

on 22 November 1979, that he would have emphasised the point in his diary note, and that there would have been an immediate letter to the airline requesting an explanation. Upon the whole, I prefer Captain Grundy's version of this conversation.

223. My opinions on this aspect of the Inquiry are:

- (a) The management of the airline and its Flight Operations Division were aware from November 1977 onwards that airline pilots on antarctic flights were flying at levels ranging from 1500 feet to 3000 feet, and that some flights travelled down McMurdo Sound in the direction of true south at such altitudes.
- (b) Civil Aviation Division was aware, probably over the whole period of the antarctic flights, but certainly from September 1978 onwards, that the airline's pilots were flying at levels well under 6000 feet in the McMurdo area.
- (c) Neither the Flight Operations Division of the airline nor Civil Aviation Division considered that there was any breach of safety requirements involved in pilots adopting flight levels in accordance with regulation 38 in view of the fact that such sightseeing flights were being conducted in VMC conditions. Both the airline and the Civil Aviation Division were correct in holding that opinion.
- (d) As previously stated, the airline should have put its house in order in terms of regulation 38 of the Civil Aviation Regulations by applying for minimum safe altitudes which would reflect the known practice of pilots operating the antarctic flights. The authorised flight path should have been amended so as to coincide with the military route down McMurdo Sound and a minimum safe altitude over McMurdo Sound and the Ross Ice Shelf to the true south should have been set at 1500 feet subject to VMC conditions, with visibility not less than 20 kilometres.
- (e) Such a revised minimum safe altitude would have been approved by the Civil Aviation Division and would also have been accepted by the United States Naval Support Force authorities at McMurdo.

#### THE CREATION OF THE FALSE McMURDO WAYPOINT AND HOW IT CAME TO BE CHANGED WITHOUT THE KNOWLEDGE OF CAPTAIN COLLINS

224. By way of preliminary, something should be said about the nature of the flight plan delivered to the crew of an aircraft just prior to departure. In an aircraft such as the DC10, with its navigation controlled by the AINS, the primary content of the flight plan is the list of waypoints running down the left hand edge of the page. In the case of scheduled routes flown by Air New Zealand the waypoints are denominated by names, and the airline's ground computer system connects those names with fixed geographical positions. The system of inserting details of the flight plan into the aircraft's own computer involves a tape cassette with which, in the present case, we are not concerned. This is because the Antarctica flights were non-scheduled and the method adopted for inserting the waypoints into the aircraft's computer system was to insert manually the co-ordinates of latitude and longitude for each waypoint. A flight plan, as well as containing these pre-determined and fixed waypoints, will also contain the distance in miles between each waypoint

and the heading along which the aircraft will fly from one waypoint to another. All these details will be constant from one flight plan to another unless for some reason it is thought necessary to change the position of some particular waypoint. Then the flight plan will also contain other material which is not constant and which must be inserted for the specific purposes of the flight in question. This will involve the different flight levels to be maintained over different sectors of the journey, and these will be determined by up-to-date weather forecasting, indicating the direction and velocity of winds at various altitudes. There are other details which also require insertion for the purposes of the particular flight, and of these perhaps the most important is the calculation of the fuel required by the aircraft on its journey. Opposite each waypoint will be printed in metric tonnes the amount of fuel then remaining at the point when that waypoint is reached. To summarise, a flight plan delivered to the crew of an antarctic flight at the pre-despatch briefing an hour or two before departure will comprise the fixed waypoints and track and distance details held in the airline's ground computer in respect of that particular route, to which has been added, for purposes of the flight, the last minute calculations to which I have just referred. During the course of the flight the aircrew will have their printed flight plan before them, and they will keep checking at all times the comparison between fuel consumed over one sector, as appearing from their instruments, with the estimated fuel components appearing on the flight plan, and they will also be checking the other operational details appearing on the flight plan.

225. In 1977 the flight plans delivered to aircrew of Air New Zealand were manually produced, that is to say, there would be a print-out document containing the fixed waypoints and track and distance details applicable to the journey, but the other details applicable to the day of the flight would be inserted by hand. In 1978 however, the decision was made that all the airline's flight plans for its different flight routes would be computerised. The ground computer unit of the airline would therefore hold a flight plan for every route, containing the fixed waypoints and track and distance details to which I have referred, but shortly before the pre-despatch briefing the flight levels and fuel calculations and other necessary data would be inserted into the ground computer for inclusion in the standard computer flight plan for that particular route. Then the Flight Despatch Section would be handed a print-out from the ground computer which would comprise the full flight plan for the journey, with all details printed thereon.

226. The alteration of the original McMurdo waypoint was said by members of the airline's Navigation Section to have originated with the decision in 1978 to computerise all flight plans, and the following narrative sets out the explanation which I was given in this respect by the Navigation Section witnesses.

