No. 38

Derby Aviation Ltd., C-47B, G-AMSW, accident near Mount Canigou, Pyrenees on 7 October 1961. Report released by the Inspectorate General of Civil Aviation, Ministry of Public Works and Transport, France, in Le Journal Officiel (No. 9, 1962). This summary is based on the translation of the final report published as C.A.P. 179 by the Ministry of Aviation, United Kingdom.

Circumstances

The aircraft was coming from Gatwick, England, and after reporting over Toulouse at about 0030 hours GMT it headed directly for Perpignan, France, at flight level 75. It was expected over the aerodrome at about 0112, and it was seen shortly before 0100 by various witnesses in the Prades area, during intermittent rain and wind of variable force. It struck the mountain side in level flight in the Canigou Massif at about 0100 hours. The wreckage, located at an elevation of 2 200 m at 1350 on the same day by a Search and Rescue Constellation, was destroyed by the impact and by fire. There were no survivors. Three crew and 31 passengers were aboard the flight.

Investigation and Evidence

The Aircraft

The aircraft's certificate of airworthiness was valid until 23 March 1962. Its total flying time up to the last flight was 13 658 hours 35 minutes.

Examination of the records revealed no serious incident entailing major structural repair of the airframe.

Since last general overhaul the Nos. 1 and 2 engines had flown 681 hours and 51 hours respectively.

On 24 September 1961 the automatic direction-finder receiver was changed at Palma following a failure in flight. This new equipment had subsequently to be repaired at Gatwick on 1 October 1961 (power supply connections). There were also failures of the Decca equipment on 10 August 1961 (receiver) and on 16 September 1961 (power supply).

At time of take-off the weight of the aircraft was 12 561 kg, i.e. below the maximum authorized weight of 12 700 kg. Its centre of gravity was within limits.

According to the Operations Manual the fuel required was 500 Imperial gallons. The fuel aboard the aircraft was 440 Imperial gallons. It was placed on the aircraft in accordance with the instructions of the captain and although adequate for the flight Gatwick - Perpignan, was 275 litres (60 gal) less than the quantity required by the Operations Manual.

Crew information

Both the pilot-in-command and co-pilot were considered to be good and competent pilots.

The pilot-in-command held an airline transport pilot's licence valid until 9 December 1961 with a rating for Dakota C-47 aircraft in Group 1. His last instrument rating check was on 16 July 1961.

His total flying hours amounted to 5 624. On the C-47 he had flown:

as co-pilot	by day :	600 hours
	by night:	50 hours
as aircraft commander	by day :	2 712 hours
	by night:	320 hours

during the last 90 days: 299 hours 45 minutes

During the last six months (after following the direct route Limoges - Perpignan) he had landed twice at Perpignan (once by day and once by night). He had flown about 1 670 hours with this airline as aircraft commander on the C-47.

The co-pilot also held an airline transport pilot's licence valid until 14 December 1961 with a rating for Dakota C-47 aircraft in Group 1. His last instrument rating check was on 25 October 1960. He had flown a total of 2 267 hours including the following hours on C-47 aircraft:

as co-pilot	by day	: 1 589 hours
as aircraft commander	" "	: 175 hours

During the last 90 days he had flown 320 hours 35 minutes as co-pilot.

During the last six months (on a route not via Toulouse), he had made five landings at Perpignan (one by day and four by night).

He joined this Company in March 1959 with about 500 hours of flight time, and flew with the Company for one season. He then rejoined the Company in March 1960 and flew as co-pilot, logging about 1 500 hours on C-47 aircraft up until the date of the accident.

The operations manual of the airline

It constitutes both a route manual and an operations manual.

In the part of the Manual dealing with en route information, the following is given for flight from Gatwick to Perpignan:

Traffic		: Gatwick-Perpignan
Non-traffic stop		
Route		: AWY
Dist. NM		: 597
Time		: 4.40
Alternate		: Toulouse
Dist. NM		: 100
Time		: 0.45
Total time		: 5.25
Sector Fuel	Weight	: 1 697
	Gallons	: 520

Pre-determined safety heights are not given, but the following formula is included in the Manual:

"The safety height for a particular route must be at least 1 500 ft above the highest obstacle within 25 NM either side of the intended track or 25 NM beyond either terminal or alternate aerodromes.

