

was covered with snow and thick ice which is totally dry. Once the aircraft began its descending orbits and the crew could see below and ahead these expanses of pack ice many square miles in extent, their attention would presumably be concentrated on a visual lookout and they would not be concerned with studying radar returns. But even if they did look at the radar after it had levelled out on its final course towards Mt. Erebus then it is not possible to say, in the absence of actual experiment with this type of radar, whether they would have seen any return at all. All the scientific probabilities are, in accordance with the evidence of Captain Lawson, that radar in the mapping mode might detect the difference between the sea water and pack ice, but once solid ice had been reached it would not reveal the existence of any high ground ahead. Once sea water had disappeared, then the radar returns would probably be nil.

Consequently the simple thesis that the air crew could have seen Mt. Erebus on the specialised radar equipment installed in the aircraft is not established. All this shows the danger of hearsay evidence. There is no substitute for making direct inquiries from the person or persons who have the information.

- (m) The final allegation of pilot error against the air crew lay in the suggestion that when manually inserting the waypoints for the flight into the aircraft computer, the crew should have noticed that there was now a difference between the destination co-ordinates and those appearing on the flight plan produced at the briefing session of which a copy had almost certainly been in the possession of Captain Collins when he plotted his flight track the night before the fatal flight. Although the meridian of longitude had been adjusted by only two digits out of five, the parallel of latitude had also been adjusted by a change of one digit and by the addition of another. Seeing that Captain Collins had been working the night before on the previous destination co-ordinates, I felt obliged to give this particular matter careful consideration.

It is perfectly true that the flight plan provided on the morning of the flight contained very large numbers of mathematical digits covering not only the geographical position of the waypoints but also track and distance information, flight levels, fuel calculations and the like. But the opportunity was certainly there for Captain Collins to have noticed that the destination co-ordinates appeared to be different from those on which he had been working the night before. He would have been required, no doubt, to have been the possessor of a very accurate memory but he was described to me as having been a very methodical man. Of course he may not himself have been concerned in the insertion of the co-ordinates. This may have been done by First Officer Cassin and First Officer Lucas, or by First Officer Cassin and Flight Engineer Brooks. This is one of the things which no one will ever know. But even if Captain Collins had himself participated in the insertion into the aircraft computer of all the figures on the flight plan, it is reasonably certain that it would never have crossed his mind that any waypoint on a standardised flight plan had been changed, and his long experience in the AINS method of navigation would render it inconceivable to him that the position of any waypoint could possibly have been changed without his knowledge. As Captain Gemmell himself said in evidence, when he learned about the transposition of the co-ordinates for the waypoint, and the non-disclosure to the air crew, it came as a "bombshell", a clear indication of the practical impossibility that

such a thing could happen without the air crew being told. In these circumstances, and bearing in mind the doubt which exists as to whether Captain Collins himself was involved in the insertion of the waypoint, I cannot accept this allegation as being an indication of error on the part of the pilot-in-command.

290. Such is the catalogue of pilot error which comprises, to the best of my recollection, a total of the acts or omissions in respect of which the air crew of TE 901 were alleged to have been at fault. I find that none of them has been established to my satisfaction.

McMURDO AIR TRAFFIC CONTROL

291. One of my terms of reference requires me to investigate and report upon whether the disaster may have been contributed to by an act or omission on the part of the air traffic controllers at McMurdo in respect of any function which they had a duty to perform or which good aviation practice required them to perform. I was therefore required to give some attention to the activities of the McMurdo Air Traffic Control on the day in question.

292. It appeared that the material witnesses who had been on duty at Mac Centre and the Ice Tower on 28 November 1979 were no longer located in Antarctica but were back in the United States. Following a series of negotiations between the New Zealand Ministry of Foreign Affairs and the State Department of the United States, it was finally settled that I could interview specified United States Navy personnel who had been members of the Air Traffic Control system at Antarctica on the date in question, but that they would only be available for interview or for the taking of evidence in the United States. Additionally, it was laid down by the State Department that these United States witnesses were not to be interviewed except in the presence of a United States Navy legal adviser. The adviser nominated for this purpose was Lieutenant-Commander E. A. Fessler, a lawyer who is a member of the Judge Advocate General's Department of the United States Navy. Lieutenant-Commander Fessler was very co-operative in arranging appointments for Mr Baragwanath and me to interview such United States Navy witnesses as were available. The witnesses were interviewed in the presence of Lieutenant-Commander Fessler at Port Hueneme, near Los Angeles, and in Washington D.C., and their statements were later reduced by Lieutenant-Commander Fessler to the form of sworn depositions and in due course the depositions were transmitted to New Zealand.

