

about the garbled nature of the taped version of anything that had been said on the flight deck from behind the pilots' seats for they had observed, by studying the chief inspector's report, that there were numbers of persons on the flight deck at different times. They said that one could place little reliance upon spoken words or phrases which were only partly decipherable. I said that I expected that the filtering devices in Washington and at Farnborough might clarify to some degree what had been said in the rear section of the flight deck, but the Bendix experts did not hold out much hope in this regard. They pointed out that filtered devices were only useful in eliminating to some extent background noise. Such devices in general either confirm, by the medium of increased clarity, what the listener thought had been said, or confirm the inherent unreliability of a transcript sought to be produced from listening to particular recorded comments and remarks.

120. Mr Davison, speaking in his final address on behalf of the estate of Captain Collins, and also as junior counsel for ALPA, was very critical of the use made by the chief inspector of this defective tape recording. It was his submission that the chief inspector had formed a preliminary view, never abandoned thereafter, that the aircraft had been flying in or towards diminished visibility during the latter stages of the flight, and that the flight engineers had become anxious about the situation of the aircraft and had expressed dissatisfaction with the decisions of the two pilots. Mr Davison submitted that the chief inspector had in effect edited the Washington transcript, as a result of his visit to Farnborough, and that the editing had in certain respects been controlled by that pre-determined belief of the chief inspector to which I have referred, namely the supposed reference to the weather being "thick" and a supposed connection between the use of the words "instruments" and the prevailing weather conditions.

121. Whilst paying due regard to the various transpositions which I have mentioned, and to the submissions of Mr Davison, I cannot agree that there was any deliberate attempt by the chief inspector to edit the Washington transcript so as to conform, so far as possible, with his own opinion as to the state of mind of the flight crew. In my opinion the chief inspector's rendition of the transcript represents a bona fide attempt on his part to reproduce what was said. But I find myself obliged to agree with the rather different proposition that the chief inspector adopted as being accurate certain remarks which I have already cited from the transcript when it was by no means certain whether those exact observations were ever made, and that he was persuaded to adopt that course because of his firmly held opinion that the crew had been uncertain of its position. That is to say, the chief inspector had a natural inclination to ascribe to remarks of doubtful meaning an interpretation which favoured his own theory because, believing as he did in the validity of that theory, he also believed that members of the flight crew must from time to time have expressed apprehensions. But as I say, I am satisfied that there was no deliberate editing of the transcript so as to conform with the chief inspector's opinion. All that happened, in my view, was that as a sequel to that prevailing opinion he was naturally inclined to construe a barely audible observation, which was capable of possible reference to apprehensions about the weather, as if the comments did in fact refer to the weather. This inclination to hear what the listener expects to hear is a familiar feature of the ordinary judicial process. It is a constant feature of Court proceedings when someone with an interest in the outcome is

testifying as to what he heard a party say, or as to what he thought that party meant by a comment which he made.

122. The CVR system installed in the DC10 and also installed in other aircraft manufactured in the United States is considered very unsatisfactory indeed by the Accidents Investigation Branch of the United Kingdom Department of Trade. British aircraft use a different cockpit voice recorder system. It is essentially the same system but is wired differently. Mr Tench and Mr Shaddick arranged for Mr Davis to play over for us a CVR recording involving a major incident with a British aircraft. We were able to hear without difficulty every word which was spoken by every person on the flight deck. It was even possible, if occasion required, to isolate the speech of one person and listen to that person alone. No electronic filters or other devices are necessary for the transcription of this type of tape recording. It can be transcribed by the simple process of a stenographer listening to the 30-minute tape and typing out its contents as they are spoken. A wholly accurate transcription can thus be produced within 40 minutes or less. Five days of debate and discussion, followed by a transcript partly based on guesswork, is not required.

123. There was also demonstrated in England to the chief inspector this vastly different CVR system and this is why at paragraph 5.13 of his report he recommends that the CVR circuitry on passenger-carrying aircraft be re-arranged to adopt the system which I have just described, and which the chief inspector refers to as the United Kingdom Civil Aviation Authority's "Hot Mike" system.

124. Broadly speaking, my conclusion with regard to the CVR transcript in the case of the fatal flight is that only limited reliance can be placed upon anything which is alleged to have been said by anyone on the flight deck apart from the two pilots, and it is indeed certain that such statements as can clearly be interpreted and identified as being made by people on the flight deck behind the pilots can not be construed as throwing any light on the state of mind of the pilots at any given time.