When flying over the sea, the aircraft must not be below 1 000 ft at any time, except for the purposes of taking-off and landing.

When operating in the vicinity of high ground, the minimum altitude to be flown must be increased to 2 000 ft above the highest obstacle within 25 NM either side of the intended track.

Airways flights will conform to the route guides issued by the Company unless otherwise instructed by Air Traffic Control. The above limits apply in instrument meteorological conditions only, but care must be taken to see that the selected flight level conforms to the quadrantal height separation rules."

No indication is given of the specific charts to be used with the formula.

The Manual also contains a chapter dealing with allowable deficiencies. As regards the flight instruments, take-off with a single directional gyro is permitted even in instrument meteorological conditions or at night.

Finally, the performance curves for the Douglas Dakota 4 itself are given in a separate log-book kept with the case containing the aircraft certificates.

Meteorological information

The forecast prepared at Gatwick was for a Gatwick-Perpignan-Palma or Barcelona route.

It included the terminal forecasts, prepared at 1800 Z and valid for the period

from 1800 Z on 6 October to 0300 Z on 7 October, were the latest which Gatwick could have had at the time when the flight forecast was handed over.

The terminal forecasts received from Perpignan were as follows:

period 0000 - 0300 Z
surface wind 160°/18 kt, gusts 25 kt;
surface visibility: 7 NM; cloud: 4/8,
base 2 000 ft (600 m) and 7/8, base 10 000 ft (3 000 m)

with intermittently:
rain; visibility: 5 NM, cloud: 4/8, base 1 200 ft (350 m) and 8/8, base 9 000 ft (2 700 m)

terminal forecasts - Toulouse

surface wind: variable, 7 kt;
surface visibility: 11 NM (20 km) rapidly becoming 6 NM between 0000 and 0300 Z
cloud: 6/8, base 4 000 ft (1 200 m) and 7/8, base 1 000 ft (300 m)

rapidly becoming between 0000 and 0300 Z:
4/8, base 1 000 ft (300 m) and
6/8, base 3 000 ft (900 m) with rain.

Briefing

During the briefing the Gatwick forecaster gave the latest observations available received from Toulouse and Perpignan, i.e. those for 1900 Z.

Toulouse 1900 Z

surface wind: 200°, 2 kt
surface visibility: 4 NM (8 km)
cloud 8/8, base 4 000 ft (1 200 m)

Perpignan 1900 Z

surface wind: 280°, 8 kt
surface visibility: 11 NM (20 km)
cloud 1/8 cumulonimbus, base 2 600 ft (800 m)
7/8, base 11 000 ft (3 300 m)

The Gatwick forecaster stressed the fact that the route, which passed to the west of the Massif Central, would be situated be between an active thunderstorm disturbance over the eastern half of France and a fresh weak disturbance coming from the west.

The forecaster has indicated that he was not asked by the captain for the wind at flight level 75 on the Gatwick-Perpignan route. He added that the captain was particularly interested in the 700 mb chart.

In conclusion, the flight forecast given to the crew was complete and contained the latest meteorological information. Nevertheless, the forecast winds below 10 000 ft (3 000 m) were not included for the sector between 48 N and Perpignan.

0000 Z meteorological observation at Perpignan

At 0025 Z the aircraft received, at its request, from Toulouse approach control the following information:

- surface wind 320°, 18 kt
- visibility 15 km
- rain
- cloud 5/8 at 900 m
  8/8 at 3 000 m

The Flight

Pre-flight preparations

The flight was arranged by Derby Aviation under contract with a London travel agency and was to transport tourists by air from Gatwick to Perpignan.

The aircraft was given a pre-flight check on 6 October for its flight to Perpignan.