293. The content of the United States Navy evidence may briefly be stated. Technical details were given of the radio facilities available at McMurdo for air-ground communication. The high frequency radio (not dependent upon line of sight) was operated from Mac Centre, which forms part of the McMurdo Base complex. The very high frequency radio (dependent upon line of sight) was available on one frequency at both Mac Centre and the Ice Tower, on another frequency at the Ice Tower only, and on a third (guard) frequency at both Mac Centre and the Ice Tower. On the common frequencies both Mac Centre and the Ice Tower could hear communications between the other and aircraft. There also existed between Mac Centre and the Ice Tower FM links.

294. Normally, VHF contact was established at 120–125 miles but sometimes no closer than 70 miles with the aircraft flying at levels between 18 000 feet and 37 000 feet. The importance of VHF radio contact was both its freedom from static and the fact that no radar directions could readily be given on HF because the Ice Tower, where the radar was situated, would need to ask Mac Centre to communicate with an aircraft on HF transmission.

295. The radar installation at McMurdo possessed an IFF mode (Identification Friend or Foe) which only operates so as to identify an approaching aircraft, and has a range of up to 150 miles. The primary mode of the radar however was aircraft surveillance (ASR) which has a range of about 40 miles and this is the primary radar function which will show the aircraft on the screen. The radar both in its ASR mode and in IFF mode performs a 360° search.

296. It was affirmed that the McMurdo Air Traffic Control expected the DC10 of the fatal flight to arrive down McMurdo Sound, as with previous flights in 1979 and in 1978. It was evidently normal to plot the waypoints given on the Air Traffic Control flight plans telexed from Auckland on the first of each season's civilian aircraft flights which in this case had been 7 November 1979.

297. The evidence was that Air Traffic Control was not aware of the restricted sector within which the DC10 aircraft are said to have been required to fly and they never in fact flew in any defined sector. They approached at low altitudes, which were 1500 feet and in some cases lower than that, and they would always approach down McMurdo Sound. Air Traffic Control had not been told that the programmed route for the fatal flight overflew Mt. Erebus, and they would have disagreed with any such proposal. They would have also disagreed with the 6000 feet descent sector because of difficulty in radar surveillance of an aircraft flying in that sector. In the view of one of the main witnesses, such a sector was "absurd".

298. But the principal fact asserted in the evidence was that the DC10 of the fatal flight had not been seen at any time on the radar screen at the Ice Tower, and this confirmed what the chief inspector had been told at McMurdo.

299. There had been VHF transmissions between the Ice Tower and the aircraft from 12.35:27 p.m. to 12.36 p.m. in which it had been confirmed between the Ice Tower and the aircraft that the DC10 was descending from 13 000 to 10 000 feet VMC and would obtain a radar lead down through cloud.

300. At 12.38:29 p.m. there was initiated a series of transmissions between the aircraft and McMurdo on HF, in which the aircraft announced that it was 34 miles to the north of McMurdo and was maintaining the 10 000 feet level.

301. Then at 12.42 p.m. there were again a series of HF transmissions in which the aircraft operator said they could not get VHF contact but they were flying VMC and would like to let down on a grid of 180° (meaning thereby to the true north) and proceed visually to McMurdo. Mac Centre instructed the aircraft to maintain VMC and to keep Mac Centre advised of its altitude as it approached. The aircraft replied that it would maintain VMC, and this series of transmissions ended with an agreement by the aircraft to report to Mac Centre when they were 10 miles out from McMurdo.