227. For the first two Antarctica flights of 1977 the destination waypoint represented the latitude and longitude co-ordinates of the landing strip at McMurdo which is known as Williams Field. Those co-ordinates were 77 degrees 53 minutes south and 166 degrees 48 minutes east. However, as previously described, a decision was made in mid-1977 that there was to be an additional MSA of 6000 feet under specified conditions. This 6000 feet cloud break procedure meant that during instrument meteorological conditions (IMC) the McMurdo non-directional beacon (NDB) had to be used in order to give the aircraft a positive confirmation of its position prior to descent. Accordingly, as from the first of the late 1977 flights,

which occurred on 18 October 1977, the McMurdo waypoint was altered so as to now coincide with the geographical position of the McMurdo NDB. This position was 77 degrees 51 minutes south and 166 degrees 41 minutes east. This geographical position for the McMurdo waypoint remained until arrangements had been completed in 1978 for the production of computerised flight plans in the manner which I have previously described. When, therefore, the waypoints for an antarctic flight to McMurdo were prepared so as to become a constant entry in the airline's ground computer, they were all repeated as used for the 1977 flights. But, so I was told, when the McMurdo destination point was typed into the airline's ground computer, a mistake was made. Instead of taking the NDB waypoint which had been operative for the last four flights in 1977, there was inserted the original Williams Field waypoint which had been discontinued as from February 1977. Therefore, instead of inserting the NDB waypoint with a longitude of 166 degrees 41 minutes east, there was inserted the out-dated Williams Field waypoint of 166 degrees 48 minutes east. This error was made, according to his evidence, by Mr C. B. Hewitt, the chief navigator for Air New Zealand. I am not quite sure whether he concedes that it was an error because he apparently based his destination waypoint upon an existing work sheet which contained the Williams Field geographical position. Nevertheless, there had been an error by someone because, as already stated, the Williams Field position had long since been discarded.

228. Then came the second error, and this is the decisive mistake said to have been discovered during the investigation of this disaster. When Mr Hewitt proceeded to type in the longitude for McMurdo as being 166 degrees 48 minutes east (being the out-dated Williams Field longitude) he inadvertently typed the longitude as 164 degrees 48 minutes east, rather than the 166 degrees 48 minutes east. He went on to say that although it was standard practice to check such figures by looking at the visual display unit on the computer, and comparing these figures with the work sheets, and although he did perform this check, he did not detect this error. The result of typing in this wrong meridian of longitude was to place the McMurdo waypoint about 25 miles to the west of the McMurdo NDB.

229. At this juncture I must pause to consider whether the Williams Field co-ordinates were in fact accidentally used. Certainly the latitudinal meridian was also the same as the Williams Field latitude. But this version of events allowed Mr Hewitt to say that he had only made a mistake in one digit, namely typing in 164° instead of 166°. If, in fact, he had intended to use the current NDB co-ordinates for McMurdo, then there would have been a mistake in two digits, namely 166 degrees 41 minutes east would have been typed in as 164 degrees 48 minutes east. Since it was the case for the airline that this alteration in the destination waypoint was purely accidental and not by design, it was therefore essential to show, if possible, that only one digit had been involved in the typing error. It was scarcely conceivable that two digits could have been mistakenly typed in out of a total of five. I have gone to some lengths to explain all this, because the explanation of the Navigation Section, based upon a mistaken alteration of the McMurdo waypoint, was not accepted by some counsel and, in particular, was doubted by both counsel assisting the Commission. In their submission, Mr Hewitt must have been fully aware of the McMurdo waypoint currently operating, that is to say, the NDB waypoint. What he could have done, so it is said, would have been

to leave the Williams Field latitude as it was, but to alter the NDB longitude so as to move it 2 degrees to the west, which would programme the aircraft to fly to a destination point just to the west of the Dailey Islands. This would conform with what was known to be the standard practice of antarctic pilots which was to fly down the centre of McMurdo Sound and then turn left into the McMurdo area at a point somewhat to the south of McMurdo Station, the purpose being to give passengers the best possible view of the McMurdo Station-Scott Base area. In other words, it was suggested that the four 1977 flights, commencing on 18 October 1977, had all flown down the Sound in approximate conformity with the military track, and the shifting of the McMurdo waypoint was done deliberately so as to conform with this general track.

230. All this was strenuously denied by the Navigation Section. I can summarise the objections in this way:

- (a) A waypoint positioned in McMurdo Sound would normally have been a published position appearing on official maps, as for example the Byrd Reporting Point, of which the co-ordinates were readily available, as opposed to a random point close to West Dailey Island. Alternatively the McMurdo NDB (also a published point) would be a natural waypoint, although it was admitted that there would be no difficulty in a crew flying the aircraft from the "incorrect position" to the NDB if so required thus making it possible to use this navigational aid if such a step were necessary.
- (b) Then the point was taken that if there had been required an additional sector from the "incorrect" position to the NDB, to enable flight across to the beacon—which may have been necessary in IMC conditions—an additional fuel calculation would have been required.
- (c) It was pointed out that if the McMurdo waypoint had been intentionally moved 25 miles to the west, then the flight plan would have a corresponding change to the track and distance information which it previously contained. Instead of a true heading from Cape Hallett to the NDB of 188.9° and a distance of 337 nautical miles, there would have been required, in respect of the changed McMurdo waypoint, a true heading of 191° and 343 nautical miles. Similar alterations would have had to be made in respect of a return journey to the true north.
- (d) It would have been unlikely for the airline to have chosen an latitude and longitude co-ordinate of such accuracy for the new position (i.e. 77 degrees 53 minutes south 164 degrees 48 minutes east). The longitude would have been rounded off, for example, to something like 164 degrees 50 minutes east or 164 degrees 30 minutes east. (Cf. Mr Amies, T.1904).
- (e) It was submitted that an alteration to the McMurdo waypoint to facilitate better sightseeing was not valid because flight captains had a discretion to deviate horizontally from the flight plan track.
- (f) Whilst the Navigation Section agreed that the altered waypoint would improve radio communications in that VHF transmissions and radar transmissions (both dependent on line of sight) would be unimpaired, whereas on the original flight track they would have been blocked out by the mountain for considerable periods of time, nevertheless it was submitted that this would not have been a sufficient reason and reliance was placed upon the evidence of

Captain Gemmell who had maintained that although tracking overhead Mt. Erebus there had been no communication problems. This had also been contained in the report of the airline inspector who was on that flight, Captain Spence.