Crews have to do their own pre-flight planning. The aircraft is equipped with a navigation bag with the necessary maps, route guides and plans. In addition, the airline prepares standard navigation logs for particular routes and these documents, which do not include minimum safe altitudes,

are intended to serve as guides, but they are not mandatory.

It is not certain whether the crew had these logs, but before departure at about 2000 Z the co-pilot went to the "briefing" room of the aircraft, where the usual aeronautical information was available to him, and then completed the Air Traffic Control flight plan at the Aerodrome Flight Clearance Section.

The route shown on the flight plan mentioned Gatwick, then Dunsfold, and finally Perpignan directly via FIR (this route did not conform to the navigation logs of the airline, but it could be used by the aircraft commander at his discretion). With an estimated elapsed time of 4-1/2 hours, an endurance of 6 hours and a true airspeed of 140 kt, the flight plan gave Toulouse Blagnac as an alternate aerodrome.

The two crew members appeared to be in good health and spirits according to witnesses who saw them before the take-off.

Reconstruction of the flight

The flight departed Gatwick at 2043 hours and shortly thereafter indicated he was flying at flight level 75 and estimated flight over the French coast for 2132 Z. It actually crossed the coast at 2136 Z.

During the exchange of communications with Paris Control the aircraft indicated specifically that it would leave the airway at Limoges in order to fly direct to Perpignan. At 2253 Z, G-AMSW reported that it was over Amboise at 52, at flight level 70, and estimated its passage over the FIR boundary for 2319 Z and over Limoges for 2340 Z. At 2319:40 Z G-AMSW contacted Bordeaux Control. After recapitulating its flight data and in particular its estimated time of arrival at Limoges at 2338 Z, it stated that it wished to fly to Limoges, then Toulouse, and from there to fly direct to Perpignan. Bordeaux replied that the direct route to Perpignan passed over Carcassonne. Bordeaux Control at 2321 Z, in order to be certain that no doubt remained about the route to be followed by the aircraft, explained that the Limoges to Perpignan route via Carcassonne was practically direct and that in view of the existence of a radio beacon at Carcassonne it seemed preferable for G-AMSW to fly over Carcassonne. It then asked the aircraft to give an estimated time of arrival at Carcassonne and to change to flight level 75 over Limoges. The aircraft replied that it would not change its flight level at Limoges for it wanted to fly Limoges - Toulouse - Perpignan. Bordeaux Control then accepted the Limoges-Toulouse route.

The aircraft reported having passed Limoges at 2336 Z and estimated passage over the boundary of Toulouse control area at 0020 Z and over radio beacon FOU at 0040 Z. Bordeaux Control explained that the upper limit of Toulouse CTA was at flight level 65, and asked the aircraft to call again over FOU. G-AMSW acknowledged receipt.

The aircraft advised (at 0009 Z) it wanted to go on flight level 75 after Toulouse. At 0010 Z and again at 0019 Z the tape recorded two calls of G-AMSW to Bordeaux Control which did not reply; there was heavy interference during the first of these calls.

From 0022 Z to 0027 Z, G-AMSW entered into communication with Toulouse Approach Control on frequency 121.1 Mc/s. It indicated that it had been unable to contact Bordeaux Control and asked for the latest meteorological reports for Perpignan. The latter were then passed to the aircraft.

At 0030 Z the aircraft again made contact with Bordeaux on 120.1 Mc/s, reported "check passing Toulouse" and gave an estimated time for passage abeam Carcassonne at 0052 Z at flight level 75. Bordeaux then asked for the estimated time of crossing the boundary between Bordeaux and Marseilles FIRs. The aircraft

confirmed 0052 Z. The aircraft was then cleared to climb to flight level 75, and Bordeaux asked for confirmation of the estimated time for crossing the FIR boundary. G-AMSW confirmed 0052 Z. It should be noted that the aircraft gave the same estimated time for abeam Carcassonne and for crossing the FIR boundary. No further contact was made with the aircraft. Except for the communications with Toulouse, it was the co-pilot who made the radio communications with the ground. No language difficulties were encountered.

