-collision beacons were seen to be operating throughout.

The post accident examination of those parts of the aircraft, its engines, flight controls and systems which survived the severe disintegration and ground fire revealed no evidence to suggest any pre-crash defects. In particular the flying control trims were at neutral, which suggests no major control problem, the engines had been operating under considerable power even up to impact, and at least some of the flight instrumentation had also been operating. There is therefore no evidence of technical failure or malfunction sufficient to have degraded the aircraft's handling or performance capabilities to an extent which would have compelled a pilot of this experience into an apparently random low level flight path culminating in a loss of control during a turn and the final crash.

Although the aircraft's VHF communications transceivers were found set to the frequencies of Preston Radar and Leeds/Bradford Approach Control there had been no call from the pilot to indicate any emergency or change of plan, nor indeed had he replied to the Tower's instruction to report passing 3,500 feet. However, the fact that electrical power was available to operate the navigation lights and some of the flight instrumentation does not necessarily preclude a form of failure resulting perhaps in the loss of radio communications and/or the loss of all or some of the radio navigation facilities. Additionally any such failure might have been compounded by the loss of other items such as cockpit lighting, auto pilot etc.

If any such failure is considered as solely one of communications then the pilot is most likely either to have followed the standard radio failure procedure and continued to

Staverton or possibly, since he had maps with prepared tracks and since the weather there was suitable, to have diverted to Tees-side. In the unlikely event of deciding to return to Leeds/Bradford in the existing weather, and retaining radio aids, he would certainly have followed an instrument approach procedure rather than the random flight path reported by the witnesses.

If the possible failure is assumed to include radio navigation facilities then he is most unlikely to have attempted to return to Leeds/Bradford in such poor weather and knowing the nearby high terrain. In such an extreme emergency it would be a more rational procedure to fly the prepared tracks towards Tees-side, which is near the coast, in relatively flat terrain, and where the weather offered a 1,000 feet cloudbase and 8 km visibility.

It is considered that the radio silence, the apparent attempt to return to Leeds/Bradford, the final random flight path and, finally, the loss of control of an essentially viable aircraft, only become explicable in the context of the pathological evidence. On that evidence the pilot had previously suffered coronary artery damage and was undoubtedly at very severe risk of a 'heart attack'. It is impossible to predicate what time factor or intensity might be involved, or the degree or rate of progressive incapacity such an attack might entail. Although he had a boom microphone and a transmit thumb-switch on the control column the pilot made no radio calls to indicate any emergency; this could suggest immediate incapacity. On the other hand the successful descent through cloud and the initially appropriate return heading could indicate some degree of positive control rather than a purely fortuitous flight sequence. Whichever of these possibilities is accepted, in view of the findings as to engine, airframe and flight instrumentation serviceability, and considered in terms of a competent professional pilot, the final flight path is certainly indicative of pilot incapacity. There is some support for this in the evidence that one of the passengers had hand injuries which may well indicate that he had been gripping the control column at impact. Since none of the passengers had any flying experience relevant to such a situation in bad weather and at night, it is apparent that the accident would become inevitable once the pilot was incapacitated.

The circumstances of this accident serve to highlight two matters of concern both of which have been the subject of discussion for some years but neither of which has yet been satisfactorily resolved. The first is whether it should be made mandatory that there be two pilots in commercial passenger carrying operations of this type. The present UK legislation does not require this for aircraft engaged for the purpose of public transport, which have a maximum certificated take-off weight of less than 5,700 kg, although it is always open to the charterer to call for a two pilot crew.

The second feature, and one which has a direct relationship to single pilot operations, is the apparent inadequacy of the present version of medical examinations as a method of disclosing whether or not a pilot is becoming or has become a 'heart attack' risk sufficient to require medical treatment or to warrant suspension of his licence privileges. This is by no means the first occasion on which post mortem examination has revealed evidence of serious heart disease, occasionally of long standing, which has not been discovered by means of the standard medical examinations even when these have incorporated resting electrocardiograms.

It is known that measures to improve the present diagnostic procedures are under review and at the instigation of the CAA the Royal College of Physicians has a working group studying the problem. There is however considerable diversity of opinion on the subject and an understandable reservation against the premature introduction of methods on which there is, as yet, no overall agreement as to their efficacy. Nevertheless it must be emphasised that it is not simply an individual pilot who may be at risk but, as in this accident, also those members of the general public who are passengers in the aircraft; the provision of improved diagnostic procedures should therefore be regarded as a matter of considerable urgency.

## 2.2 Conclusions

### (a) Findings

- (i) The aircraft had been maintained in accordance with an approved maintenance schedule and its documentation was in order.
- (ii) The pilot was properly licensed and adequately experienced for the flight.
- (iii) There is no evidence that any pre-crash defect or malfunction of the aircraft, its engines, or services was a causal factor.
- (iv) The aircraft struck the ground, approximately two miles south of its point of departure, in a high speed spiral dive after flying a random path at low height for about three minutes.
- (v) The pilot was suffering from severe coronary artery disease. The post mortem examination revealed that there was an acute change present in the coronary arteries which could have led to pilot incapacitation.
- (vi) One month prior to the accident the pilot had a medical examination which included a routine electrocardiograph; this was reported as showing no abnormalities.
- (vii) The evidence of the pilot's heart condition and the random flight path flown by the aircraft strongly suggests that control of the aircraft was lost following pilot incapacitation.

### (b) Probable cause

It appears extremely probable that the pilot became incapacitated in the air following an acute coronary episode and control of the aircraft was lost.

### 3. Recommendations

- 3.1 It is recommended that a review covering the minimum crew requirements for passenger public transport operations of aircraft below 5,700 kg maximum certificated take-off weight be made.
- 3.2 It is recommended that the effort at present being directed to the improvement of diagnostic procedures relating to the detection of significant coronary artery disease during professional pilot medical examinations should be intensified and the institution of improved procedures treated as a matter of urgency.

R D Westlake  
*Inspector of Accidents*

Accidents Investigation Branch  
Department of Trade

November 1975