THE ORIGIN OF AND THE PLANNING OF ANTARCTIC FLIGHTS BY AIR NEW ZEALAND

125. In 1968 the airline was exploring the possibility of operating a limited number of services between New Zealand and the Antarctic for the purposes of carrying tourists, scientists, and other interested parties to that area. There were preliminary discussions on the project with the Director of Civil Aviation and some of his officers during 1969 concerning the appropriate consents needed for such flights, and at the same time technical investigations were being carried out by the airline into various operational features of the proposed flights especially the question of fuel requirements. These matters are referred to in the notes of a meeting held at the Head Office of the Department of Transport on 10 June 1969 (Exhibit 75) and the Antarctic Division of the Department of Scientific and Industrial Research was also involved in these discussions. Later in 1969 Captain Tredrea, who was Fleet Captain of the airline at that time, discussed the situation with the United States Operation Deep Freeze organisation in Christchurch. Captain Tredrea prepared a report and sent a copy to the Department of Civil Aviation. That report (Exhibit 76) contains a detailed appraisal of all operational features.

126. Between 15 and 22 November 1969 a visit was made to Antarctica by the present Director of Civil Aviation and Captain Spence, representing the Ministry of Transport, Captain Tredrea and Captain Grundy from Air New Zealand, and Mr G. Willetts from the Engineering Section of Air New Zealand. Captain Tredrea prepared a report dated 25 November 1969 (Exhibit 77) which summarised the essential results of that investigation. In the end the proposal to conduct this type of flight to Antarctica, which would have involved the use of DC8 aircraft intended to land on the ice runway, was abandoned. Time went by and in due course the airline acquired a number of DC10 aircraft. Towards the end of 1976 the airline became aware that QANTAS intended to conduct tourist flights which would overfly part of the Antarctic Continent early in 1977. Air New Zealand decided to institute a comparable service with their DC10 aircraft which had the fuel capacity to fly to Antarctica and back without having to land in Antarctica, the total estimated flying time being 11 hours. The proposed QANTAS flights were also known to contemplate flying to Antarctica and back without landing on the ice.

127. Captain Gemmell was at that time chief pilot of the airline and his immediate superior was Captain D. W. G. Keesing, Director of Flight Operations. Captain Keesing looked into the reports previously filed in relation to the 1969 inquiries, and then made an approach to Civil Aviation Division for consent to the flights. The first proposal was to take the flight to the South Magnetic Pole and return to Christchurch, but subsequently it was decided to proceed to McMurdo itself and to overfly McMurdo Station and Scott Base. Diplomatic approval for the flights was obtained by the Ministry of Foreign Affairs from the United States authorities. The airline had first requested approval from the Director of Civil Aviation to operate two DC10 charters on 15 and 22 February 1977, and these had been intended to operate in accordance with the first proposal, namely, a flight to the South Magnetic Pole. But it was later submitted to the Director of Civil Aviation that the overflight to McMurdo was preferable to the former proposal, and that the South Magnetic Pole destination should only be operated as an alternative if weather conditions were not satisfactory in McMurdo Sound. The Director of Civil Aviation was accordingly asked for approval to operate over the McMurdo Sound route, and by letter dated 19 January 1977 the Civil Aviation Division approved both alternative flights subject to compliance with certain operational conditions. Route feasibility studies had been made by the airline and it was clear that there was no operational difficulty in flying either of these routes. The appropriate Air Services Licence to operate the flights was obtained, and approval was also granted for the flights to make radio contact with specified stations en route to Antarctica and return.

128. On 4 February 1977 Captain Gemmell and Captain Grundy, together with Captain Young, an Airline Inspector with the Civil Aviation Division, attended a United States Deep Freeze briefing at Christchurch. This was not a full "briefing" in the technical sense. As I understand it, it was really a discussion with the American authorities, and involved the obtaining of information from the Americans relating to the routes to be flown, radio communication frequencies, search and rescue procedures, and meteorological conditions en route and at McMurdo Sound. There was discussion about weather conditions at McMurdo. The possibility of whiteout conditions was also discussed but because the flights were

planned to overfly the antarctic area the possibility of whiteout conditions, which were particularly applicable to landing operations, was not regarded as very significant.

129. I must now look at the documentation involved in the formal approach of the airline for approval of the initial flights to take place on 15 and 22 February 1977, pausing to observe that the first QANTAS flight to Antarctica took place on 13 February 1977. The initial approach to Civil Aviation Division was made by Captain Keesing, the airline's Director of Flight Operations. His first letter was dated 24 December 1976, and a copy was produced as Exhibit 1/2. This application involved the first proposed route to the South Magnetic Pole. The next letter is dated 18 January 1977 and is signed on behalf of Captain Keesing by Captain Gemmell. Permission was now sought to implement the alternative route to McMurdo Sound. In the context of setting out fuel calculations, it was stated that a full fuel load would be carried in order to "allow some flights at lower level—this to be completely at the captain's discretion having due regard to the operational conditions prevailing on the particular day". Captain Keesing's letter of 24 December 1976 had referred to proposed descent to 9000 feet (approximately 1000 feet above terrain) for flying over certain glaciers on the route from Auckland to the South Magnetic Pole and return. In these circumstances, I am not quite sure what was meant in the letter of 18 January 1977 by "some flights at lower level".