Examination of the wreckage

The aircraft struck the northwest side of Pic Barbet, a northeast spur of Mount Canigou at a flight level of very nearly 75. The impact point was about 40 km from Perpignan aerodrome and 150 km from Toulouse. At the accident site the mountain side slopes at about 60 to 70°. It is very rugged, with boulders, crags and even cliffs, which make access difficult, and the ground is covered with dense vegetation in the form of rhododendrons 60 cm high, and wooded, sometimes only sparsely, with pine trees. From evidence at the scene of the accident, it was ascertained that at time of impact the aircraft was flying straight and level on a heading of about 148°T. (heading from Toulouse to the place of the accident: 141°T.)

General condition

The aircraft was partially disintegrated by the shock of impact. The port wing, which was wrecked, part of the fuselage and the starboard wing, which was less damaged, remained practically at the point of impact. The remainder of the wreckage was flung 50 m higher up the mountain side, but the rear part of the fuselage and the tail, which were little damaged, dropped back a little way behind the initial point of impact.

The two engines and their propellers were separated from their mountings, the lower cylinders broken and the connections and accessories smashed, while the reduction gears followed the propellers which broke away from the engines. After being flung further up the mountain side, the two engines fell back again and the starboard engine was stopped by the main wreckage while the port engine came to a standstill under the trees about 100 m lower down.

Fire broke out immediately after the crash and the tanks, the centre section and the forward part of the fuselage, as well as the wreckage of the crew compartment, were seriously damaged by the fire. The pilot's position and instruments were completely destroyed by the crash and the fire. The flaps and undercarriage were in the retracted position at the time of the accident. The elevator and rudder tabs were in the neutral position. The two engines were developing power at time of impact. From examination at the scene of the accident, the appearance of the engines did not reveal any indication of mechanical failure before the accident. The ground fire was caused by the rupture of the fuel tanks.

The observations of the wreckage showed no evidence of any structural failure or of fire during flight. No sign of a lightning strike was noticed. No part of the aircraft broke away before the impact and all the control surfaces, in particular, were in position. The Decca equipment was probably not in operation at impact. The radio compass was functioning and set to a frequency corresponding to that of Perpignan. There was no evidence to indicate a radio failure although such a possibility remained after 0030.

Discussion of Evidence

Meteorological Situation - General

During the night of 6 to 7 October, a depression was located between Ireland and Cornwall. It was extended towards the southeast by a pronounced trough, as far as the Gulf of Lions where a secondary was in process of formation. In front of this trough the winds were southerly, whereas behind it they were blowing from the west.

There were two disturbances in this trough, both with a NNW-SSE alignment.

On 7 October at 0000 Z, the first disturbance was aligned along Dunkirk, Geneva and Ajaccio, and was, therefore, far to the east of the Gatwick-Perpignan route. The second disturbance, on a smaller scale than the first, was aligned at this same time along Dieppe, Clermont-Ferrand and Montpellier. Both gave rise to a number of thunderstorms over the western slopes of the Massif Central, but at the time of the flight of G-AMSW, there were no reports of thunderstorms by the meteorological stations situated along the aircraft's route.

The greater part of the flight was made behind the second disturbance, for the aircraft passed through the weaker part of the disturbance between the French coast and Chateaudun.

From the standpoint of cloudiness and altitude of the cloud layers, the forecast prepared by Gatwick was approximately correct and corresponded well to what was observed by the meteorological stations and by those aircraft from which a report is available.

The surface visibility along the route also conformed to the forecast.

It is difficult to make a comparison for the upper winds, for G-AMSW flew sometimes at flight level 70 and sometimes at flight level 75, and the lowest level for which the Gatwick forecast gave the wind was 10 000 ft.