231. I should now indicate my own opinion in respect of these considerations just enumerated.

232. As to (a) . . . It may be correct that on scheduled flights a waypoint is always in a published position. But these were unscheduled flights. As to the further point that it is unusual for a flight plan not to terminate over the navigational aid to be used for a particular descent procedure, it was of course possible for the aircraft to fly from a new McMurdo position towards the beacon and thus obtain a positive fix as to its position.

233. As to (b) . . . Technically speaking an additional sector from the new position to the NDB would be required to enable crews to programme the AINS to fly to the beacon. But the Navigation Section, in my opinion, knew quite well that DC10 flights were operating at low levels in McMurdo Sound and flying by Heading Select in the immediate McMurdo area. As to the fuel calculation point, the flight plans made ample provision for extra fuel to cover sightseeing in the area of McMurdo Station and that sightseeing would have started some time before the new destination point was reached. Such fuel calculations were based upon the approximate time which sightseeing would take and not upon any track from the destination point, and of course the minimum fuel which had to be available for the return from McMurdo to Christchurch was fixed in all cases.

234. As to (c) . . . I agree that there is considerable validity in this point. The track and distance details of the Cape Hallett/McMurdo sector would have required amendment in the manner indicated by the Navigation Section witnesses. As opposed to this, I observe that when the Williams Field waypoint was changed to the NDB waypoint, there was no amendment of the track and distance details, minor though such amendments would have been. In addition, the Navigation Section may have thought it not necessary to alter the track and distance criteria from Cape Hallett to McMurdo for the reason that the pilots were accustomed to flying on Heading Select down this sector and not by reference to the fixed heading programmed into the AINS.

235. As to (d) . . . No doubt it is true to say that a convenient longitudinal co-ordinate for the new waypoint could have been rounded off instead of being fixed at 164 degrees 48 minutes east, but by the same token it was an even more simple procedure merely to move the destination co-ordinate 2° to the west.

236. As to (e) . . . This is a valid objection.

237. As to (f) . . . Although the airline denied that there was any validity in the point that communications might be improved by the adoption of something very close to the military route, there can be no doubt at all that radar identification and VHF transmission would have been wholly uninterrupted in consequence of the adoption of the new waypoint. As to the evidence of Captain Gemmell and the report of Captain Spence in respect of the first of the antarctic flights when they said that communications were uniformly good throughout, I can only suppose that as they approached Mt. Erebus at 16 000 feet (if indeed that happened) they had satisfactory HF communication (which does not depend upon line of sight) because VHF transmissions could not have been received for

the last 20 or 30 miles before Mount Erebus was reached, and similarly, radar identification in the ASR mode would not have been possible at all until after Captain Gemmell's aircraft had overflown the mountain.

238. As will be seen, there was here a close and detailed conflict between the Navigation Section of the airline and those counsel who declined to accept the proposition that the transposition of the McMurdo waypoint had been a mistake. This conflict was further exacerbated when Mr Davison, on behalf of the estate of Captain Collins, produced to Mr Amies in cross-examination the document which became **Exhibit 164**. This is a track and distance diagram prepared by the Navigation Section, which contains headings and distances for the area north of the Auckland Islands down to the two alternate routes available to antarctic flights. The principal feature of this document, which it turned out Mr Amies had in part prepared, was a plotted track from Cape Hallett down McMurdo Sound on a path which appeared to lead it not only to the east of the Byrd Reporting Point but also to a position situated somewhat further to the true south. Now this flight path (making due allowance for the imperfections of what is a fairly poor photocopy of an original) appears to be indistinguishable from a flight path running from Cape Hallett down to the altered McMurdo waypoint. In addition the draftsman had run a dotted semi-circular line around the south of Ross Island, and then a straight line had been drawn back to Cape Hallett along 170° meridian of east longitude. On that line had been drawn an arrow pointing towards Cape Hallett.

239. Mr Amies, who appeared disconcerted when **Exhibit 164** was placed in front of him by Mr Davison, was cross-examined closely about its content. He asserted that it was only a draft track and distance diagram and pointed out that there was no track and distance notation for the southern or northern legs of the Cape Hallett/McMurdo sector. He also alluded to certain other slight inaccuracies in the chart. As to the arrow pointing in the direction of Cape Hallett after a presumed circuit of Ross Island, Mr Amies agreed that he had drawn this arrow but maintained that it was not intended to be an aircraft track. He maintained that he had drawn it there only to indicate the position of true north, and this was because he had been working with grid navigation when entering details on this chart. This latter assertion was certainly surprising.

240. Mr Amies is a navigation expert of great experience. He was responsible for introducing grid navigation on the North Atlantic routes and for many years used grid navigation techniques in those areas. He was associated with the production of the AINS for installation in DC10 aircraft, and he had been employed by McDonnell-Douglas Corporation to give area navigation instruction to airline crews in California; by Swissair, to instruct their crews in the same system; and he had also been retained for that purpose by British Airways in London. The arrow which Mr Amies marked on the line of 170° E longitude was naturally pointing north because all meridians of longitude point north and south. I wondered whether companies like Swissair and British Airways were aware of the fact that their navigation consultant had to plot an arrow on a map to remind himself that a meridian of longitude pointed true north. However, the principal feature of **Exhibit 164** was that it was delivered to the RCU briefing unit for inclusion in the 1978 briefings of pilots and was similar in content to other diagrams given to pilots which also showed a flight path going down McMurdo Sound. I can quite understand that **Exhibit 164** may have been originally intended as a draft working

document to indicate possible tracks from Cape Hallett to McMurdo and back, and I can also see that there are no track and distance guides from Cape Hallett to McMurdo and return, although this latter omission may have been due to the factor previously mentioned, namely that crews were authorised to deviate horizontally from the official flight paths over that sector. But for some reason **Exhibit 164** became part of the briefing material to crews of 1978 and I am not sure that it also did not form part of the briefing material for 1979. In addition, the evidence suggests that the same **Exhibit 164** was included in the flight documents taken by aircraft crews to Antarctica, and that it was included in those flight documents for 1978 and 1979. Again, in this particular context, reference must be made to what is known as "Annex J" to the chief inspector's report. This consisted of a track and distance diagram which showed the flight path as being over the centre of Ross Island. Captain Gemmell handed it to the chief inspector and told him that it had formed part of the flight documents carried by the crew on the fatal flight.