130. On 19 January 1977 the letter of 24 December 1976 was acknowledged by the Civil Aviation Division and approval was given for the two flights, subject to operational conditions which the division set out.

131. On 2 February 1977 Captain Keesing replied in detail to the Civil Aviation Division and he set out the proposed routing and flight plan information in respect of both routes. As to flight levels, Captain Keesing stated that there would be a flight level of 31 000 feet to Invercargill and thereafter optimum flight levels to Cape Hallett, and then "descending to maintain at least 2000 feet terrain clearance as permitted by excess fuel over mandatory reserves" and then climbing to flight level 35 000 to 39 000 feet for return to Christchurch. I should here interpolate that the reference to 2000 feet terrain clearance was based upon Regulation 38 of the Civil Aviation Regulations 1953. The relevant provisions of Regulation 38 are clauses 1, 2, 2A, and 4, which are as follows:

Regulation 38 (1) Subject to the provisions of these Regulations no aircraft shall be flown over any city, town, or populous area except at such altitude as will enable the aircraft to complete a safe landing should engine failure or other cause necessitate a forced landing.

(2) Without limiting the provisions of subclause (1) hereof, no aircraft shall be flown over—

(a) Any city, town, or populous area at a lower height above the area than 1000 feet; or

(b) Any other area at a lower height above the area than 500 feet.

(2A) A height specified in subclause (2) hereof is the highest point of the terrain or any other obstacle thereon, within a radius of 2000 feet of a line extending vertically below the aircraft.

- (4) No aircraft, unless landing or taking off, shall be flown in accordance with instrument flight rules at a lower height than 1000 feet above the highest obstacle located within 5 nautical miles of the estimated position of the aircraft in flight: Provided that in areas of mountainous terrain a clearance of at least 2000 feet shall be maintained.

132. There was to be an attendance by the pilots-in-command of both proposed flights at the Christchurch headquarters of the United States Operation Deep Freeze where there would be a briefing on 4 February and, in addition, the airline intended to conduct a navigation briefing which would involve navigation and compass procedures. Further, arrangements were completed for an Airline inspector to accompany the flight as an observer.

133. The first Air New Zealand flight to Antarctica then took place on 15 February 1977. The pilot-in-command was Captain Gemmell and his co-pilot was Captain A. A. E. Lawson who was at that time the airline's route clearance briefing officer. He was scheduled for the flight so as to prepare an Air New Zealand Route Clearance Antarctica brief for later flights should they become a regular occurrence. Also present on the aircraft was Mr W. K. Amies, who at the time was a flight navigator with the airline and as from March 1977 became navigation services officer. Mr Amies had very extensive experience in all aspects of navigation, including the grid navigation procedure to be followed in the antarctic. He had also been navigation consultant for several overseas airlines in connection with the AINS system of navigation. The prime purpose of the attendance of Mr Amies on the flight was to check the accuracy of the AINS equipment by overflying the destination point of the flight, which was the non-directional beacon (NDB) located near McMurdo Station. At the conclusion of this flight Captain Spence, who had been on board as the airline inspector for the Civil Aviation Division, prepared a report as to the conduct of the flight and his report described the operation as satisfactory in all respects. In particular he referred to the accuracy of the AINS equipment. He said in his report that the accuracy of this navigation system in polar regions was established on the return flight when the inertial navigation system differed by only 3 nautical miles after a flight of over 3000 nautical miles without any radio update into the AINS.

134. The next flight of 22 February 1977 was commanded by Captain Grundy. His first officer was Captain Caudwell and the senior flight engineer was Mr Gordon Brooks who was on Flight TE 901 on 28 November 1979. In addition to having been to the Deep Freeze briefing at Christchurch with Captain Gemmell on 4 February 1977, Captain Grundy had attended a briefing conducted by Captain Gemmell and Mr Amies. Both Captain Gemmell and Captain Grundy testified before the Commission that on the occasions of their respective flights a minimum altitude of 16 000 feet was maintained in the McMurdo area before climbing to cruising altitude for the return to Christchurch and in each case the evidence was that the aircraft descended to 16 000 feet upon approaching McMurdo and flew over Mt. Erebus on nav track on a point just to the west of the peak.

135. I should here pause to say that there was evidence before the Commission to suggest that neither of these flights maintained a flight level of 16 000 feet over McMurdo and that Mt. Erebus was not in fact overflown. At this point, it is relevant to consider the difference between

the minimum safe altitude of 16 000 feet said to have been adopted by Captain Gemmell and Captain Grundy on their two flights of 15 and 22 February 1977, and the detailed operational conditions which had been sent by Captain Keesing to the Director of Civil Aviation on 2 February 1977. As will be recalled, Captain Keesing had indicated that there would be maintained at least a 2000 feet terrain clearance. There is not on record any written reply from the Civil Aviation Division to Captain Keesing in relation to his letter of 2 February 1977. However, Captain Gemmell, who was his immediate subordinate, had evidently arranged with the Civil Aviation Division a minimum safe altitude of 16 000 feet for the first flight which took place only 13 days after Captain Keesing's letter to Civil Aviation Division. The evidence before the Commission later disclosed that Captain Keesing, although Director of Flight Operations, never became aware that his proposed 2000 feet terrain clearance had been superseded by a Minimum Safe Altitude of 16 000 feet, and this gave rise to specific evidence by Captain Keesing at a later stage at the hearings of the Commission.