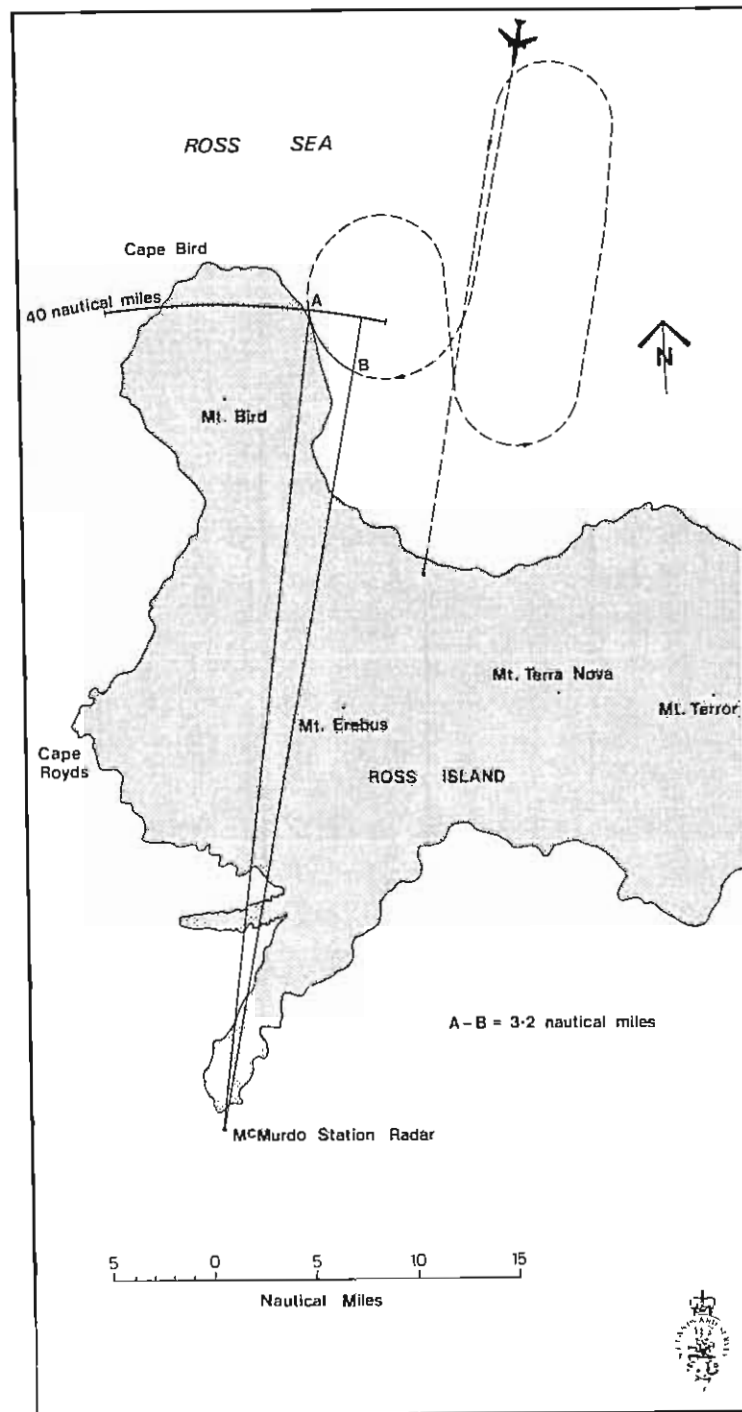


FIGURE 15

302. There were later transmissions on HF between Mac Centre and the ground, from 12.44:36 p.m. to 12.45:08 p.m., in which the aircraft reported that at 50 miles north the cloud base had been 10 000 feet, and in which the aircraft further advised that it was now at 6000 feet and in the process of descending to 2000 feet flying VMC. This was the last transmission received from the aircraft. Four minutes 52 seconds after that final transmission, the aircraft struck the slopes of Mt. Erebus.

303. It was clear from all this that the aircraft had first requested and obtained a radar-monitored letdown, but eventually in its final transmission it had announced that it was now flying down to 2000 feet (below the McMurdo cloud base where Mac Centre had said there was unlimited visibility) and that it was now flying VMC. This final message, acknowledged by Mac Centre, could only have meant that the aircraft was now discontinuing its request for a radar letdown and would be flying to McMurdo under the cloud base.

304. When the aircraft had previously reported that it was at 10 000 feet and flying VMC, it was then in the course of undertaking the two orbits to which I have referred, and the obvious inference is that having successfully descended from 10 000 feet to 6000 feet in clear air, the crew anticipated not requiring any further radar assistance because forward visibility was clear and the aircraft was about to descend under the cloud cover which lay over the McMurdo area.

305. I now turn to the question whether the DC10 was ever visible on the radar screen at the Ice Tower. The theory had consistently been that because the DC10 was approaching on a nav track which took it directly at the summit of Mt. Erebus, and because the track was approximately on line with the radar installation at the Ice Tower, then the height of the mountain would effectively preclude any sight of the aircraft, in view of the fact that it was approaching at altitudes progressively less than 20 000 feet.

306. All this was clear enough, but it seemed to me that the theory overlooked the point that at about 43 miles out from the Ice Tower the aircraft had begun its right hand orbit at an altitude of 17 000 feet. It reached the southern point of its orbit at 37 miles out, and continued to turn to the west and then towards the north following its circular path. By the time the aircraft had turned away to the north at a point 40 miles out, it had dropped to a height of 14 000 feet and was now at the extreme western limit of its orbit which is something like 5 to 6 miles to the west of the peak of the mountain. Then the aircraft had continued turning towards the east, and at about 43 miles out had disappeared behind the mountain peak at about 12 000 feet.