241. I have examined the exhaustive analysis of the evidence relating to **Exhibit 164** and Annex J which is contained in the closing submissions of counsel for the airline. But in my opinion, on the totality of the evidence, Annex J never formed part of the 1979 flight documents and was not on the fatal flight. Consequently there was no track and distance guide carried on the fatal flight which indicated that the nav track lay on a direct course with Mt. Erebus. On the contrary, there were three charts or diagrams (four, if I include **Exhibit 164**) which all showed a track down the centre of McMurdo Sound.

242. The next instalment of this navigational saga concerns the incident which caused the McMurdo waypoint to be moved back to a point close to its original position. Captain Simpson piloted the flight of 14 November 1979 and he had attended the briefing session with Captain Collins and First Officer Cassin five days previously. As at the date of this flight the "incorrect" McMurdo position was still contained in the airline's ground computer. When checking the flight plan co-ordinates entered into the system of his own aircraft Captain Simpson noted, by reference to a topographical map, that the McMurdo destination was well to the west of McMurdo Station. On his return to New Zealand Captain Simpson reported that the McMurdo destination waypoint was approximately 27 miles to the true west of the TACAN because when he had been overhead the TACAN he had observed a cross-track error of these dimensions. Captain Simpson was surprised at the distance between the flight plan McMurdo position and the TACAN position, and he merely suggested to Captain R. T. Johnson that crews should be notified of the distance between the TACAN and the flight plan McMurdo position. Captain Simpson said that he did not believe that the McMurdo position on the flight plan was other than a correct position, and certainly did not suggest that there had been any mistake on the part of the Navigation Section.

243. Then there seemed to follow a considerable degree of confusion. Captain R. T. Johnson said in evidence that he believed that he had been told that the McMurdo position was an error and should be at 166 degrees 58 minutes longitude east. Captain Simpson strongly disagreed with this evidence, and in particular disagreed with the suggestion that he told Captain Johnson that the McMurdo waypoint would be better positioned at the TACAN. But it appears that it was decided by someone, I am not sure whom, that the McMurdo position should be moved to the TACAN. Captain Johnson evidently did not check the actual destination waypoint.

He assumed that it coincided with the geographical position of the McMurdo NDB. His evidence was that he understood that Captain Simpson had been saying, in effect, that the McMurdo position should be at the TACAN rather than at the NDB. The difference between those two positions was only 10 minutes of longitude, representing 2.1 miles. Therefore when on the night before the fatal flight the McMurdo co-ordinates were changed to the TACAN position, it was believed by Captain Johnson, so he says, that the difference involved was only 2.1 miles and that consequently there was no need to appraise Captain Collins of the change. In order to clarify the difference of 10 minutes, I should indicate that the TACAN position was 166 degrees 58 minutes east longitude and the NDB position, as previously indicated, was 166 degrees 48 minutes east longitude.

244. Now this was certainly a most detailed and elaborate explanation for the fatal decision not to notify Captain Collins of the alteration in the McMurdo waypoint. But is the explanation true? Captain Simpson does not agree at all with the evidence that he suggested a change to the TACAN position. Nor does he agree at all with the suggestion that he reported an "error" in the McMurdo position. Why, therefore, was the position changed to the TACAN, thus representing a shift of the computer track from the centre of McMurdo Sound to a collision course with Mt. Erebus? There is no memorandum in existence which records any of the communications and decisions to which I have just referred. Captain Johnson set out in a letter, after the disaster, the explanation to which I have just referred. But there is no documentation contemporary with the various steps which were taken.

245. There seem to me to be only three possible explanations having regard to the fact that I accept without reservation what Captain Simpson had to say in evidence. He is very obviously a careful and methodical man, with no element of indecision about what he saw and did during and after his flight. The three possible explanations are—

- (a) The first is that the communication by Captain Simpson was in fact misinterpreted by Captain Johnson, who directed that the computer flight track be now aligned with the TACAN in the belief—which he did not verify—that it had always been aligned with the NDB and thus the alteration would be minimal.
- (b) The second explanation is that both Captain Johnson and the Navigation Section knew quite well that the McMurdo waypoint lay 27 miles to the west of the TACAN and that since his track had not officially been approved by the Civil Aviation Division it should therefore be realigned with the TACAN and then someone forgot to ensure that Captain Collins was told of the change. Such an interpretation means that the evidence as to the alleged belief of a displacement of only 2.1 miles is untrue.
- (c) The third explanation is that the relocation of the McMurdo waypoint at the TACAN position was never intended and was effected by mistake, and that after the disaster it was thought better to back-date the "mistake" by 14 months as this would look a little better than admitting the occurrence of a computer error only hours before the flight departed. However, whether this in fact occurred will never be known, and I propose not to discuss this point further.