Assuming that the winds at flight level 75 had the same direction as at 10 000 ft, and that their force was 5 kt lower, the forecast would have given:

Gatwick to 48 N	180°/30 kt
48 N to 45 N	180°/25 kt
45 N to Perpignan	variable 10 then 240°/20 kt

According to the upper air charts, the real winds appear to have been the following at flight levels 70 and 75:

Gatwick - Chateaudun	160°/25 kt
Chateaudun - Limoges	200°/20 kt
Limoges - Toulouse	290°/30 kt
Toulouse - Perpignan	290°/25 kt

The considerable difference from the winds forecast, from Limoges onwards, is explained by the fact that this part of the flight was made behind the second disturbance referred to previously and not in front of it. For the same reason, the upper air temperatures were slightly lower than those forecast.

The terminal forecasts corresponded approximately to the real conditions: overcast with intermittent rain, but without very low cloud or bad visibility. On the other hand, the surface winds were WNW instead of SSE at Perpignan. The cause was the same as that given above.

At the accident site

On account of the rugged nature of the terrain, the local meteorological conditions may have been quite different from those recorded at the nearest meteorological stations: Perpignan, Carcassonne, Toulouse (the stations of St. Girons and of the Pic du Midi do not provide a night service) and cannot be known with certainty.

From the statements of witnesses and the summary indications provided by the auxiliary climatological stations of Pyrenees-Orientales, and also from the reports of other aircraft, it may be estimated that:

> The Tet Valley was covered by a continuous cloud layer, with its base at about 2 700 to 3 000 m and top at about 5 000 to 6 000 m, giving slight intermittent precipitation: rain in the valley, snow above 1 600 to 1 800 m. There was no low cloud in the valley, but the top of the Pic du

Canigou must have been covered in cloud.

The wind was slight or nil in the valley, but strong from the north-west near the peaks.

Thunderstorms

G-AMSW does not appear to have encountered thunderstorms on its route. On the other hand, there was probably considerable static interference.

Icing

The aircraft, flying at flight level 70 or 75, was always in temperatures close to 0°. The absence of temperature inversion above the flight level excludes the possibility of freezing rain and considerable icing. It is highly probable that there was no icing of the aircraft.

Turbulence

The existence of local mountain turbulence was possible at the time of the accident, but only in the immediate vicinity of the mountains.

Conclusions

At the time of the accident the weather was very cloudy if not overcast, with some slight rain, but there was no particular meteorological phenomenon of exceptional intensity.

The ground visibility was good, and there was no very low cloud.

The only factor which could have affected the flight appears to be the west-northwest direction of the wind on the second half of the route, giving a tailwind instead of the expected wind from starboard causing port drift.

Observations

Flight plan

1) It was not completed in accordance with the directions given in the French regulations as regards the route to be followed under instrument flight rules, directions reproduced for the greater part from ICAO Doc 4444-RAC/501/7. In this part of the flight plan, in fact, only the point of departure, the radio beacon of Dunsfold and the point of destination Perpignan, the estimated elapsed times between these points (4 minutes and 4 hours 26 minutes respectively) and the cruising level (75) are shown.

   According to the directions, it was mandatory to indicate the points at which airways were crossed, and in addition the points at which FIR boundaries were crossed and, if necessary, certain radio fixes ought also to have been indicated.

2) The direct route from Dunsfold to Perpignan passes through the FIRs of Paris, Bordeaux and Marseilles in succession, the portion of the route inside Bordeaux FIR being very short. Probably because the points of crossing these FIR boundaries were not shown on the flight plan, Gatwick ATC did not address this departure plan to Bordeaux area control centre.

These two irregularities had no effect on the course of the flight from the standpoint of the co-ordination ensured by telephone between the various French air traffic services units.

It may also be noted that, as opposed to the British regulations, the French regulations require the filing of a flight plan when the flight is to be made in instrument flight rules conditions.

Communications between the aircraft and ground stations

The poor technical quality of the communications between the aircraft and Bordeaux Control led to difficulties in understanding at times. The quality of reception of other aircraft by Bordeaux Control was good at about the same time. It was clear, however, that ultimately the control services and the aircraft commander were in agreement on the route to be followed and the altitudes to be assumed.