307. For radar transmissions to make contact with the aircraft at 17 000 feet, with the radar being situated 20 miles from the peak of the mountain, I made some calculations which suggested that the radar beam would need a terrain clearance of not less than 9000 feet. This seemed to show that the radar would have picked up the aircraft just after the southern limit of its right hand orbit, and as it began to turn away to the north-west.

308. I asked the New Zealand Department of Lands and Survey if they would prepare me an accurate plot to see if my conclusion was correct. Fig. 15, page 129, shows the plot which was prepared. As will be seen, taking into account the necessary ground clearance which was affirmed at being about 9000 feet, this would mean that the aircraft would become visible on the radar screen from point B to point A on fig. 15 which

represents a distance of 3.2 nautical miles. But this is postulating that the maximum range of the radar is 40 miles. Supposing that it was capable of obtaining a picture at a range of, say, 43 miles, then the aircraft would have been in line of sight of the radar and within range for over 6 miles, which represents 1 minute of flying time.

309. It is also to be noted that the only successful series of VHF transmissions from the Ice Tower to the aircraft had commenced at about point A on fig. 15 and had continued for half a minute while the DC10 moved away to the north, so that the DC10 was certainly in line of sight with the Ice Tower while it travelled at least 6 miles.

310. Even assuming that the range of the Ice Tower radar was limited to 40 miles exactly (which is unlikely), and even making allowance for any initial slight deflection off the western slope of Mt. Erebus possibly sustained by the radar beam at 9000 feet, the aircraft should have been visible on the screen whilst it travelled from a little to the left of position B on fig. 15 to position A. This represents half a minute of flying time. Assuming that the radar sweep at the Ice Tower completes a circuit once in 4 seconds, then there should have been a minimum of seven or eight consecutive "blips" on the Ice Tower radar screen up to the 40-mile limit.

311. I am aware of the apparently outmoded nature of this radar equipment as described by the United States Navy witnesses, although it must certainly have been sufficiently accurate to identify the distance and bearing of the big Starlifter jets and the C-130 aircraft which always used that radar for a glide path. In addition, about 45 minutes after the crash of the DC10, the Ice Tower radar had picked up the approaching Starlifter of Major Gumbie and according to his depositions he was told "at about 38 miles" that the Ice Tower had picked him up on radar, which would infer a pick-up some little time before, probably somewhat in excess of 40 miles out. So after making all allowances, it seems difficult to see how the DC10 did not appear on the Ice Tower radar screen for an ascertainable period of time, being not less than half a minute.

312. There is an independent factor which tends to confirm that the DC10 was in fact seen on the radar screen. This is contained in the telex messages received from McMurdo shortly after the accident, when they reported that the aircraft was overdue and then said that its last estimated position was "38 nautical miles true north of McMurdo" (Annex C to Mr Coker's brief of evidence). There is no radio transmission from the aircraft which mentions a distance to run of 38 miles. There are references in the latter stages on the CVR to other distances, but the phrase "38 miles" is not mentioned. There is accordingly a strong inference that McMurdo Air Traffic Control could not have ascertained the 38 mile distance from the Ice Tower and the exact bearing (true north of McMurdo) unless the distance and bearing had been read by the operator from the radar screen.

313. Just a little north of point B on fig. 15, page 129, the transponder of the DC10 was activated. This occurred at 12.35:15 p.m., following a request from Mac Centre at 12.33:34 pm. to "Squawk" the aircraft's transponder on Code 0400. The fact that the aircraft's transponder is recognising interrogation by ground radar is conveyed to the crew by a light on the transponder panel which remains on for 15 seconds after the last transmission from the aircraft's transponder to the ground station. The ordinary explanation as to what happened here is that Mac Centre instructed the crew to set Code 0400 on the aircraft's transponder for the purposes of ground radar interrogation. In other words, Mac Centre was anticipating a radar return from the aircraft and accordingly asked for the

aircraft's transponder to be activated. The fact that it was so activated at the time which I have stated produces the obvious answer that the DC10 had then been identified on the ground radar screen.

314. The above interpretation of the aircraft's transponder response was challenged by the United States Navy witnesses. It was contended that when the crew of the DC10 were asked to activate the aircraft's transponder this had reference not to identification of the aircraft on the radar screen, but to the radio link between the aircraft and the TACAN. In other words, it was being suggested that the request from Mac Centre referred to the DC10 establishing contact with the TACAN, it being recalled that a DC10 is not equipped to obtain a bearing from the TACAN but is equipped to communicate with the DME function of the TACAN.