246. Concentrating now upon the possibility of (b) mentioned above, it seems to me that the evidence supports this interpretation. When the new co-ordinates of 166 degrees 58 minutes east were written into the work

sheet from which they would be typed into the airline's ground computer, there also had to be written into that work sheet a symbol which would ensure that the changed co-ordinates also appeared on the abbreviated version of the flight plan which would be radioed to McMurdo on the morning of the flight. But the witness responsible for this task testified that there was yet a further computer mistake. Instead of writing this symbol into the correct column of the work sheet dealing with geographical changes he wrote it into the column dealing with navigational aids. So when this symbol was typed into the ground computer it had the accidental effect of deleting the new co-ordinates from that part of the flight plan which would be radioed to McMurdo and replacing it merely by the name "McMurdo". The result therefore was that on the flight plan printed out for Captain Collins the longitudinal co-ordinates for McMurdo were printed as 166 degrees 58 minutes east, but the flight plan sent to McMurdo omitted the co-ordinates and merely gave the place name. All previous flight plans radioed to McMurdo in 1978 and 1979 had contained the "incorrect" co-ordinates, placing the waypoint 2 degrees to the west.

247. This explanation about the wrong symbol being typed into the ground computer seemed to me to be very difficult to accept. The operator who did this knew the printed work sheet like the back of his hand. The unfortunate inference is open that he was instructed to programme the computer so as to conceal from the McMurdo Air Traffic Controller that the destination waypoint had been changed. The McMurdo Air Traffic Control personnel had, according to the evidence, plotted the first of the 1979 co-ordinates and thereafter relied on those being constant. But when they received from Auckland by radio their section of the flight plan, which would advise them of the times and flight levels and approach path of TE 901, they only saw the word "McMurdo", whereas if the new co-ordinates had been revealed then the United States Air Traffic Control personnel would immediately have identified those co-ordinates as being the co-ordinates of the TACAN.

248. Such is the nature of this shadowy and undocumented explanation conveyed to me in evidence by Captain Johnson and members of the Navigation Section. I use the term "undocumented" because, as I have said, there is not one contemporary document in the form of a memorandum either instructing what steps were to be taken with the co-ordinates or confirming what steps had been taken. The only document, if I can call it such, is an extract from an informal log referring to the proposed change of co-ordinates. But that log or diary had certain unusual features which I shall later describe.

249. Here is a list of the mistakes which in some cases were admittedly made, and in other cases alleged to have been made, as appearing from the foregoing narrative:

1. The computerised flight plan prepared for the 1978 flights was intended to display as the destination waypoint the position of the McMurdo NDB. But in fact the waypoint was located at the geographical position of Williams Field. That position had been abandoned after the first two flights in 1977.

2. The typing into the airline's ground computer of the longitude 164 degrees-48 minutes east instead of 166 degrees 48 minutes east.

3. Failing to detect that error when checking the waypoint co-ordinates entered into the ground computer against the print-out of those figures as appearing on the screen of the computer display unit (CDU).

4. The mistake on the part of Captain Johnson that Captain Simpson, after his flight on 14 November 1979, had stated that there was an error of 27 miles in the McMurdo waypoint when in fact all Captain Simpson had said was that the pilots should be told that the distance from the TACAN over to the McMurdo waypoint was 27 miles.

5. The mistake by Captain Johnson that Captain Simpson had stated that the McMurdo waypoint should be shifted to the TACAN position.

6. As indicated under error No. 1, the longitudinal position of the NDB was established in the airline's computerised flight plans as 166 degrees 48 minutes east which is, in fact, the longitudinal co-ordinate for Williams Field, the correct longitudinal position of the NDB being 166 degrees 41 minutes east. As a result of this, it was estimated that the lateral distance from the supposed position of the NDB to the TACAN was 2.1 miles representing 10 minutes of longitude (166 degrees 48 minutes east as against 166 degrees 58 minutes east). There was an omission to notice, however, that the lateral distance should have been from 166 degrees 41 minutes east to 166 degrees 58 minutes east, which amounts to a variation of 17 minutes of longitude representing a lateral distance of 3.7 miles.

7. When writing the TACAN co-ordinates of 166 degrees 58 minutes east into the worksheet for the ground computer, the operator (Mr Brown) entered a symbol which had the effect of obliterating those figures from the flight plan extract to be sent to the United States air traffic controller at McMurdo and substituting as the destination waypoint the word "McMurdo". The comparison between the Air Traffic Control flight plan received on 21 November 1969 (having the same waypoints as all the Air Traffic Control flight plans transmitted for the previous flights for 1978 and 1979) and the Air Traffic Control flight plan sent in advance of the fatal flight is shown in the following tabulation:

21 November 1979		28 November 1979	
50° 42' S	166° 10' E	50° 42' S	166° 10' E
55° S	165° 28' E	55° S	165° 28' E
60° S	164° 32' E	60° S	164° 32' E
66° 45' S	163° E	66° 45' S	163° E
72° 20' S	170° 13' E	72° 20' S	170° 13' E
77° 53' S	164° 48' E	McMurdo	
72° 20' S	170° 13' E	72° 20' S	170° 13' E
70° S	170° 04' E	70° S	170° 04' E
65° S	160° 47' E	65° S	169° 47' E
60° S	169° 33' E	60° S	169° 33' E
55° S	169° 21' E	55° S	269° 21' E

I have omitted data relating to flight levels also appearing in the Air Traffic Control flight plans and have merely indicated those waypoints applicable from 50 degrees 42 minutes south back to McMurdo, and then back again as far as 55 degrees South. All co-ordinates are the same on each Air Traffic Control flight plan, except for the omission to notify the McMurdo Air Traffic Control of the new co-ordinates for the McMurdo waypoint.