Because of this poor quality, no conclusions can be drawn with regard to possible deterioration in the functioning of the aircraft equipment used for communications on the mobile service. At no time did the crew appear to show any anxiety on this subject. Only on two occasions did it ask for repetition of the messages from Bordeaux Control. Also, at the time of the contact established on 121.1 M/cs with Toulouse approach control, the quality of the recording shows that the functioning of this airborne equipment seems to have been normal, at any rate on this frequency.

Navigation

With regard to the aircraft's navigation, a certain number of differences from the estimated times given by the aircraft commander were noted (see Reconstruction of flight). During the last contact with Bordeaux Control, G-AMSW gave 0052 Z both for the passage abeam Carcassonne and for the crossing of the FIR boundary.

Carcassonne radio beacon is located exactly on the FIR boundary. The theoretical direct route marked on a map shows that between the passage abeam Carcassonne and the crossing of the FIR boundary about three minutes should have elapsed.

This coincidence in the estimated time does not mean that the pilot had finally decided to fly over Carcassonne, for during the last contact with Bordeaux Control he definitely used the formula "abeam Carcassonne".

Navigational aids

The whole of the flight from London/Paris FIR boundary to Toulouse was normal. During none of the R/T contacts did it report any irregularity in the functioning of the navigational aids.

The functioning of the MF radio beacons of Carcassonne and Perpignan gave rise to no comment by the services responsible for their maintenance, for the period of time of interest for the flight of G-AMSW.

It is estimated that the range of Perpignan's radio beacon is about 60 NM. British crew members statements indicated that its range is only 20 NM, another estimated that its usual range is about 75 NM and that this radio beacon is very good by day and night, although he had never had occasion to use it in bad weather conditions or with heavy static interference.

Carcassonne radio beacon is less powerful. It is estimated that its range is about 25 NM.

It should be recalled that the use of MF radio aids is governed to a relatively large degree by the irregularities of propagation due to night effect and to orographical conditions, by the degree of interference due to atmospheric conditions (static, icing, etc.) and by the quality of the airborne receiver.

Regarding the Decca chain, the main aerial of Aurillac station was struck by lightning on 6 October at 1807 Z. The result was a maladjustment. The repairs were completed, and the station was again performing normally at 2000 Z. Between 2000 Z on 6 October and 0300 Z on 7 October no irregularity of functioning was reported.

The use of this navigational aid in the Toulouse-Perpignan area must not be considered as absolutely reliable, although

certain pilots claim that they obtain the correct degree of accuracy on decometers. (Flight log use is in any event not to be recommended). This area is in fact situated on the edge of the limit of acceptable accuracy on the British maps published for this purpose.

It is believed that the pilot-in-command was fully informed of the conditions governing the use of and the possibilities afforded by the radio aids in this area.

A coding error in the Channel Islands sector of the chart gives reason to think that the crew must have switched off the flight log when they realized that it was not possible to use it. In consequence, the pilots may well have also had doubts about the satisfactory functioning of the decometers.

In the absence of any VOR airborne receiver, G-AMSW could not use the VHF omni-directional range of Toulouse (TO-117.7 Mc/s).

Choice of route

At 2319 Z, at the time of the first R/T contact with Bordeaux Control, the pilot reported that he wished to fly via Limoges - Toulouse - Perpignan. Perhaps he decided to abandon the direct Limoges - Perpignan route, either because of the bad weather conditions to the east, or because of the possible doubt regarding the use of the Decca.

In spite of the insistence of the controller who suggested to him that he should take the practically direct route from Limoges to Perpignan via Carcassonne, the pilot refused, and the controller finally gave his agreement to the route requested.

Of three possible routes, the pilot chose the third, Limoges - Toulouse - Perpignan, 218 NM, but the reason for this choice is not apparent.

Safe altitude for the chosen route

Mount Canigou (altitude 9 138 ft or 2 785 m) is inside the limit of 25 NM from Perpignan; consequently, the correct application of the formula for safe altitudes specified in the Operations Manual determines a minimum altitude of 11 500 ft.