136. On 10 August 1977 Captain Gemmell, in his capacity as chief pilot, wrote to the Civil Aviation Division requesting approval to operate five DC10 charter flights to McMurdo on 18 and 25 October 1977 and 1, 8, and 17 November 1977. His letter (Exhibit 1/8) then went on to say:

"The flights will be operated to the specification earlier submitted and approved in January 1977, with the following exception.

It is proposed to permit descent to 6000 feet QNH in VMC conditions, or by the approved NDB procedure in IMC conditions, provided that:

- (1) Cloud base reported to be 7000 feet or better.
- (2) Visibility reported to be 20 kms or better.
- (3) ASR is available and used to monitor flight below Flight Level 160.
- (4) No snow showers in area.

Two captains and a co-pilot will be crewed on each flight, they will receive a comprehensive briefing and complete a simulator detail involving a letdown and climb-out procedure, particular emphasis being placed on the use of grid navigation procedures.

Flight in the McMurdo area below Flight Level 160 will be restricted to an arc corresponding to a bearing of 120° G through 360° G to 270° G from the NDB within 20 nms in order to keep well clear of the Mt. Erebus region."

137. As will be observed, it was now proposed by Captain Gemmell that minimum safe altitude was to be 6000 feet subject to the conditions referred to in his letter. There is reference in the last paragraph of his letter to the area within which the descent to 6000 feet would be authorised, and this refers to an arc with a radius of 20 miles situated immediately to the south of Scott Base.

138. Approval of these flights was duly given, and they were all carried out on the specified dates.

139. On 19 September 1978 the airline made a further application for approval for four flights in November 1978, indicating that the same crew training and operational procedures would be carried out. Civil Aviation Division also approved this proposal. As from 1 April 1978 Captain Keesing had retired from his position as Director of Flight Operations but was still employed by the airline as a consultant. On 27 September 1979 the airline again wrote to the Director of Civil Aviation asking for

approval for further flights to take place on 7, 14, 21 and 28 November 1979, and it was proposed to operate over the same routes as the previous year, utilising the same crew briefing, training and en route procedures.

140. On 3 October 1979 the Civil Aviation Division granted approval for these flights but in a supplementary paragraph reminded the airline that no reply had been received regarding a letter which the Division had sent to the airline on 9 August 1979 raising the question of the carriage of life-saving equipment in terms of the requirements of Annex 6 to the ICAO Convention.

141. On 10 October 1979 the airline replied to the effect that the carriage of survival suits was not warranted as there was no intention of landing at McMurdo airfield. However the matter of survival equipment continued to be informally discussed between the airline and the Civil Aviation Division up to November 1979.

142. As stated previously, approval had been obtained from the Americans who controlled the air space over the McMurdo area for these commercial overflights, and on 13 October 1977 the Commander of the United States Naval Support Force in Antarctica had notified Civil Aviation Division of certain limitations on aircraft aids at McMurdo. It had been pointed out that United States Navy weather forecasting was not provided for the benefit of commercial carriers, and that reported weather might not be reliable, with the result that any action taken by a civil airline in response to a McMurdo weather report would have to be the responsibility of the pilot-in-command. Apart from the foregoing, there seems to have been no further communication or liaison with the United States Naval Support Force in Antarctica with regard to these Antarctic flights except that in 1979 the United States authorities in Antarctica advised that the non-directional beacon (NDB) situated near McMurdo Station had now been withdrawn. As a result of this information Captain R. T. Johnson, on 8 November 1979, issued for the crew briefing sheets in respect of further antarctic flights, the following memorandum:

"McMURDO NDB NOT AVAILABLE:

Delete all reference in briefing dated 23/10/79. Note that the only let-down procedure available is **VMC** below FL 160 to 6000 feet as follows:

1. Vis. 20 km plus.
2. No snow showers in area.
3. Avoid Mt. Erebus area by operating in an arc from 120° Grid 360G to 270G from McMurdo Field, within 20 nm of TACAN CH29.
4. Descent to be co-ordinated with local radar control as they may have other traffic in the area."

On 22 November 1979 Captain Omundsen of the Civil Aviation Division spoke to Captain Grundy by telephone and told him that reports had been received from the United States authorities at Antarctica that civil aircraft had been observed at lower than normal altitudes and at 1000 feet above glaciers.