8. Despite the minor distance thought to be involved by changing the co-ordinates (2.1 miles, although in reality 3.7 miles) failing to advise Captain Collins and his crew that the destination waypoint had been changed from the NDB to the TACAN.

250. This history of the computer programming of the antarctic flights from October 1977 to November 1979 is distinguished (as stated already) by an almost total lack of documents recording these navigational decisions. There is not one memorandum from the Flight Operations Division to the Navigation Section giving instructions for any change, nor is there any written report from the Navigation Section notifying Flight Operations of changes which had been made. There was no memorandum to the Navigation Section by Captain Johnson recording Captain Johnson's erroneous but vital misconception that there was supposed to be a 27 mile error in the destination co-ordinates. There is no memorandum from the Navigation Section back to Captain Johnson recording the outcome of their investigations.

251. In respect of this whole period there have been produced only two contemporary documents. One is a handwritten logbook maintained by Mr D. T. Kealey who is flight services controller (flight despatch) for the airline. This is the log or diary to which I previously referred. This logbook was produced as **Exhibit 177**. A copy of the relevant page was produced as **Exhibit 17**. Under the handwritten entry "Wed 21 11" (meaning 21 November 1979) there appears an item referring to the proposed change of the destination co-ordinates but containing the phrase "nil update of computer files tonight". This entry is timed at 1301 hours whereas it appears to be followed by other entries commencing at 1058 hours. Mr Kealey explained that these latter entries in reality referred to 27 November 1979 and that he had inadvertently recorded three entries for 27 November 1979 in a blank space which had been left for Wednesday, 21 November, this error being occasioned by the misplacement of a clip which is used to secure the pages of the notebook. Further, Mr Hewitt, the chief navigator for the airline, had originally said that this conversation with Mr Kealey referring to the computer being updated had taken place on 20 November. This appeared to be corroborated by Mr Kealey's note about not updating the computer "tonight" because the next flight to Antarctica was to leave on the morning of 21 November. The recording of the conversation as having been made at 1301 hours on 21 November therefore purported to indicate that the message had not been received until after the departure of Captain White's flight to Antarctica on Wednesday, 21 November thus justifying no action being taken on the previous night. However, Mr Hewitt later changed his recollection and said that he now recalled that the conversation was in fact on 21 November 1979.

252. This extract from the log of Mr Kealey came under the scrutiny of the chief inspector and of Captain Gemmell, the chief pilot, during their inquiries in December 1979, about 4 weeks after the date of the disaster. It appears that the chief inspector was not satisfied with the accuracy of this handwritten informal notebook which serves as a log but which contains various items of a personal nature. Captain Gemmell, on 20 December 1979, wrote to Mr Kealey requiring an explanation as to why the chief navigator had directed a change in the McMurdo position on 20 November, yet no amendment had been made to the flight plan of TE 901 which left on 21 November. On 24 December 1979 Mr Kealey replied, and stated that the requirement was not passed on to the flight planner

concerned. He then stated "I am unable to offer any explanation of this" Long after this, Mr Kealey produced the explanation to which I have just referred, but I can only say in passing that it seems surprising that the alteration of the co-ordinates, known by the Flight Despatch Section on the night of the disaster to have taken place in the early morning of that day, was not given the closest attention by Mr Kealey and Mr Hewitt on the morning after the disaster (8 days after the log entry) and the present explanation offered immediately to Captain Gemmell when he made his inquiry. So much for the first of the two memoranda produced in relation to the antarctic destination waypoints.

253. The second and last document is the notification sent out to all pilots on 8 November 1979 by Captain Johnson intimating that the NDB facility had been withdrawn and that the briefing notes were to be amended accordingly, and restating the position that MSA was 6000 feet under specified conditions.

254. In effect, therefore, there was not one document produced which verified the occurrence of the various mistakes which are said to have been made. I am compelled to stress this alarming lack of written communication between the Flight Operations Division, and Navigation Section, and the Flight Despatch Section, and the lack of written communications within each of these departments of the airline, because it was very clearly this absence of written memoranda and settled inter-departmental communication systems which was responsible for the failure to notify Captain Collins that the destination waypoint on his flight plan had been changed.

255. Before setting out my conclusions on all these matters, I must take into account the fact that the Navigation Section of the airline is staffed by personnel of extreme skill and long experience. They are noted, according to evidence given on behalf of the line pilots, for their meticulous checking and cross-checking. For this reason alone I find it impossible to accept that this remarkable list of mistakes, omissions, and misunderstandings can be totally correct.

Here are my views as to these explanations:

- (a) The first question is whether the programming of the McMurdo waypoint into the "false" position before the commencement of the 1978 flights was the result of accident or design. On balance, it seems likely that this transposition of the McMurdo waypoint was deliberate. I say this because of the decision reached at approximately the same time to include in the briefing documents, and to include in the flight documents to be carried on each aircraft, the document described as **Exhibit 164**. That is the track and distance diagram which, as will be recalled, indicates a track down McMurdo Sound past the Byrd Reporting Point. I fully appreciate that it contains certain technical and minor inaccuracies, including the lack of any specific heading for an aircraft to follow when travelling towards McMurdo. But, as indicated already, this could merely reflect the knowledge of the Navigation Section (although they deny it) that pilots on the most recent flights had been flying in the area on Heading Select and with no obligation to follow any defined flight path. In addition, **Exhibit 164** coincided with the other schematic diagrams carried by Antarctica flight crews which each depicted a flight path down McMurdo Sound. As I have said, I am satisfied that the document known as Annex J—a diagram

depicting a direct path to Mt. Erebus—was not in fact carried on any of the 1978 or 1979 flights and that Captain Gemmell was mistaken when he handed a copy of Annex J to the chief inspector and told him that it had been on the fatal flight. So as I say, I think it likely that the change of the McMurdo destination point was intended and was designed by the Navigation Section to give aircraft a nav track for the final leg of the journey which would keep the aircraft well clear of high ground.