315. This explanation cannot possibly be accepted. With ground radar, that radar equipment is the interrogator and the aircraft returns a radio pulse from its transponder thus confirming that radar contact has in fact been made with the aircraft. But in the case of the TACAN, the system works the other way round. The DC10 radio link with the TACAN, if successfully established, carries out the interrogation of the DME system of the TACAN and in this case it is the TACAN equipment which acts as the transponder replying to the airborne interrogation. The instruction therefore from Mac Centre to the aircraft to activate its transponder could have had nothing to do with the TACAN at all. The purpose of the aircraft being asked to activate its transponder was solely for the purposes of surveillance by the Ice Tower radar equipment.

316. It should be noted that I have been compelled to express conclusions as to what might have been seen on the Ice Tower radar because there was no direct evidence on the point from the United States Navy witnesses. Neither the radar operator nor the Ice Tower radio operator was available to give evidence.

317. From all this I draw the following conclusions:

- (1) The probabilities are that the DC10 was in fact on the radar screen for something like half a minute as it emerged from behind Ross Island at about 16 000 feet travelling west on its first orbit, and it may have been on the screen for as long as one minute.
- (2) Seeing that the DC10 began turning to the west on this orbit at 37 miles out (as revealed by the black box) then a pick-up at the 38 miles referred to in the United States Navy telex message would thus be corroborated.
- (3) If the DC10 was observed on the screen, then the radar operator would immediately have noticed that it was on a bearing about 40° to the east of where he had supposed the aircraft to be.
- (4) If the aircraft was seen and the unexpected bearing observed, then the radar operator may have been deterred from any inquiry by reason of the fact that the crew intended to fly out on 180° grid (meaning thereby true north) and proceed visually to McMurdo. That is, the radar operator may have believed that the air crew were aware of their true position and were intending to fly away to the north.
- (5) In any event the last transmission from the aircraft had announced that it was in the process of descending to 2000 feet and was flying VMC. This again would justify, at least in practical terms, a lack of any further communication from the ground to the aircraft.

- (6) In summary therefore, I have formed the view that the aircraft did appear on the radar screen, that it was observed by the radar operator, but that for the reasons just expressed he is not to be blamed, at least within my own terms of reference, from taking any step towards advising the aircraft (on HF through Mac Centre) as to its estimated location. In terms of the official United States Department of Defence publication covering use of the McMurdo navigation aids, there is a public notification that civilian aircraft must use these aids at their own risk. It will be understood that I am not here concerned with any question of liability of the United States Navy at common law, I am only concerned with the question asked in my terms of reference, and I do not believe that the radar operator at McMurdo, if he saw the aircraft appear on his screen, was guilty of any omission in respect of a function which he had a duty to perform or which good aviation practice required him to perform.

THE FACTUAL CIRCUMSTANCES OF THE DESCENT AS DEDUCED FROM THE AVAILABLE EVIDENCE

318. I have now reached the stage when I must indicate my view as to the nature of the descent, and what happened during the course of descent towards the ultimate flight level of 1500 feet. What I have to say is based upon the CVR transcript of communications between the two pilots, the data relating to the descent provided by interrogation of the black box, and the inferences legitimately to be derived from the known circumstances.

Pre-descent Briefing

319. In accordance with standard practice, Captain Collins would have conducted a pre-descent briefing involving not only First Officer Cassin but also Flight Engineers Brooks and Moloney. He would at that briefing have announced his intentions in regard to the descent, and stated exactly how it would be carried out. He would expect to listen to and discuss any queries from the other three members of the flight crew as to his proposed descent procedure.

320. On this topic of pre-descent briefing, there was what I might describe as a noticeable silence on the part of the executive pilots who gave evidence in support of the case for the airline. They all knew, as well as I know, that a detailed pre-descent briefing would have been carried out by Captain Collins. They would also know, as I know, that the descent procedure adopted would have been in accordance with the settled agreement by the flight crew as to the future handling of the aircraft.

321. One of the major difficulties in the Inquiry has been that this pre-descent briefing occurred at a time more than 30 minutes from the collision of the aircraft with the mountain side, and accordingly there is no taped record of what took place at that briefing. If only the tape recording of that pre-descent briefing had been available then many of the disputed questions which occurred during these hearings before the Commission would not have arisen. Since we can never know what plan was settled by the crew as a result of the pre-descent briefing, it is only possible to infer