143. After the occurrence of the disaster Captain Omundsen wrote to the Director of Flight Operations for the airline on 24 December 1979 in the following terms:

"It has been brought to my attention that news media reporting of previous antarctic DC10 flights operated at altitudes lower than 6000 feet in the vicinity of McMurdo.

Mr Thomson of DSIR is reported as having been on board an aircraft which operated at a height of 1500 feet above ground level. In addition, the news media also report other passengers as having been carried in the McMurdo area at altitudes of about 1000 feet.

It is noted that there is no mention in the captains' reports of such low altitude operations. You will recall that a report of low altitude operation was discussed with you by the writer of this letter on the 22 November 1979.

Such operations are contrary to the conditions of antarctic operations approval granted by this Ministry and your comments upon the circumstances related to such operation is requested."

On 11 January 1980 he received a reply from Captain Grundy, which reads as follows:

"I refer to your letter of 24 December 1979 (reference 98/4/76) in this matter, and in particular to your comments on the telephone conversation of 22 November last between Mr Omundsen and the writer.

Your concern during our telephone conversation was directed at separation from future helicopter operations and you offered no specific information of previous flights descending below 6000 feet on which I could inquire further.

Subsequent to our conversation I made arrangements for Captain Spence to be rostered on the next antarctic flight as you requested, and confirmed with the Flight Manager Line Operations that 6000 feet was still the minimum altitude specified in the briefing in case a change had been made with which I was unaware.

I have no personal knowledge of operations at the altitudes referred to in media reports and therefore I am unable to comment on the matter."

144. As will be observed, it was the opinion of Captain Grundy that this telephone conversation, six days before the fatal flight, was meant by Captain Omundsen only to emphasise the necessity to separate civil aircraft from low-level helicopter operations, and that Captain Omundsen did not make any point of the apparent breach of the MSA of 6000 feet. However, Captain Omundsen told me in evidence that on 6 November 1979 he discussed with Captain R. T. Johnson the recent information that the NDB was now not available, and he produced his file note of this conversation (**Exhibit 1/22**) which terminates with the following observation:

"ANZ will descend below safety height of 16 000 feet only in VMC conditions with no snow showers and with at least 20 km visibility. No descent below 6000 feet."

This, of course, is in accord with the notification issued by Captain Johnson three days later, to which I have already referred. But the reason why Captain Omundsen referred me to his above-quoted file note was for the purpose of corroborating what he said had been the reason for his conversation with Captain Grundy 16 days later, namely that there had been a report of an aircraft flying below 6000 feet. I have difficulty, however, in accepting that Captain Omundsen's file note has any corroborative effect in the manner suggested. His file note is only recording what Captain Johnson told him. It has no apparent connection at all with his later conversation with Captain Grundy.

Captain Omundsen signed on 23 November 1979 a file note of his conversation of the day before, and this file note was produced as **Exhibit**

1/25. This refers to the report that civil aircraft had been flying at 1000 feet above glacier level. Captain Omundsen's file note makes no reference at all to any criticism by him of flights below the official MSA of 16 000 feet or 6000 feet.

145. In these circumstances I am left with Captain Grundy's recollection that Captain Omundsen's telephone call of 22 November 1979 did not refer to any purported breach of the MSA rules but was only concerned with safety to helicopter traffic in the McMurdo area. I think I am obliged to take the inference that if Captain Omundsen had previously been unaware of descent below 6000 feet in the McMurdo area, then he would have constructed a file note on 22 November 1979 recording not only the transmission of the "low flying" information to Captain Grundy but also recording a request for an immediate explanation from the airline as to why flights were apparently being permitted under 6000 feet. He did ultimately ask for such an explanation but not until after the disaster. I shall deal with the point at a later stage as to whether Civil Aviation Division had any information or knowledge that the minimum safe altitude of 16 000 feet and 6000 feet were not in fact being complied with for, as I shall indicate when dealing with the question of MSA, all the Antarctic flights which went to McMurdo in the summer of 1977, in 1978 and in 1979 in fact flew at altitudes well under the minimum MSA of 6000 feet.

146. I must now pay some attention to certain features of these minimum safe altitudes which are summarised, together with the conditions of descent, in Captain Johnson's memorandum of 8 November 1979 already quoted. In the first place, the track of an aircraft which had descended to the minimum flight level of 16 000 feet on the approach to McMurdo was aligned on a direct course from Cape Hallett to the NDB located near McMurdo Station. This track took the aircraft over the peak of Mt. Erebus on a line about 2 miles to the east of the summit. Then the pilot-in-command, after this overflight of the mountain, was authorised to descend in VMC conditions to 6000 feet in the nominated sector to the south of the mountain, subject to the conditions in Captain Johnson's memorandum and, of course, they had been the operative conditions since August 1977. Then the pilot-in-command was authorised (in terms of what apparently was verbal approval from Civil Aviation Division) to fly away from McMurdo, along McMurdo Sound, at an altitude of 10 000 feet so as to give passengers a lower altitude view of the Admiralty Range to the west of the aircraft. Subsequently the aircraft would then ascend to its cruising level of 30 000 feet and higher as it returned to New Zealand. But in relation to the alternative route involving an overflight of the South Magnetic Pole, Civil Aviation Division had approved the original request of Air New Zealand for a minimum terrain clearance of 2000 feet and in this area the aircraft would, of course, be flying over mountainous terrain.