However, I propose to make no positive finding on this point. I must pay regard to the circumstance strongly urged upon me by counsel for the airline in their closing submissions, namely, that if the alteration was intentional then it was not accompanied by the normal realignment of the aircraft's heading so as to join up with the new waypoint. As I say, I think this latter omission is capable of explanation but it is a material fact in favour of the Navigation Section which I cannot disregard, and it is the single reason why I refrain from making a positive finding that the alteration of the waypoint was intentional.

- (b) I believe, however, that the error made by Mr Hewitt was ascertained long before Captain Simpson reported the cross-track distance of 27 miles between the TACAN and the McMurdo waypoint, and I am satisfied that because of the operational utility and logic of the altered waypoint it was thereafter maintained by the Navigation Section as an approved position.
- (c) Captain R. T. Johnson was quite wrong in his belief that Captain Simpson told him that the McMurdo position was an error and that the position ought to be switched to the TACAN. He seems now to admit that he was mistaken. But I must ask myself the question whether in the course of a conversation between these two very experienced pilots such a misinterpretation could possibly have arisen. Captain Johnson had always believed, so he said in evidence, that the destination waypoint was located at the McMurdo NDB, which is in close proximity to the TACAN, and it seems impossible to accept that he could ever have taken Captain Simpson to mean that the McMurdo position was in error to the extent of 27 miles.

On 17 October 1979 Captain Johnson wrote to the Director of Civil Aviation referring to the latest Ross Sea chart—NZ-RNC4—dated 26 September 1979, which in turn referred to the United States Department of Defence publications as to navigation aids at McMurdo. Captain Johnson pointed out that the current edition of the United States publication (of 4 October 1979) deleted any reference to an NDB approach and had published TACAN approach charts only. Following this letter, Civil Aviation Division ascertained from the United States authorities that the NDB facility had been withdrawn. This in turn was communicated to Captain Johnson. He then issued his written notice (to which I have referred already) dated 8 November 1979 advising pilots that the NDB facility at McMurdo was no longer available. In the light of this sequence of events I cannot follow how, on or about 15 November, Captain Johnson would have understood Captain Simpson as saying that the McMurdo position (thought by Captain Johnson to have been at the NDB) would be "better positioned at the TACAN", and how Captain Johnson could then have passed on these comments to the Navigation Section. Captain Johnson knew that the NDB facility

had been withdrawn some time previously and if it was the airline's policy (frequently asserted before me) that a destination waypoint must be located at a published position, then the TACAN was the only other published navigational position at McMurdo. DC10 aircraft were not programmed to pick up a bearing from the TACAN but they were capable of interrogating the DME function of the TACAN. Again I prefer to make no positive finding, but I can only say that Captain Johnson's evidence as to referring to the Navigation Section an inquiry about the desirability of the TACAN becoming the destination waypoint, must be open to considerable doubt. The truth of the matter most likely is that the Flight Operations Division simply directed the Navigation Section to reprogramme the Hallett-McMurdo flight path to the TACAN because they had found out that the NDB navigational aid had been withdrawn.

- (d) If, as I have held, the Navigation Section knew the actual position of the McMurdo waypoint as being 27 miles to the west of the TACAN, then why did they not submit to Captain Johnson, or to Flight Operations Division, that the waypoint should remain where it was? One view is that the Flight Operations Division expected, in terms of Captain Johnson's letter to the Director of Civil Aviation dated 17 October 1979, that the next edition of the Ross Sea chart NZ-RNC4 would contain the official Air New Zealand flight path to McMurdo, and that the safest course would be to put the destination point back to the approximate location at which Civil Aviation Division had thought it had always been.
- (e) When the TACAN position was typed into the airline's ground computer in the early morning of 28 November 1979, there was also made the additional entry to which I have referred, which would result in the new co-ordinates not being transmitted to McMurdo with the Air Traffic Control flight plan for that day. It was urged upon me, on behalf of the airline, that McMurdo Air Traffic Control would consider the word "McMurdo" as indicating a different position from that appearing on Air Traffic Control flight plans despatched from Auckland during 1978 and 1979. I cannot for a moment accept that suggestion. First Officer Rhodcs made a specific inquiry at McMurdo within a few days of the disaster and ascertained that the destination waypoint of the first Air Traffic Control flight plan for 1979 had been plotted by the United States Air Traffic Control personnel, and there was evidence from the United States witnesses that this would be normal practice. In my view the word "McMurdo" would merely be regarded, and was indeed regarded, by McMurdo Air Traffic Control as referring to the same McMurdo waypoint which had always existed. In my opinion, the introduction of the word "McMurdo" into the Air Traffic Control flight plan for the fatal flight was deliberately designed to conceal from the United States authorities that the flight path had been changed, and probably because it was known that the United States Air Traffic Control would lodge an objection to the new flight path.
- (f) I have reviewed the evidence in support of the allegation that the Navigation Section believed, by reason of a mistaken verbal communication, that the altered McMurdo waypoint only involved a change of 2.1 nautical miles. I am obliged to say that I do not accept that explanation. There were certainly grave deficiencies in

communication within the Navigation Section, but the high professional skills of the Navigation Section's staff entirely preclude the possibility of such an error. In my opinion this explanation that the change in the waypoint was thought to be minimal in terms of distance is a concocted story designed to explain away the fundamental mistake, made by someone; in failing to ensure that Captain Collins was notified that his aircraft was now programmed to fly on a collision course with Mt. Erebus.