While it is the responsibility of the aircraft commander to ensure that a flight is made at a safe altitude, it was found that application of this formula to the different types of maps and charts, which may have been on board G-AMSW, can result in calculations of safe altitudes varying between 1 500 ft and 11 500 ft.

Reconstruction of the navigation

According to the navigation plan reconstructed and the radio transcripts, the estimated time of arrival of G-AMSW was very close to 2340. In fact, the aircraft had fixed its reporting point "past Limoges" as 2336 hours.

After having discarded the possibility that the aircraft may have used another route than the one intended, the Commission then considered attempts to reconstruct the navigation on a Limoges - Toulouse route and then on a route from Toulouse to the accident site.

Passage at Toulouse

The aircraft arrived at 0030 Z, i.e. 10 minutes ahead of its estimated time of arrival. It is legitimate to think that the navigator had used a head wind from Limoges, without drift, whereas in actual fact he had been subjected to a crosswind with a drift of about 11° to port and a tailwind component of about 6 - 8 kt. This unexpected drift, which was probably nil at Limoges, increased to 11° near Toulouse, and gives reason to think that the aircraft had to bracket the track indicated by its radio compass during the flight from

Limoges to Toulouse. As a result 10 minutes before its estimated time of arrival over Toulouse and at the time when it arrived in the vicinity of the town, G-AMSW could perfectly well have been several kilometres off its route; it may, therefore, logically be thought that the aircraft probably passed in the vicinity of Toulouse ("passing Toulouse") and not *over Toulouse* ("over Toulouse").

It might normally have been thought that the pilot, after having passed Toulouse would have navigated by QDRs using a back bearing on the radio beacon FOU for a track covering a distance of 90 to 100 km (probable limit of the night range of the radio beacon), before going over to "homing" on the Perpignan radio beacon FOP.

In the absence of evidence, it is impossible to know whether such a procedure was adopted by the crew.

Abeam Carcassonne

The flight was asked to call abeam Carcassonne (CS), but the call was not heard by any ground station. It may have been out of range at the estimated time for this call. At the estimated time the aircraft may have had some difficulty in identifying the Perpignan radio beacon. This would have taken the attention of the co-pilot and might explain the absence of *communication with the ground.*

Toulouse vicinity to accident site

In conclusion (and subject to the reservation that on the hypothesis of correct functioning of the radio compass, its indications may have been difficult to interpret, wrongly interpreted or even *disregarded) the following points may* give an explanation of the course of the navigation:

The aircraft, when it had passed Toulouse and in the immediate vicinity of that town, went on to a heading with the *intention* of following the direct Toulouse - Perpignan track (without flying over Carcassonne).

It is not known whether the radio compass, the only really effective navigation aid on board, was used. It seems probable that the crew placed more reliance on navigation by dead reckoning than on the *indications of the* radio compass.

If the crew calculated its course by using the forecast wind (about 240°/25 kt) which gave it a drift to port of about 10°, whereas the known reconstructed wind was approximately 290°/25 kt and therefore causing no drift, then the course would have become the effective track (137° true).

If parallel lines are drawn through FOU and throught the place of the accident on a bearing of 137° true, they are found to be about 8.5 km apart.

In consequence, in order to intercept the track leading to the place of the accident, the minimum error in relation to a position over FOU would have been a passage by G-AMSW of about 6.5 km to the west of FOU, followed by the assumption of a heading (137° true) 75 seconds later.

Although this reconstruction seems to offer a perfectly acceptable solution, in the absence of evidence to the contrary, including in particular precise information of the kind which could be provided by a flight recorder, the Commission cannot consider it as definitive.

The possibility of a failure of the single magnetic compass has in particular been considered. The whole of the evidence before the Commission, however, seems rather to point to normal functioning.

Probable Cause

The accident was attributed to a navigational error, the origin of which it was not possible to determine for lack of sufficient evidence.