147. With these factors thus isolated, the following considerations come to mind:

- (a) The aircraft was programmed to fly over an active volcano with a clearance of 3500 feet between the aircraft and the eastern edge of the crater. The volcano continuously discharges steam from the crater, and the height of the plume of steam will vary according to wind conditions. Photographs were produced to the Commission demonstrating the steam rising to a height of 5000 feet or more. On any view, this decision to programme the track of an aircraft over an active volcano seems indefensible. Apart altogether from the safety

aspect, only those passengers with a view to the right would obtain any photographs of the unique view, at close quarters, of the crater. Mr Amies, in his Brief of Evidence, first stated that the track over the volcano was only for "planning purposes" but when he gave evidence on the following day he qualified that statement—which had appeared in a very carefully prepared brief—by then stating that the flight track had been determined for "flight planning purposes". In addition, it was also disclosed during the course of the evidence that flight crews were authorised to depart from this track. In the final result therefore there was in reality no planned flight track to McMurdo.

- (b) The limitation of descent to 6000 feet over the defined sector to the south of Mt. Erebus was said to be based upon a clearance sufficient to avoid the highest point of the Black and White Islands situated at the south of that sector, namely, Mt. Aurora which is 3000 feet high. It will therefore be observed that the terrain clearance over Mt. Erebus was 3500 feet but that the terrain clearance over Mt. Aurora was 2500 feet.
- (c) Approval by Civil Aviation Division to fly out from the Scott Base area at 10 000 feet over the Ross Sea is not recorded in writing but evidently was regarded as an officially approved MSA for this sector. It will be noticed that whereas the MSA over the Ross Sea whilst flying towards Ross Island in VMC was set at 16 000 feet, nevertheless the MSA whilst flying the return route in VMC over exactly the same area of flat sea and pack ice was 10 000 feet.
- (d) Official authority to over-fly the mountainous terrain of the South Magnetic Pole at 2000 feet may usefully be contrasted with the previous requirement that flight over the flat surface of the Ross Sea was not to be lower than either 16 000 feet or 10 000 feet.

148. I am driven to the conclusion that these officially approved minimum safe altitudes, which at the hearing were asserted in the most adamant fashion by the airline and by the Civil Aviation Division to have been applicable to all flights to Antarctic, were unrealistic, and incapable of any logical justification, and that the various altitudes were mutually inconsistent. In the event, these altitude limits were later disregarded by the airline, and in my opinion justifiably so. I think I must go further and say that the original decision to overfly Mt. Erebus and the NDB at 16 000 feet has every appearance of being an initially designated track and altitude devised (as Mr Amies said before he amended his evidence) for planning purposes only, the idea being to check the accuracy of the AINS in polar regions and, in general, to allow the airline's chief pilot and the civil aviation division's airline inspector and an expert navigator (Mr Amies) to survey the entire area. As the evidence disclosed, the programmed flight track direct from Cape Hallett to the NDB was almost immediately departed from, with the express authority of the airline, and on all flights after the second flight in February 1977 the 16 000 feet clearance over the Ross Sea and the 6000 feet clearance over the area to the south of Ross Island were each disregarded with the express authority of the officer conducting the briefing of the crews for these flights.

149. In my opinion there were a number of deficiencies in the planning of these flights. They were:

- (a) The initial flight plan with its direct track over Mt. Erebus and with its minimum safe altitudes of 16 000 feet and 6000 feet was retained as the airline's official approach procedure to McMurdo when, as