**WHETHER CAPTAIN COLLINS RELIED UPON THE  
INCORRECT CO-ORDINATES PRODUCED AT THE  
BRIEFING ON 9 NOVEMBER 1979**

256. I have already indicated my finding that it is really beyond dispute that Captain Collins plotted on a topographical map or maps the nav track of the proposed flight which would journey from Cape Hallett down to the destination co-ordinates located near the Dailey Islands at about the centre of the southern end of McMurdo Sound. This fact dominates the whole of the Inquiry. It is a fact which must always have been distinctly unpalatable to the management of Air New Zealand and to the Director of the Civil Aviation Division because it led to a conclusion which they strongly desired to avoid. But on the evidence, the conclusion is inescapable.

257. The starting point of this aspect of the Inquiry occurs towards the very end of the narrative of the flight. That starting point is, of course, the decision of Captain Collins to switch the aircraft back on to its nav track when the aircraft was turning into its final approach after completing the second orbit, and when it was only 6 minutes 15 seconds away from impact. That is to say, Captain Collins was proposing to fly the aircraft at about 2000 feet straight ahead, with the mountainside only 25 miles away. In addition, he was proposing to cover that 25 miles at 300 miles per hour. In these circumstances, it is and was folly to suggest that Captain Collins was not relying upon the false co-ordinates which had been changed without his knowledge shortly before the flight. That is why no serious attempt was made at the hearing to challenge this unassailable inference.

258. As will be recalled, the chief inspector had this to say (at para. 2.5 of his report) in regard to the false co-ordinates which had been in existence for 14 months prior to the disaster:

"As all previous flights to McMurdo had approached the area in VMC earlier crews had not adhered to the flight plan track and hence had not detected the error. In the case of this crew no evidence was found to suggest that they had been misled by this error in the flight plan shown to them at the briefing".

The chief inspector explained this final sentence in the course of his testimony before the Commission. It turned out, not unnaturally, that he did not really mean what he had said. He agreed, in the course of his evidence (at T. 243) that in his opinion the crew had a misconception as to where their flight path was taking them in relation to Ross Island. He explained that sentence of his report just referred to by saying that he had no "evidence" in the sense of a statement by an eyewitness to the effect that he had distinctly seen Captain Collins plot on a map the erroneous path of the nav track from Cape Hallett down the centre of McMurdo Sound. In addition, the chief inspector had something further to say

during his evidence on this particular point. He made it clear during cross-examination by Mr Davison (at T. 249) that because the crew had not been provided with a topographical map upon which the nav track had been plotted, then either they should have plotted the track themselves on a map during flight or "had it been considered that such a procedure was cumbersome within the confines of the cockpit or the flight deck area, then the actual track could have been plotted on a map prior to departure". The evidence was clear that Captain Collins had in fact taken the latter course.

259. Mrs Collins testified that her husband owned a copy of a limited edition New Zealand Atlas. It had been presented to Captain Collins by the parents of Mrs Collins in April 1977. A copy of this atlas was produced in evidence as Exhibit 46. At page 184 of the atlas there is a detailed map setting out the area of the whole of the Ross Dependency and showing the Balleny Islands and Cape Hallett and McMurdo Sound. On page 185 is a map containing a detailed view of the area from Beaufort Island to a point about 100 miles south of McMurdo Station. The scale of this latter map is approximately 16 miles to the inch. If the last stage of the erroneous flight path had been plotted on this latter map, then in order to determine the aircraft's position a pilot could tell at a glance his exact position merely by referring to the miles to run on his instrument panel and then glancing at the map. It is common ground that Captain Collins brought this atlas with him to the RCU briefing on 9 November 1979 and that he was seen to be closely examining the two pages at a time when he was in possession of a flight plan showing the incorrect co-ordinates. It is also common ground that he took this atlas with him on the fatal flight.

260. Mrs Collins testified that from about 8 p.m. to 9.30 or 10 p.m. on the night before the flight her husband was working with a number of maps spread out over a table. She said that it was a reasonably frequent practice for Captain Collins to spend time in preparation for his flights by going over briefing materials and so forth, particularly in respect of a new route which he had not flown before or a route that he had not recently flown (Brief of Evidence pages 1-2). Mrs Collins herself did not pay attention to the maps or to the other materials with which her husband was working. More particular evidence was given by the two daughters of Captain Collins. Kathryn Collins (who is 17 years old) said that on the evening of 27 November 1979 her father was working at home "with a large chart of the Antarctica-Ross Sea region". She said that he had a ruler "or some measuring equipment" and was working on the chart. Kathryn Collins discussed with her father this impending flight to Antarctica and in order to explain the flight he opened the New Zealand atlas. He said that the scale (presumably referring to page 184) was a bit too small for demonstration purposes and he then referred to another larger map "which was not the one that he had been working on when I interrupted him". She went on to say that this larger map was of such extent that instead of opening it out on the table Captain Collins spread it out on the floor. He then explained to his daughter Kathryn, by reference to this map, that the aircraft would fly down McMurdo Sound near the coast of Victoria Land and he indicated that the aircraft would fly back on the same track.

261. The other daughter is Elizabeth Collins, who is 15 years old. She said that she glanced at the map her father was working on some time before her sister Kathryn had spoken to him. She asked whether the aircraft was to land on the Ross Ice Shelf which was depicted on the map.