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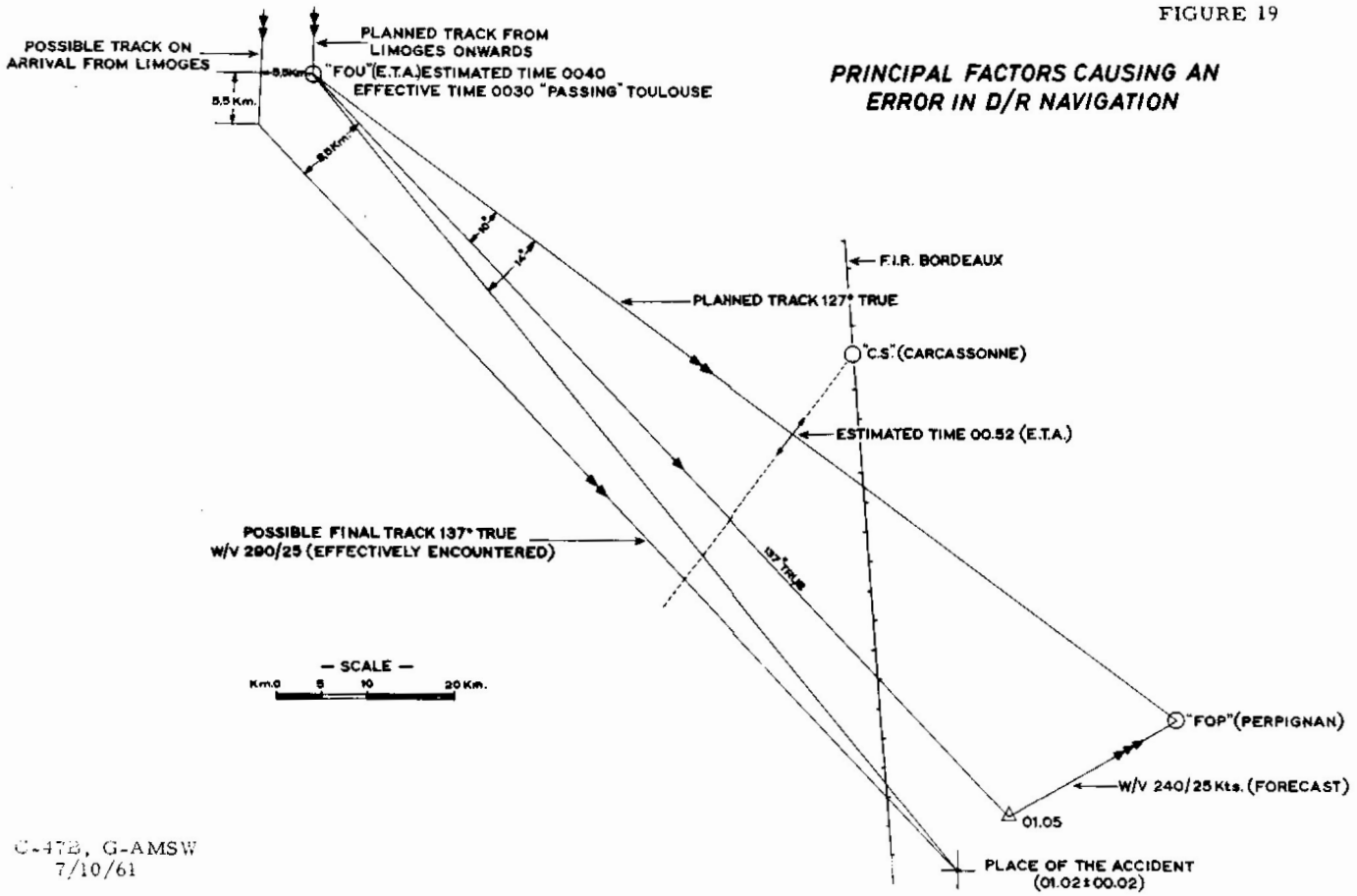
ICAO Ref: AR/717

FIGURE 19

PRINCIPAL FACTORS CAUSING AN ERROR IN D/R NAVIGATION



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7/10/61