- from mid-1977, its inept and unjustified criteria were departed from by pilots with the express authority of the airline.
- (b) The United States Naval authorities at McMurdo were never appraised of the official flight path, or of the minimum safe altitudes officially adopted by the airline and Civil Aviation Division.
 - (c) There was no adequate consultation with the United States Navy authorities as to the most appropriate approach route to McMurdo or as to the exact functions and capacities of the navigation aids located at McMurdo.
 - (d) The Royal New Zealand Air Force, which had many years of experience of flights in the antarctic area, was not consulted as to appropriate briefing of crews or as to the exact nature of weather conditions in Antarctica.
 - (e) There was a complete misapprehension on the part of the airline as to what was meant by "whiteout". When a visit was made to Antarctica in November 1969 by officials of the Civil Aviation Division and by Captain Tredrea and Captain Grundy from Air New Zealand, they were told about the special "whiteout" landing area at McMurdo and they understood, quite correctly, that this emergency landing area was for use when strong winds filled the atmosphere with fine particles of dry snow so that an aircraft coming in to land was flying in conditions equivalent to thick cloud. This is the reason why Captain Johnson, in his memorandum of 8 November 1979, repeated as one of the criteria for a let-down procedure to 6000 feet the condition that there should be "no snow shower in the area". No one in the airline appears to have discovered the nature and insidious dangers of that variety of "whiteout" which occurs in perfectly clear air under conditions which I have mentioned before. Yet this latter information was in the possession at all times of the Royal New Zealand Air Force and the United States Naval Support Force in Antarctica.
 - (f) Although it seems that the airline was aware of the requirements by the Royal New Zealand Air Force and the United States Navy that no pilot could command a flight to Antarctica unless he had flown in the area previously, such a requirement was not implemented as from the summer 1977 flights onwards, even though a flight familiarisation requirement is in fact contained in the airline's operations specifications.
 - (g) The direct track of the aircraft planned for the initial flight was from Cape Hallett and across Ross Island (as I have said, overflying Mt Erebus) and then overheading the non-directional beacon (NDB) situated near McMurdo Station. This flight path had special disadvantages in addition to those already mentioned, in that it was not adequately related to the navigational aids at McMurdo. The ground navigation aids were the non-directional beacon (NDB), a tactical air navigation system (TACAN) which could be interrogated by the aircraft's distance measuring equipment (DME) so as to ascertain its distance from the TACAN (as opposed to the distance from the destination waypoint inserted into the aircraft's own computer navigation system). In addition, there was the radar installation situated at the ice runway, and there was radio communication which consisted of high frequency (HF) transmissions from Mac Centre and very high frequency transmissions (VHF) from the Ice Tower.

- The principal defects of this first flight path in relation to the ground navigation aids were in connection with the radar and radio transmissions. The radar was equipped with an IFF mode which could locate the position and bearing of an aircraft at ranges of up to about 150 miles but it could not be used as a basis for air traffic control. Its only use was to identify the approaching aircraft. When the radar was switched on to its primary ASR mode, meaning thereby its aircraft surveillance function, it could pick up on its screen an aircraft within an approximate range of 40 miles. However, the ASR mode of the radar was only operative on a line of sight basis. In respect of radio transmissions, HF is not dependent upon line of sight and has a very extensive range, but HF radio traffic in the Antarctic area is notoriously erratic and liable to disruption and black-out under various weather and atmospheric conditions. VHF transmissions are relatively short range with an average of about 150 miles. VHF contact is far superior to HF since VHF transmissions are typically free from atmospheric static interference. But VHF transmissions are dependent upon line of sight. It follows from this that if an aircraft approached Ross Island on the track which was programmed for this first flight piloted by Captain Gemmell, then because of the height of Mt. Erebus the aircraft, if approaching at 16 000 feet, would suffer radar and VHF radio black-out for 20 or 30 miles until it arrived over the summit of the mountain.
- (h) The agreement between the airline and Civil Aviation Division in August 1977 for an authorised let-down to 6000 feet in the designated sector south of Ross Island was regarded by the Americans, when they found out about it after the disaster, as quite impracticable. In the view of Chief Warrant Officer Priest, who was chief traffic controller and Mac Centre Supervisor during the 1979/80 season, this 6000 feet sector was "absurd" because of the inability of radar control in that area. The United States authorities at McMurdo were never advised of any officially approved Civil Aviation Division flight plan or descent approach and they would have opposed from the outset the direct approach to Mt. Erebus and the subsequent 6000 feet descent clearance behind Ross Island.

150. The visit to Antarctica which was made in November 1969 by the officials whom I have described no doubt persuaded them, and I think quite correctly, that there was nothing inherently dangerous in flying in the McMurdo area in perfect weather conditions. The planning evidence disclosed, however, for reasons which I have already indicated, a serious lack of proper inquiry into the weather hazards. But the principal defect in the planning, in my opinion, was the decision to adhere to the track and flight level set for the first flight and then amended in August 1977 so as to provide for the 6000 foot minimum safe altitude under the specified conditions. As I have said, the United States authorities were at no time advised of these official flight levels and would not have approved of them. As will later be described, the airline itself very quickly abandoned the MSA requirement of 16 000 feet and 6000 feet and in my opinion was justified in doing so. But there still remained, as a matter of official record between the Civil Aviation Division and the airline the MSA levels of 16 000 feet and 6000 feet together with a flight path from Cape Hallett direct to McMurdo Station. The airline should have realigned the official flight path down the military route so as to bring aircraft down the middle

of McMurdo Sound, and should have obtained Civil Aviation Division approval, which would have been automatic. In addition, these artificial flight levels of 16 000 feet and 6000 feet should have been amended so as to permit a flight in VMC conditions down the military track at heights between 1500 feet and 6000 feet. Again, there could not have been the slightest ground for Civil Aviation Division to object to those altitudes as they would have fully complied with Regulation 38 of the Civil Aviation Regulations. The United States authorities would have approved, without question, these flight data.

151. In the final result, the omission to obtain official approval for altered flight data of this kind made no difference because, as will be shown, the airline informally varied the track and varied the altitudes in the very manner which I suggest it should have done on an official basis. But because the flight levels of 16 000 feet and 6000 feet and the flight path over Mt. Erebus still remained as part of the official approval of Civil Aviation Division as at 28 November 1979, both the airline and Civil Aviation Division immediately seized upon these official conditions as being the vital factor in the disaster. From the point of view of both organisations they could obtain, so they believed, absolution from their own numerous errors by merely ascribing the disaster to a failure by Captain Collins to observe a minimum flight level of 16 000 feet. This was the principal basis of the case for Civil Aviation Division and, as will be seen from what I have already written, it was in my view a basis without any justification whatever.

THE BRIEFING PROCEDURES FOR ANTARCTIC FLIGHTS

152. Regulation 77 (1) (a) and (b) of the Civil Aviation Regulations (which came into effect by way of amendment of previous provisions as from 12 February 1979) reads as follows:

- "77. Route and aerodrome qualifications of pilot in command—
- (1) A pilot shall not act as pilot in command of an aircraft engaged in an air transport operation on a particular route unless:
 - (a) He has demonstrated to the operator that he has an adequate knowledge of the route to be flown and the aerodromes which are to be used, including an adequate knowledge of:
 - (i) The terrain and minimum safe altitudes;
 - (ii) The seasonal meteorological conditions;
 - (iii) The meteorological, communication, air traffic facilities, services and procedures;
 - (iv) The search and rescue procedures; and
 - (v) The navigational facilities associated with the route along which the flight is to take place; and
 - (b) He has demonstrated to the operator that he has adequate knowledge of procedures applicable to flight paths over heavily populated areas of high traffic density, obstructions, physical layout, lighting, approach aids, and arrival, departure, holding instrument approach procedures and applicable meteorological minima. PROVIDED THAT any portion of the demonstration relating to arrival, departure, holding or instrument approach procedures may be accomplished in an aircraft flight simulator if specifically approved by the director."

153. A method adopted by airlines throughout the world of making pilots familiar with the details of scheduled routes and landing procedures at the termination of such flights, is not only to require pilots to fly those routes as observers prior to acting as pilot-in-command on any such flights, but also to brief pilots by means of audio-visual presentation of the various data required to be known and accompanied if necessary by exercises in an aircraft simulator which will be related to the operational procedures of the flight in question.

154. In Air New Zealand there was established a Route Clearance Unit (RCU) which was under the control of the airline's Flight Operations Division, and the supervisor of this unit was charged with the responsibility of adequately briefing crews by medium of the audio-visual material and simulator training to which I have referred. Broadly speaking, the content of the audio-visual presentation will be a prepared script describing the main features of the flight and this will usually be produced by a tape recording which has been duly prepared for that purpose. Then at suitable intervals during the oral description, slides will be shown upon a screen and for the most part they will contain photographic representations of different aspects of the flight and in particular of the destination waypoint. At the conclusion of the audio-visual presentation there will be oral elaboration by the supervisor of relevant aspects of the prepared text. The simulator exercise will be devoted to whatever are the special operational requirements, in particular, the settled approach and let-down procedures at the airport of destination. Copies of the prepared text of the presentation will be distributed to crew members for their retention and use on the flight. These are called "briefing documents." In the case of Air New Zealand, the Route Clearance Unit was established in about 1974 and the purpose was to provide to crew members more comprehensive information than could be obtained merely by a previous flight under supervision over the route in question. A quantity of material, including photographs, was collected so as to form the basis of RCU briefings for the various scheduled routes of the airline.

155. There was no official supervisor of the Route Clearance Unit until 1 April 1977 when that position was given to Captain A. A. E. Lawson whilst he was still a DC10 captain. He supervised the RCU on a part-time basis until 1 January 1978 when Captain J. P. Wilson (who had retired from operational flying) was appointed full-time Route Clearance Unit supervisor.

156. When it was decided to start operating antarctic flights, Captain Lawson was directed by the chief pilot to travel on the first flight for RCU purposes. Captain Lawson therefore travelled on the first flight as co-pilot. After the first two antarctic flights in 1977, Captain Lawson began assembling an RCU antarctic brief. He obtained various photographs of Antarctica from the publicity section of the airline, and eventually selected certain slides thought suitable to depict the general topography of the area. Captain Lawson also prepared written material which was subsequently recorded and used in conjunction with the display of the slides.

157. When the new MSA of 6000 feet was decided upon in mid-1977, the procedure and the sector of permitted descent was based upon the high level NDB approach procedure used by the United States Navy aircraft. On the third flight of 1977 the amended 6000 feet procedure was now operative and Captain Lawson went on that flight and instructed